Package ‘keras’

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Type Package

Title R Interface to 'Keras'

Version 2.2.4

Description Interface to 'Keras' <https://keras.io>, a high-level neural
networks 'API'. 'Keras' was developed with a focus on enabling fast experimentation,
supports both convolution based networks and recurrent networks (as well as
combinations of the two), and runs seamlessly on both 'CPU' and 'GPU' devices.

Encoding UTF-8

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URL `https://keras.rstudio.com`

BugReports `https://github.com/rstudio/keras/issues`

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Author JJ Allaire [aut, cre],
François Chollet [aut, cph],
RStudio [ctb, cph, fnd],
Google [ctb, cph, fnd],
Yuan Tang [ctb, cph] (<https://orcid.org/0000-0001-5243-233X>),
Daniel Falbel [ctb, cph],
Wouter Van Der Bijl [ctb, cph],
Martin Studer [ctb, cph],
Sigrid Keydana [ctb]

Maintainer JJ Allaire `<jj@rstudio.com>`

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`keras-package` *R interface to Keras*

Description

Keras is a high-level neural networks API, developed with a focus on enabling fast experimentation. Keras has the following key features:

Details

- Allows the same code to run on CPU or on GPU, seamlessly.
- User-friendly API which makes it easy to quickly prototype deep learning models.
- Built-in support for convolutional networks (for computer vision), recurrent networks (for sequence processing), and any combination of both.
- Supports arbitrary network architectures: multi-input or multi-output models, layer sharing, model sharing, etc. This means that Keras is appropriate for building essentially any deep learning model, from a memory network to a neural Turing machine.
- Is capable of running on top of multiple back-ends including TensorFlow, CNTK, or Theano.

See the package website at `https://keras.rstudio.com` for complete documentation.

Author(s)

Maintainer: JJ Allaire `<jj@rstudio.com>`

Authors:

- François Chollet [copyright holder]

Other contributors:

- RStudio [contributor, copyright holder, funder]
- Google [contributor, copyright holder, funder]
- Yuan Tang `<terrytangyuan@gmail.com>` (0000-0001-5243-233X) [contributor, copyright holder]

- Daniel Falbel [contributor, copyright holder]
- Wouter Van Der Bijl [contributor, copyright holder]
- Martin Studer [contributor, copyright holder]
- Sigrid Keydana [contributor]

See Also

Useful links:

- https://keras.rstudio.com
- Report bugs at https://github.com/rstudio/keras/issues

`activation_relu` *Activation functions*

Description

Activations functions can either be used through `layer_activation()`, or through the activation argument supported by all forward layers.

Usage

```
activation_relu(x, alpha = 0, max_value = NULL, threshold = 0)

activation_elu(x, alpha = 1)

activation_selu(x)

activation_hard_sigmoid(x)

activation_linear(x)

activation_sigmoid(x)

activation_softmax(x, axis = -1)

activation_softplus(x)

activation_softsign(x)

activation_tanh(x)

activation_exponential(x)
```

Arguments

`x`	Tensor
`alpha`	Alpha value
`max_value`	Max value
`threshold`	Threshold value for thresholded activation.
`axis`	Integer, axis along which the softmax normalization is applied

Details

- `activation_selu()` to be used together with the initialization "lecun_normal".
- `activation_selu()` to be used together with the dropout variant "AlphaDropout".

Value

Tensor with the same shape and dtype as `x`.

References

- `activation_selu()`: Self-Normalizing Neural Networks

`application_densenet` *Instantiates the DenseNet architecture.*

Description

Instantiates the DenseNet architecture.

Usage

```
application_densenet(blocks, include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

application_densenet121(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

application_densenet169(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

application_densenet201(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

densenet_preprocess_input(x, data_format = NULL)
```

Arguments

`blocks`	numbers of building blocks for the four dense layers.
`include_top`	whether to include the fully-connected layer at the top of the network.
`weights`	one of `NULL` (random initialization), 'imagenet' (pre-training on ImageNet), or the path to the weights file to be loaded.
`input_tensor`	optional Keras tensor (i.e. output of `layer_input()`) to use as image input for the model.
`input_shape`	optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(224, 224, 3)` (with `channels_last` data format) or `(3, 224, 224)` (with `channels_first` data format). It should have exactly 3 inputs channels.
`pooling`	optional pooling mode for feature extraction when `include_top` is `FALSE`. - `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer. - `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. - `max` means that global max pooling will be applied.
`classes`	optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.
`x`	a 3D or 4D array consists of RGB values within `[0, 255]`.
`data_format`	data format of the image tensor.

Details

Optionally loads weights pre-trained on ImageNet. Note that when using TensorFlow, for best performance you should set `image_data_format='channels_last'` in your Keras config at ~/.keras/keras.json.

The model and the weights are compatible with TensorFlow, Theano, and CNTK. The data format convention used by the model is the one specified in your Keras config file.

---

application_inception_resnet_v2 *Inception-ResNet v2 model, with weights trained on ImageNet*

Description

Inception-ResNet v2 model, with weights trained on ImageNet

Usage

```
application_inception_resnet_v2(include_top = TRUE,
  weights = "imagenet", input_tensor = NULL, input_shape = NULL,
  pooling = NULL, classes = 1000)

inception_resnet_v2_preprocess_input(x)
```

Arguments

include_top	whether to include the fully-connected layer at the top of the network.
weights	NULL (random initialization), imagenet (ImageNet weights), or the path to the weights file to be loaded.
input_tensor	optional Keras tensor to use as image input for the model.
input_shape	optional shape list, only to be specified if include_top is FALSE (otherwise the input shape has to be (299, 299, 3). It should have exactly 3 inputs channels, and width and height should be no smaller than 75. E.g. (150, 150, 3) would be one valid value.
pooling	Optional pooling mode for feature extraction when include_top is FALSE. • NULL means that the output of the model will be the 4D tensor output of the last convolutional layer. • avg means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. • max means that global max pooling will be applied.
classes	optional number of classes to classify images into, only to be specified if include_top is TRUE, and if no weights argument is specified.
x	Input tensor for preprocessing

Details

Do note that the input image format for this model is different than for the VGG16 and ResNet models (299x299 instead of 224x224).

The inception_resnet_v2_preprocess_input() function should be used for image preprocessing.

Value

A Keras model instance.

Reference

- Inception-v4, Inception-ResNet and the Impact of Residual Connections on Learning(http://arxiv.org/abs/1512.00567)

---

application_inception_v3

Inception V3 model, with weights pre-trained on ImageNet.

Description

Inception V3 model, with weights pre-trained on ImageNet.

Usage

```
application_inception_v3(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

inception_v3_preprocess_input(x)
```

Arguments

`include_top`	whether to include the fully-connected layer at the top of the network.
`weights`	`NULL` (random initialization), `imagenet` (ImageNet weights), or the path to the weights file to be loaded.
`input_tensor`	optional Keras tensor to use as image input for the model.
`input_shape`	optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(299, 299, 3)`. It should have exactly 3 inputs channels, and width and height should be no smaller than 75. E.g. `(150, 150, 3)` would be one valid value.
`pooling`	Optional pooling mode for feature extraction when `include_top` is `FALSE`. • `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer. • `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. • `max` means that global max pooling will be applied.
`classes`	optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.
`x`	Input tensor for preprocessing

Details

Do note that the input image format for this model is different than for the VGG16 and ResNet models (299x299 instead of 224x224).

The `inception_v3_preprocess_input()` function should be used for image preprocessing.

Value

A Keras model instance.

Reference

- Rethinking the Inception Architecture for Computer Vision application_mobilenet *MobileNet model architecture.*

Description

MobileNet model architecture.

Usage

```
application_mobilenet(input_shape = NULL, alpha = 1,
  depth_multiplier = 1, dropout = 0.001, include_top = TRUE,
  weights = "imagenet", input_tensor = NULL, pooling = NULL,
  classes = 1000)

mobilenet_preprocess_input(x)

mobilenet_decode_predictions(preds, top = 5)

mobilenet_load_model_hdf5(filepath)
```

Arguments

`input_shape`	optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(224, 224, 3)` (with `channels_last` data format) or (3, 224, 224) (with `channels_first` data format). It should have exactly 3 inputs channels, and width and height should be no smaller than 32. E.g. `(200, 200, 3)` would be one valid value.
`alpha`	controls the width of the network. • If `alpha` < 1.0, proportionally decreases the number of filters in each layer. • If `alpha` > 1.0, proportionally increases the number of filters in each layer. • If `alpha` = 1, default number of filters from the paper are used at each layer.
`depth_multiplier`	depth multiplier for depthwise convolution (also called the resolution multiplier)
`dropout`	dropout rate
`include_top`	whether to include the fully-connected layer at the top of the network.
`weights`	`NULL` (random initialization), `imagenet` (ImageNet weights), or the path to the weights file to be loaded.
`input_tensor`	optional Keras tensor (i.e. output of `layer_input()`) to use as image input for the model.
`pooling`	Optional pooling mode for feature extraction when `include_top` is `FALSE`. - `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer. - `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. - `max` means that global max pooling will be applied.

`classes`	optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.
`x`	input tensor, 4D
`preds`	Tensor encoding a batch of predictions.
`top`	integer, how many top-guesses to return.
`filepath`	File path

Details

The `mobilenet_preprocess_input()` function should be used for image preprocessing. To load a saved instance of a MobileNet model use the `mobilenet_load_model_hdf5()` function. To prepare image input for MobileNet use `mobilenet_preprocess_input()`. To decode predictions use `mobilenet_decode_predictions()`.

Value

`application_mobilenet()` and `mobilenet_load_model_hdf5()` return a Keras model instance. `mobilenet_preprocess_input()` returns image input suitable for feeding into a mobilenet model. `mobilenet_decode_predictions()` returns a list of data frames with variables `class_name`, `class_description`, and `score` (one data frame per sample in batch input).

Reference

- MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications.

`application_mobilenet_v2`

MobileNetV2 model architecture

Description

MobileNetV2 model architecture

Usage

```
application_mobilenet_v2(input_shape = NULL, alpha = 1,
  depth_multiplier = 1, include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, pooling = NULL, classes = 1000)

mobilenet_v2_preprocess_input(x)

mobilenet_v2_decode_predictions(preds, top = 5)

mobilenet_v2_load_model_hdf5(filepath)
```

Arguments

input_shape
: optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(224, 224, 3)` (with `channels_last` data format) or (3, 224, 224) (with `channels_first` data format). It should have exactly 3 inputs channels, and width and height should be no smaller than 32. E.g. `(200, 200, 3)` would be one valid value.

alpha
: controls the width of the network.
  - If `alpha` < 1.0, proportionally decreases the number of filters in each layer.
  - If `alpha` > 1.0, proportionally increases the number of filters in each layer.
  - If `alpha` = 1, default number of filters from the paper are used at each layer.

depth_multiplier
: depth multiplier for depthwise convolution (also called the resolution multiplier)

include_top
: whether to include the fully-connected layer at the top of the network.

weights
: `NULL` (random initialization), `imagenet` (ImageNet weights), or the path to the weights file to be loaded.

input_tensor
: optional Keras tensor (i.e. output of `layer_input()`) to use as image input for the model.

pooling
: Optional pooling mode for feature extraction when `include_top` is `FALSE`. - `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer. - `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. - `max` means that global max pooling will be applied.

classes
: optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.

x
: input tensor, 4D

preds
: Tensor encoding a batch of predictions.

top
: integer, how many top-guesses to return.

filepath
: File path

Value

`application_mobilenet_v2()` and `mobilenet_v2_load_model_hdf5()` return a Keras model instance. `mobilenet_v2_preprocess_input()` returns image input suitable for feeding into a mobilenet v2 model. `mobilenet_v2_decode_predictions()` returns a list of data frames with variables `class_name`, `class_description`, and `score` (one data frame per sample in batch input).

Reference

- MobileNetV2: Inverted Residuals and Linear Bottlenecks

See Also

application_mobilenet

`application_nasnet` *Instantiates a NASNet model.*

Description

Note that only TensorFlow is supported for now, therefore it only works with the data format `image_data_format='channels_last'` in your Keras config at `~/.keras/keras.json`.

Usage

```
application_nasnet(input_shape = NULL, penultimate_filters = 4032L,
  num_blocks = 6L, stem_block_filters = 96L, skip_reduction = TRUE,
  filter_multiplier = 2L, include_top = TRUE, weights = NULL,
  input_tensor = NULL, pooling = NULL, classes = 1000,
  default_size = NULL)

application_nasnetlarge(input_shape = NULL, include_top = TRUE,
  weights = NULL, input_tensor = NULL, pooling = NULL,
  classes = 1000)

application_nasnetmobile(input_shape = NULL, include_top = TRUE,
  weights = NULL, input_tensor = NULL, pooling = NULL,
  classes = 1000)

nasnet_preprocess_input(x)
```

Arguments

`input_shape`	Optional shape list, the input shape is by default `(331, 331, 3)` for NASNet-Large and `(224, 224, 3)` for NASNetMobile It should have exactly 3 inputs channels, and width and height should be no smaller than 32. E.g. `(224, 224, 3)` would be one valid value.
`penultimate_filters`	Number of filters in the penultimate layer. NASNet models use the notation `NASNet (N @ P)`, where: - N is the number of blocks - P is the number of penultimate filters
`num_blocks`	Number of repeated blocks of the NASNet model. NASNet models use the notation `NASNet (N @ P)`, where: - N is the number of blocks - P is the number of penultimate filters
`stem_block_filters`	Number of filters in the initial stem block
`skip_reduction`	Whether to skip the reduction step at the tail end of the network. Set to `FALSE` for CIFAR models.
`filter_multiplier`	Controls the width of the network.

- If filter_multiplier < 1.0, proportionally decreases the number of filters in each layer.
- If filter_multiplier > 1.0, proportionally increases the number of filters in each layer. - If filter_multiplier = 1, default number of filters from the paper are used at each layer.

include_top	Whether to include the fully-connected layer at the top of the network.
weights	NULL (random initialization) or imagenet (ImageNet weights)
input_tensor	Optional Keras tensor (i.e. output of layer_input()) to use as image input for the model.
pooling	Optional pooling mode for feature extraction when include_top is FALSE. - NULL means that the output of the model will be the 4D tensor output of the last convolutional layer. - avg means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. - max means that global max pooling will be applied.
classes	Optional number of classes to classify images into, only to be specified if include_top is TRUE, and if no weights argument is specified.
default_size	Specifies the default image size of the model
x	a 4D array consists of RGB values within [0, 255].

---

application_resnet50 *ResNet50 model for Keras.*

Description

ResNet50 model for Keras.

Usage

```
application_resnet50(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)
```

Arguments

include_top	whether to include the fully-connected layer at the top of the network.
weights	NULL (random initialization), imagenet (ImageNet weights), or the path to the weights file to be loaded.
input_tensor	optional Keras tensor to use as image input for the model.
input_shape	optional shape list, only to be specified if include_top is FALSE (otherwise the input shape has to be (224, 224, 3). It should have exactly 3 inputs channels, and width and height should be no smaller than 32. E.g. (200, 200, 3) would be one valid value.
pooling	Optional pooling mode for feature extraction when include_top is FALSE.

- `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer.
- `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor.
- `max` means that global max pooling will be applied.

`classes` optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.

Details

Optionally loads weights pre-trained on ImageNet.

The `imagenet_preprocess_input()` function should be used for image preprocessing.

Value

A Keras model instance.

Reference

- Deep Residual Learning for Image Recognition

Examples

```
## Not run:
library(keras)

# instantiate the model
model <- application_resnet50(weights = 'imagenet')

# load the image
img_path <- "elephant.jpg"
img <- image_load(img_path, target_size = c(224,224))
x <- image_to_array(img)

# ensure we have a 4d tensor with single element in the batch dimension,
# the preprocess the input for prediction using resnet50
x <- array_reshape(x, c(1, dim(x)))
x <- imagenet_preprocess_input(x)

# make predictions then decode and print them
preds <- model %>% predict(x)
imagenet_decode_predictions(preds, top = 3)[[1]]

## End(Not run)
```

`application_vgg` *VGG16 and VGG19 models for Keras.*

Description

VGG16 and VGG19 models for Keras.

Usage

```
application_vgg16(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

application_vgg19(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)
```

Arguments

`include_top`	whether to include the 3 fully-connected layers at the top of the network.
`weights`	`NULL` (random initialization), `imagenet` (ImageNet weights), or the path to the weights file to be loaded.
`input_tensor`	optional Keras tensor to use as image input for the model.
`input_shape`	optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(224, 224, 3)` It should have exactly 3 inputs channels, and width and height should be no smaller than 32. E.g. `(200, 200, 3)` would be one valid value.
`pooling`	Optional pooling mode for feature extraction when `include_top` is `FALSE`. • `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer. • `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor. • `max` means that global max pooling will be applied.
`classes`	optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.

Details

Optionally loads weights pre-trained on ImageNet.

The `imagenet_preprocess_input()` function should be used for image preprocessing.

Value

Keras model instance.

Reference

- Very Deep Convolutional Networks for Large-Scale Image Recognition

Examples

```
## Not run:
library(keras)

model <- application_vgg16(weights = 'imagenet', include_top = FALSE)

img_path <- "elephant.jpg"
img <- image_load(img_path, target_size = c(224,224))
x <- image_to_array(img)
x <- array_reshape(x, c(1, dim(x)))
x <- imagenet_preprocess_input(x)

features <- model %>% predict(x)

## End(Not run)
```

---

application_xception *Xception V1 model for Keras.*

Description

Xception V1 model for Keras.

Usage

```
application_xception(include_top = TRUE, weights = "imagenet",
  input_tensor = NULL, input_shape = NULL, pooling = NULL,
  classes = 1000)

xception_preprocess_input(x)
```

Arguments

`include_top`	whether to include the fully-connected layer at the top of the network.
`weights`	`NULL` (random initialization), `imagenet` (ImageNet weights), or the path to the weights file to be loaded.
`input_tensor`	optional Keras tensor to use as image input for the model.
`input_shape`	optional shape list, only to be specified if `include_top` is FALSE (otherwise the input shape has to be `(299, 299, 3)`. It should have exactly 3 inputs channels, and width and height should be no smaller than 75. E.g. `(150, 150, 3)` would be one valid value.
`pooling`	Optional pooling mode for feature extraction when `include_top` is `FALSE`.

- `NULL` means that the output of the model will be the 4D tensor output of the last convolutional layer.
- `avg` means that global average pooling will be applied to the output of the last convolutional layer, and thus the output of the model will be a 2D tensor.
- `max` means that global max pooling will be applied.

`classes`	optional number of classes to classify images into, only to be specified if `include_top` is TRUE, and if no `weights` argument is specified.
`x`	Input tensor for preprocessing

Details

On ImageNet, this model gets to a top-1 validation accuracy of 0.790 and a top-5 validation accuracy of 0.945.

Do note that the input image format for this model is different than for the VGG16 and ResNet models (299x299 instead of 224x224).

The `xception_preprocess_input()` function should be used for image preprocessing.

This application is only available when using the TensorFlow back-end.

Value

A Keras model instance.

Reference

- Xception: Deep Learning with Depthwise Separable Convolutions

---

`backend` *Keras backend tensor engine*

Description

Obtain a reference to the `keras.backend` Python module used to implement tensor operations.

Usage

```
backend(convert = TRUE)
```

Arguments

`convert`	`TRUE` to automatically convert Python objects to their R equivalent. If you pass `FALSE` you can do manual conversion using the `py_to_r()` function.

Value

Reference to Keras backend python module.

Note

See the documentation here https://keras.io/backend/ for additional details on the available functions.

`bidirectional` *Bidirectional wrapper for RNNs.*

Description

Bidirectional wrapper for RNNs.

Usage

```
bidirectional(object, layer, merge_mode = "concat", input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`layer`	Recurrent instance.
`merge_mode`	Mode by which outputs of the forward and backward RNNs will be combined. One of 'sum', 'mul', 'concat', 'ave', NULL. If NULL, the outputs will not be combined, they will be returned as a list.
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Other layer wrappers: `time_distributed`

callback_csv_logger *Callback that streams epoch results to a csv file*

Description

Supports all values that can be represented as a string

Usage

```
callback_csv_logger(filename, separator = ",", append = FALSE)
```

Arguments

filename	filename of the csv file, e.g. 'run/log.csv'.
separator	string used to separate elements in the csv file.
append	TRUE: append if file exists (useful for continuing training). FALSE: overwrite existing file,

See Also

Other callbacks: callback_early_stopping, callback_lambda, callback_learning_rate_scheduler, callback_model_checkpoint, callback_progbar_logger, callback_reduce_lr_on_plateau, callback_remote_monitor, callback_tensorboard, callback_terminate_on_naan

callback_early_stopping *Stop training when a monitored quantity has stopped improving.*

Description

Stop training when a monitored quantity has stopped improving.

Usage

```
callback_early_stopping(monitor = "val_loss", min_delta = 0,
  patience = 0, verbose = 0, mode = c("auto", "min", "max"),
  baseline = NULL, restore_best_weights = FALSE)
```

Arguments

`monitor`	quantity to be monitored.
`min_delta`	minimum change in the monitored quantity to qualify as an improvement, i.e. an absolute change of less than min_delta, will count as no improvement.
`patience`	number of epochs with no improvement after which training will be stopped.
`verbose`	verbosity mode, 0 or 1.
`mode`	one of "auto", "min", "max". In `min` mode, training will stop when the quantity monitored has stopped decreasing; in `max` mode it will stop when the quantity monitored has stopped increasing; in `auto` mode, the direction is automatically inferred from the name of the monitored quantity.
`baseline`	Baseline value for the monitored quantity to reach. Training will stop if the model doesn't show improvement over the baseline.
`restore_best_weights`	Whether to restore model weights from the epoch with the best value of the monitored quantity. If `FALSE`, the model weights obtained at the last step of training are used.

See Also

Other callbacks: `callback_csv_logger`, `callback_lambda`, `callback_learning_rate_scheduler`, `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_remote_monitor`, `callback_tensorboard`, `callback_terminate_on_naan`

`callback_lambda` *Create a custom callback*

Description

This callback is constructed with anonymous functions that will be called at the appropriate time. Note that the callbacks expects positional arguments, as:

- `on_epoch_begin` and `on_epoch_end` expect two positional arguments: `epoch`, `logs`
- `on_batch_begin` and `on_batch_end` expect two positional arguments: `batch`, `logs`
- `on_train_begin` and `on_train_end` expect one positional argument: `logs`

Usage

```
callback_lambda(on_epoch_begin = NULL, on_epoch_end = NULL,
  on_batch_begin = NULL, on_batch_end = NULL, on_train_begin = NULL,
  on_train_end = NULL)
```

Arguments

`on_epoch_begin`	called at the beginning of every epoch.
`on_epoch_end`	called at the end of every epoch.
`on_batch_begin`	called at the beginning of every batch.
`on_batch_end`	called at the end of every batch.
`on_train_begin`	called at the beginning of model training.
`on_train_end`	called at the end of model training.

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_learning_rate_scheduler`, `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_remote_monitor`, `callback_tensorboard`, `callback_terminate_on_naan`

---

callback_learning_rate_scheduler

Learning rate scheduler.

Description

Learning rate scheduler.

Usage

```
callback_learning_rate_scheduler(schedule)
```

Arguments

`schedule`	a function that takes an epoch index as input (integer, indexed from 0) and current learning rate and returns a new learning rate as output (float).

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_lambda`, `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_remote_monitor`, `callback_tensorboard`, `callback_terminate_on_naan` callback_model_checkpoint

Save the model after every epoch.

Description

filepath can contain named formatting options, which will be filled the value of epoch and keys in logs (passed in on_epoch_end). For example: if filepath is weights.{epoch:02d}-{val_loss:.2f}.hdf5, then the model checkpoints will be saved with the epoch number and the validation loss in the filename.

Usage

```
callback_model_checkpoint(filepath, monitor = "val_loss", verbose = 0,
  save_best_only = FALSE, save_weights_only = FALSE, mode = c("auto",
  "min", "max"), period = 1)
```

Arguments

filepath	string, path to save the model file.
monitor	quantity to monitor.
verbose	verbosity mode, 0 or 1.
save_best_only	if save_best_only=TRUE, the latest best model according to the quantity monitored will not be overwritten.
save_weights_only	if TRUE, then only the model's weights will be saved (save_model_weights_hdf5(filepath)), else the full model is saved (save_model_hdf5(filepath)).
mode	one of "auto", "min", "max". If save_best_only=TRUE, the decision to overwrite the current save file is made based on either the maximization or the minimization of the monitored quantity. For val_acc, this should be max, for val_loss this should be min, etc. In auto mode, the direction is automatically inferred from the name of the monitored quantity.
period	Interval (number of epochs) between checkpoints.

For example

if filepath is weights.{epoch:02d}-{val_loss:.2f}.hdf5,: then the model checkpoints will be saved with the epoch number and the validation loss in the filename.

See Also

Other callbacks: callback_csv_logger, callback_early_stopping, callback_lambda, callback_learning_rate_sch callback_progbar_logger, callback_reduce_lr_on_plateau, callback_remote_monitor, callback_tensorboard, callback_terminate_on_naan

callback_progbar_logger

Callback that prints metrics to stdout.

Description

Callback that prints metrics to stdout.

Usage

```
callback_progbar_logger(count_mode = "samples",
  stateful_metrics = NULL)
```

Arguments

count_mode	One of "steps" or "samples". Whether the progress bar should count samples seens or steps (batches) seen.
stateful_metrics	List of metric names that should *not* be averaged onver an epoch. Metrics in this list will be logged as-is in on_epoch_end. All others will be averaged in on_epoch_end.

See Also

Other callbacks: callback_csv_logger, callback_early_stopping, callback_lambda, callback_learning_rate_sch callback_model_checkpoint, callback_reduce_lr_on_plateau, callback_remote_monitor, callback_tensorboard, callback_terminate_on_naan

callback_reduce_lr_on_plateau

Reduce learning rate when a metric has stopped improving.

Description

Models often benefit from reducing the learning rate by a factor of 2-10 once learning stagnates. This callback monitors a quantity and if no improvement is seen for a 'patience' number of epochs, the learning rate is reduced.

Usage

```
callback_reduce_lr_on_plateau(monitor = "val_loss", factor = 0.1,
  patience = 10, verbose = 0, mode = c("auto", "min", "max"),
  min_delta = 1e-04, cooldown = 0, min_lr = 0)
```

Arguments

`monitor`	quantity to be monitored.
`factor`	factor by which the learning rate will be reduced. new_lr = lr • factor
`patience`	number of epochs with no improvement after which learning rate will be reduced.
`verbose`	int. 0: quiet, 1: update messages.
`mode`	one of "auto", "min", "max". In min mode, lr will be reduced when the quantity monitored has stopped decreasing; in max mode it will be reduced when the quantity monitored has stopped increasing; in auto mode, the direction is automatically inferred from the name of the monitored quantity.
`min_delta`	threshold for measuring the new optimum, to only focus on significant changes.
`cooldown`	number of epochs to wait before resuming normal operation after lr has been reduced.
`min_lr`	lower bound on the learning rate.

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_lambda`, `callback_learning_rate_sch` `callback_model_checkpoint`, `callback_progbar_logger`, `callback_remote_monitor`, `callback_tensorboard`, `callback_terminate_on_naan`

`callback_remote_monitor`

Callback used to stream events to a server.

Description

Callback used to stream events to a server.

Usage

```
callback_remote_monitor(root = "http://localhost:9000",
  path = "/publish/epoch/end/", field = "data", headers = NULL,
  send_as_json = FALSE)
```

Arguments

`root`	root url of the target server.
`path`	path relative to root to which the events will be sent.
`field`	JSON field under which the data will be stored.
`headers`	Optional named list of custom HTTP headers. Defaults to: `list(Accept = "application/json", Cont` `Type = "application/json")`
`send_as_json`	Whether the request should be sent as application/json.

Details

Events are sent to `root + '/publish/epoch/end/'` by default. Calls are HTTP POST, with a `data` argument which is a JSON-encoded dictionary of event data. If send_as_json is set to True, the content type of the request will be application/json. Otherwise the serialized JSON will be send within a form

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_lambda`, `callback_learning_rate_sch` `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_tensorboard`, `callback_terminate_on_naan`

`callback_tensorboard` *TensorBoard basic visualizations*

Description

This callback writes a log for TensorBoard, which allows you to visualize dynamic graphs of your training and test metrics, as well as activation histograms for the different layers in your model.

Usage

```
callback_tensorboard(log_dir = NULL, histogram_freq = 0,
  batch_size = 32, write_graph = TRUE, write_grads = FALSE,
  write_images = FALSE, embeddings_freq = 0,
  embeddings_layer_names = NULL, embeddings_metadata = NULL,
  embeddings_data = NULL, update_freq = "epoch")
```

Arguments

`log_dir`	The path of the directory where to save the log files to be parsed by Tensorboard. The default is `NULL`, which will use the active run directory (if available) and otherwise will use "logs".
`histogram_freq`	frequency (in epochs) at which to compute activation histograms for the layers of the model. If set to 0, histograms won't be computed.
`batch_size`	size of batch of inputs to feed to the network for histograms computation.
`write_graph`	whether to visualize the graph in Tensorboard. The log file can become quite large when write_graph is set to `TRUE`
`write_grads`	whether to visualize gradient histograms in TensorBoard. `histogram_freq` must be greater than 0.
`write_images`	whether to write model weights to visualize as image in Tensorboard.
`embeddings_freq`	frequency (in epochs) at which selected embedding layers will be saved.
`embeddings_layer_names`	a list of names of layers to keep eye on. If `NULL` or empty list all the embedding layers will be watched.

`embeddings_metadata`
: a named list which maps layer name to a file name in which metadata for this embedding layer is saved. See the details about the metadata file format. In case if the same metadata file is used for all embedding layers, string can be passed.

`embeddings_data`
: Data to be embedded at layers specified in `embeddings_layer_names`. Array (if the model has a single input) or list of arrays (if the model has multiple inputs). Learn more about embeddings

`update_freq`
: `'batch'` or `'epoch'` or integer. When using `'batch'`, writes the losses and metrics to TensorBoard after each batch. The same applies for `'epoch'`. If using an integer, let's say `10000`, the callback will write the metrics and losses to TensorBoard every 10000 samples. Note that writing too frequently to TensorBoard can slow down your training.

Details

TensorBoard is a visualization tool provided with TensorFlow.

You can find more information about TensorBoard here.

When using a backend other than TensorFlow, TensorBoard will still work (if you have TensorFlow installed), but the only feature available will be the display of the losses and metrics plots.

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_lambda`, `callback_learning_rate_sch` `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_remote_monitor`, `callback_terminate_on_naan`

`callback_terminate_on_naan`

Callback that terminates training when a NaN loss is encountered.

Description

Callback that terminates training when a NaN loss is encountered.

Usage

```
callback_terminate_on_naan()
```

See Also

Other callbacks: `callback_csv_logger`, `callback_early_stopping`, `callback_lambda`, `callback_learning_rate_sch` `callback_model_checkpoint`, `callback_progbar_logger`, `callback_reduce_lr_on_plateau`, `callback_remote_monitor`, `callback_tensorboard`

clone_model *Clone a model instance.*

Description

Model cloning is similar to calling a model on new inputs, except that it creates new layers (and thus new weights) instead of sharing the weights of the existing layers.

Usage

```
clone_model(model, input_tensors = NULL)
```

Arguments

`model`	Instance of Keras model (could be a functional model or a Sequential model).
`input_tensors`	Optional list of input tensors to build the model upon. If not provided, placeholders will be created.

compile.keras.engine.training.Model *Configure a Keras model for training*

Description

Configure a Keras model for training

Usage

```
## S3 method for class 'keras.engine.training.Model'
compile(object, optimizer, loss,
  metrics = NULL, loss_weights = NULL, sample_weight_mode = NULL,
  weighted_metrics = NULL, target_tensors = NULL, ...)
```

Arguments

`object`	Model object to compile.
`optimizer`	Name of optimizer or optimizer instance.
`loss`	Name of objective function or objective function. If the model has multiple outputs, you can use a different loss on each output by passing a dictionary or a list of objectives. The loss value that will be minimized by the model will then be the sum of all individual losses.
`metrics`	List of metrics to be evaluated by the model during training and testing. Typically you will use `metrics='accuracy'`. To specify different metrics for different outputs of a multi-output model, you could also pass a named list such as `metrics=list(output_a = 'accuracy')`.

`loss_weights` Optional list specifying scalar coefficients to weight the loss contributions of different model outputs. The loss value that will be minimized by the model will then be the *weighted sum* of all indvidual losses, weighted by the `loss_weights` coefficients.

`sample_weight_mode`
If you need to do timestep-wise sample weighting (2D weights), set this to "temporal". `NULL` defaults to sample-wise weights (1D). If the model has multiple outputs, you can use a different `sample_weight_mode` on each output by passing a list of modes.

`weighted_metrics`
List of metrics to be evaluated and weighted by sample_weight or class_weight during training and testing

`target_tensors` By default, Keras will create a placeholder for the model's target, which will be fed with the target data during training. If instead you would like to use your own target tensor (in turn, Keras will not expect external data for these targets at training time), you can specify them via the `target_tensors` argument. It should be a single tensor (for a single-output sequential model),

`...` When using the Theano/CNTK backends, these arguments are passed into K.function. When using the TensorFlow backend, these arguments are passed into `tf$Session()$run`.

See Also

Other model functions: `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training`
`fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

`constraints` *Weight constraints*

Description

Functions that impose constraints on weight values.

Usage

```
constraint_maxnorm(max_value = 2, axis = 0)

constraint_nonneg()

constraint_unitnorm(axis = 0)

constraint_minmaxnorm(min_value = 0, max_value = 1, rate = 1,
  axis = 0)
```

Arguments

`max_value`	The maximum norm for the incoming weights.
`axis`	The axis along which to calculate weight norms. For instance, in a dense layer the weight matrix has shape `input_dim, output_dim`, set `axis` to `0` to constrain each weight vector of length `input_dim,`. In a convolution 2D layer with `dim_ordering="tf"`, the weight tensor has shape `rows, cols, input_depth, output_depth`, set `axis` to `c(0, 1, 2)` to constrain the weights of each filter tensor of size `rows, cols, input_depth`.
`min_value`	The minimum norm for the incoming weights.
`rate`	The rate for enforcing the constraint: weights will be rescaled to yield (1 - rate) * norm + rate * norm.clip(low, high). Effectively, this means that rate=1.0 stands for strict enforcement of the constraint, while rate<1.0 means that weights will be rescaled at each step to slowly move towards a value inside the desired interval.

Details

- `constraint_maxnorm()` constrains the weights incident to each hidden unit to have a norm less than or equal to a desired value.
- `constraint_nonneg()` constraints the weights to be non-negative
- `constraint_unitnorm()` constrains the weights incident to each hidden unit to have unit norm.
- `constraint_minmaxnorm()` constrains the weights incident to each hidden unit to have the norm between a lower bound and an upper bound.

Custom constraints

You can implement your own constraint functions in R. A custom constraint is an R function that takes weights (`w`) as input and returns modified weights. Note that keras `backend()` tensor functions (e.g. `k_greater_equal()`) should be used in the implementation of custom constraints. For example:

```
nonneg_constraint <- function(w) {
  w * k_cast(k_greater_equal(w, 0), k_floatx())
}

layer_dense(units = 32, input_shape = c(784),
            kernel_constraint = nonneg_constraint)
```

Note that models which use custom constraints cannot be serialized using `save_model_hdf5()`. Rather, the weights of the model should be saved and restored using `save_model_weights_hdf5()`.

See Also

Dropout: A Simple Way to Prevent Neural Networks from Overfitting Srivastava, Hinton, et al. 2014

KerasConstraint

count_params — *Count the total number of scalars composing the weights.*

Description

Count the total number of scalars composing the weights.

Usage

```
count_params(object)
```

Arguments

object	Layer or model object

Value

An integer count

See Also

Other layer methods: get_config, get_input_at, get_weights, reset_states

create_layer — *Create a Keras Layer*

Description

Create a Keras Layer

Usage

```
create_layer(layer_class, object, args = list())
```

Arguments

layer_class	Python layer class or R6 class of type KerasLayer
object	Object to compose layer with. This is either a keras_model_sequential() to add the layer to, or another Layer which this layer will call.
args	List of arguments to layer constructor function

Value

A Keras layer

Note

The `object` parameter can be missing, in which case the layer is created without a connection to an existing graph.

`create_wrapper` *Create a Keras Wrapper*

Description

Create a Keras Wrapper

Usage

```
create_wrapper(wrapper_class, object, args = list())
```

Arguments

`wrapper_class`	R6 class of type KerasWrapper
`object`	Object to compose layer with. This is either a `keras_model_sequential()` to add the layer to, or another Layer which this layer will call.
`args`	List of arguments to layer constructor function

Value

A Keras wrapper

Note

The `object` parameter can be missing, in which case the layer is created without a connection to an existing graph.

`dataset_boston_housing` *Boston housing price regression dataset*

Description

Dataset taken from the StatLib library which is maintained at Carnegie Mellon University.

Usage

```
dataset_boston_housing(path = "boston_housing.npz", test_split = 0.2,
  seed = 113L)
```

Arguments

`path`	Path where to cache the dataset locally (relative to ~/.keras/datasets).
`test_split`	fraction of the data to reserve as test set.
`seed`	Random seed for shuffling the data before computing the test split.

Value

Lists of training and test data: `train$x, train$y, test$x, test$y`.

Samples contain 13 attributes of houses at different locations around the Boston suburbs in the late 1970s. Targets are the median values of the houses at a location (in k$).

See Also

Other datasets: `dataset_cifar100`, `dataset_cifar10`, `dataset_fashion_mnist`, `dataset_imdb`, `dataset_mnist`, `dataset_reuters`

`dataset_cifar10` *CIFAR10 small image classification*

Description

Dataset of 50,000 32x32 color training images, labeled over 10 categories, and 10,000 test images.

Usage

```
dataset_cifar10()
```

Value

Lists of training and test data: `train$x, train$y, test$x, test$y`.

The `x` data is an array of RGB image data with shape (num_samples, 3, 32, 32).

The `y` data is an array of category labels (integers in range 0-9) with shape (num_samples).

See Also

Other datasets: `dataset_boston_housing`, `dataset_cifar100`, `dataset_fashion_mnist`, `dataset_imdb`, `dataset_mnist`, `dataset_reuters`

dataset_cifar100 *CIFAR100 small image classification*

Description

Dataset of 50,000 32x32 color training images, labeled over 100 categories, and 10,000 test images.

Usage

```
dataset_cifar100(label_mode = c("fine", "coarse"))
```

Arguments

`label_mode`	one of "fine", "coarse".

Value

Lists of training and test data: `train$x, train$y, test$x, test$y`.

The `x` data is an array of RGB image data with shape (num_samples, 3, 32, 32).

The `y` data is an array of category labels with shape (num_samples).

See Also

Other datasets: `dataset_boston_housing`, `dataset_cifar10`, `dataset_fashion_mnist`, `dataset_imdb`, `dataset_mnist`, `dataset_reuters`

dataset_fashion_mnist *Fashion-MNIST database of fashion articles*

Description

Dataset of 60,000 28x28 grayscale images of the 10 fashion article classes, along with a test set of 10,000 images. This dataset can be used as a drop-in replacement for MNIST. The class labels are encoded as integers from 0-9 which correspond to T-shirt/top, Trouser, Pullover, Dress, Coat, Sandal, Shirt,

Usage

```
dataset_fashion_mnist()
```

Details

Dataset of 60,000 28x28 grayscale images of 10 fashion categories, along with a test set of 10,000 images. This dataset can be used as a drop-in replacement for MNIST. The class labels are:

- 0 - T-shirt/top
- 1 - Trouser
- 2 - Pullover
- 3 - Dress
- 4 - Coat
- 5 - Sandal
- 6 - Shirt
- 7 - Sneaker
- 8 - Bag
- 9 - Ankle boot

Value

Lists of training and test data: `train$x`, `train$y`, `test$x`, `test$y`, where `x` is an array of grayscale image data with shape (num_samples, 28, 28) and `y` is an array of article labels (integers in range 0-9) with shape (num_samples).

See Also

Other datasets: `dataset_boston_housing`, `dataset_cifar100`, `dataset_cifar10`, `dataset_imdb`, `dataset_mnist`, `dataset_reuters`

---

dataset_imdb — *IMDB Movie reviews sentiment classification*

Description

Dataset of 25,000 movies reviews from IMDB, labeled by sentiment (positive/negative). Reviews have been preprocessed, and each review is encoded as a sequence of word indexes (integers). For convenience, words are indexed by overall frequency in the dataset, so that for instance the integer "3" encodes the 3rd most frequent word in the data. This allows for quick filtering operations such as: "only consider the top 10,000 most common words, but eliminate the top 20 most common words".

Usage

```
dataset_imdb(path = "imdb.npz", num_words = NULL, skip_top = 0L,
  maxlen = NULL, seed = 113L, start_char = 1L, oov_char = 2L,
  index_from = 3L)

dataset_imdb_word_index(path = "imdb_word_index.json")
```

Arguments

`path`	Where to cache the data (relative to `~/.keras/dataset`).
`num_words`	Max number of words to include. Words are ranked by how often they occur (in the training set) and only the most frequent words are kept
`skip_top`	Skip the top N most frequently occuring words (which may not be informative).
`maxlen`	sequences longer than this will be filtered out.
`seed`	random seed for sample shuffling.
`start_char`	The start of a sequence will be marked with this character. Set to 1 because 0 is usually the padding character.
`oov_char`	Words that were cut out because of the `num_words` or `skip_top` limit will be replaced with this character.
`index_from`	Index actual words with this index and higher.

Details

As a convention, "0" does not stand for a specific word, but instead is used to encode any unknown word.

Value

Lists of training and test data: `train$x, train$y, test$x, test$y`.

The `x` data includes integer sequences. If the `num_words` argument was specific, the maximum possible index value is `num_words-1`. If the `` maxlen`` argument was specified, the largest possible sequence length ``

The `y` data includes a set of integer labels (0 or 1).

The `dataset_imdb_word_index()` function returns a list where the names are words and the values are integer.

See Also

Other datasets: `dataset_boston_housing`, `dataset_cifar100`, `dataset_cifar10`, `dataset_fashion_mnist`, `dataset_mnist`, `dataset_reuters`

`dataset_mnist` *MNIST database of handwritten digits*

Description

Dataset of 60,000 28x28 grayscale images of the 10 digits, along with a test set of 10,000 images.

Usage

```
dataset_mnist(path = "mnist.npz")
```

Arguments

path	Path where to cache the dataset locally (relative to ~/.keras/datasets).

Value

Lists of training and test data: `train$x, train$y, test$x, test$y`, where `x` is an array of grayscale image data with shape (num_samples, 28, 28) and `y` is an array of digit labels (integers in range 0-9) with shape (num_samples).

See Also

Other datasets: `dataset_boston_housing`, `dataset_cifar100`, `dataset_cifar10`, `dataset_fashion_mnist`, `dataset_imdb`, `dataset_reuters`

---

dataset_reuters *Reuters newswire topics classification*

Description

Dataset of 11,228 newswires from Reuters, labeled over 46 topics. As with `dataset_imdb()` , each wire is encoded as a sequence of word indexes (same conventions).

Usage

```
dataset_reuters(path = "reuters.npz", num_words = NULL,
  skip_top = 0L, maxlen = NULL, test_split = 0.2, seed = 113L,
  start_char = 1L, oov_char = 2L, index_from = 3L)

dataset_reuters_word_index(path = "reuters_word_index.pkl")
```

Arguments

path	Where to cache the data (relative to `~/.keras/dataset`).
num_words	Max number of words to include. Words are ranked by how often they occur (in the training set) and only the most frequent words are kept
skip_top	Skip the top N most frequently occuring words (which may not be informative).
maxlen	Truncate sequences after this length.
test_split	Fraction of the dataset to be used as test data.
seed	Random seed for sample shuffling.
start_char	The start of a sequence will be marked with this character. Set to 1 because 0 is usually the padding character.
oov_char	words that were cut out because of the `num_words` or `skip_top` limit will be replaced with this character.
index_from	index actual words with this index and higher.

Value

Lists of training and test data: train$x, train$y, test$x, test$y with same format as dataset_imdb(). The dataset_reuters_word_index() function returns a list where the names are words and the values are integer. e.g. word_index[["giraffe"]] might return 1234.

See Also

Other datasets: dataset_boston_housing, dataset_cifar100, dataset_cifar10, dataset_fashion_mnist, dataset_imdb, dataset_mnist

---

evaluate.keras.engine.training.Model
Evaluate a Keras model

Description

Evaluate a Keras model

Usage

```
## S3 method for class 'keras.engine.training.Model'
evaluate(object, x = NULL,
  y = NULL, batch_size = NULL, verbose = 1, sample_weight = NULL,
  steps = NULL, ...)
```

Arguments

object	Model object to evaluate
x	Vector, matrix, or array of test data (or list if the model has multiple inputs). If all inputs in the model are named, you can also pass a list mapping input names to data. x can be NULL (default) if feeding from framework-native tensors (e.g. TensorFlow data tensors).
y	Vector, matrix, or array of target (label) data (or list if the model has multiple outputs). If all outputs in the model are named, you can also pass a list mapping output names to data. y can be NULL (default) if feeding from framework-native tensors (e.g. TensorFlow data tensors).
batch_size	Integer or NULL. Number of samples per gradient update. If unspecified, batch_size will default to 32.
verbose	Verbosity mode (0 = silent, 1 = progress bar, 2 = one line per epoch).
sample_weight	Optional array of the same length as x, containing weights to apply to the model's loss for each sample. In the case of temporal data, you can pass a 2D array with shape (samples, sequence_length), to apply a different weight to every timestep of every sample. In this case you should make sure to specify sample_weight_mode="temporal" in compile().
steps	Total number of steps (batches of samples) before declaring the evaluation round finished. Ignored with the default value of NULL.
...	Unused

Value

Named list of model test loss (or losses for models with multiple outputs) and model metrics.

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

`evaluate_generator` *Evaluates the model on a data generator.*

Description

The generator should return the same kind of data as accepted by `test_on_batch()`.

Usage

```
evaluate_generator(object, generator, steps, max_queue_size = 10,
  workers = 1)
```

Arguments

`object`	Model object to evaluate
`generator`	Generator yielding lists (inputs, targets) or (inputs, targets, sample_weights)
`steps`	Total number of steps (batches of samples) to yield from `generator` before stopping.
`max_queue_size`	Maximum size for the generator queue. If unspecified, `max_queue_size` will default to 10.
`workers`	Maximum number of threads to use for parallel processing. Note that parallel processing will only be performed for native Keras generators (e.g. `flow_images_from_directory()`) as R based generators must run on the main thread.

Value

Named list of model test loss (or losses for models with multiple outputs) and model metrics.

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `fit.keras.engine.training.Model`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

`export_savedmodel.keras.engine.training.Model`
Export a Saved Model

Description

Serialize a model to disk.

Usage

```
## S3 method for class 'keras.engine.training.Model'
export_savedmodel(object,
  export_dir_base, overwrite = TRUE, versioned = !overwrite,
  remove_learning_phase = TRUE, as_text = FALSE, ...)
```

Arguments

`object`	An R object.
`export_dir_base`	A string containing a directory in which to export the SavedModel.
`overwrite`	Should the `export_dir_base` directory be overwritten?
`versioned`	Should the model be exported under a versioned subdirectory?
`remove_learning_phase`	Should the learning phase be removed by saving and reloading the model? Defaults to `TRUE`.
`as_text`	Whether to write the SavedModel in text format.
`...`	Unused

Value

The path to the exported directory, as a string.

`fit.keras.engine.training.Model`
Train a Keras model

Description

Trains the model for a fixed number of epochs (iterations on a dataset).

Usage

```
## S3 method for class 'keras.engine.training.Model'
fit(object, x = NULL, y = NULL,
  batch_size = NULL, epochs = 10,
  verbose = getOption("keras.fit_verbose", default = 1),
  callbacks = NULL, view_metrics = getOption("keras.view_metrics",
  default = "auto"), validation_split = 0, validation_data = NULL,
  shuffle = TRUE, class_weight = NULL, sample_weight = NULL,
  initial_epoch = 0, steps_per_epoch = NULL, validation_steps = NULL,
  ...)
```

Arguments

`object`	Model to train.
`x`	Vector, matrix, or array of training data (or list if the model has multiple inputs). If all inputs in the model are named, you can also pass a list mapping input names to data. `x` can be `NULL` (default) if feeding from framework-native tensors (e.g. TensorFlow data tensors).
`y`	Vector, matrix, or array of target (label) data (or list if the model has multiple outputs). If all outputs in the model are named, you can also pass a list mapping output names to data. `y` can be `NULL` (default) if feeding from framework-native tensors (e.g. TensorFlow data tensors).
`batch_size`	Integer or `NULL`. Number of samples per gradient update. If unspecified, `batch_size` will default to 32.
`epochs`	Number of epochs to train the model. Note that in conjunction with `initial_epoch`, epochs is to be understood as "final epoch". The model is not trained for a number of iterations given by epochs, but merely until the epoch of index epochs is reached.
`verbose`	Verbosity mode (0 = silent, 1 = progress bar, 2 = one line per epoch).
`callbacks`	List of callbacks to be called during training.
`view_metrics`	View realtime plot of training metrics (by epoch). The default (`"auto"`) will display the plot when running within RStudio, `metrics` were specified during model `compile()`, `epochs > 1` and `verbose > 0`. Use the global `keras.view_metrics` option to establish a different default.
`validation_split`	Float between 0 and 1. Fraction of the training data to be used as validation data. The model will set apart this fraction of the training data, will not train on it, and will evaluate the loss and any model metrics on this data at the end of each epoch. The validation data is selected from the last samples in the `x` and `y` data provided, before shuffling.
`validation_data`	Data on which to evaluate the loss and any model metrics at the end of each epoch. The model will not be trained on this data. This could be a list (x_val, y_val) or a list (x_val, y_val, val_sample_weights). `validation_data` will override `validation_split`.

`shuffle` shuffle: Logical (whether to shuffle the training data before each epoch) or string (for "batch"). "batch" is a special option for dealing with the limitations of HDF5 data; it shuffles in batch-sized chunks. Has no effect when `steps_per_epoch` is not `NULL`.

`class_weight` Optional named list mapping indices (integers) to a weight (float) value, used for weighting the loss function (during training only). This can be useful to tell the model to "pay more attention" to samples from an under-represented class.

`sample_weight` Optional array of the same length as x, containing weights to apply to the model's loss for each sample. In the case of temporal data, you can pass a 2D array with shape (samples, sequence_length), to apply a different weight to every timestep of every sample. In this case you should make sure to specify `sample_weight_mode="temporal"` in `compile()`.

`initial_epoch` Integer, Epoch at which to start training (useful for resuming a previous training run).

`steps_per_epoch` Total number of steps (batches of samples) before declaring one epoch finished and starting the next epoch. When training with input tensors such as TensorFlow data tensors, the default `NULL` is equal to the number of samples in your dataset divided by the batch size, or 1 if that cannot be determined.

`validation_steps` Only relevant if `steps_per_epoch` is specified. Total number of steps (batches of samples) to validate before stopping.

`...` Unused

Value

A `history` object that contains all information collected during training.

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

`fit_generator` *Fits the model on data yielded batch-by-batch by a generator.*

Description

The generator is run in parallel to the model, for efficiency. For instance, this allows you to do real-time data augmentation on images on CPU in parallel to training your model on GPU.

Usage

```
fit_generator(object, generator, steps_per_epoch, epochs = 1,
  verbose = getOption("keras.fit_verbose", default = 1),
  callbacks = NULL, view_metrics = getOption("keras.view_metrics",
  default = "auto"), validation_data = NULL, validation_steps = NULL,
  class_weight = NULL, max_queue_size = 10, workers = 1,
  initial_epoch = 0)
```

Arguments

`object` Keras model object

`generator` A generator (e.g. like the one provided by `flow_images_from_directory()` or a custom R generator function).

The output of the generator must be a list of one of these forms:

```
- (inputs, targets)
- (inputs, targets, sample_weights)
```

This list (a single output of the generator) makes a single batch. Therefore, all arrays in this list must have the same length (equal to the size of this batch). Different batches may have different sizes. For example, the last batch of the epoch is commonly smaller than the others, if the size of the dataset is not divisible by the batch size. The generator is expected to loop over its data indefinitely. An epoch finishes when `steps_per_epoch` batches have been seen by the model.

`steps_per_epoch` Total number of steps (batches of samples) to yield from `generator` before declaring one epoch finished and starting the next epoch. It should typically be equal to the number of samples if your dataset divided by the batch size.

`epochs` Integer. Number of epochs to train the model. An epoch is an iteration over the entire data provided, as defined by `steps_per_epoch`. Note that in conjunction with `initial_epoch`, `epochs` is to be understood as "final epoch". The model is not trained for a number of iterations given by `epochs`, but merely until the epoch of index `epochs` is reached.

`verbose` Verbosity mode (0 = silent, 1 = progress bar, 2 = one line per epoch).

`callbacks` List of callbacks to apply during training.

`view_metrics` View realtime plot of training metrics (by epoch). The default (`"auto"`) will display the plot when running within RStudio, `metrics` were specified during model `compile()`, `epochs > 1` and `verbose > 0`. Use the global `keras.view_metrics` option to establish a different default.

`validation_data` this can be either:

- a generator for the validation data
- a list (inputs, targets)
- a list (inputs, targets, sample_weights). on which to evaluate the loss and any model metrics at the end of each epoch. The model will not be trained on this data.

validation_steps
: Only relevant if `validation_data` is a generator. Total number of steps (batches of samples) to yield from `generator` before stopping at the end of every epoch. It should typically be equal to the number of samples of your validation dataset divided by the batch size.

class_weight
: Optional named list mapping class indices (integer) to a weight (float) value, used for weighting the loss function (during training only). This can be useful to tell the model to "pay more attention" to samples from an under-represented class.

max_queue_size
: Maximum size for the generator queue. If unspecified, `max_queue_size` will default to 10.

workers
: Maximum number of threads to use for parallel processing. Note that parallel processing will only be performed for native Keras generators (e.g. `flow_images_from_directory()`) as R based generators must run on the main thread.

initial_epoch
: epoch at which to start training (useful for resuming a previous training run)

Value

Training history object (invisibly)

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training.Model`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

---

fit_image_data_generator

Fit image data generator internal statistics to some sample data.

Description

Required for `featurewise_center`, `featurewise_std_normalization` and `zca_whitening`.

Usage

```
fit_image_data_generator(object, x, augment = FALSE, rounds = 1,
  seed = NULL)
```

Arguments

object
: `image_data_generator()`

x
: array, the data to fit on (should have rank 4). In case of grayscale data, the channels axis should have value 1, and in case of RGB data, it should have value 3.

`augment`	Whether to fit on randomly augmented samples
`rounds`	If `augment`, how many augmentation passes to do over the data
`seed`	random seed.

See Also

Other image preprocessing: `flow_images_from_data`, `flow_images_from_directory`, `image_load`, `image_to_array`

`fit_text_tokenizer` *Update tokenizer internal vocabulary based on a list of texts or list of sequences.*

Description

Update tokenizer internal vocabulary based on a list of texts or list of sequences.

Usage

```
fit_text_tokenizer(object, x)
```

Arguments

`object`	Tokenizer returned by `text_tokenizer()`
`x`	Vector/list of strings, or a generator of strings (for memory-efficiency); Alternatively a list of "sequence" (a sequence is a list of integer word indices).

Note

Required before using `texts_to_sequences()`, `texts_to_matrix()`, or `sequences_to_matrix()`.

See Also

Other text tokenization: `save_text_tokenizer`, `sequences_to_matrix`, `text_tokenizer`, `texts_to_matrix`, `texts_to_sequences_generator`, `texts_to_sequences` `flow_images_from_data` *Generates batches of augmented/normalized data from image data and labels*

Description

Generates batches of augmented/normalized data from image data and labels

Usage

```
flow_images_from_data(x, y = NULL, generator = image_data_generator(),
  batch_size = 32, shuffle = TRUE, sample_weight = NULL,
  seed = NULL, save_to_dir = NULL, save_prefix = "",
  save_format = "png", subset = NULL)
```

Arguments

`x`	data. Should have rank 4. In case of grayscale data, the channels axis should have value 1, and in case of RGB data, it should have value 3.
`y`	labels (can be `NULL` if no labels are required)
`generator`	Image data generator to use for augmenting/normalizing image data.
`batch_size`	int (default: `32`).
`shuffle`	boolean (defaut: `TRUE`).
`sample_weight`	Sample weights.
`seed`	int (default: `NULL`).
`save_to_dir`	`NULL` or str (default: `NULL`). This allows you to optionally specify a directory to which to save the augmented pictures being generated (useful for visualizing what you are doing).
`save_prefix`	str (default: ”). Prefix to use for filenames of saved pictures (only relevant if `save_to_dir` is set).
`save_format`	one of "png", "jpeg" (only relevant if save_to_dir is set). Default: "png".
`subset`	Subset of data (`"training"` or `"validation"`) if `validation_split` is set in `image_data_generator()`.

Details

Yields batches indefinitely, in an infinite loop.

Yields

`(x, y)` where `x` is an array of image data and `y` is a array of corresponding labels. The generator loops indefinitely.

See Also

Other image preprocessing: fit_image_data_generator, flow_images_from_directory, image_load, image_to_array

---

flow_images_from_directory

Generates batches of data from images in a directory (with optional augmented/normalized data)

Description

Generates batches of data from images in a directory (with optional augmented/normalized data)

Usage

```
flow_images_from_directory(directory, generator = image_data_generator(),
  target_size = c(256, 256), color_mode = "rgb", classes = NULL,
  class_mode = "categorical", batch_size = 32, shuffle = TRUE,
  seed = NULL, save_to_dir = NULL, save_prefix = "",
  save_format = "png", follow_links = FALSE, subset = NULL,
  interpolation = "nearest")
```

Arguments

directory	path to the target directory. It should contain one subdirectory per class. Any PNG, JPG, BMP, PPM, or TIF images inside each of the subdirectories directory tree will be included in the generator. See this script for more details.
generator	Image data generator (default generator does no data augmentation/normalization transformations)
target_size	integer vector, default: `c(256, 256)`. The dimensions to which all images found will be resized.
color_mode	one of "grayscale", "rbg". Default: "rgb". Whether the images will be converted to have 1 or 3 color channels.
classes	optional list of class subdirectories (e.g. `c('dogs', 'cats')`). Default: `NULL`, If not provided, the list of classes will be automatically inferred (and the order of the classes, which will map to the label indices, will be alphanumeric).
class_mode	one of "categorical", "binary", "sparse" or `NULL`. Default: "categorical". Determines the type of label arrays that are returned: "categorical" will be 2D one-hot encoded labels, "binary" will be 1D binary labels, "sparse" will be 1D integer labels. If `NULL`, no labels are returned (the generator will only yield batches of image data, which is useful to use `predict_generator()`, `evaluate_generator()`, etc.).
batch_size	int (default: `32`).
shuffle	boolean (defaut: `TRUE`).

seed	int (default: NULL).
save_to_dir	NULL or str (default: NULL). This allows you to optionally specify a directory to which to save the augmented pictures being generated (useful for visualizing what you are doing).
save_prefix	str (default: ''). Prefix to use for filenames of saved pictures (only relevant if save_to_dir is set).
save_format	one of "png", "jpeg" (only relevant if save_to_dir is set). Default: "png".
follow_links	whether to follow symlinks inside class subdirectories (default: FALSE)
subset	Subset of data ("training" or "validation") if validation_split is set in image_data_generator().
interpolation	Interpolation method used to resample the image if the target size is different from that of the loaded image. Supported methods are "nearest", "bilinear", and "bicubic". If PIL version 1.1.3 or newer is installed, "lanczos" is also supported. If PIL version 3.4.0 or newer is installed, "box" and "hamming" are also supported. By default, "nearest" is used.

Details

Yields batches indefinitely, in an infinite loop.

Yields

(x, y) where x is an array of image data and y is a array of corresponding labels. The generator loops indefinitely.

See Also

Other image preprocessing: fit_image_data_generator, flow_images_from_data, image_load, image_to_array

---

freeze_weights *Freeze and unfreeze weights*

Description

Freeze weights in a model or layer so that they are no longer trainable.

Usage

```
freeze_weights(object, from = NULL, to = NULL)

unfreeze_weights(object, from = NULL, to = NULL)
```

Arguments

`object`	Keras model or layer object
`from`	Layer instance, layer name, or layer index within model
`to`	Layer instance, layer name, or layer index within model

Note

The `from` and `to` layer arguments are both inclusive.

When applied to a model, the freeze or unfreeze is a global operation over all layers in the model (i.e. layers not within the specified range will be set to the opposite value, e.g. unfrozen for a call to freeze).

Models must be compiled again after weights are frozen or unfrozen.

Examples

```
## Not run:
# instantiate a VGG16 model
conv_base <- application_vgg16(
  weights = "imagenet",
  include_top = FALSE,
  input_shape = c(150, 150, 3)
)

# freeze it's weights
freeze_weights(conv_base)

# create a composite model that includes the base + more layers
model <- keras_model_sequential() %>%
  conv_base %>%
  layer_flatten() %>%
  layer_dense(units = 256, activation = "relu") %>%
  layer_dense(units = 1, activation = "sigmoid")

# compile
model %>% compile(
  loss = "binary_crossentropy",
  optimizer = optimizer_rmsprop(lr = 2e-5),
  metrics = c("accuracy")
)

# unfreeze weights from "block5_conv1" on
unfreeze_weights(conv_base, from = "block5_conv1")

# compile again since we froze or unfroze weights
model %>% compile(
  loss = "binary_crossentropy",
  optimizer = optimizer_rmsprop(lr = 2e-5),
  metrics = c("accuracy")
)
```

```
## End(Not run)
```

`generator_next` *Retrieve the next item from a generator*

Description

Use to retrieve items from generators (e.g. `image_data_generator()`). Will return either the next item or `NULL` if there are no more items.

Usage

```
generator_next(generator, completed = NULL)
```

Arguments

`generator`	Generator
`completed`	Sentinel value to return from `generator_next()` if the iteration completes (defaults to `NULL` but can be any R value you specify).

`get_config` *Layer/Model configuration*

Description

A layer config is an object returned from `get_config()` that contains the configuration of a layer or model. The same layer or model can be reinstantiated later (without its trained weights) from this configuration using `from_config()`. The config does not include connectivity information, nor the class name (those are handled externally).

Usage

```
get_config(object)

from_config(config)
```

Arguments

`object`	Layer or model object
`config`	Object with layer or model configuration

Value

get_config() returns an object with the configuration, from_config() returns a re-instantation of hte object.

Note

Objects returned from get_config() are not serializable. Therefore, if you want to save and restore a model across sessions, you can use the model_to_json() or model_to_yaml() functions (for model configuration only, not weights) or the save_model_hdf5() function to save the model configuration and weights to a file.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_layer, keras_model_sequential, keras_model, multi_gpu_model, pop_layer, predict.keras.engine.training.Model, predict_generator, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

Other layer methods: count_params, get_input_at, get_weights, reset_states

---

get_file *Downloads a file from a URL if it not already in the cache.*

Description

Passing the MD5 hash will verify the file after download as well as if it is already present in the cache.

Usage

```
get_file(fname, origin, file_hash = NULL, cache_subdir = "datasets",
  hash_algorithm = "auto", extract = FALSE, archive_format = "auto",
  cache_dir = NULL)
```

Arguments

fname	Name of the file. If an absolute path /path/to/file.txt is specified the file will be saved at that location.
origin	Original URL of the file.
file_hash	The expected hash string of the file after download. The sha256 and md5 hash algorithms are both supported.
cache_subdir	Subdirectory under the Keras cache dir where the file is saved. If an absolute path /path/to/folder is specified the file will be saved at that location.
hash_algorithm	Select the hash algorithm to verify the file. options are 'md5', 'sha256', and 'auto'. The default 'auto' detects the hash algorithm in use.
extract	True tries extracting the file as an Archive, like tar or zip.

archive_format	Archive format to try for extracting the file. Options are 'auto', 'tar', 'zip', and None. 'tar' includes tar, tar.gz, and tar.bz files. The default 'auto' is ('tar', 'zip'). None or an empty list will return no matches found.
cache_dir	Location to store cached files, when NULL it defaults to the Keras configuration directory.

Value

Path to the downloaded file

---

get_input_at *Retrieve tensors for layers with multiple nodes*

Description

Whenever you are calling a layer on some input, you are creating a new tensor (the output of the layer), and you are adding a "node" to the layer, linking the input tensor to the output tensor. When you are calling the same layer multiple times, that layer owns multiple nodes indexed as 1, 2, 3. These functions enable you to retrieve various tensor properties of layers with multiple nodes.

Usage

```
get_input_at(object, node_index)

get_output_at(object, node_index)

get_input_shape_at(object, node_index)

get_output_shape_at(object, node_index)

get_input_mask_at(object, node_index)

get_output_mask_at(object, node_index)
```

Arguments

object	Layer or model object
node_index	Integer, index of the node from which to retrieve the attribute. E.g. node_index = 1 will correspond to the first time the layer was called.

Value

A tensor (or list of tensors if the layer has multiple inputs/outputs).

See Also

Other layer methods: count_params, get_config, get_weights, reset_states

get_layer *Retrieves a layer based on either its name (unique) or index.*

Description

Indices are based on order of horizontal graph traversal (bottom-up) and are 1-based. If `name` and `index` are both provided, `index` will take precedence.

Usage

```
get_layer(object, name = NULL, index = NULL)
```

Arguments

`object`	Keras model object
`name`	String, name of layer.
`index`	Integer, index of layer (0-based)

Value

A layer instance.

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training.Model`, `fit_generator`, `get_config`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

get_weights *Layer/Model weights as R arrays*

Description

Layer/Model weights as R arrays

Usage

```
get_weights(object)

set_weights(object, weights)
```

Arguments

`object`	Layer or model object
`weights`	Weights as R array

See Also

Other model persistence: model_to_json, model_to_yaml, save_model_hdf5, save_model_weights_hdf5, serialize_model

Other layer methods: count_params, get_config, get_input_at, reset_states

---

hdf5_matrix *Representation of HDF5 dataset to be used instead of an R array*

Description

Representation of HDF5 dataset to be used instead of an R array

Usage

```
hdf5_matrix(datapath, dataset, start = 0, end = NULL,
  normalizer = NULL)
```

Arguments

datapath	string, path to a HDF5 file
dataset	string, name of the HDF5 dataset in the file specified in datapath
start	int, start of desired slice of the specified dataset
end	int, end of desired slice of the specified dataset
normalizer	function to be called on data when retrieved

Details

Providing `start` and end allows use of a slice of the dataset.

Optionally, a normalizer function (or lambda) can be given. This will be called on every slice of data retrieved.

Value

An array-like HDF5 dataset.

imagenet_decode_predictions

Decodes the prediction of an ImageNet model.

Description

Decodes the prediction of an ImageNet model.

Usage

```
imagenet_decode_predictions(preds, top = 5)
```

Arguments

`preds`	Tensor encoding a batch of predictions.
`top`	integer, how many top-guesses to return.

Value

List of data frames with variables `class_name`, `class_description`, and `score` (one data frame per sample in batch input).

imagenet_preprocess_input

Preprocesses a tensor or array encoding a batch of images.

Description

Preprocesses a tensor or array encoding a batch of images.

Usage

```
imagenet_preprocess_input(x, data_format = NULL, mode = "caffe")
```

Arguments

`x`	Input Numpy or symbolic tensor, 3D or 4D.
`data_format`	Data format of the image tensor/array.
`mode`	One of "caffe", "tf", or "torch" • caffe: will convert the images from RGB to BGR, then will zero-center each color channel with respect to the ImageNet dataset, without scaling. • tf: will scale pixels between -1 and 1, sample-wise. • torch: will scale pixels between 0 and 1 and then will normalize each channel with respect to the ImageNet dataset.

Value

Preprocessed tensor or array.

`image_data_generator` *Generate batches of image data with real-time data augmentation. The data will be looped over (in batches).*

Description

Generate batches of image data with real-time data augmentation. The data will be looped over (in batches).

Usage

```
image_data_generator(featurewise_center = FALSE,
  samplewise_center = FALSE, featurewise_std_normalization = FALSE,
  samplewise_std_normalization = FALSE, zca_whitening = FALSE,
  zca_epsilon = 1e-06, rotation_range = 0, width_shift_range = 0,
  height_shift_range = 0, brightness_range = NULL, shear_range = 0,
  zoom_range = 0, channel_shift_range = 0, fill_mode = "nearest",
  cval = 0, horizontal_flip = FALSE, vertical_flip = FALSE,
  rescale = NULL, preprocessing_function = NULL, data_format = NULL,
  validation_split = 0)
```

Arguments

`featurewise_center`
: Set input mean to 0 over the dataset, feature-wise.

`samplewise_center`
: Boolean. Set each sample mean to 0.

`featurewise_std_normalization`
: Divide inputs by std of the dataset, feature-wise.

`samplewise_std_normalization`
: Divide each input by its std.

`zca_whitening`
: apply ZCA whitening.

`zca_epsilon`
: Epsilon for ZCA whitening. Default is 1e-6.

`rotation_range`
: degrees (0 to 180).

`width_shift_range`
: fraction of total width.

`height_shift_range`
: fraction of total height.

`brightness_range`
: the range of brightness to apply

`shear_range`
: shear intensity (shear angle in radians).

`zoom_range`	amount of zoom. if scalar z, zoom will be randomly picked in the range `[1-z, 1+z]`. A sequence of two can be passed instead to select this range.
`channel_shift_range`	shift range for each channels.
`fill_mode`	One of "constant", "nearest", "reflect" or "wrap". Points outside the boundaries of the input are filled according to the given mode: • "constant": `kkkkkkkk|abcd|kkkkkkkk` (`cval=k`) • "nearest": `aaaaaaaa|abcd|dddddddd` • "reflect": `abcddcba|abcd|dcbaabcd` • "wrap": `abcdabcd|abcd|abcdabcd`
`cval`	value used for points outside the boundaries when fill_mode is 'constant'. Default is 0.
`horizontal_flip`	whether to randomly flip images horizontally.
`vertical_flip`	whether to randomly flip images vertically.
`rescale`	rescaling factor. If NULL or 0, no rescaling is applied, otherwise we multiply the data by the value provided (before applying any other transformation).
`preprocessing_function`	function that will be implied on each input. The function will run before any other modification on it. The function should take one argument: one image (tensor with rank 3), and should output a tensor with the same shape.
`data_format`	'channels_first' or 'channels_last'. In 'channels_first' mode, the channels dimension (the depth) is at index 1, in 'channels_last' mode it is at index 3. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`validation_split`	fraction of images reserved for validation (strictly between 0 and 1).

`image_load` *Loads an image into PIL format.*

Description

Loads an image into PIL format.

Usage

```
image_load(path, grayscale = FALSE, target_size = NULL,
  interpolation = "nearest")
```

Arguments

`path`	Path to image file
`grayscale`	Boolean, whether to load the image as grayscale.
`target_size`	Either `NULL` (default to original size) or integer vector `(img_height, img_width)`.
`interpolation`	Interpolation method used to resample the image if the target size is different from that of the loaded image. Supported methods are "nearest", "bilinear", and "bicubic". If PIL version 1.1.3 or newer is installed, "lanczos" is also supported. If PIL version 3.4.0 or newer is installed, "box" and "hamming" are also supported. By default, "nearest" is used.

Value

A PIL Image instance.

See Also

Other image preprocessing: `fit_image_data_generator`, `flow_images_from_data`, `flow_images_from_directory`, `image_to_array`

`image_to_array` *3D array representation of images*

Description

3D array that represents an image with dimensions (height,width,channels) or (channels,height,width) depending on the data_format.

Usage

```
image_to_array(img, data_format = c("channels_last", "channels_first"))

image_array_resize(img, height, width, data_format = c("channels_last",
  "channels_first"))

image_array_save(img, path, data_format = NULL, file_format = NULL,
  scale = TRUE)
```

Arguments

`img`	Image
`data_format`	Image data format ("channels_last" or "channels_first")
`height`	Height to resize to
`width`	Width to resize to
`path`	Path to save image to

`file_format`	Optional file format override. If omitted, the format to use is determined from the filename extension. If a file object was used instead of a filename, this parameter should always be used.
`scale`	Whether to rescale image values to be within 0,255

See Also

Other image preprocessing: `fit_image_data_generator`, `flow_images_from_data`, `flow_images_from_directory`, `image_load`

`implementation` *Keras implementation*

Description

Obtain a reference to the Python module used for the implementation of Keras.

Usage

```
implementation()
```

Details

There are currently two Python modules which implement Keras:

- keras ("keras")
- tensorflow.keras ("tensorflow")

This function returns a reference to the implementation being currently used by the keras package. The default implementation is "keras". You can override this by setting the `KERAS_IMPLEMENTATION` environment variable to "tensorflow".

Value

Reference to the Python module used for the implementation of Keras.

initializer_constant *Initializer that generates tensors initialized to a constant value.*

Description

Initializer that generates tensors initialized to a constant value.

Usage

```
initializer_constant(value = 0)
```

Arguments

value	float; the value of the generator tensors.

See Also

Other initializers: initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

initializer_glorot_normal *Glorot normal initializer, also called Xavier normal initializer.*

Description

It draws samples from a truncated normal distribution centered on 0 with `stddev = sqrt(2 / (fan_in + fan_out))` where `fan_in` is the number of input units in the weight tensor and `fan_out` is the number of output units in the weight tensor.

Usage

```
initializer_glorot_normal(seed = NULL)
```

Arguments

seed	Integer used to seed the random generator.

References

Glorot & Bengio, AISTATS 2010 http://jmlr.org/proceedings/papers/v9/glorot10a/glorot10a.pdf

See Also

Other initializers: initializer_constant, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

initializer_glorot_uniform *Glorot uniform initializer, also called Xavier uniform initializer.*

Description

It draws samples from a uniform distribution within `-limit, limit` where `limit` is `sqrt(6 / (fan_in + fan_out))` where `fan_in` is the number of input units in the weight tensor and `fan_out` is the number of output units in the weight tensor.

Usage

```
initializer_glorot_uniform(seed = NULL)
```

Arguments

`seed`	Integer used to seed the random generator.

References

Glorot & Bengio, AISTATS 2010 http://jmlr.org/proceedings/papers/v9/glorot10a/glorot10a.pdf

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

initializer_he_normal *He normal initializer.*

Description

It draws samples from a truncated normal distribution centered on 0 with `stddev = sqrt(2 / fan_in)` where `fan_in` is the number of input units in the weight tensor.

Usage

```
initializer_he_normal(seed = NULL)
```

Arguments

seed	Integer used to seed the random generator.

References

He et al., http://arxiv.org/abs/1502.01852

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

initializer_he_uniform

He uniform variance scaling initializer.

Description

It draws samples from a uniform distribution within `-limit, limit` where `limit`` is` sqrt(6 / fan_in)`where` fan_in‘ is the number of input units in the weight tensor.

Usage

```
initializer_he_uniform(seed = NULL)
```

Arguments

seed	Integer used to seed the random generator.

References

He et al., http://arxiv.org/abs/1502.01852

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

initializer_identity *Initializer that generates the identity matrix.*

Description

Only use for square 2D matrices.

Usage

```
initializer_identity(gain = 1)
```

Arguments

gain	Multiplicative factor to apply to the identity matrix

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

initializer_lecun_normal *LeCun normal initializer.*

Description

It draws samples from a truncated normal distribution centered on 0 with `stddev <- sqrt(1 / fan_in)` where `fan_in` is the number of input units in the weight tensor..

Usage

```
initializer_lecun_normal(seed = NULL)
```

Arguments

seed	A Python integer. Used to seed the random generator.

References

- Self-Normalizing Neural Networks
- Efficient Backprop

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_uniform, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

`initializer_lecun_uniform` *LeCun uniform initializer.*

Description

It draws samples from a uniform distribution within `-limit, limit` where `limit` is `sqrt(3 / fan_in)` where `fan_in` is the number of input units in the weight tensor.

Usage

```
initializer_lecun_uniform(seed = NULL)
```

Arguments

`seed`	Integer used to seed the random generator.

References

LeCun 98, Efficient Backprop, http://yann.lecun.com/exdb/publis/pdf/lecun-98b.pdf

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_ones, initializer_orthogonal, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

`initializer_ones` *Initializer that generates tensors initialized to 1.*

Description

Initializer that generates tensors initialized to 1.

Usage

```
initializer_ones()
```

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_orthogonal, initializer_random_normal, initializer_random_unifo
initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

initializer_orthogonal

Initializer that generates a random orthogonal matrix.

Description

Initializer that generates a random orthogonal matrix.

Usage

```
initializer_orthogonal(gain = 1, seed = NULL)
```

Arguments

gain	Multiplicative factor to apply to the orthogonal matrix.
seed	Integer used to seed the random generator.

References

Saxe et al., http://arxiv.org/abs/1312.6120

See Also

Other initializers: initializer_constant, initializer_glorot_normal, initializer_glorot_uniform, initializer_he_normal, initializer_he_uniform, initializer_identity, initializer_lecun_normal, initializer_lecun_uniform, initializer_ones, initializer_random_normal, initializer_random_uniform, initializer_truncated_normal, initializer_variance_scaling, initializer_zeros

---

initializer_random_normal

Initializer that generates tensors with a normal distribution.

Description

Initializer that generates tensors with a normal distribution.

Usage

```
initializer_random_normal(mean = 0, stddev = 0.05, seed = NULL)
```

Arguments

`mean`	Mean of the random values to generate.
`stddev`	Standard deviation of the random values to generate.
`seed`	Integer used to seed the random generator.

See Also

Other initializers: `initializer_constant`, `initializer_glorot_normal`, `initializer_glorot_uniform`, `initializer_he_normal`, `initializer_he_uniform`, `initializer_identity`, `initializer_lecun_normal`, `initializer_lecun_uniform`, `initializer_ones`, `initializer_orthogonal`, `initializer_random_uniform`, `initializer_truncated_normal`, `initializer_variance_scaling`, `initializer_zeros`

`initializer_random_uniform`

Initializer that generates tensors with a uniform distribution.

Description

Initializer that generates tensors with a uniform distribution.

Usage

```
initializer_random_uniform(minval = -0.05, maxval = 0.05,
  seed = NULL)
```

Arguments

`minval`	Lower bound of the range of random values to generate.
`maxval`	Upper bound of the range of random values to generate. Defaults to 1 for float types.
`seed`	seed

See Also

Other initializers: `initializer_constant`, `initializer_glorot_normal`, `initializer_glorot_uniform`, `initializer_he_normal`, `initializer_he_uniform`, `initializer_identity`, `initializer_lecun_normal`, `initializer_lecun_uniform`, `initializer_ones`, `initializer_orthogonal`, `initializer_random_normal`, `initializer_truncated_normal`, `initializer_variance_scaling`, `initializer_zeros`

initializer_truncated_normal

Initializer that generates a truncated normal distribution.

Description

These values are similar to values from an `initializer_random_normal()` except that values more than two standard deviations from the mean are discarded and re-drawn. This is the recommended initializer for neural network weights and filters.

Usage

```
initializer_truncated_normal(mean = 0, stddev = 0.05, seed = NULL)
```

Arguments

`mean`	Mean of the random values to generate.
`stddev`	Standard deviation of the random values to generate.
`seed`	Integer used to seed the random generator.

See Also

Other initializers: `initializer_constant`, `initializer_glorot_normal`, `initializer_glorot_uniform`, `initializer_he_normal`, `initializer_he_uniform`, `initializer_identity`, `initializer_lecun_normal`, `initializer_lecun_uniform`, `initializer_ones`, `initializer_orthogonal`, `initializer_random_normal`, `initializer_random_uniform`, `initializer_variance_scaling`, `initializer_zeros`

initializer_variance_scaling

Initializer capable of adapting its scale to the shape of weights.

Description

With `distribution="normal"`, samples are drawn from a truncated normal distribution centered on zero, with `stddev = sqrt(scale / n)` where n is:

- number of input units in the weight tensor, if mode = "fan_in"
- number of output units, if mode = "fan_out"
- average of the numbers of input and output units, if mode = "fan_avg"

Usage

```
initializer_variance_scaling(scale = 1, mode = c("fan_in", "fan_out",
  "fan_avg"), distribution = c("normal", "uniform"), seed = NULL)
```

Arguments

scale	Scaling factor (positive float).
mode	One of "fan_in", "fan_out", "fan_avg".
distribution	One of "normal", "uniform"
seed	Integer used to seed the random generator.

Details

With `distribution="uniform"`, samples are drawn from a uniform distribution within `-limit, limit`, with `limit = sqrt(3 * scale / n)`.

See Also

Other initializers: `initializer_constant`, `initializer_glorot_normal`, `initializer_glorot_uniform`, `initializer_he_normal`, `initializer_he_uniform`, `initializer_identity`, `initializer_lecun_normal`, `initializer_lecun_uniform`, `initializer_ones`, `initializer_orthogonal`, `initializer_random_normal`, `initializer_random_uniform`, `initializer_truncated_normal`, `initializer_zeros`

---

initializer_zeros   *Initializer that generates tensors initialized to 0.*

Description

Initializer that generates tensors initialized to 0.

Usage

```
initializer_zeros()
```

See Also

Other initializers: `initializer_constant`, `initializer_glorot_normal`, `initializer_glorot_uniform`, `initializer_he_normal`, `initializer_he_uniform`, `initializer_identity`, `initializer_lecun_normal`, `initializer_lecun_uniform`, `initializer_ones`, `initializer_orthogonal`, `initializer_random_normal`, `initializer_random_uniform`, `initializer_truncated_normal`, `initializer_variance_scaling` install_keras *Install Keras and the TensorFlow backend*

Description

Keras and TensorFlow will be installed into an "r-tensorflow" virtual or conda environment. Note that "virtualenv" is not available on Windows (as this isn't supported by TensorFlow).

Usage

```
install_keras(method = c("auto", "virtualenv", "conda"),
  conda = "auto", version = "default", tensorflow = "default",
  extra_packages = c("tensorflow-hub"))
```

Arguments

method	Installation method ("virtualenv" or "conda")
conda	Path to conda executable (or "auto" to find conda using the PATH and other conventional install locations).
version	Version of Keras to install. Specify "default" to install the latest release. Otherwise specify an alternate version (e.g. "2.2.2").
tensorflow	TensorFlow version to install. Specify "default" to install the CPU version of the latest release. Specify "gpu" to install the GPU version of the latest release. You can also provide a full major.minor.patch specification (e.g. "1.1.0"), appending "-gpu" if you want the GPU version (e.g. "1.1.0-gpu"). Alternatively, you can provide the full URL to an installer binary (e.g. for a nightly binary).
extra_packages	Additional PyPI packages to install along with Keras and TensorFlow.

GPU Installation

Keras and TensorFlow can be configured to run on either CPUs or GPUs. The CPU version is much easier to install and configure so is the best starting place especially when you are first learning how to use Keras. Here's the guidance on CPU vs. GPU versions from the TensorFlow website:

- *TensorFlow with CPU support only*. If your system does not have a NVIDIA® GPU, you must install this version. Note that this version of TensorFlow is typically much easier to install, so even if you have an NVIDIA GPU, we recommend installing this version first.
- *TensorFlow with GPU support*. TensorFlow programs typically run significantly faster on a GPU than on a CPU. Therefore, if your system has a NVIDIA® GPU meeting all prerequisites and you need to run performance-critical applications, you should ultimately install this version.

To install the GPU version:

1. Ensure that you have met all installation prerequisites including installation of the CUDA and cuDNN libraries as described in TensorFlow GPU Prerequistes.

2. Pass `tensorflow = "gpu"` to `install_keras()`. For example:

   ```
   install_keras(tensorflow = "gpu")
   ```

Windows Installation

The only supported installation method on Windows is "conda". This means that you should install Anaconda 3.x for Windows prior to installing Keras.

Custom Installation

Installing Keras and TensorFlow using `install_keras()` isn't required to use the Keras R package. You can do a custom installation of Keras (and desired backend) as described on the Keras website and the Keras R package will find and use that version.

See the documentation on custom installations for additional information on how version of Keras and TensorFlow are located by the Keras package.

Additional Packages

If you wish to add additional PyPI packages to your Keras / TensorFlow environment you can either specify the packages in the `extra_packages` argument of `install_keras()`, or alternatively install them into an existing environment using the `reticulate::py_install()` function.

Examples

```
## Not run:

# default installation
library(keras)
install_keras()

# install using a conda environment (default is virtualenv)
install_keras(method = "conda")

# install with GPU version of TensorFlow
# (NOTE: only do this if you have an NVIDIA GPU + CUDA!)
install_keras(tensorflow = "gpu")

# install a specific version of TensorFlow
install_keras(tensorflow = "1.2.1")
install_keras(tensorflow = "1.2.1-gpu")


## End(Not run)
```

is_keras_available *Check if Keras is Available*

Description

Probe to see whether the Keras python package is available in the current system environment.

Usage

```
is_keras_available(version = NULL)
```

Arguments

`version`	Minimum required version of Keras (defaults to `NULL`, no required version).

Value

Logical indicating whether Keras (or the specified minimum version of Keras) is available.

Examples

```
## Not run:
# testthat utilty for skipping tests when Keras isn't available
skip_if_no_keras <- function(version = NULL) {
  if (!is_keras_available(version))
    skip("Required keras version not available for testing")
}

# use the function within a test
test_that("keras function works correctly", {
  skip_if_no_keras()
  # test code here
})

## End(Not run)
```

KerasCallback *Base R6 class for Keras callbacks*

Description

Base R6 class for Keras callbacks

Usage

```
KerasCallback
```

Format

An R6Class generator object

Details

The logs named list that callback methods take as argument will contain keys for quantities relevant to the current batch or epoch.

Currently, the fit.keras.engine.training.Model() method for sequential models will include the following quantities in the logs that it passes to its callbacks:

- on_epoch_end: logs include acc and loss, and optionally include val_loss (if validation is enabled in fit), and val_acc (if validation and accuracy monitoring are enabled).
- on_batch_begin: logs include size, the number of samples in the current batch.
- on_batch_end: logs include loss, and optionally acc (if accuracy monitoring is enabled).

Value

KerasCallback.

Fields

params Named list with training parameters (eg. verbosity, batch size, number of epochs...).

model Reference to the Keras model being trained.

Methods

on_epoch_begin(epoch, logs) Called at the beginning of each epoch.

on_epoch_end(epoch, logs) Called at the end of each epoch.

on_batch_begin(batch, logs) Called at the beginning of each batch.

on_batch_end(batch, logs) Called at the end of each batch.

on_train_begin(logs) Called at the beginning of training.

on_train_end(logs) Called at the end of training.

Examples

```
## Not run:
library(keras)

LossHistory <- R6::R6Class("LossHistory",
  inherit = KerasCallback,

  public = list(

    losses = NULL,

    on_batch_end = function(batch, logs = list()) {
      self$losses <- c(self$losses, logs[["loss"]])
    }
```

```
  )
)

## End(Not run)
```

KerasConstraint *Base R6 class for Keras constraints*

Description

Base R6 class for Keras constraints

Usage

```
KerasConstraint
```

Format

An R6Class generator object

Details

You can implement a custom constraint either by creating an R function that accepts a weights (`w`) parameter, or by creating an R6 class that derives from `KerasConstraint` and implements a `call` method.

Methods

`call(w)` Constrain the specified weights.

Note

Models which use custom constraints cannot be serialized using `save_model_hdf5()`. Rather, the weights of the model should be saved and restored using `save_model_weights_hdf5()`.

See Also

constraints

Examples

```
## Not run:
CustomNonNegConstraint <- R6::R6Class(
  "CustomNonNegConstraint",
  inherit = KerasConstraint,
  public = list(
    call = function(x) {
       w * k_cast(k_greater_equal(w, 0), k_floatx())
    }
```

```
  )
)

layer_dense(units = 32, input_shape = c(784),
            kernel_constraint = CustomNonNegConstraint$new())

## End(Not run)
```

`KerasLayer` *Base R6 class for Keras layers*

Description

Base R6 class for Keras layers

Usage

```
KerasLayer
```

Format

An R6Class generator object #'

Value

KerasLayer.

Methods

`build(input_shape)` Creates the layer weights (must be implemented by all layers that have weights)

`call(inputs,mask)` Call the layer on an input tensor.

`compute_output_shape(input_shape)` Compute the output shape for the layer.

`add_loss(losses, inputs)` Add losses to the layer.

`add_weight(name,shape,dtype,initializer,regularizer,trainable,constraint)` Adds a weight variable to the layer.

KerasWrapper — *Base R6 class for Keras wrappers*

Description

Base R6 class for Keras wrappers

Usage

```
KerasWrapper
```

Format

An R6Class generator object

Value

KerasWrapper.

Methods

`build(input_shape)` Builds the wrapped layer. Subclasses can extend this to perform custom operations on that layer.

`call(inputs,mask)` Calls the wrapped layer on an input tensor.

`compute_output_shape(input_shape)` Computes the output shape for the wrapped layer.

`add_loss(losses, inputs)` Subclasses can use this to add losses to the wrapped layer.

`add_weight(name,shape,dtype,initializer,regularizer,trainable,constraint)` Subclasses can use this to add weights to the wrapped layer.

keras_array — *Keras array object*

Description

Convert an R vector, matrix, or array object to an array that has the optimal in-memory layout and floating point data type for the current Keras backend.

Usage

```
keras_array(x, dtype = NULL)
```

Arguments

`x`	Object or list of objects to convert
`dtype`	NumPy data type (e.g. float32, float64). If this is unspecified then R doubles will be converted to the default floating point type for the current Keras backend.

Details

Keras does frequent row-oriented access to arrays (for shuffling and drawing batches) so the order of arrays created by this function is always row-oriented ("C" as opposed to "Fortran" ordering, which is the default for R arrays).

If the passed array is already a NumPy array with the desired `dtype` and "C" order then it is returned unmodified (no additional copies are made).

Value

NumPy array with the specified `dtype` (or list of NumPy arrays if a list was passed for `x`).

`keras_model` *Keras Model*

Description

A model is a directed acyclic graph of layers.

Usage

```
keras_model(inputs, outputs = NULL)
```

Arguments

`inputs`	Input layer
`outputs`	Output layer

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training.Model`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`, `train_on_batch`

Examples

```
## Not run:
library(keras)

# input layer
inputs <- layer_input(shape = c(784))

# outputs compose input + dense layers
predictions <- inputs %>%
  layer_dense(units = 64, activation = 'relu') %>%
  layer_dense(units = 64, activation = 'relu') %>%
  layer_dense(units = 10, activation = 'softmax')
```

```
# create and compile model
model <- keras_model(inputs = inputs, outputs = predictions)
model %>% compile(
  optimizer = 'rmsprop',
  loss = 'categorical_crossentropy',
  metrics = c('accuracy')
)

## End(Not run)
```

---

keras_model_custom *Create a Keras custom model*

Description

Create a Keras custom model

Usage

```
keras_model_custom(model_fn, name = NULL)
```

Arguments

model_fn	Function that returns an R custom model
name	Optional name for model

Details

For documentation on using custom models, see https://keras.rstudio.com/articles/custom_models.html.

Value

A Keras model

---

keras_model_sequential *Keras Model composed of a linear stack of layers*

Description

Keras Model composed of a linear stack of layers

Usage

```
keras_model_sequential(layers = NULL, name = NULL)
```

Arguments

layers	List of layers to add to the model
name	Name of model

Note

The first layer passed to a Sequential model should have a defined input shape. What that means is that it should have received an input_shape or batch_input_shape argument, or for some type of layers (recurrent, Dense...) an input_dim argument.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model, multi_gpu_model, pop_layer, predict.keras.engine.training.Model, predict_generator, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

Examples

```
## Not run:

library(keras)

model <- keras_model_sequential()
model %>%
  layer_dense(units = 32, input_shape = c(784)) %>%
  layer_activation('relu') %>%
  layer_dense(units = 10) %>%
  layer_activation('softmax')

model %>% compile(
  optimizer = 'rmsprop',
  loss = 'categorical_crossentropy',
  metrics = c('accuracy')
)

## End(Not run)
```

---

k_abs *Element-wise absolute value.*

Description

Element-wise absolute value.

Usage

```
k_abs(x)
```

Arguments

`x`	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_all` *Bitwise reduction (logical AND).*

Description

Bitwise reduction (logical AND).

Usage

```
k_all(x, axis = NULL, keepdims = FALSE)
```

Arguments

`x`	Tensor or variable.
`axis`	Axis along which to perform the reduction (axis indexes are 1-based).
`keepdims`	whether the drop or broadcast the reduction axes.

Value

A uint8 tensor (0s and 1s).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_any — *Bitwise reduction (logical OR).*

Description

Bitwise reduction (logical OR).

Usage

```
k_any(x, axis = NULL, keepdims = FALSE)
```

Arguments

x	Tensor or variable.
axis	Axis along which to perform the reduction (axis indexes are 1-based).
keepdims	whether the drop or broadcast the reduction axes.

Value

A uint8 tensor (0s and 1s).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_arange — *Creates a 1D tensor containing a sequence of integers.*

Description

The function arguments use the same convention as Theano's arange: if only one argument is provided, it is in fact the "stop" argument. The default type of the returned tensor is 'int32' to match TensorFlow's default.

Usage

```
k_arange(start, stop = NULL, step = 1, dtype = "int32")
```

Arguments

`start`	Start value.
`stop`	Stop value.
`step`	Difference between two successive values.
`dtype`	Integer dtype to use.

Value

An integer tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_argmax — *Returns the index of the maximum value along an axis.*

Description

Returns the index of the maximum value along an axis.

Usage

```
k_argmax(x, axis = -1)
```

Arguments

`x`	Tensor or variable.
`axis`	Axis along which to perform the reduction (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_argmin — *Returns the index of the minimum value along an axis.*

Description

Returns the index of the minimum value along an axis.

Usage

```
k_argmin(x, axis = -1)
```

Arguments

x	Tensor or variable.
axis	Axis along which to perform the reduction (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_backend — *Active Keras backend*

Description

Active Keras backend

Usage

```
k_backend()
```

Value

The name of the backend Keras is currently using.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_batch_dot` *Batchwise dot product.*

Description

`batch_dot` is used to compute dot product of `x` and `y` when `x` and `y` are data in batch, i.e. in a shape of `(batch_size)`. `batch_dot` results in a tensor or variable with less dimensions than the input. If the number of dimensions is reduced to 1, we use `expand_dims` to make sure that ndim is at least 2.

Usage

```
k_batch_dot(x, y, axes)
```

Arguments

`x`	Keras tensor or variable with 2 more more axes.
`y`	Keras tensor or variable with 2 or more axes
`axes`	List of (or single) integer with target dimensions (axis indexes are 1-based). The lengths of `axes[[1]]` and `axes[[2]]` should be the same.

Value

A tensor with shape equal to the concatenation of `x`'s shape (less the dimension that was summed over) and `y`'s shape (less the batch dimension and the dimension that was summed over). If the final rank is 1, we reshape it to `(batch_size, 1)`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_batch_flatten` *Turn a nD tensor into a 2D tensor with same 1st dimension.*

Description

In other words, it flattens each data samples of a batch.

Usage

```
k_batch_flatten(x)
```

Arguments

`x`	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_batch_get_value` *Returns the value of more than one tensor variable.*

Description

Returns the value of more than one tensor variable.

Usage

```
k_batch_get_value(ops)
```

Arguments

`ops`	List of ops to evaluate.

Value

A list of arrays.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

See Also

`k_batch_set_value()`

---

k_batch_normalization *Applies batch normalization on x given mean, var, beta and gamma.*

Description

i.e. returns `output <- (x - mean) / (sqrt(var) + epsilon) * gamma + beta`

Usage

```
k_batch_normalization(x, mean, var, beta, gamma, axis = -1,
  epsilon = 0.001)
```

Arguments

`x`	Input tensor or variable.
`mean`	Mean of batch.
`var`	Variance of batch.
`beta`	Tensor with which to center the input.
`gamma`	Tensor by which to scale the input.
`axis`	Axis (axis indexes are 1-based). Pass -1 (the default) to select the last axis.
`epsilon`	Fuzz factor.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_batch_set_value — *Sets the values of many tensor variables at once.*

Description

Sets the values of many tensor variables at once.

Usage

```
k_batch_set_value(lists)
```

Arguments

`lists`	a list of lists `(tensor, value)`. `value` should be an R array.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

See Also

`k_batch_get_value()`

k_bias_add — *Adds a bias vector to a tensor.*

Description

Adds a bias vector to a tensor.

Usage

```
k_bias_add(x, bias, data_format = NULL)
```

Arguments

`x`	Tensor or variable.
`bias`	Bias tensor to add.
`data_format`	string, `"channels_last"` or `"channels_first"`.

Value

Output tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_binary_crossentropy *Binary crossentropy between an output tensor and a target tensor.*

Description

Binary crossentropy between an output tensor and a target tensor.

Usage

```
k_binary_crossentropy(target, output, from_logits = FALSE)
```

Arguments

`target`	A tensor with the same shape as `output`.
`output`	A tensor.
`from_logits`	Whether `output` is expected to be a logits tensor. By default, we consider that `output` encodes a probability distribution.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_cast` *Casts a tensor to a different dtype and returns it.*

Description

You can cast a Keras variable but it still returns a Keras tensor.

Usage

```
k_cast(x, dtype)
```

Arguments

`x`	Keras tensor (or variable).
`dtype`	String, either (`'float16'`, `'float32'`, or `'float64'`).

Value

Keras tensor with dtype `dtype`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_cast_to_floatx` *Cast an array to the default Keras float type.*

Description

Cast an array to the default Keras float type.

Usage

```
k_cast_to_floatx(x)
```

Arguments

`x`	Array.

Value

The same array, cast to its new type.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_categorical_crossentropy

Categorical crossentropy between an output tensor and a target tensor.

Description

Categorical crossentropy between an output tensor and a target tensor.

Usage

```
k_categorical_crossentropy(target, output, from_logits = FALSE,
  axis = -1)
```

Arguments

target	A tensor of the same shape as output.
output	A tensor resulting from a softmax (unless from_logits is TRUE, in which case output is expected to be the logits).
from_logits	Logical, whether output is the result of a softmax, or is a tensor of logits.
axis	Axis (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

Output tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_clear_session` *Destroys the current TF graph and creates a new one.*

Description

Useful to avoid clutter from old models / layers.

Usage

```
k_clear_session()
```

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_clip` *Element-wise value clipping.*

Description

Element-wise value clipping.

Usage

```
k_clip(x, min_value, max_value)
```

Arguments

`x`	Tensor or variable.
`min_value`	Float or integer.
`max_value`	Float or integer.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_concatenate	*Concatenates a list of tensors alongside the specified axis.*

Description

Concatenates a list of tensors alongside the specified axis.

Usage

```
k_concatenate(tensors, axis = -1)
```

Arguments

`tensors`	list of tensors to concatenate.
`axis`	concatenation axis (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_constant	*Creates a constant tensor.*

Description

Creates a constant tensor.

Usage

```
k_constant(value, dtype = NULL, shape = NULL, name = NULL)
```

Arguments

`value`	A constant value
`dtype`	The type of the elements of the resulting tensor.
`shape`	Optional dimensions of resulting tensor.
`name`	Optional name for the tensor.

Value

A Constant Tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_conv1d` *1D convolution.*

Description

1D convolution.

Usage

```
k_conv1d(x, kernel, strides = 1, padding = "valid",
  data_format = NULL, dilation_rate = 1)
```

Arguments

`x`	Tensor or variable.
`kernel`	kernel tensor.
`strides`	stride integer.
`padding`	string, `"same"`, `"causal"` or `"valid"`.
`data_format`	string, `"channels_last"` or `"channels_first"`.
`dilation_rate`	integer dilate rate.

Value

A tensor, result of 1D convolution.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_conv2d — *2D convolution.*

Description

2D convolution.

Usage

```
k_conv2d(x, kernel, strides = c(1, 1), padding = "valid",
  data_format = NULL, dilation_rate = c(1, 1))
```

Arguments

`x`	Tensor or variable.
`kernel`	kernel tensor.
`strides`	strides
`padding`	string, `"same"` or `"valid"`.
`data_format`	string, `"channels_last"` or `"channels_first"`. Whether to use Theano or TensorFlow/CNTK data format for inputs/kernels/outputs.
`dilation_rate`	vector of 2 integers.

Value

A tensor, result of 2D convolution.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_conv2d_transpose — *2D deconvolution (i.e. transposed convolution).*

Description

2D deconvolution (i.e. transposed convolution).

Usage

```
k_conv2d_transpose(x, kernel, output_shape, strides = c(1, 1),
  padding = "valid", data_format = NULL)
```

Arguments

`x`	Tensor or variable.
`kernel`	kernel tensor.
`output_shape`	1D int tensor for the output shape.
`strides`	strides list.
`padding`	string, `"same"` or `"valid"`.
`data_format`	string, `"channels_last"` or `"channels_first"`. Whether to use Theano or TensorFlow/CNTK data format for inputs/kernels/outputs.

Value

A tensor, result of transposed 2D convolution.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_conv3d *3D convolution.*

Description

3D convolution.

Usage

```
k_conv3d(x, kernel, strides = c(1, 1, 1), padding = "valid",
  data_format = NULL, dilation_rate = c(1, 1, 1))
```

Arguments

`x`	Tensor or variable.
`kernel`	kernel tensor.
`strides`	strides
`padding`	string, `"same"` or `"valid"`.
`data_format`	string, `"channels_last"` or `"channels_first"`. Whether to use Theano or TensorFlow/CNTK data format for inputs/kernels/outputs.
`dilation_rate`	list of 3 integers.

Value

A tensor, result of 3D convolution.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_conv3d_transpose` *3D deconvolution (i.e. transposed convolution).*

Description

3D deconvolution (i.e. transposed convolution).

Usage

```
k_conv3d_transpose(x, kernel, output_shape, strides = c(1, 1, 1),
  padding = "valid", data_format = NULL)
```

Arguments

`x`	input tensor.
`kernel`	kernel tensor.
`output_shape`	1D int tensor for the output shape.
`strides`	strides
`padding`	string, "same" or "valid".
`data_format`	string, `"channels_last"` or `"channels_first"`. Whether to use Theano or TensorFlow/CNTK data format for inputs/kernels/outputs.

Value

A tensor, result of transposed 3D convolution.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_cos` *Computes cos of x element-wise.*

Description

Computes cos of x element-wise.

Usage

```
k_cos(x)
```

Arguments

`x`	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_count_params` *Returns the static number of elements in a Keras variable or tensor.*

Description

Returns the static number of elements in a Keras variable or tensor.

Usage

```
k_count_params(x)
```

Arguments

`x`	Keras variable or tensor.

Value

Integer, the number of elements in `x`, i.e., the product of the array's static dimensions.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_ctc_batch_cost *Runs CTC loss algorithm on each batch element.*

Description

Runs CTC loss algorithm on each batch element.

Usage

```
k_ctc_batch_cost(y_true, y_pred, input_length, label_length)
```

Arguments

`y_true`	tensor `(samples, max_string_length)` containing the truth labels.
`y_pred`	tensor `(samples, time_steps, num_categories)` containing the prediction, or output of the softmax.
`input_length`	tensor `(samples, 1)` containing the sequence length for each batch item in `y_pred`.
`label_length`	tensor `(samples, 1)` containing the sequence length for each batch item in `y_true`.

Value

Tensor with shape (samples,1) containing the CTC loss of each element.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_ctc_decode *Decodes the output of a softmax.*

Description

Can use either greedy search (also known as best path) or a constrained dictionary search.

Usage

```
k_ctc_decode(y_pred, input_length, greedy = TRUE, beam_width = 100L,
  top_paths = 1)
```

Arguments

y_pred	tensor (samples, time_steps, num_categories) containing the prediction, or output of the softmax.
input_length	tensor (samples,) containing the sequence length for each batch item in y_pred.
greedy	perform much faster best-path search if TRUE. This does not use a dictionary.
beam_width	if greedy is FALSE: a beam search decoder will be used with a beam of this width.
top_paths	if greedy is FALSE, how many of the most probable paths will be returned.

Value

If greedy is TRUE, returns a list of one element that contains the decoded sequence. If FALSE, returns the top_paths most probable decoded sequences. Important: blank labels are returned as -1. Tensor (top_paths) that contains the log probability of each decoded sequence.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_ctc_label_dense_to_sparse

Converts CTC labels from dense to sparse.

Description

Converts CTC labels from dense to sparse.

Usage

```
k_ctc_label_dense_to_sparse(labels, label_lengths)
```

Arguments

labels	dense CTC labels.
label_lengths	length of the labels.

Value

A sparse tensor representation of the labels.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_cumprod

Cumulative product of the values in a tensor, alongside the specified axis.

Description

Cumulative product of the values in a tensor, alongside the specified axis.

Usage

```
k_cumprod(x, axis = 1)
```

Arguments

x	A tensor or variable.
axis	An integer, the axis to compute the product (axis indexes are 1-based).

Value

A tensor of the cumulative product of values of `x` along `axis`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_cumsum` *Cumulative sum of the values in a tensor, alongside the specified axis.*

Description

Cumulative sum of the values in a tensor, alongside the specified axis.

Usage

```
k_cumsum(x, axis = 1)
```

Arguments

`x`	A tensor or variable.
`axis`	An integer, the axis to compute the sum (axis indexes are 1-based).

Value

A tensor of the cumulative sum of values of `x` along `axis`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_depthwise_conv2d *Depthwise 2D convolution with separable filters.*

Description

Depthwise 2D convolution with separable filters.

Usage

```
k_depthwise_conv2d(x, depthwise_kernel, strides = c(1, 1),
  padding = "valid", data_format = NULL, dilation_rate = c(1, 1))
```

Arguments

x	input tensor
depthwise_kernel	convolution kernel for the depthwise convolution.
strides	strides (length 2).
padding	string, "same" or "valid".
data_format	string, "channels_last" or "channels_first".
dilation_rate	vector of integers, dilation rates for the separable convolution.

Value

Output tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_dot *Multiplies 2 tensors (and/or variables) and returns a* tensor.

Description

When attempting to multiply a nD tensor with a nD tensor, it reproduces the Theano behavior. (e.g. `(2, 3) * (4, 3, 5) -> (2, 4, 5)`)

Usage

```
k_dot(x, y)
```

Arguments

`x`	Tensor or variable.
`y`	Tensor or variable.

Value

A tensor, dot product of `x` and `y`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_dropout` *Sets entries in `x` to zero at random, while scaling the entire tensor.*

Description

Sets entries in `x` to zero at random, while scaling the entire tensor.

Usage

```
k_dropout(x, level, noise_shape = NULL, seed = NULL)
```

Arguments

`x`	tensor
`level`	fraction of the entries in the tensor that will be set to 0.
`noise_shape`	shape for randomly generated keep/drop flags, must be broadcastable to the shape of `x`
`seed`	random seed to ensure determinism.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_dtype` *Returns the dtype of a Keras tensor or variable, as a string.*

Description

Returns the dtype of a Keras tensor or variable, as a string.

Usage

```
k_dtype(x)
```

Arguments

`x`	Tensor or variable.

Value

String, dtype of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_elu` *Exponential linear unit.*

Description

Exponential linear unit.

Usage

```
k_elu(x, alpha = 1)
```

Arguments

`x`	A tensor or variable to compute the activation function for.
`alpha`	A scalar, slope of negative section.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_epsilon — *Fuzz factor used in numeric expressions.*

Description

Fuzz factor used in numeric expressions.

Usage

```
k_epsilon()

k_set_epsilon(e)
```

Arguments

e	float. New value of epsilon.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_equal — *Element-wise equality between two tensors.*

Description

Element-wise equality between two tensors.

Usage

```
k_equal(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_eval — *Evaluates the value of a variable.*

Description

Evaluates the value of a variable.

Usage

```
k_eval(x)
```

Arguments

x	A variable.

Value

An R array.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_exp` *Element-wise exponential.*

Description

Element-wise exponential.

Usage

```
k_exp(x)
```

Arguments

`x`	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_expand_dims` *Adds a 1-sized dimension at index* `axis`.

Description

Adds a 1-sized dimension at index `axis`.

Usage

```
k_expand_dims(x, axis = -1)
```

Arguments

`x`	A tensor or variable.
`axis`	Position where to add a new axis (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

A tensor with expanded dimensions.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_eye` *Instantiate an identity matrix and returns it.*

Description

Instantiate an identity matrix and returns it.

Usage

```
k_eye(size, dtype = NULL, name = NULL)
```

Arguments

`size`	Integer, number of rows/columns.
`dtype`	String, data type of returned Keras variable.
`name`	String, name of returned Keras variable.

Value

A Keras variable, an identity matrix.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_flatten *Flatten a tensor.*

Description

Flatten a tensor.

Usage

```
k_flatten(x)
```

Arguments

x	A tensor or variable.

Value

A tensor, reshaped into 1-D

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_floatx *Default float type*

Description

Default float type

Usage

```
k_floatx()

k_set_floatx(floatx)
```

Arguments

floatx	String, 'float16', 'float32', or 'float64'.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_foldl *Reduce elems using fn to combine them from left to right.*

Description

Reduce elems using fn to combine them from left to right.

Usage

```
k_foldl(fn, elems, initializer = NULL, name = NULL)
```

Arguments

fn	Function that will be called upon each element in elems and an accumulator
elems	tensor
initializer	The first value used (first element of `elems` in case of 'NULL")
name	A string name for the foldl node in the graph

Value

Tensor with same type and shape as `initializer`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_foldr` *Reduce elems using fn to combine them from right to left.*

Description

Reduce elems using fn to combine them from right to left.

Usage

```
k_foldr(fn, elems, initializer = NULL, name = NULL)
```

Arguments

`fn`	Function that will be called upon each element in elems and an accumulator
`elems`	tensor
`initializer`	The first value used (last element of `elems` in case of NULL)
`name`	A string name for the foldr node in the graph

Value

Tensor with same type and shape as `initializer`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_function` *Instantiates a Keras function*

Description

Instantiates a Keras function

Usage

```
k_function(inputs, outputs, updates = NULL, ...)
```

Arguments

`inputs`	List of placeholder tensors.
`outputs`	List of output tensors.
`updates`	List of update ops.
`...`	Named arguments passed to `tf$Session$run`.

Value

Output values as R arrays.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

---

k_gather — *Retrieves the elements of indices* `indices` *in the tensor* `reference`.

Description

Retrieves the elements of indices `indices` in the tensor `reference`.

Usage

```
k_gather(reference, indices)
```

Arguments

`reference`	A tensor.
`indices`	Indices. Dimension indices are 1-based. Note however that if you pass a tensor for `indices` they will be passed as-is, in which case indices will be 0 based because no normalizing of R 1-based axes to Python 0-based axes is performed.

Value

A tensor of same type as `reference`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_get_session — *TF session to be used by the backend.*

Description

If a default TensorFlow session is available, we will return it. Else, we will return the global Keras session. If no global Keras session exists at this point: we will create a new global session. Note that you can manually set the global session via `k_set_session()`.

Usage

```
k_get_session()

k_set_session(session)
```

Arguments

`session`	A TensorFlow Session.

Value

A TensorFlow session

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_get_uid — *Get the uid for the default graph.*

Description

Get the uid for the default graph.

Usage

```
k_get_uid(prefix = "")
```

Arguments

`prefix`	An optional prefix of the graph.

Value

A unique identifier for the graph.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_get_value — *Returns the value of a variable.*

Description

Returns the value of a variable.

Usage

```
k_get_value(x)
```

Arguments

x	input variable.

Value

An R array.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_get_variable_shape` *Returns the shape of a variable.*

Description

Returns the shape of a variable.

Usage

```
k_get_variable_shape(x)
```

Arguments

`x`	A variable.

Value

A vector of integers.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_gradients` *Returns the gradients of* `variables` *w.r.t.* `loss`*.*

Description

Returns the gradients of `variables` w.r.t. `loss`.

Usage

```
k_gradients(loss, variables)
```

Arguments

`loss`	Scalar tensor to minimize.
`variables`	List of variables.

Value

A gradients tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_greater — *Element-wise truth value of (x > y).*

Description

Element-wise truth value of (x > y).

Usage

```
k_greater(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_greater_equal — *Element-wise truth value of (x >= y).*

Description

Element-wise truth value of (x >= y).

Usage

```
k_greater_equal(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_hard_sigmoid — *Segment-wise linear approximation of sigmoid.*

Description

Faster than sigmoid. Returns `0.` if `x < -2.5`, `1.` if `x > 2.5`. In `-2.5 <= x <= 2.5`, returns `0.2 * x + 0.5`.

Usage

```
k_hard_sigmoid(x)
```

Arguments

x	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_identity` *Returns a tensor with the same content as the input tensor.*

Description

Returns a tensor with the same content as the input tensor.

Usage

```
k_identity(x, name = NULL)
```

Arguments

`x`	The input tensor.
`name`	String, name for the variable to create.

Value

A tensor of the same shape, type and content.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_image_data_format` *Default image data format convention ('channels_first' or 'channels_last').*

Description

Default image data format convention ('channels_first' or 'channels_last').

Usage

```
k_image_data_format()

k_set_image_data_format(data_format)
```

Arguments

`data_format`	string. `'channels_first'` or `'channels_last'`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_int_shape` *Returns the shape of tensor or variable as a list of int or NULL entries.*

Description

Returns the shape of tensor or variable as a list of int or NULL entries.

Usage

```
k_int_shape(x)
```

Arguments

`x`	Tensor or variable.

Value

A list of integers (or NULL entries).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_in_test_phase` *Selects `x` in test phase, and `alt` otherwise.*

Description

Note that `alt` should have the *same shape* as `x`.

Usage

```
k_in_test_phase(x, alt, training = NULL)
```

Arguments

`x`	What to return in test phase (tensor or function that returns a tensor).
`alt`	What to return otherwise (tensor or function that returns a tensor).
`training`	Optional scalar tensor (or R logical or integer) specifying the learning phase.

Value

Either `x` or `alt` based on `k_learning_phase()`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

---

k_in_top_k — *Returns whether the* `targets` *are in the top* `k` `predictions`.

Description

Returns whether the `targets` are in the top `k` `predictions`.

Usage

```
k_in_top_k(predictions, targets, k)
```

Arguments

`predictions`	A tensor of shape `(batch_size, classes)` and type `float32`.
`targets`	A 1D tensor of length `batch_size` and type `int32` or `int64`.
`k`	An `int`, number of top elements to consider.

Value

A 1D tensor of length `batch_size` and type `bool`. `output[[i]]` is `TRUE` if `predictions[i, targets[[i]]` is within top-`k` values of `predictions[[i]]`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_in_train_phase *Selects x in train phase, and alt otherwise.*

Description

Note that `alt` should have the *same shape* as `x`.

Usage

```
k_in_train_phase(x, alt, training = NULL)
```

Arguments

`x`	What to return in train phase (tensor or function that returns a tensor).
`alt`	What to return otherwise (tensor or function that returns a tensor).
`training`	Optional scalar tensor (or R logical or integer) specifying the learning phase.

Value

Either `x` or `alt` based on the `training` flag. the `training` flag defaults to `k_learning_phase()`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_is_keras_tensor *Returns whether x is a Keras tensor.*

Description

A "Keras tensor" is a tensor that was returned by a Keras layer

Usage

```
k_is_keras_tensor(x)
```

Arguments

`x`	A candidate tensor.

Value

A logical: Whether the argument is a Keras tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_is_placeholder` *Returns whether* `x` *is a placeholder.*

Description

Returns whether `x` is a placeholder.

Usage

```
k_is_placeholder(x)
```

Arguments

`x`	A candidate placeholder.

Value

A logical

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_is_sparse` *Returns whether a tensor is a sparse tensor.*

Description

Returns whether a tensor is a sparse tensor.

Usage

```
k_is_sparse(tensor)
```

Arguments

`tensor`	A tensor instance.

Value

A logical

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_is_tensor — *Returns whether x is a symbolic tensor.*

Description

Returns whether x is a symbolic tensor.

Usage

```
k_is_tensor(x)
```

Arguments

x	A candidate tensor.

Value

A logical: Whether the argument is a symbolic tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_l2_normalize *Normalizes a tensor wrt the L2 norm alongside the specified axis.*

Description

Normalizes a tensor wrt the L2 norm alongside the specified axis.

Usage

```
k_l2_normalize(x, axis = NULL)
```

Arguments

x	Tensor or variable.
axis	Axis along which to perform normalization (axis indexes are 1-based)

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_learning_phase *Returns the learning phase flag.*

Description

The learning phase flag is a bool tensor (0 = test, 1 = train) to be passed as input to any Keras function that uses a different behavior at train time and test time.

Usage

```
k_learning_phase()
```

Value

Learning phase (scalar integer tensor or R integer).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_less — *Element-wise truth value of (x < y).*

Description

Element-wise truth value of (x < y).

Usage

```
k_less(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_less_equal — *Element-wise truth value of (x <= y).*

Description

Element-wise truth value of (x <= y).

Usage

```
k_less_equal(x, y)
```

Arguments

`x`	Tensor or variable.
`y`	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_local_conv1d — *Apply 1D conv with un-shared weights.*

Description

Apply 1D conv with un-shared weights.

Usage

```
k_local_conv1d(inputs, kernel, kernel_size, strides, data_format = NULL)
```

Arguments

`inputs`	3D tensor with shape: (batch_size, steps, input_dim)
`kernel`	the unshared weight for convolution, with shape (output_length, feature_dim, filters)
`kernel_size`	a list of a single integer, specifying the length of the 1D convolution window
`strides`	a list of a single integer, specifying the stride length of the convolution
`data_format`	the data format, channels_first or channels_last

Value

the tensor after 1d conv with un-shared weights, with shape (batch_size, output_length, filters)

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_local_conv2d *Apply 2D conv with un-shared weights.*

Description

Apply 2D conv with un-shared weights.

Usage

```
k_local_conv2d(inputs, kernel, kernel_size, strides, output_shape,
  data_format = NULL)
```

Arguments

`inputs`	4D tensor with shape: (batch_size, filters, new_rows, new_cols) if data_format='channels_first' or 4D tensor with shape: (batch_size, new_rows, new_cols, filters) if data_format='channels_last'.
`kernel`	the unshared weight for convolution, with shape (output_items, feature_dim, filters)
`kernel_size`	a list of 2 integers, specifying the width and height of the 2D convolution window.
`strides`	a list of 2 integers, specifying the strides of the convolution along the width and height.
`output_shape`	a list with (output_row, output_col)
`data_format`	the data format, channels_first or channels_last

Value

A 4d tensor with shape: (batch_size, filters, new_rows, new_cols) if data_format='channels_first' or 4D tensor with shape: (batch_size, new_rows, new_cols, filters) if data_format='channels_last'.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_log — *Element-wise log.*

Description

Element-wise log.

Usage

```
k_log(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_logsumexp — *Computes log(sum(exp(elements across dimensions of a tensor))).*

Description

This function is more numerically stable than log(sum(exp(x))). It avoids overflows caused by taking the exp of large inputs and underflows caused by taking the log of small inputs.

Usage

```
k_logsumexp(x, axis = NULL, keepdims = FALSE)
```

Arguments

x	A tensor or variable.
axis	An integer, the axis to reduce over (axis indexes are 1-based).
keepdims	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

The reduced tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_manual_variable_initialization

Sets the manual variable initialization flag.

Description

This boolean flag determines whether variables should be initialized as they are instantiated (default), or if the user should handle the initialization (e.g. via `tf$initialize_all_variables()`).

Usage

```
k_manual_variable_initialization(value)
```

Arguments

`value`	Logical

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_map_fn — *Map the function fn over the elements elems and return the outputs.*

Description

Map the function fn over the elements elems and return the outputs.

Usage

```
k_map_fn(fn, elems, name = NULL, dtype = NULL)
```

Arguments

`fn`	Function that will be called upon each element in elems
`elems`	tensor
`name`	A string name for the map node in the graph
`dtype`	Output data type.

Value

Tensor with dtype `dtype`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_max — *Maximum value in a tensor.*

Description

Maximum value in a tensor.

Usage

```
k_max(x, axis = NULL, keepdims = FALSE)
```

Arguments

x	A tensor or variable.
axis	An integer, the axis to find maximum values (axis indexes are 1-based).
keepdims	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

A tensor with maximum values of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_maximum — *Element-wise maximum of two tensors.*

Description

Element-wise maximum of two tensors.

Usage

```
k_maximum(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_mean — *Mean of a tensor, alongside the specified axis.*

Description

Mean of a tensor, alongside the specified axis.

Usage

```
k_mean(x, axis = NULL, keepdims = FALSE)
```

Arguments

x	A tensor or variable.
axis	A list of axes to compute the mean over (axis indexes are 1-based).
keepdims	A boolean, whether to keep the dimensions or not. If keepdims is FALSE, the rank of the tensor is reduced by 1 for each entry in axis. If keep_dims is TRUE, the reduced dimensions are retained with length 1.

Value

A tensor with the mean of elements of x.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_min — *Minimum value in a tensor.*

Description

Minimum value in a tensor.

Usage

```
k_min(x, axis = NULL, keepdims = FALSE)
```

Arguments

`x`	A tensor or variable.
`axis`	An integer, axis to find minimum values (axis indexes are 1-based).
`keepdims`	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

A tensor with miminum values of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_minimum` *Element-wise minimum of two tensors.*

Description

Element-wise minimum of two tensors.

Usage

```
k_minimum(x, y)
```

Arguments

`x`	Tensor or variable.
`y`	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_moving_average_update *Compute the moving average of a variable.*

Description

Compute the moving average of a variable.

Usage

```
k_moving_average_update(x, value, momentum)
```

Arguments

x	A Variable.
value	A tensor with the same shape as x.
momentum	The moving average momentum.

Value

An operation to update the variable.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_ndim *Returns the number of axes in a tensor, as an integer.*

Description

Returns the number of axes in a tensor, as an integer.

Usage

```
k_ndim(x)
```

Arguments

x	Tensor or variable.

Value

Integer (scalar), number of axes.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_normalize_batch_in_training — *Computes mean and std for batch then apply batch_normalization on batch.*

Description

Computes mean and std for batch then apply batch_normalization on batch.

Usage

```
k_normalize_batch_in_training(x, gamma, beta, reduction_axes,
  epsilon = 0.001)
```

Arguments

x	Input tensor or variable.
gamma	Tensor by which to scale the input.
beta	Tensor with which to center the input.
reduction_axes	iterable of integers, axes over which to normalize.
epsilon	Fuzz factor.

Value

A list length of 3, `(normalized_tensor, mean, variance)`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_not_equal` *Element-wise inequality between two tensors.*

Description

Element-wise inequality between two tensors.

Usage

```
k_not_equal(x, y)
```

Arguments

x	Tensor or variable.
y	Tensor or variable.

Value

A bool tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_ones` *Instantiates an all-ones tensor variable and returns it.*

Description

Instantiates an all-ones tensor variable and returns it.

Usage

```
k_ones(shape, dtype = NULL, name = NULL)
```

Arguments

shape	Tuple of integers, shape of returned Keras variable.
dtype	String, data type of returned Keras variable.
name	String, name of returned Keras variable.

Value

A Keras variable, filled with `1.0`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_ones_like` *Instantiates an all-ones variable of the same shape as another tensor.*

Description

Instantiates an all-ones variable of the same shape as another tensor.

Usage

```
k_ones_like(x, dtype = NULL, name = NULL)
```

Arguments

`x`	Keras variable or tensor.
`dtype`	String, dtype of returned Keras variable. NULL uses the dtype of x.
`name`	String, name for the variable to create.

Value

A Keras variable with the shape of x filled with ones.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_one_hot` *Computes the one-hot representation of an integer tensor.*

Description

Computes the one-hot representation of an integer tensor.

Usage

```
k_one_hot(indices, num_classes)
```

Arguments

`indices`	nD integer tensor of shape `(batch_size, dim1, dim2, ... dim(n-1))`
`num_classes`	Integer, number of classes to consider.

Value

(n + 1)D one hot representation of the input with shape `(batch_size, dim1, dim2, ... dim(n-1), num_classes)`

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_permute_dimensions` *Permutes axes in a tensor.*

Description

Permutes axes in a tensor.

Usage

```
k_permute_dimensions(x, pattern)
```

Arguments

`x`	Tensor or variable.
`pattern`	A list of dimension indices, e.g. `(1, 3, 2)`. Dimension indices are 1-based.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_placeholder   *Instantiates a placeholder tensor and returns it.*

Description

Instantiates a placeholder tensor and returns it.

Usage

```
k_placeholder(shape = NULL, ndim = NULL, dtype = NULL,
  sparse = FALSE, name = NULL)
```

Arguments

shape	Shape of the placeholder (integer list, may include NULL entries).
ndim	Number of axes of the tensor. At least one of shape, ndim must be specified. If both are specified, shape is used.
dtype	Placeholder type.
sparse	Logical, whether the placeholder should have a sparse type.
name	Optional name string for the placeholder.

Value

Tensor instance (with Keras metadata included).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_pool2d *2D Pooling.*

Description

2D Pooling.

Usage

```
k_pool2d(x, pool_size, strides = c(1, 1), padding = "valid",
  data_format = NULL, pool_mode = "max")
```

Arguments

x	Tensor or variable.
pool_size	list of 2 integers.
strides	list of 2 integers.
padding	string, "same" or "valid".
data_format	string, "channels_last" or "channels_first".
pool_mode	string, "max" or "avg".

Value

A tensor, result of 2D pooling.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_pool3d *3D Pooling.*

Description

3D Pooling.

Usage

```
k_pool3d(x, pool_size, strides = c(1, 1, 1), padding = "valid",
  data_format = NULL, pool_mode = "max")
```

Arguments

`x`	Tensor or variable.
`pool_size`	list of 3 integers.
`strides`	list of 3 integers.
`padding`	string, `"same"` or `"valid"`.
`data_format`	string, `"channels_last"` or `"channels_first"`.
`pool_mode`	string, `"max"` or `"avg"`.

Value

A tensor, result of 3D pooling.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_pow` *Element-wise exponentiation.*

Description

Element-wise exponentiation.

Usage

```
k_pow(x, a)
```

Arguments

`x`	Tensor or variable.
`a`	R integer.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_print_tensor — *Prints* `message` *and the tensor value when evaluated.*

Description

Note that `print_tensor` returns a new tensor identical to `x` which should be used in the following code. Otherwise the print operation is not taken into account during evaluation.

Usage

```
k_print_tensor(x, message = "")
```

Arguments

`x`	Tensor to print.
`message`	Message to print jointly with the tensor.

Value

The same tensor `x`, unchanged.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_prod — *Multiplies the values in a tensor, alongside the specified axis.*

Description

Multiplies the values in a tensor, alongside the specified axis.

Usage

```
k_prod(x, axis = NULL, keepdims = FALSE)
```

Arguments

`x`	A tensor or variable.
`axis`	An integer, axis to compute the product over (axis indexes are 1-based).
`keepdims`	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

A tensor with the product of elements of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_random_binomial` *Returns a tensor with random binomial distribution of values.*

Description

Returns a tensor with random binomial distribution of values.

Usage

```
k_random_binomial(shape, p = 0, dtype = NULL, seed = NULL)
```

Arguments

`shape`	A list of integers, the shape of tensor to create.
`p`	A float, `0. <= p <= 1`, probability of binomial distribution.
`dtype`	String, dtype of returned tensor.
`seed`	Integer, random seed.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_random_normal *Returns a tensor with normal distribution of values.*

Description

Returns a tensor with normal distribution of values.

Usage

```
k_random_normal(shape, mean = 0, stddev = 1, dtype = NULL,
  seed = NULL)
```

Arguments

shape	A list of integers, the shape of tensor to create.
mean	A float, mean of the normal distribution to draw samples.
stddev	A float, standard deviation of the normal distribution to draw samples.
dtype	String, dtype of returned tensor.
seed	Integer, random seed.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_random_normal_variable *Instantiates a variable with values drawn from a normal distribution.*

Description

Instantiates a variable with values drawn from a normal distribution.

Usage

```
k_random_normal_variable(shape, mean, scale, dtype = NULL, name = NULL,
  seed = NULL)
```

Arguments

`shape`	Tuple of integers, shape of returned Keras variable.
`mean`	Float, mean of the normal distribution.
`scale`	Float, standard deviation of the normal distribution.
`dtype`	String, dtype of returned Keras variable.
`name`	String, name of returned Keras variable.
`seed`	Integer, random seed.

Value

A Keras variable, filled with drawn samples.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_random_uniform` *Returns a tensor with uniform distribution of values.*

Description

Returns a tensor with uniform distribution of values.

Usage

```
k_random_uniform(shape, minval = 0, maxval = 1, dtype = NULL,
  seed = NULL)
```

Arguments

`shape`	A list of integers, the shape of tensor to create.
`minval`	A float, lower boundary of the uniform distribution to draw samples.
`maxval`	A float, upper boundary of the uniform distribution to draw samples.
`dtype`	String, dtype of returned tensor.
`seed`	Integer, random seed.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_random_uniform_variable`

Instantiates a variable with values drawn from a uniform distribution.

Description

Instantiates a variable with values drawn from a uniform distribution.

Usage

```
k_random_uniform_variable(shape, low, high, dtype = NULL, name = NULL,
  seed = NULL)
```

Arguments

shape	Tuple of integers, shape of returned Keras variable.
low	Float, lower boundary of the output interval.
high	Float, upper boundary of the output interval.
dtype	String, dtype of returned Keras variable.
name	String, name of returned Keras variable.
seed	Integer, random seed.

Value

A Keras variable, filled with drawn samples.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_relu — *Rectified linear unit.*

Description

With default values, it returns element-wise `max(x, 0)`.

Usage

```
k_relu(x, alpha = 0, max_value = NULL)
```

Arguments

x	A tensor or variable.
alpha	A scalar, slope of negative section (default=`0.`).
max_value	Saturation threshold.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_repeat — *Repeats a 2D tensor.*

Description

If x has shape (samples, dim) and n is 2, the output will have shape (samples, 2, dim).

Usage

```
k_repeat(x, n)
```

Arguments

x	Tensor or variable.
n	Integer, number of times to repeat.

Value

A tensor

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_repeat_elements` *Repeats the elements of a tensor along an axis.*

Description

If `x` has shape `(s1, s2, s3)` and `axis` is `2`, the output will have shape `(s1, s2 * rep, s3)`.

Usage

```
k_repeat_elements(x, rep, axis)
```

Arguments

`x`	Tensor or variable.
`rep`	Integer, number of times to repeat.
`axis`	Axis along which to repeat (axis indexes are 1-based)

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_reset_uids` *Reset graph identifiers.*

Description

Reset graph identifiers.

Usage

```
k_reset_uids()
```

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_reshape` *Reshapes a tensor to the specified shape.*

Description

Reshapes a tensor to the specified shape.

Usage

```
k_reshape(x, shape)
```

Arguments

x	Tensor or variable.
shape	Target shape list.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_resize_images *Resizes the images contained in a 4D tensor.*

Description

Resizes the images contained in a 4D tensor.

Usage

```
k_resize_images(x, height_factor, width_factor, data_format)
```

Arguments

x	Tensor or variable to resize.
height_factor	Positive integer.
width_factor	Positive integer.
data_format	string, "channels_last" or "channels_first".

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_resize_volumes *Resizes the volume contained in a 5D tensor.*

Description

Resizes the volume contained in a 5D tensor.

Usage

```
k_resize_volumes(x, depth_factor, height_factor, width_factor, data_format)
```

Arguments

`x`	Tensor or variable to resize.
`depth_factor`	Positive integer.
`height_factor`	Positive integer.
`width_factor`	Positive integer.
`data_format`	string, `"channels_last"` or `"channels_first"`.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_reverse` *Reverse a tensor along the specified axes.*

Description

Reverse a tensor along the specified axes.

Usage

```
k_reverse(x, axes)
```

Arguments

`x`	Tensor to reverse.
`axes`	Integer or list of integers of axes to reverse (axis indexes are 1-based).

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_rnn` *Iterates over the time dimension of a tensor*

Description

Iterates over the time dimension of a tensor

Usage

```
k_rnn(step_function, inputs, initial_states, go_backwards = FALSE,
  mask = NULL, constants = NULL, unroll = FALSE,
  input_length = NULL)
```

Arguments

`step_function`	RNN step function.
`inputs`	Tensor with shape (samples, ...) (no time dimension), representing input for the batch of samples at a certain time step.
`initial_states`	Tensor with shape (samples, output_dim) (no time dimension), containing the initial values for the states used in the step function.
`go_backwards`	Logical If `TRUE`, do the iteration over the time dimension in reverse order and return the reversed sequence.
`mask`	Binary tensor with shape (samples, time, 1), with a zero for every element that is masked.
`constants`	A list of constant values passed at each step.
`unroll`	Whether to unroll the RNN or to use a symbolic loop (while_loop or scan depending on backend).
`input_length`	Not relevant in the TensorFlow implementation. Must be specified if using unrolling with Theano.

Value

A list with:

- `last_output`: the latest output of the rnn, of shape (samples, ...)
- `outputs`: tensor with shape (samples, time, ...) where each entry `outputs[s, t]` is the output of the step function at time t for sample s.
- `new_states`: list of tensors, latest states returned by the step function, of shape (samples, ...).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_round — *Element-wise rounding to the closest integer.*

Description

In case of tie, the rounding mode used is "half to even".

Usage

```
k_round(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_separable_conv2d — *2D convolution with separable filters.*

Description

2D convolution with separable filters.

Usage

```
k_separable_conv2d(x, depthwise_kernel, pointwise_kernel, strides = c(1,
  1), padding = "valid", data_format = NULL, dilation_rate = c(1, 1))
```

Arguments

x	input tensor
depthwise_kernel	convolution kernel for the depthwise convolution.
pointwise_kernel	kernel for the 1x1 convolution.
strides	strides list (length 2).
padding	string, "same" or "valid".
data_format	string, "channels_last" or "channels_first".
dilation_rate	list of integers, dilation rates for the separable convolution.

Value

Output tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_set_learning_phase *Sets the learning phase to a fixed value.*

Description

Sets the learning phase to a fixed value.

Usage

```
k_set_learning_phase(value)
```

Arguments

value	Learning phase value, either 0 or 1 (integers).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_set_value — *Sets the value of a variable, from an R array.*

Description

Sets the value of a variable, from an R array.

Usage

```
k_set_value(x, value)
```

Arguments

x	Tensor to set to a new value.
value	Value to set the tensor to, as an R array (of the same shape).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_shape — *Returns the symbolic shape of a tensor or variable.*

Description

Returns the symbolic shape of a tensor or variable.

Usage

```
k_shape(x)
```

Arguments

x	A tensor or variable.

Value

A symbolic shape (which is itself a tensor).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_sigmoid *Element-wise sigmoid.*

Description

Element-wise sigmoid.

Usage

```
k_sigmoid(x)
```

Arguments

x	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_sign *Element-wise sign.*

Description

Element-wise sign.

Usage

```
k_sign(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_sin — *Computes sin of x element-wise.*

Description

Computes sin of x element-wise.

Usage

```
k_sin(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_softmax` *Softmax of a tensor.*

Description

Softmax of a tensor.

Usage

```
k_softmax(x, axis = -1)
```

Arguments

`x`	A tensor or variable.
`axis`	The dimension softmax would be performed on. The default is -1 which indicates the last dimension.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_softplus` *Softplus of a tensor.*

Description

Softplus of a tensor.

Usage

```
k_softplus(x)
```

Arguments

`x`	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_softsign *Softsign of a tensor.*

Description

Softsign of a tensor.

Usage

```
k_softsign(x)
```

Arguments

x	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_sparse_categorical_crossentropy *Categorical crossentropy with integer targets.*

Description

Categorical crossentropy with integer targets.

Usage

```
k_sparse_categorical_crossentropy(target, output, from_logits = FALSE,
  axis = -1)
```

Arguments

`target`	An integer tensor.
`output`	A tensor resulting from a softmax (unless `from_logits` is TRUE, in which case `output` is expected to be the logits).
`from_logits`	Boolean, whether `output` is the result of a softmax, or is a tensor of logits.
`axis`	Axis (axis indexes are 1-based). Pass -1 (the default) to select the last axis.

Value

Output tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

`k_spatial_2d_padding` *Pads the 2nd and 3rd dimensions of a 4D tensor.*

Description

Pads the 2nd and 3rd dimensions of a 4D tensor.

Usage

```
k_spatial_2d_padding(x, padding = list(list(1, 1), list(1, 1)),
  data_format = NULL)
```

Arguments

`x`	Tensor or variable.
`padding`	Tuple of 2 lists, padding pattern.
`data_format`	string, `"channels_last"` or `"channels_first"`.

Value

A padded 4D tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_spatial_3d_padding *Pads 5D tensor with zeros along the depth, height, width dimensions.*

Description

Pads these dimensions with respectively padding[[1]], padding[[2]], and padding[[3]] zeros left and right. For 'channels_last' data_format, the 2nd, 3rd and 4th dimension will be padded. For 'channels_first' data_format, the 3rd, 4th and 5th dimension will be padded.

Usage

```
k_spatial_3d_padding(x, padding = list(list(1, 1), list(1, 1), list(1,
  1)), data_format = NULL)
```

Arguments

x	Tensor or variable.
padding	List of 3 lists, padding pattern.
data_format	string, "channels_last" or "channels_first".

Value

A padded 5D tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_sqrt *Element-wise square root.*

Description

Element-wise square root.

Usage

```
k_sqrt(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_square — *Element-wise square.*

Description

Element-wise square.

Usage

```
k_square(x)
```

Arguments

x	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_squeeze *Removes a 1-dimension from the tensor at index `axis`.*

Description

Removes a 1-dimension from the tensor at index `axis`.

Usage

```
k_squeeze(x, axis)
```

Arguments

`x`	A tensor or variable.
`axis`	Axis to drop (axis indexes are 1-based).

Value

A tensor with the same data as `x` but reduced dimensions.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_stack *Stacks a list of rank `R` tensors into a rank `R+1` tensor.*

Description

Stacks a list of rank `R` tensors into a rank `R+1` tensor.

Usage

```
k_stack(x, axis = 1)
```

Arguments

`x`	List of tensors.
`axis`	Axis along which to perform stacking (axis indexes are 1-based).

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_std` *Standard deviation of a tensor, alongside the specified axis.*

Description

Standard deviation of a tensor, alongside the specified axis.

Usage

```
k_std(x, axis = NULL, keepdims = FALSE)
```

Arguments

`x`	A tensor or variable.
`axis`	An integer, the axis to compute the standard deviation over (axis indexes are 1-based).
`keepdims`	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

A tensor with the standard deviation of elements of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_stop_gradient — *Returns* `variables` *but with zero gradient w.r.t. every other variable.*

Description

Returns `variables` but with zero gradient w.r.t. every other variable.

Usage

```
k_stop_gradient(variables)
```

Arguments

`variables`	tensor or list of tensors to consider constant with respect to any other variable.

Value

A single tensor or a list of tensors (depending on the passed argument) that has constant gradient with respect to any other variable.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_sum — *Sum of the values in a tensor, alongside the specified axis.*

Description

Sum of the values in a tensor, alongside the specified axis.

Usage

```
k_sum(x, axis = NULL, keepdims = FALSE)
```

Arguments

`x`	A tensor or variable.
`axis`	An integer, the axis to sum over (axis indexes are 1-based).
`keepdims`	A boolean, whether to keep the dimensions or not. If `keepdims` is `FALSE`, the rank of the tensor is reduced by 1. If `keepdims` is `TRUE`, the reduced dimension is retained with length 1.

Value

A tensor with sum of `x`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_switch — *Switches between two operations depending on a scalar value.*

Description

Note that both `then_expression` and `else_expression` should be symbolic tensors of the *same shape*.

Usage

```
k_switch(condition, then_expression, else_expression)
```

Arguments

`condition`	tensor (`int` or `bool`).
`then_expression`	either a tensor, or a function that returns a tensor.
`else_expression`	either a tensor, or a function that returns a tensor.

Value

The selected tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_tanh — *Element-wise tanh.*

Description

Element-wise tanh.

Usage

```
k_tanh(x)
```

Arguments

x	A tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_temporal_padding — *Pads the middle dimension of a 3D tensor.*

Description

Pads the middle dimension of a 3D tensor.

Usage

```
k_temporal_padding(x, padding = c(1, 1))
```

Arguments

x	Tensor or variable.
padding	List of 2 integers, how many zeros to add at the start and end of dim 1.

Value

A padded 3D tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

`k_tile` *Creates a tensor by tiling `x` by `n`.*

Description

Creates a tensor by tiling `x` by `n`.

Usage

```
k_tile(x, n)
```

Arguments

`x`	A tensor or variable
`n`	A list of integers. The length must be the same as the number of dimensions in `x`.

Value

A tiled tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_to_dense — *Converts a sparse tensor into a dense tensor and returns it.*

Description

Converts a sparse tensor into a dense tensor and returns it.

Usage

```
k_to_dense(tensor)
```

Arguments

`tensor`	A tensor instance (potentially sparse).

Value

A dense tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: `https://keras.rstudio.com/articles/backend.html#backend-functions`.

k_transpose — *Transposes a tensor and returns it.*

Description

Transposes a tensor and returns it.

Usage

```
k_transpose(x)
```

Arguments

`x`	Tensor or variable.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_truncated_normal *Returns a tensor with truncated random normal distribution of values.*

Description

The generated values follow a normal distribution with specified mean and standard deviation, except that values whose magnitude is more than two standard deviations from the mean are dropped and re-picked.

Usage

```
k_truncated_normal(shape, mean = 0, stddev = 1, dtype = NULL,
  seed = NULL)
```

Arguments

shape	A list of integers, the shape of tensor to create.
mean	Mean of the values.
stddev	Standard deviation of the values.
dtype	String, dtype of returned tensor.
seed	Integer, random seed.

Value

A tensor.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_update — *Update the value of* `x` *to* `new_x`.

Description

Update the value of `x` to `new_x`.

Usage

```
k_update(x, new_x)
```

Arguments

`x`	A `Variable`.
`new_x`	A tensor of same shape as `x`.

Value

The variable `x` updated.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_update_add — *Update the value of* `x` *by adding* `increment`.

Description

Update the value of `x` by adding `increment`.

Usage

```
k_update_add(x, increment)
```

Arguments

`x`	A `Variable`.
`increment`	A tensor of same shape as `x`.

Value

The variable `x` updated.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_update_sub   *Update the value of* `x` *by subtracting* `decrement`*.*

Description

Update the value of `x` by subtracting `decrement`.

Usage

```
k_update_sub(x, decrement)
```

Arguments

`x`	A `Variable`.
`decrement`	A tensor of same shape as `x`.

Value

The variable `x` updated.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_var   *Variance of a tensor, alongside the specified axis.*

Description

Variance of a tensor, alongside the specified axis.

Usage

```
k_var(x, axis = NULL, keepdims = FALSE)
```

Arguments

x	A tensor or variable.
axis	An integer, the axis to compute the variance over (axis indexes are 1-based).
keepdims	A boolean, whether to keep the dimensions or not. If keepdims is FALSE, the rank of the tensor is reduced by 1. If keepdims is TRUE, the reduced dimension is retained with length 1.

Value

A tensor with the variance of elements of x.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

k_variable — *Instantiates a variable and returns it.*

Description

Instantiates a variable and returns it.

Usage

```
k_variable(value, dtype = NULL, name = NULL, constraint = NULL)
```

Arguments

value	Numpy array, initial value of the tensor.
dtype	Tensor type.
name	Optional name string for the tensor.
constraint	Optional projection function to be applied to the variable after an optimizer update.

Value

A variable instance (with Keras metadata included).

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_zeros — *Instantiates an all-zeros variable and returns it.*

Description

Instantiates an all-zeros variable and returns it.

Usage

```
k_zeros(shape, dtype = NULL, name = NULL)
```

Arguments

shape	Tuple of integers, shape of returned Keras variable
dtype	String, data type of returned Keras variable
name	String, name of returned Keras variable

Value

A variable (including Keras metadata), filled with `0.0`.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

k_zeros_like — *Instantiates an all-zeros variable of the same shape as another tensor.*

Description

Instantiates an all-zeros variable of the same shape as another tensor.

Usage

```
k_zeros_like(x, dtype = NULL, name = NULL)
```

Arguments

x	Keras variable or Keras tensor.
dtype	String, dtype of returned Keras variable. NULL uses the dtype of x.
name	String, name for the variable to create.

Value

A Keras variable with the shape of x filled with zeros.

Keras Backend

This function is part of a set of Keras backend functions that enable lower level access to the core operations of the backend tensor engine (e.g. TensorFlow, CNTK, Theano, etc.).

You can see a list of all available backend functions here: https://keras.rstudio.com/articles/backend.html#backend-functions.

---

layer_activation — *Apply an activation function to an output.*

Description

Apply an activation function to an output.

Usage

```
layer_activation(object, activation, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`activation`	Name of activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: a(x) = x).
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Other core layers: `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_repeat_vector`, `layer_reshape`

Other activation layers: `layer_activation_elu`, `layer_activation_leaky_relu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_selu`, `layer_activation_softmax`, `layer_activation_thresholded_re`

`layer_activation_elu` *Exponential Linear Unit.*

Description

It follows: `f(x) =  alpha * (exp(x) - 1.0)` for `x < 0`, `f(x) = x` for ‘x = 0‘.

Usage

```
layer_activation_elu(object, alpha = 1, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`alpha`	Scale for the negative factor.
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Fast and Accurate Deep Network Learning by Exponential Linear Units (ELUs).

Other activation layers: `layer_activation_leaky_relu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_selu`, `layer_activation_softmax`, `layer_activation_thresholded_re` `layer_activation` layer_activation_leaky_relu

Leaky version of a Rectified Linear Unit.

Description

Allows a small gradient when the unit is not active: `f(x) = alpha * x` for `x < 0`, `f(x) = x` for `x >= 0`.

Usage

```
layer_activation_leaky_relu(object, alpha = 0.3, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`alpha`	float >= 0. Negative slope coefficient.
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Rectifier Nonlinearities Improve Neural Network Acoustic Models.

Other activation layers: `layer_activation_elu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_selu`, `layer_activation_softmax`, `layer_activation_thresholded_relu`, `layer_activation` layer_activation_parametric_relu

Parametric Rectified Linear Unit.

Description

It follows: `f(x) = alpha * x`` for x < 0, f(x) = xforx >= 0`, where alpha is a learned array with the same shape as x.

Usage

```
layer_activation_parametric_relu(object, alpha_initializer = "zeros",
  alpha_regularizer = NULL, alpha_constraint = NULL,
  shared_axes = NULL, input_shape = NULL, batch_input_shape = NULL,
  batch_size = NULL, dtype = NULL, name = NULL, trainable = NULL,
  weights = NULL)
```

Arguments

`object`	Model or layer object
`alpha_initializer`	Initializer function for the weights.
`alpha_regularizer`	Regularizer for the weights.
`alpha_constraint`	Constraint for the weights.
`shared_axes`	The axes along which to share learnable parameters for the activation function. For example, if the incoming feature maps are from a 2D convolution with output shape (batch, height, width, channels), and you wish to share parameters across space so that each filter only has one set of parameters, set shared_axes=c(1, 2).
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification.

Other activation layers: layer_activation_elu, layer_activation_leaky_relu, layer_activation_relu, layer_activation_selu, layer_activation_softmax, layer_activation_thresholded_relu, layer_activation

---

layer_activation_relu *Rectified Linear Unit activation function*

Description

Rectified Linear Unit activation function

Usage

```
layer_activation_relu(object, max_value = NULL, negative_slope = 0,
  threshold = 0, input_shape = NULL, batch_input_shape = NULL,
  batch_size = NULL, dtype = NULL, name = NULL, trainable = NULL,
  weights = NULL)
```

Arguments

object	Model or layer object
max_value	loat, the maximum output value.
negative_slope	float >= 0 Negative slope coefficient.
threshold	float. Threshold value for thresholded activation.
input_shape	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
batch_input_shape	Shapes, including the batch size. For instance, batch_input_shape=c(10, 32) indicates that the expected input will be batches of 10 32-dimensional vectors. batch_input_shape=list(NULL, 32) indicates batches of an arbitrary number of 32-dimensional vectors.
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (float32, float64, int32...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

See Also

Other activation layers: layer_activation_elu, layer_activation_leaky_relu, layer_activation_parametric_relu, layer_activation_selu, layer_activation_softmax, layer_activation_thresholded_relu, layer_activation

layer_activation_selu *Scaled Exponential Linear Unit.*

Description

SELU is equal to: `scale * elu(x, alpha)`, where alpha and scale are pre-defined constants.

Usage

```
layer_activation_selu(object, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Details

The values of `alpha` and `scale` are chosen so that the mean and variance of the inputs are preserved between two consecutive layers as long as the weights are initialized correctly (see initializer_lecun_normal) and the number of inputs is "large enough" (see article for more information).

Note:

- To be used together with the initialization "lecun_normal".
- To be used together with the dropout variant "AlphaDropout".

See Also

Self-Normalizing Neural Networks, `initializer_lecun_normal`, `layer_alpha_dropout`

Other activation layers: `layer_activation_elu`, `layer_activation_leaky_relu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_softmax`, `layer_activation_thresholded_relu`, `layer_activation` `layer_activation_softmax`

Softmax activation function.

Description

It follows: `f(x) = alpha * (exp(x) - 1.0)` for `x < 0`, `f(x) = x` for ‘x

= 0‘.

Usage

```
layer_activation_softmax(object, axis = -1, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`axis`	Integer, axis along which the softmax normalization is applied.
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Other activation layers: `layer_activation_elu`, `layer_activation_leaky_relu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_selu`, `layer_activation_thresholded_relu`, `layer_activation` layer_activation_thresholded_relu

Thresholded Rectified Linear Unit.

Description

It follows: `f(x) = x` for `x > theta`, `f(x) = 0` otherwise.

Usage

```
layer_activation_thresholded_relu(object, theta = 1,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`theta`	float >= 0. Threshold location of activation.
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Zero-bias autoencoders and the benefits of co-adapting features.

Other activation layers: `layer_activation_elu`, `layer_activation_leaky_relu`, `layer_activation_parametric_relu`, `layer_activation_relu`, `layer_activation_selu`, `layer_activation_softmax`, `layer_activation`

layer_activity_regularization
Layer that applies an update to the cost function based input activity.

Description

Layer that applies an update to the cost function based input activity.

Usage

```
layer_activity_regularization(object, l1 = 0, l2 = 0,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`l1`	L1 regularization factor (positive float).
`l2`	L2 regularization factor (positive float).
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

Arbitrary. Use the keyword argument `input_shape` (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Same shape as input.

See Also

Other core layers: `layer_activation`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_repeat_vector`, `layer_reshape`

layer_add — *Layer that adds a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape, and returns a single tensor (also of the same shape).

Usage

```
layer_add(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`inputs`	A list of input tensors (at least 2).
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Value

A tensor, the sum of the inputs.

See Also

Other merge layers: `layer_average`, `layer_concatenate`, `layer_dot`, `layer_maximum`, `layer_minimum`, `layer_multiply`, `layer_subtract`

layer_alpha_dropout — *Applies Alpha Dropout to the input.*

Description

Alpha Dropout is a dropout that keeps mean and variance of inputs to their original values, in order to ensure the self-normalizing property even after this dropout.

Usage

```
layer_alpha_dropout(object, rate, noise_shape = NULL, seed = NULL,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`rate`	float, drop probability (as with `layer_dropout()`). The multiplicative noise will have standard deviation `sqrt(rate / (1 - rate))`.
`noise_shape`	Noise shape
`seed`	An integer to use as random seed.
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Details

Alpha Dropout fits well to Scaled Exponential Linear Units by randomly setting activations to the negative saturation value.

Input shape

Arbitrary. Use the keyword argument `input_shape` (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Same shape as input.

References

- Self-Normalizing Neural Networks

See Also

Other noise layers: `layer_gaussian_dropout`, `layer_gaussian_noise` `layer_average` *Layer that averages a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape, and returns a single tensor (also of the same shape).

Usage

```
layer_average(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`inputs`	A list of input tensors (at least 2).
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Value

A tensor, the average of the inputs.

See Also

Other merge layers: `layer_add`, `layer_concatenate`, `layer_dot`, `layer_maximum`, `layer_minimum`, `layer_multiply`, `layer_subtract`

`layer_average_pooling_1d` *Average pooling for temporal data.*

Description

Average pooling for temporal data.

Usage

```
layer_average_pooling_1d(object, pool_size = 2L, strides = NULL,
  padding = "valid", data_format = "channels_last",
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
pool_size	Integer, size of the average pooling windows.
strides	Integer, or NULL. Factor by which to downscale. E.g. 2 will halve the input. If NULL, it will default to pool_size.
padding	One of "valid" or "same" (case-insensitive).
data_format	One of channels_last (default) or channels_first. The ordering of the dimensions in the inputs.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

3D tensor with shape: (batch_size, steps, features).

Output shape

3D tensor with shape: (batch_size, downsampled_steps, features).

See Also

Other pooling layers: layer_average_pooling_2d, layer_average_pooling_3d, layer_global_average_pooling_1d, layer_global_average_pooling_2d, layer_global_average_pooling_3d, layer_global_max_pooling_1d, layer_global_max_pooling_2d, layer_global_max_pooling_3d, layer_max_pooling_1d, layer_max_pooling_2d, layer_max_pooling_3d

---

layer_average_pooling_2d

Average pooling operation for spatial data.

Description

Average pooling operation for spatial data.

Usage

```
layer_average_pooling_2d(object, pool_size = c(2L, 2L), strides = NULL,
  padding = "valid", data_format = NULL, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`pool_size`	integer or list of 2 integers, factors by which to downscale (vertical, horizontal). (2, 2) will halve the input in both spatial dimension. If only one integer is specified, the same window length will be used for both dimensions.
`strides`	Integer, list of 2 integers, or NULL. Strides values. If NULL, it will default to `pool_size`.
`padding`	One of `"valid"` or `"same"` (case-insensitive).
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 4D tensor with shape: `(batch_size, rows, cols, channels)`
- If `data_format='channels_first'`: 4D tensor with shape: `(batch_size, channels, rows, cols)`

Output shape

- If `data_format='channels_last'`: 4D tensor with shape: `(batch_size, pooled_rows, pooled_cols, channels)`
- If `data_format='channels_first'`: 4D tensor with shape: `(batch_size, channels, pooled_rows, pooled_cols`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_2d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d`

layer_average_pooling_3d
Average pooling operation for 3D data (spatial or spatio-temporal).

Description

Average pooling operation for 3D data (spatial or spatio-temporal).

Usage

```
layer_average_pooling_3d(object, pool_size = c(2L, 2L, 2L),
  strides = NULL, padding = "valid", data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`pool_size`	list of 3 integers, factors by which to downscale (dim1, dim2, dim3). (2, 2, 2) will halve the size of the 3D input in each dimension.
`strides`	list of 3 integers, or NULL. Strides values.
`padding`	One of `"valid"` or `"same"` (case-insensitive).
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, spatial_dim1, spatial_dim2, spatial`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, spatial_dim1, spatial_di`

Output shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, pooled_dim1, pooled_dim2, pooled_di`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, pooled_dim1, pooled_dim2`

See Also

Other pooling layers: layer_average_pooling_1d, layer_average_pooling_2d, layer_global_average_pooling_1d, layer_global_average_pooling_2d, layer_global_average_pooling_3d, layer_global_max_pooling_1d, layer_global_max_pooling_2d, layer_global_max_pooling_3d, layer_max_pooling_1d, layer_max_pooling_2d, layer_max_pooling_3d

---

layer_batch_normalization

Batch normalization layer (Ioffe and Szegedy, 2014).

Description

Normalize the activations of the previous layer at each batch, i.e. applies a transformation that maintains the mean activation close to 0 and the activation standard deviation close to 1.

Usage

```
layer_batch_normalization(object, axis = -1L, momentum = 0.99,
  epsilon = 0.001, center = TRUE, scale = TRUE,
  beta_initializer = "zeros", gamma_initializer = "ones",
  moving_mean_initializer = "zeros",
  moving_variance_initializer = "ones", beta_regularizer = NULL,
  gamma_regularizer = NULL, beta_constraint = NULL,
  gamma_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`axis`	Integer, the axis that should be normalized (typically the features axis). For instance, after a `Conv2D` layer with `data_format="channels_first"`, set `axis=1` in `BatchNormalization`.
`momentum`	Momentum for the moving mean and the moving variance.
`epsilon`	Small float added to variance to avoid dividing by zero.
`center`	If TRUE, add offset of `beta` to normalized tensor. If FALSE, `beta` is ignored.
`scale`	If TRUE, multiply by `gamma`. If FALSE, `gamma` is not used. When the next layer is linear (also e.g. `nn.relu`), this can be disabled since the scaling will be done by the next layer.
`beta_initializer`	Initializer for the beta weight.
`gamma_initializer`	Initializer for the gamma weight.
`moving_mean_initializer`	Initializer for the moving mean.

`moving_variance_initializer`
Initializer for the moving variance.

`beta_regularizer`
Optional regularizer for the beta weight.

`gamma_regularizer`
Optional regularizer for the gamma weight.

`beta_constraint`
Optional constraint for the beta weight.

`gamma_constraint`
Optional constraint for the gamma weight.

`input_shape` Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

`batch_input_shape`
Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

`batch_size` Fixed batch size for layer

`dtype` The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

`name` An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable` Whether the layer weights will be updated during training.

`weights` Initial weights for layer.

Input shape

Arbitrary. Use the keyword argument `input_shape` (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Same shape as input.

References

- Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift layer_concatenate *Layer that concatenates a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape expect for the concatenation axis, and returns a single tensor, the concatenation of all inputs.

Usage

```
layer_concatenate(inputs, axis = -1, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

inputs	A list of input tensors (at least 2).
axis	Concatenation axis.
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (float32, float64, int32...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Value

A tensor, the concatenation of the inputs alongside axis axis.

See Also

Other merge layers: layer_add, layer_average, layer_dot, layer_maximum, layer_minimum, layer_multiply, layer_subtract

layer_conv_1d *1D convolution layer (e.g. temporal convolution).*

Description

This layer creates a convolution kernel that is convolved with the layer input over a single spatial (or temporal) dimension to produce a tensor of outputs. If use_bias is TRUE, a bias vector is created and added to the outputs. Finally, if activation is not NULL, it is applied to the outputs as well. When using this layer as the first layer in a model, provide an input_shape argument (list of integers or NULL , e.g. (10, 128) for sequences of 10 vectors of 128-dimensional vectors, or (NULL, 128) for variable-length sequences of 128-dimensional vectors.

Usage

```
layer_conv_1d(object, filters, kernel_size, strides = 1L,
  padding = "valid", data_format = "channels_last",
  dilation_rate = 1L, activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`filters`	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
`kernel_size`	An integer or list of a single integer, specifying the length of the 1D convolution window.
`strides`	An integer or list of a single integer, specifying the stride length of the convolution. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
`padding`	One of `"valid"`, `"causal"` or `"same"` (case-insensitive). `"valid"` means "no padding". `"same"` results in padding the input such that the output has the same length as the original input. `"causal"` results in causal (dilated) convolutions, e.g. `output[t]` does not depend on `input[t+1:]`. Useful when modeling temporal data where the model should not violate the temporal order. See WaveNet: A Generative Model for Raw Audio, section 2.1.
`data_format`	A string, one of `"channels_last"` (default) or `"channels_first"`. The ordering of the dimensions in the inputs. `"channels_last"` corresponds to inputs with shape `(batch, length, channels)` (default format for temporal data in Keras) while `"channels_first"` corresponds to inputs with shape `(batch, channels, length)`.
`dilation_rate`	an integer or list of a single integer, specifying the dilation rate to use for dilated convolution. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any `strides` value != 1.
`activation`	Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).
`use_bias`	Boolean, whether the layer uses a bias vector.
`kernel_initializer`	Initializer for the `kernel` weights matrix.
`bias_initializer`	Initializer for the bias vector.
`kernel_regularizer`	Regularizer function applied to the `kernel` weights matrix.
`bias_regularizer`	Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint
: Constraint function applied to the kernel matrix.

bias_constraint
: Constraint function applied to the bias vector.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Input shape

3D tensor with shape: `(batch_size, steps, input_dim)`

Output shape

3D tensor with shape: `(batch_size, new_steps, filters)` `steps` value might have changed due to padding or strides.

See Also

Other convolutional layers: `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

---

layer_conv_2d *2D convolution layer (e.g. spatial convolution over images).*

Description

This layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs. If `use_bias` is TRUE, a bias vector is created and added to the outputs. Finally, if `activation` is not `NULL`, it is applied to the outputs as well. When using this layer as the first layer in a model, provide the keyword argument `input_shape` (list of integers, does not include the sample axis), e.g. `input_shape=c(128, 128, 3)` for 128x128 RGB pictures in `data_format="channels_last"`.

Usage

```
layer_conv_2d(object, filters, kernel_size, strides = c(1L, 1L),
  padding = "valid", data_format = NULL, dilation_rate = c(1L, 1L),
  activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

- `object` Model or layer object
- `filters` Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
- `kernel_size` An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
- `strides` An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
- `padding` one of `"valid"` or `"same"` (case-insensitive). Note that `"same"` is slightly inconsistent across backends with `strides` != 1, as described here
- `data_format` A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
- `dilation_rate` an integer or list of 2 integers, specifying the dilation rate to use for dilated convolution. Can be a single integer to specify the same value for all spatial dimensions. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any stride value != 1.
- `activation` Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).
- `use_bias` Boolean, whether the layer uses a bias vector.
- `kernel_initializer` Initializer for the `kernel` weights matrix.
- `bias_initializer` Initializer for the bias vector.
- `kernel_regularizer` Regularizer function applied to the `kernel` weights matrix.
- `bias_regularizer` Regularizer function applied to the bias vector.

`activity_regularizer`
: Regularizer function applied to the output of the layer (its "activation")..

`kernel_constraint`
: Constraint function applied to the kernel matrix.

`bias_constraint`
: Constraint function applied to the bias vector.

`input_shape`
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

`batch_input_shape`
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

`batch_size`
: Fixed batch size for layer

`dtype`
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

`name`
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable`
: Whether the layer weights will be updated during training.

`weights`
: Initial weights for layer.

Input shape

4D tensor with shape: `(samples, channels, rows, cols)` if data_format='channels_first' or 4D tensor with shape: `(samples, rows, cols, channels)` if data_format='channels_last'.

Output shape

4D tensor with shape: `(samples, filters, new_rows, new_cols)` if data_format='channels_first' or 4D tensor with shape: `(samples, new_rows, new_cols, filters)` if data_format='channels_last'. `rows` and `cols` values might have changed due to padding.

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

layer_conv_2d_transpose
Transposed 2D convolution layer (sometimes called Deconvolution).

Description

The need for transposed convolutions generally arises from the desire to use a transformation going in the opposite direction of a normal convolution, i.e., from something that has the shape of the output of some convolution to something that has the shape of its input while maintaining a connectivity pattern that is compatible with said convolution. When using this layer as the first layer in a model, provide the keyword argument `input_shape` (list of integers, does not include the sample axis), e.g. `input_shape=c(128L, 128L, 3L)` for 128x128 RGB pictures in `data_format="channels_last"`.

Usage

```
layer_conv_2d_transpose(object, filters, kernel_size, strides = c(1, 1),
  padding = "valid", output_padding = NULL, data_format = NULL,
  dilation_rate = c(1, 1), activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`filters`	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
`kernel_size`	An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
`strides`	An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
`padding`	one of `"valid"` or `"same"` (case-insensitive).
`output_padding`	An integer or list of 2 integers, specifying the amount of padding along the height and width of the output tensor. Can be a single integer to specify the same value for all spatial dimensions. The amount of output padding along a given dimension must be lower than the stride along that same dimension. If set to `NULL` (default), the output shape is inferred.

data_format — A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs. channels_last corresponds to inputs with shape (batch, height, width, channels) while channels_first corresponds to inputs with shape (batch, channels, height, width). It defaults to the image_data_format value found in your Keras config file at ~/.keras/keras.json. If you never set it, then it will be "channels_last".

dilation_rate — Dialation rate.

activation — Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: a(x) = x).

use_bias — Boolean, whether the layer uses a bias vector.

kernel_initializer — Initializer for the kernel weights matrix.

bias_initializer — Initializer for the bias vector.

kernel_regularizer — Regularizer function applied to the kernel weights matrix.

bias_regularizer — Regularizer function applied to the bias vector.

activity_regularizer — Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint — Constraint function applied to the kernel matrix.

bias_constraint — Constraint function applied to the bias vector.

input_shape — Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape — Shapes, including the batch size. For instance, batch_input_shape=c(10, 32) indicates that the expected input will be batches of 10 32-dimensional vectors. batch_input_shape=list(NULL, 32) indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size — Fixed batch size for layer

dtype — The data type expected by the input, as a string (float32, float64, int32...)

name — An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable — Whether the layer weights will be updated during training.

weights — Initial weights for layer.

Input shape

4D tensor with shape: (batch, channels, rows, cols) if data_format='channels_first' or 4D tensor with shape: (batch, rows, cols, channels) if data_format='channels_last'.

Output shape

4D tensor with shape: `(batch, filters, new_rows, new_cols)` if data_format='channels_first' or 4D tensor with shape: `(batch, new_rows, new_cols, filters)` if data_format='channels_last'. `rows` and `cols` values might have changed due to padding.

References

- A guide to convolution arithmetic for deep learning
- Deconvolutional Networks

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

`layer_conv_3d` *3D convolution layer (e.g. spatial convolution over volumes).*

Description

This layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs. If `use_bias` is TRUE, a bias vector is created and added to the outputs. Finally, if `activation` is not `NULL`, it is applied to the outputs as well. When using this layer as the first layer in a model, provide the keyword argument `input_shape` (list of integers, does not include the sample axis), e.g. `input_shape=c(128L, 128L, 128L, 3L)` for 128x128x128 volumes with a single channel, in `data_format="channels_last"`.

Usage

```
layer_conv_3d(object, filters, kernel_size, strides = c(1L, 1L, 1L),
  padding = "valid", data_format = NULL, dilation_rate = c(1L, 1L,
  1L), activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`filters`	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).

kernel_size An integer or list of 3 integers, specifying the depth, height, and width of the 3D convolution window. Can be a single integer to specify the same value for all spatial dimensions.

strides An integer or list of 3 integers, specifying the strides of the convolution along each spatial dimension. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.

padding one of `"valid"` or `"same"` (case-insensitive).

data_format A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2`
It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".

dilation_rate an integer or list of 3 integers, specifying the dilation rate to use for dilated convolution. Can be a single integer to specify the same value for all spatial dimensions. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any stride value != 1.

activation Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).

use_bias Boolean, whether the layer uses a bias vector.

kernel_initializer
Initializer for the `kernel` weights matrix.

bias_initializer
Initializer for the bias vector.

kernel_regularizer
Regularizer function applied to the `kernel` weights matrix.

bias_regularizer
Regularizer function applied to the bias vector.

activity_regularizer
Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint
Constraint function applied to the kernel matrix.

bias_constraint
Constraint function applied to the bias vector.

input_shape Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size Fixed batch size for layer

dtype The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

5D tensor with shape: `(samples, channels, conv_dim1, conv_dim2, conv_dim3)` if data_format='channels_first' or 5D tensor with shape: `(samples, conv_dim1, conv_dim2, conv_dim3, channels)` if data_format='channels_last'.

Output shape

5D tensor with shape: `(samples, filters, new_conv_dim1, new_conv_dim2, new_conv_dim3)` if data_format='channels_first' or 5D tensor with shape: `(samples, new_conv_dim1, new_conv_dim2, new_conv_dim3,` if data_format='channels_last'. `new_conv_dim1`, `new_conv_dim2` and `new_conv_dim3` values might have changed due to padding.

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_conv_3d_transpose

Transposed 3D convolution layer (sometimes called Deconvolution).

Description

The need for transposed convolutions generally arises from the desire to use a transformation going in the opposite direction of a normal convolution, i.e., from something that has the shape of the output of some convolution to something that has the shape of its input while maintaining a connectivity pattern that is compatible with said convolution.

Usage

```
layer_conv_3d_transpose(object, filters, kernel_size, strides = c(1, 1,
  1), padding = "valid", output_padding = NULL, data_format = NULL,
  activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
filters	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
kernel_size	An integer or list of 3 integers, specifying the depth, height, and width of the 3D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
strides	An integer or list of 3 integers, specifying the strides of the convolution along the depth, height and width.. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
padding	one of `"valid"` or `"same"` (case-insensitive).
output_padding	An integer or list of 3 integers, specifying the amount of padding along the depth, height, and width of the output tensor. Can be a single integer to specify the same value for all spatial dimensions. The amount of output padding along a given dimension must be lower than the stride along that same dimension. If set to `NULL` (default), the output shape is inferred.
data_format	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, depth, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, depth, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
activation	Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).
use_bias	Boolean, whether the layer uses a bias vector.
kernel_initializer	Initializer for the `kernel` weights matrix.
bias_initializer	Initializer for the bias vector.
kernel_regularizer	Regularizer function applied to the `kernel` weights matrix,
bias_regularizer	Regularizer function applied to the bias vector.
activity_regularizer	Regularizer function applied to the output of the layer (its "activation").
kernel_constraint	Constraint function applied to the kernel matrix.
bias_constraint	Constraint function applied to the bias vector.
input_shape	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Details

When using this layer as the first layer in a model, provide the keyword argument `input_shape` (list of integers, does not include the sample axis), e.g. `input_shape = list(128, 128, 128, 3)` for a 128x128x128 volume with 3 channels if `data_format="channels_last"`.

References

- A guide to convolution arithmetic for deep learning
- Deconvolutional Networks

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

---

layer_conv_lstm_2d *Convolutional LSTM.*

Description

It is similar to an LSTM layer, but the input transformations and recurrent transformations are both convolutional.

Usage

```
layer_conv_lstm_2d(object, filters, kernel_size, strides = c(1L, 1L),
  padding = "valid", data_format = NULL, dilation_rate = c(1L, 1L),
  activation = "tanh", recurrent_activation = "hard_sigmoid",
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  unit_forget_bias = TRUE, kernel_regularizer = NULL,
```

```
  recurrent_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  recurrent_constraint = NULL, bias_constraint = NULL,
  return_sequences = FALSE, go_backwards = FALSE, stateful = FALSE,
  dropout = 0, recurrent_dropout = 0, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL,
  input_shape = NULL)
```

Arguments

object	Model or layer object
filters	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
kernel_size	An integer or list of n integers, specifying the dimensions of the convolution window.
strides	An integer or list of n integers, specifying the strides of the convolution. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
padding	One of `"valid"` or `"same"` (case-insensitive).
data_format	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, time, ..., channels)` while `channels_first` corresponds to inputs with shape `(batch, time, channels, ...)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
dilation_rate	An integer or list of n integers, specifying the dilation rate to use for dilated convolution. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any `strides` value != 1.
activation	Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).
recurrent_activation	Activation function to use for the recurrent step.
use_bias	Boolean, whether the layer uses a bias vector.
kernel_initializer	Initializer for the `kernel` weights matrix, used for the linear transformation of the inputs..
recurrent_initializer	Initializer for the `recurrent_kernel` weights matrix, used for the linear transformation of the recurrent state..
bias_initializer	Initializer for the bias vector.
unit_forget_bias	Boolean. If TRUE, add 1 to the bias of the forget gate at initialization. Use in combination with `bias_initializer="zeros"`. This is recommended in Jozefowicz et al.

`kernel_regularizer`
: Regularizer function applied to the `kernel` weights matrix.

`recurrent_regularizer`
: Regularizer function applied to the `recurrent_kernel` weights matrix.

`bias_regularizer`
: Regularizer function applied to the bias vector.

`activity_regularizer`
: Regularizer function applied to the output of the layer (its "activation")..

`kernel_constraint`
: Constraint function applied to the `kernel` weights matrix.

`recurrent_constraint`
: Constraint function applied to the `recurrent_kernel` weights matrix.

`bias_constraint`
: Constraint function applied to the bias vector.

`return_sequences`
: Boolean. Whether to return the last output in the output sequence, or the full sequence.

`go_backwards`
: Boolean (default FALSE). If TRUE, rocess the input sequence backwards.

`stateful`
: Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.

`dropout`
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the inputs.

`recurrent_dropout`
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the recurrent state.

`batch_size`
: Fixed batch size for layer

`name`
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable`
: Whether the layer weights will be updated during training.

`weights`
: Initial weights for layer.

`input_shape`
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

Input shape

- if data_format='channels_first' 5D tensor with shape: `(samples,time, channels, rows, cols)`
  - if data_format='channels_last' 5D tensor with shape: `(samples,time, rows, cols, channels)`

References

- Convolutional LSTM Network: A Machine Learning Approach for Precipitation Nowcasting The current implementation does not include the feedback loop on the cells output

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_cropping_1d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_cropping_1d *Cropping layer for 1D input (e.g. temporal sequence).*

Description

It crops along the time dimension (axis 1).

Usage

```
layer_cropping_1d(object, cropping = c(1L, 1L), batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
cropping	int or list of int (length 2) How many units should be trimmed off at the beginning and end of the cropping dimension (axis 1). If a single int is provided, the same value will be used for both.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

3D tensor with shape `(batch, axis_to_crop, features)`

Output shape

3D tensor with shape `(batch, cropped_axis, features)`

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d `layer_cropping_2d` *Cropping layer for 2D input (e.g. picture).*

Description

It crops along spatial dimensions, i.e. width and height.

Usage

```
layer_cropping_2d(object, cropping = list(c(0L, 0L), c(0L, 0L)),
  data_format = NULL, batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`cropping`	int, or list of 2 ints, or list of 2 lists of 2 ints. • If int: the same symmetric cropping is applied to width and height. • If list of 2 ints: interpreted as two different symmetric cropping values for height and width: `(symmetric_height_crop, symmetric_width_crop)`. • If list of 2 lists of 2 ints: interpreted as `((top_crop, bottom_crop), (left_crop, right_crop))`
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

4D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, rows, cols, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, rows, cols)`

Output shape

4D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, cropped_rows, cropped_cols, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, cropped_rows, cropped_cols)`

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_cropping_3d *Cropping layer for 3D data (e.g. spatial or spatio-temporal).*

Description

Cropping layer for 3D data (e.g. spatial or spatio-temporal).

Usage

```
layer_cropping_3d(object, cropping = list(c(1L, 1L), c(1L, 1L), c(1L,
  1L)), data_format = NULL, batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`cropping`	int, or list of 3 ints, or list of 3 lists of 2 ints. • If int: the same symmetric cropping is applied to depth, height, and width. • If list of 3 ints: interpreted as two different symmetric cropping values for depth, height, and width: `(symmetric_dim1_crop, symmetric_dim2_crop, symmetric_dim3_cr` • If list of 3 list of 2 ints: interpreted as `((left_dim1_crop, right_dim1_crop), (left_dim2_crop`
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

5D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, first_axis_to_crop, second_axis_to_crop, third_axis_to_cr`
- If `data_format` is `"channels_first"`: `(batch, depth, first_axis_to_crop, second_axis_to_crop, third_ax`

Output shape

5D tensor with shape:

- If data_format is "channels_last": (batch, first_cropped_axis, second_cropped_axis, third_cropped_ax
- If data_format is "channels_first": (batch, depth, first_cropped_axis, second_cropped_axis, third_cr

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_2d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_cudnn_gru *Fast GRU implementation backed by Rhrefhttps://developer.nvidia.com/cudnnCuDNN.*

Description

Can only be run on GPU, with the TensorFlow backend.

Usage

```
layer_cudnn_gru(object, units, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  kernel_regularizer = NULL, recurrent_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, recurrent_constraint = NULL,
  bias_constraint = NULL, return_sequences = FALSE,
  return_state = FALSE, stateful = FALSE, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
units	Positive integer, dimensionality of the output space.
kernel_initializer	Initializer for the kernel weights matrix, used for the linear transformation of the inputs.
recurrent_initializer	Initializer for the recurrent_kernel weights matrix, used for the linear transformation of the recurrent state.
bias_initializer	Initializer for the bias vector.

`kernel_regularizer`
: Regularizer function applied to the `kernel` weights matrix.

`recurrent_regularizer`
: Regularizer function applied to the `recurrent_kernel` weights matrix.

`bias_regularizer`
: Regularizer function applied to the bias vector.

`activity_regularizer`
: Regularizer function applied to the output of the layer (its "activation")..

`kernel_constraint`
: Constraint function applied to the `kernel` weights matrix.

`recurrent_constraint`
: Constraint function applied to the `recurrent_kernel` weights matrix.

`bias_constraint`
: Constraint function applied to the bias vector.

`return_sequences`
: Boolean. Whether to return the last output in the output sequence, or the full sequence.

`return_state`
: Boolean (default FALSE). Whether to return the last state in addition to the output.

`stateful`
: Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.

`input_shape`
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

`batch_input_shape`
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

`batch_size`
: Fixed batch size for layer

`dtype`
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

`name`
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable`
: Whether the layer weights will be updated during training.

`weights`
: Initial weights for layer.

References

- On the Properties of Neural Machine Translation: Encoder-Decoder Approaches
- Empirical Evaluation of Gated Recurrent Neural Networks on Sequence Modeling
- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

See Also

Other recurrent layers: `layer_cudnn_lstm`, `layer_gru`, `layer_lstm`, `layer_simple_rnn`

layer_cudnn_lstm *Fast LSTM implementation backed by* R*hrefhttps://developer.nvidia.com/cudnnCuDNN.*

Description

Can only be run on GPU, with the TensorFlow backend.

Usage

```
layer_cudnn_lstm(object, units, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  unit_forget_bias = TRUE, kernel_regularizer = NULL,
  recurrent_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  recurrent_constraint = NULL, bias_constraint = NULL,
  return_sequences = FALSE, return_state = FALSE, stateful = FALSE,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

- `object` Model or layer object
- `units` Positive integer, dimensionality of the output space.
- `kernel_initializer` Initializer for the `kernel` weights matrix, used for the linear transformation of the inputs.
- `recurrent_initializer` Initializer for the `recurrent_kernel` weights matrix, used for the linear transformation of the recurrent state.
- `bias_initializer` Initializer for the bias vector.
- `unit_forget_bias` Boolean. If TRUE, add 1 to the bias of the forget gate at initialization. Setting it to true will also force `bias_initializer="zeros"`. This is recommended in Jozefowicz et al.
- `kernel_regularizer` Regularizer function applied to the `kernel` weights matrix.
- `recurrent_regularizer` Regularizer function applied to the `recurrent_kernel` weights matrix.
- `bias_regularizer` Regularizer function applied to the bias vector.
- `activity_regularizer` Regularizer function applied to the output of the layer (its "activation")..
- `kernel_constraint` Constraint function applied to the `kernel` weights matrix.

recurrent_constraint
: Constraint function applied to the recurrent_kernel weights matrix.

bias_constraint
: Constraint function applied to the bias vector.

return_sequences
: Boolean. Whether to return the last output in the output sequence, or the full sequence.

return_state
: Boolean (default FALSE). Whether to return the last state in addition to the output.

stateful
: Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, batch_input_shape=c(10, 32) indicates that the expected input will be batches of 10 32-dimensional vectors. batch_input_shape=list(NULL, 32) indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (float32, float64, int32...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

References

- Long short-term memory (original 1997 paper)
- Supervised sequence labeling with recurrent neural networks
- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

See Also

Other recurrent layers: layer_cudnn_gru, layer_gru, layer_lstm, layer_simple_rnn

---

layer_dense *Add a densely-connected NN layer to an output*

Description

Implements the operation: output = activation(dot(input, kernel) + bias) where activation is the element-wise activation function passed as the activation argument, kernel is a weights matrix created by the layer, and bias is a bias vector created by the layer (only applicable if use_bias is TRUE). Note: if the input to the layer has a rank greater than 2, then it is flattened prior to the initial dot product with kernel.

Usage

```
layer_dense(object, units, activation = NULL, use_bias = TRUE,
  kernel_initializer = "glorot_uniform", bias_initializer = "zeros",
  kernel_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
units	Positive integer, dimensionality of the output space.
activation	Name of activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: a(x) = x).
use_bias	Whether the layer uses a bias vector.
kernel_initializer	Initializer for the `kernel` weights matrix.
bias_initializer	Initializer for the bias vector.
kernel_regularizer	Regularizer function applied to the `kernel` weights matrix.
bias_regularizer	Regularizer function applied to the bias vector.
activity_regularizer	Regularizer function applied to the output of the layer (its "activation")..
kernel_constraint	Constraint function applied to the `kernel` weights matrix.
bias_constraint	Constraint function applied to the bias vector.
input_shape	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
batch_input_shape	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input and Output Shapes

Input shape: nD tensor with shape: `(batch_size, ..., input_dim)`. The most common situation would be a 2D input with shape `(batch_size, input_dim)`.

Output shape: nD tensor with shape: `(batch_size, ..., units)`. For instance, for a 2D input with shape `(batch_size, input_dim)`, the output would have shape `(batch_size, unit)`.

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_repeat_vector`, `layer_reshape`

---

layer_depthwise_conv_2d

Depthwise separable 2D convolution.

Description

Depthwise Separable convolutions consists in performing just the first step in a depthwise spatial convolution (which acts on each input channel separately). The `depth_multiplier` argument controls how many output channels are generated per input channel in the depthwise step.

Usage

```
layer_depthwise_conv_2d(object, kernel_size, strides = c(1, 1),
  padding = "valid", depth_multiplier = 1, data_format = NULL,
  activation = NULL, use_bias = TRUE,
  depthwise_initializer = "glorot_uniform", bias_initializer = "zeros",
  depthwise_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, depthwise_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`kernel_size`	An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
`strides`	An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
`padding`	one of `"valid"` or `"same"` (case-insensitive).

depth_multiplier
: The number of depthwise convolution output channels for each input channel. The total number of depthwise convolution output channels will be equal to `filters_in * depth_multiplier`.

data_format
: A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".

activation
: Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).

use_bias
: Boolean, whether the layer uses a bias vector.

depthwise_initializer
: Initializer for the depthwise kernel matrix.

bias_initializer
: Initializer for the bias vector.

depthwise_regularizer
: Regularizer function applied to the depthwise kernel matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

depthwise_constraint
: Constraint function applied to the depthwise kernel matrix.

bias_constraint
: Constraint function applied to the bias vector.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_dot *Layer that computes a dot product between samples in two tensors.*

Description

Layer that computes a dot product between samples in two tensors.

Usage

```
layer_dot(inputs, axes, normalize = FALSE, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

inputs	A list of input tensors (at least 2).
axes	Integer or list of integers, axis or axes along which to take the dot product.
normalize	Whether to L2-normalize samples along the dot product axis before taking the dot product. If set to TRUE, then the output of the dot product is the cosine proximity between the two samples. **kwargs: Standard layer keyword arguments.
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (float32, float64, int32...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Value

A tensor, the dot product of the samples from the inputs.

See Also

Other merge layers: layer_add, layer_average, layer_concatenate, layer_maximum, layer_minimum, layer_multiply, layer_subtract layer_dropout *Applies Dropout to the input.*

Description

Dropout consists in randomly setting a fraction rate of input units to 0 at each update during training time, which helps prevent overfitting.

Usage

```
layer_dropout(object, rate, noise_shape = NULL, seed = NULL,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
rate	float between 0 and 1. Fraction of the input units to drop.
noise_shape	1D integer tensor representing the shape of the binary dropout mask that will be multiplied with the input. For instance, if your inputs have shape (batch_size, timesteps, features) and you want the dropout mask to be the same for all timesteps, you can use noise_shape=c(batch_size, 1, features).
seed	integer to use as random seed.
input_shape	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
batch_input_shape	Shapes, including the batch size. For instance, batch_input_shape=c(10, 32) indicates that the expected input will be batches of 10 32-dimensional vectors. batch_input_shape=list(NULL, 32) indicates batches of an arbitrary number of 32-dimensional vectors.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

See Also

Other core layers: layer_activation, layer_activity_regularization, layer_dense, layer_flatten, layer_input, layer_lambda, layer_masking, layer_permute, layer_repeat_vector, layer_reshape

Other dropout layers: layer_spatial_dropout_1d, layer_spatial_dropout_2d, layer_spatial_dropout_3d layer_embedding *Turns positive integers (indexes) into dense vectors of fixed size.*

Description

For example, `list(4L, 20L) -> list(c(0.25, 0.1), c(0.6, -0.2))` This layer can only be used as the first layer in a model.

Usage

```
layer_embedding(object, input_dim, output_dim,
  embeddings_initializer = "uniform", embeddings_regularizer = NULL,
  activity_regularizer = NULL, embeddings_constraint = NULL,
  mask_zero = FALSE, input_length = NULL, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`input_dim`	int > 0. Size of the vocabulary, i.e. maximum integer index + 1.
`output_dim`	int >= 0. Dimension of the dense embedding.
`embeddings_initializer`	Initializer for the `embeddings` matrix.
`embeddings_regularizer`	Regularizer function applied to the `embeddings` matrix.
`activity_regularizer`	activity_regularizer
`embeddings_constraint`	Constraint function applied to the `embeddings` matrix.
`mask_zero`	Whether or not the input value 0 is a special "padding" value that should be masked out. This is useful when using recurrent layers, which may take variable length inputs. If this is `TRUE` then all subsequent layers in the model need to support masking or an exception will be raised. If mask_zero is set to TRUE, as a consequence, index 0 cannot be used in the vocabulary (input_dim should equal size of vocabulary + 1).
`input_length`	Length of input sequences, when it is constant. This argument is required if you are going to connect `Flatten` then `Dense` layers upstream (without it, the shape of the dense outputs cannot be computed).
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

2D tensor with shape: `(batch_size, sequence_length)`.

Output shape

3D tensor with shape: `(batch_size, sequence_length, output_dim)`.

References

- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

---

`layer_flatten` *Flattens an input*

Description

Flatten a given input, does not affect the batch size.

Usage

```
layer_flatten(object, data_format = NULL, input_shape = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	A string. one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. The purpose of this argument is to preserve weight ordering when switching a model from one data format to another. `channels_last` corresponds to inputs with shape `(batch, ..., channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, ...)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_repeat_vector`, `layer_reshape` layer_gaussian_dropout

Apply multiplicative 1-centered Gaussian noise.

Description

As it is a regularization layer, it is only active at training time.

Usage

```
layer_gaussian_dropout(object, rate, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
rate	float, drop probability (as with Dropout). The multiplicative noise will have standard deviation `sqrt(rate / (1 - rate))`.
input_shape	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
batch_input_shape	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

Arbitrary. Use the keyword argument `input_shape` (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Same shape as input.

References

- Dropout: A Simple Way to Prevent Neural Networks from Overfitting Srivastava, Hinton, et al. 2014

See Also

Other noise layers: `layer_alpha_dropout`, `layer_gaussian_noise`

`layer_gaussian_noise` *Apply additive zero-centered Gaussian noise.*

Description

This is useful to mitigate overfitting (you could see it as a form of random data augmentation). Gaussian Noise (GS) is a natural choice as corruption process for real valued inputs. As it is a regularization layer, it is only active at training time.

Usage

```
layer_gaussian_noise(object, stddev, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`stddev`	float, standard deviation of the noise distribution.
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

Arbitrary. Use the keyword argument `input_shape` (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Same shape as input.

See Also

Other noise layers: layer_alpha_dropout, layer_gaussian_dropout

---

layer_global_average_pooling_1d
Global average pooling operation for temporal data.

Description

Global average pooling operation for temporal data.

Usage

```
layer_global_average_pooling_1d(object, data_format = "channels_last",
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
data_format	One of channels_last (default) or channels_first. The ordering of the dimensions in the inputs.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

3D tensor with shape: (batch_size, steps, features).

Output shape

2D tensor with shape: (batch_size, channels)

See Also

Other pooling layers: layer_average_pooling_1d, layer_average_pooling_2d, layer_average_pooling_3d, layer_global_average_pooling_2d, layer_global_average_pooling_3d, layer_global_max_pooling_1d, layer_global_max_pooling_2d, layer_global_max_pooling_3d, layer_max_pooling_1d, layer_max_pooling_2d, layer_max_pooling_3d `layer_global_average_pooling_2d` *Global average pooling operation for spatial data.*

Description

Global average pooling operation for spatial data.

Usage

```
layer_global_average_pooling_2d(object, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 4D tensor with shape: `(batch_size, rows, cols, channels)`
- If `data_format='channels_first'`: 4D tensor with shape: `(batch_size, channels, rows, cols)`

Output shape

2D tensor with shape: `(batch_size, channels)`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_2d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d` layer_global_average_pooling_3d

Global Average pooling operation for 3D data.

Description

Global Average pooling operation for 3D data.

Usage

```
layer_global_average_pooling_3d(object, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, spatial_dim1, spatial_dim2, spatial`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, spatial_dim1, spatial_di`

Output shape

2D tensor with shape: `(batch_size, channels)`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_2d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d`

`layer_global_max_pooling_1d`
Global max pooling operation for temporal data.

Description

Global max pooling operation for temporal data.

Usage

```
layer_global_max_pooling_1d(object, data_format = "channels_last",
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	One of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs.
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

3D tensor with shape: `(batch_size, steps, features)`.

Output shape

2D tensor with shape: `(batch_size, channels)`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_2d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d`

layer_global_max_pooling_2d
Global max pooling operation for spatial data.

Description

Global max pooling operation for spatial data.

Usage

```
layer_global_max_pooling_2d(object, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 4D tensor with shape: `(batch_size, rows, cols, channels)`
- If `data_format='channels_first'`: 4D tensor with shape: `(batch_size, channels, rows, cols)`

Output shape

2D tensor with shape: `(batch_size, channels)`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d`

layer_global_max_pooling_3d
Global Max pooling operation for 3D data.

Description

Global Max pooling operation for 3D data.

Usage

```
layer_global_max_pooling_3d(object, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, spatial_dim1, spatial_dim2, spatial`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, spatial_dim1, spatial_di`

Output shape

2D tensor with shape: `(batch_size, channels)`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_2d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`, `layer_max_pooling_3d`

layer_gru *Gated Recurrent Unit - Cho et al.*

Description

There are two variants. The default one is based on 1406.1078v3 and has reset gate applied to hidden state before matrix multiplication. The other one is based on original 1406.1078v1 and has the order reversed.

Usage

```
layer_gru(object, units, activation = "tanh",
  recurrent_activation = "hard_sigmoid", use_bias = TRUE,
  return_sequences = FALSE, return_state = FALSE,
  go_backwards = FALSE, stateful = FALSE, unroll = FALSE,
  reset_after = FALSE, kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  kernel_regularizer = NULL, recurrent_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, recurrent_constraint = NULL,
  bias_constraint = NULL, dropout = 0, recurrent_dropout = 0,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`units`	Positive integer, dimensionality of the output space.
`activation`	Activation function to use. Default: hyperbolic tangent (`tanh`). If you pass `NULL`, no activation is applied (ie. "linear" activation: `a(x) = x`).
`recurrent_activation`	Activation function to use for the recurrent step.
`use_bias`	Boolean, whether the layer uses a bias vector.
`return_sequences`	Boolean. Whether to return the last output in the output sequence, or the full sequence.
`return_state`	Boolean (default FALSE). Whether to return the last state in addition to the output.
`go_backwards`	Boolean (default FALSE). If TRUE, process the input sequence backwards and return the reversed sequence.
`stateful`	Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.
`unroll`	Boolean (default FALSE). If TRUE, the network will be unrolled, else a symbolic loop will be used. Unrolling can speed-up a RNN, although it tends to be more memory-intensive. Unrolling is only suitable for short sequences.

reset_after
: GRU convention (whether to apply reset gate after or before matrix multiplication). FALSE = "before" (default), TRUE = "after" (CuDNN compatible).

kernel_initializer
: Initializer for the `kernel` weights matrix, used for the linear transformation of the inputs.

recurrent_initializer
: Initializer for the `recurrent_kernel` weights matrix, used for the linear transformation of the recurrent state.

bias_initializer
: Initializer for the bias vector.

kernel_regularizer
: Regularizer function applied to the `kernel` weights matrix.

recurrent_regularizer
: Regularizer function applied to the `recurrent_kernel` weights matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint
: Constraint function applied to the `kernel` weights matrix.

recurrent_constraint
: Constraint function applied to the `recurrent_kernel` weights matrix.

bias_constraint
: Constraint function applied to the bias vector.

dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the inputs.

recurrent_dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the recurrent state.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Details

The second variant is compatible with CuDNNGRU (GPU-only) and allows inference on CPU. Thus it has separate biases for `kernel` and `recurrent_kernel`. Use `reset_after = TTRUE` and `recurrent_activation = "sigmoid"`.

Input shapes

3D tensor with shape `(batch_size, timesteps, input_dim)`, (Optional) 2D tensors with shape `(batch_size, output_dim)`.

Output shape

- if `return_state`: a list of tensors. The first tensor is the output. The remaining tensors are the last states, each with shape `(batch_size, units)`.
- if `return_sequences`: 3D tensor with shape `(batch_size, timesteps, units)`.
- else, 2D tensor with shape `(batch_size, units)`.

Masking

This layer supports masking for input data with a variable number of timesteps. To introduce masks to your data, use an embedding layer with the `mask_zero` parameter set to `TRUE`.

Statefulness in RNNs

You can set RNN layers to be 'stateful', which means that the states computed for the samples in one batch will be reused as initial states for the samples in the next batch. This assumes a one-to-one mapping between samples in different successive batches.

To enable statefulness:

- Specify `stateful=TRUE` in the layer constructor.
- Specify a fixed batch size for your model. For sequential models, pass `batch_input_shape = c(...)` to the first layer in your model. For functional models with 1 or more Input layers, pass `batch_shape = c(...)` to all the first layers in your model. This is the expected shape of your inputs *including the batch size*. It should be a vector of integers, e.g. `c(32, 10, 100)`.
- Specify `shuffle = FALSE` when calling fit().

To reset the states of your model, call `reset_states()` on either a specific layer, or on your entire model.

Initial State of RNNs

You can specify the initial state of RNN layers symbolically by calling them with the keyword argument `initial_state`. The value of `initial_state` should be a tensor or list of tensors representing the initial state of the RNN layer.

You can specify the initial state of RNN layers numerically by calling `reset_states` with the keyword argument `states`. The value of `states` should be a numpy array or list of numpy arrays representing the initial state of the RNN layer.

References

- Learning Phrase Representations using RNN Encoder-Decoder for Statistical Machine Translation
- On the Properties of Neural Machine Translation: Encoder-Decoder Approaches
- Empirical Evaluation of Gated Recurrent Neural Networks on Sequence Modeling
- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

See Also

Other recurrent layers: `layer_cudnn_gru`, `layer_cudnn_lstm`, `layer_lstm`, `layer_simple_rnn`

`layer_input` *Input layer*

Description

Layer to be used as an entry point into a graph.

Usage

```
layer_input(shape = NULL, batch_shape = NULL, name = NULL,
  dtype = NULL, sparse = FALSE, tensor = NULL)
```

Arguments

`shape`	Shape, not including the batch size. For instance, `shape=c(32)` indicates that the expected input will be batches of 32-dimensional vectors.
`batch_shape`	Shape, including the batch size. For instance, `shape = c(10,32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_shape = list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`sparse`	Boolean, whether the placeholder created is meant to be sparse.
`tensor`	Existing tensor to wrap into the `Input` layer. If set, the layer will not create a placeholder tensor.

Value

A tensor

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_repeat_vector`, `layer_reshape` layer_lambda *Wraps arbitrary expression as a layer*

Description

Wraps arbitrary expression as a layer

Usage

```
layer_lambda(object, f, output_shape = NULL, mask = NULL,
  arguments = NULL, input_shape = NULL, batch_input_shape = NULL,
  batch_size = NULL, dtype = NULL, name = NULL, trainable = NULL,
  weights = NULL)
```

Arguments

`object`	Model or layer object
`f`	The function to be evaluated. Takes input tensor as first argument.
`output_shape`	Expected output shape from the function (not required when using TensorFlow back-end).
`mask`	mask
`arguments`	optional named list of keyword arguments to be passed to the function.
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

Arbitrary. Use the keyword argument input_shape (list of integers, does not include the samples axis) when using this layer as the first layer in a model.

Output shape

Arbitrary (based on tensor returned from the function)

See Also

Other core layers: layer_activation, layer_activity_regularization, layer_dense, layer_dropout, layer_flatten, layer_input, layer_masking, layer_permute, layer_repeat_vector, layer_reshape

---

layer_locally_connected_1d

Locally-connected layer for 1D inputs.

Description

layer_locally_connected_1d() works similarly to layer_conv_1d() , except that weights are unshared, that is, a different set of filters is applied at each different patch of the input.

Usage

```
layer_locally_connected_1d(object, filters, kernel_size, strides = 1L,
  padding = "valid", data_format = NULL, activation = NULL,
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  bias_initializer = "zeros", kernel_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, bias_constraint = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
filters	Integer, the dimensionality of the output space (i.e. the number output of filters in the convolution).
kernel_size	An integer or list of a single integer, specifying the length of the 1D convolution window.
strides	An integer or list of a single integer, specifying the stride length of the convolution. Specifying any stride value != 1 is incompatible with specifying any dilation_rate value != 1.
padding	Currently only supports "valid" (case-insensitive). "same" may be supported in the future.
data_format	A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs. channels_last corresponds to inputs with shape (batch, height, width, channels) while channels_first corresponds to inputs with shape (batch, channels, height, width). It defaults to the image_data_format value found in your Keras config file at ~/.keras/keras.json. If you never set it, then it will be "channels_last".
activation	Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: a(x) = x).
use_bias	Boolean, whether the layer uses a bias vector.

kernel_initializer
: Initializer for the kernel weights matrix.

bias_initializer
: Initializer for the bias vector.

kernel_regularizer
: Regularizer function applied to the kernel weights matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint
: Constraint function applied to the kernel matrix.

bias_constraint
: Constraint function applied to the bias vector.

batch_size
: Fixed batch size for layer

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Input shape

3D tensor with shape: (batch_size, steps, input_dim)

Output shape

3D tensor with shape: (batch_size, new_steps, filters) steps value might have changed due to padding or strides.

See Also

Other locally connected layers: layer_locally_connected_2d

---

layer_locally_connected_2d

Locally-connected layer for 2D inputs.

Description

layer_locally_connected_2d works similarly to layer_conv_2d(), except that weights are unshared, that is, a different set of filters is applied at each different patch of the input.

Usage

```
layer_locally_connected_2d(object, filters, kernel_size, strides = c(1L,
  1L), padding = "valid", data_format = NULL, activation = NULL,
  use_bias = TRUE, kernel_initializer = "glorot_uniform",
  bias_initializer = "zeros", kernel_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, bias_constraint = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

- `object` Model or layer object
- `filters` Integer, the dimensionality of the output space (i.e. the number output of filters in the convolution).
- `kernel_size` An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
- `strides` An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
- `padding` Currently only supports `"valid"` (case-insensitive). `"same"` may be supported in the future.
- `data_format` A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, width, height, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, width, height)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
- `activation` Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).
- `use_bias` Boolean, whether the layer uses a bias vector.
- `kernel_initializer` Initializer for the `kernel` weights matrix.
- `bias_initializer` Initializer for the bias vector.
- `kernel_regularizer` Regularizer function applied to the `kernel` weights matrix.
- `bias_regularizer` Regularizer function applied to the bias vector.
- `activity_regularizer` Regularizer function applied to the output of the layer (its "activation")..
- `kernel_constraint` Constraint function applied to the kernel matrix.

bias_constraint
: Constraint function applied to the bias vector.

batch_size
: Fixed batch size for layer

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Input shape

4D tensor with shape: `(samples, channels, rows, cols)` if data_format='channels_first' or 4D tensor with shape: `(samples, rows, cols, channels)` if data_format='channels_last'.

Output shape

4D tensor with shape: `(samples, filters, new_rows, new_cols)` if data_format='channels_first' or 4D tensor with shape: `(samples, new_rows, new_cols, filters)` if data_format='channels_last'. `rows` and `cols` values might have changed due to padding.

See Also

Other locally connected layers: `layer_locally_connected_1d`

`layer_lstm` *Long Short-Term Memory unit - Hochreiter 1997.*

Description

For a step-by-step description of the algorithm, see this tutorial.

Usage

```
layer_lstm(object, units, activation = "tanh",
  recurrent_activation = "hard_sigmoid", use_bias = TRUE,
  return_sequences = FALSE, return_state = FALSE,
  go_backwards = FALSE, stateful = FALSE, unroll = FALSE,
  kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  unit_forget_bias = TRUE, kernel_regularizer = NULL,
  recurrent_regularizer = NULL, bias_regularizer = NULL,
  activity_regularizer = NULL, kernel_constraint = NULL,
  recurrent_constraint = NULL, bias_constraint = NULL, dropout = 0,
  recurrent_dropout = 0, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object` Model or layer object

`units` Positive integer, dimensionality of the output space.

`activation` Activation function to use. Default: hyperbolic tangent (`tanh`). If you pass `NULL`, no activation is applied (ie. "linear" activation: `a(x) = x`).

`recurrent_activation` Activation function to use for the recurrent step.

`use_bias` Boolean, whether the layer uses a bias vector.

`return_sequences` Boolean. Whether to return the last output in the output sequence, or the full sequence.

`return_state` Boolean (default FALSE). Whether to return the last state in addition to the output.

`go_backwards` Boolean (default FALSE). If TRUE, process the input sequence backwards and return the reversed sequence.

`stateful` Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.

`unroll` Boolean (default FALSE). If TRUE, the network will be unrolled, else a symbolic loop will be used. Unrolling can speed-up a RNN, although it tends to be more memory-intensive. Unrolling is only suitable for short sequences.

`kernel_initializer` Initializer for the `kernel` weights matrix, used for the linear transformation of the inputs.

`recurrent_initializer` Initializer for the `recurrent_kernel` weights matrix, used for the linear transformation of the recurrent state.

`bias_initializer` Initializer for the bias vector.

`unit_forget_bias` Boolean. If TRUE, add 1 to the bias of the forget gate at initialization. Setting it to true will also force `bias_initializer="zeros"`. This is recommended in Jozefowicz et al.

`kernel_regularizer` Regularizer function applied to the `kernel` weights matrix.

`recurrent_regularizer` Regularizer function applied to the `recurrent_kernel` weights matrix.

`bias_regularizer` Regularizer function applied to the bias vector.

`activity_regularizer` Regularizer function applied to the output of the layer (its "activation")..

`kernel_constraint` Constraint function applied to the `kernel` weights matrix.

`recurrent_constraint` Constraint function applied to the `recurrent_kernel` weights matrix.

bias_constraint
: Constraint function applied to the bias vector.

dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the inputs.

recurrent_dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the recurrent state.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Input shapes

3D tensor with shape `(batch_size, timesteps, input_dim)`, (Optional) 2D tensors with shape `(batch_size, output_dim)`.

Output shape

- if `return_state`: a list of tensors. The first tensor is the output. The remaining tensors are the last states, each with shape `(batch_size, units)`.
- if `return_sequences`: 3D tensor with shape `(batch_size, timesteps, units)`.
- else, 2D tensor with shape `(batch_size, units)`.

Masking

This layer supports masking for input data with a variable number of timesteps. To introduce masks to your data, use an embedding layer with the `mask_zero` parameter set to `TRUE`.

Statefulness in RNNs

You can set RNN layers to be 'stateful', which means that the states computed for the samples in one batch will be reused as initial states for the samples in the next batch. This assumes a one-to-one mapping between samples in different successive batches.

To enable statefulness:

- Specify `stateful=TRUE` in the layer constructor.

- Specify a fixed batch size for your model. For sequential models, pass `batch_input_shape = c(...)` to the first layer in your model. For functional models with 1 or more Input layers, pass `batch_shape = c(...)` to all the first layers in your model. This is the expected shape of your inputs *including the batch size*. It should be a vector of integers, e.g. `c(32, 10, 100)`.
- Specify `shuffle = FALSE` when calling fit().

To reset the states of your model, call `reset_states()` on either a specific layer, or on your entire model.

Initial State of RNNs

You can specify the initial state of RNN layers symbolically by calling them with the keyword argument `initial_state`. The value of `initial_state` should be a tensor or list of tensors representing the initial state of the RNN layer.

You can specify the initial state of RNN layers numerically by calling `reset_states` with the keyword argument `states`. The value of `states` should be a numpy array or list of numpy arrays representing the initial state of the RNN layer.

References

- Long short-term memory (original 1997 paper)
- Supervised sequence labeling with recurrent neural networks
- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

See Also

Other recurrent layers: `layer_cudnn_gru`, `layer_cudnn_lstm`, `layer_gru`, `layer_simple_rnn`

Other recurrent layers: `layer_cudnn_gru`, `layer_cudnn_lstm`, `layer_gru`, `layer_simple_rnn`

`layer_masking` *Masks a sequence by using a mask value to skip timesteps.*

Description

For each timestep in the input tensor (dimension #1 in the tensor), if all values in the input tensor at that timestep are equal to `mask_value`, then the timestep will be masked (skipped) in all downstream layers (as long as they support masking). If any downstream layer does not support masking yet receives such an input mask, an exception will be raised.

Usage

```
layer_masking(object, mask_value = 0, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`mask_value`	float, mask value
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_permute`, `layer_repeat_vector`, `layer_reshape`

`layer_maximum` *Layer that computes the maximum (element-wise) a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape, and returns a single tensor (also of the same shape).

Usage

```
layer_maximum(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`inputs`	A list of input tensors (at least 2).
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Value

A tensor, the element-wise maximum of the inputs.

See Also

Other merge layers: `layer_add`, `layer_average`, `layer_concatenate`, `layer_dot`, `layer_minimum`, `layer_multiply`, `layer_subtract`

`layer_max_pooling_1d` *Max pooling operation for temporal data.*

Description

Max pooling operation for temporal data.

Usage

```
layer_max_pooling_1d(object, pool_size = 2L, strides = NULL,
  padding = "valid", batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`pool_size`	Integer, size of the max pooling windows.
`strides`	Integer, or NULL. Factor by which to downscale. E.g. 2 will halve the input. If NULL, it will default to `pool_size`.
`padding`	One of `"valid"` or `"same"` (case-insensitive).
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

3D tensor with shape: `(batch_size, steps, features)`.

Output shape

3D tensor with shape: `(batch_size, downsampled_steps, features)`.

See Also

Other pooling layers: layer_average_pooling_1d, layer_average_pooling_2d, layer_average_pooling_3d, layer_global_average_pooling_1d, layer_global_average_pooling_2d, layer_global_average_pooling_3d, layer_global_max_pooling_1d, layer_global_max_pooling_2d, layer_global_max_pooling_3d, layer_max_pooling_2d, layer_max_pooling_3d

---

layer_max_pooling_2d *Max pooling operation for spatial data.*

Description

Max pooling operation for spatial data.

Usage

```
layer_max_pooling_2d(object, pool_size = c(2L, 2L), strides = NULL,
  padding = "valid", data_format = NULL, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
pool_size	integer or list of 2 integers, factors by which to downscale (vertical, horizontal). (2, 2) will halve the input in both spatial dimension. If only one integer is specified, the same window length will be used for both dimensions.
strides	Integer, list of 2 integers, or NULL. Strides values. If NULL, it will default to pool_size.
padding	One of "valid" or "same" (case-insensitive).
data_format	A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs. channels_last corresponds to inputs with shape (batch, height, width, channels) while channels_first corresponds to inputs with shape (batch, channels, height, width). It defaults to the image_data_format value found in your Keras config file at ~/.keras/keras.json. If you never set it, then it will be "channels_last".
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

- If data_format='channels_last': 4D tensor with shape: (batch_size, rows, cols, channels)
- If data_format='channels_first': 4D tensor with shape: (batch_size, channels, rows, cols)

Output shape

- If data_format='channels_last': 4D tensor with shape: (batch_size, pooled_rows, pooled_cols, channels)
- If data_format='channels_first': 4D tensor with shape: (batch_size, channels, pooled_rows, pooled_cols

See Also

Other pooling layers: layer_average_pooling_1d, layer_average_pooling_2d, layer_average_pooling_3d, layer_global_average_pooling_1d, layer_global_average_pooling_2d, layer_global_average_pooling_3d, layer_global_max_pooling_1d, layer_global_max_pooling_2d, layer_global_max_pooling_3d, layer_max_pooling_1d, layer_max_pooling_3d

---

layer_max_pooling_3d *Max pooling operation for 3D data (spatial or spatio-temporal).*

Description

Max pooling operation for 3D data (spatial or spatio-temporal).

Usage

```
layer_max_pooling_3d(object, pool_size = c(2L, 2L, 2L), strides = NULL,
  padding = "valid", data_format = NULL, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
pool_size	list of 3 integers, factors by which to downscale (dim1, dim2, dim3). (2, 2, 2) will halve the size of the 3D input in each dimension.
strides	list of 3 integers, or NULL. Strides values.
padding	One of "valid" or "same" (case-insensitive).
data_format	A string, one of channels_last (default) or channels_first. The ordering of the dimensions in the inputs. channels_last corresponds to inputs with shape (batch, spatial_dim1, spatial_dim2, spatial_dim3, channels) while channels_first corresponds to inputs with shape (batch, channels, spatial_dim1, spatial_dim2 It defaults to the image_data_format value found in your Keras config file at ~/.keras/keras.json. If you never set it, then it will be "channels_last".
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, spatial_dim1, spatial_dim2, spatial`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, spatial_dim1, spatial_di`

Output shape

- If `data_format='channels_last'`: 5D tensor with shape: `(batch_size, pooled_dim1, pooled_dim2, pooled_di`
- If `data_format='channels_first'`: 5D tensor with shape: `(batch_size, channels, pooled_dim1, pooled_dim2`

See Also

Other pooling layers: `layer_average_pooling_1d`, `layer_average_pooling_2d`, `layer_average_pooling_3d`, `layer_global_average_pooling_1d`, `layer_global_average_pooling_2d`, `layer_global_average_pooling_3d`, `layer_global_max_pooling_1d`, `layer_global_max_pooling_2d`, `layer_global_max_pooling_3d`, `layer_max_pooling_1d`, `layer_max_pooling_2d`

`layer_minimum` *Layer that computes the minimum (element-wise) a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape, and returns a single tensor (also of the same shape).

Usage

```
layer_minimum(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`inputs`	A list of input tensors (at least 2).
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Value

A tensor, the element-wise maximum of the inputs.

See Also

Other merge layers: `layer_add`, `layer_average`, `layer_concatenate`, `layer_dot`, `layer_maximum`, `layer_multiply`, `layer_subtract`

layer_multiply — *Layer that multiplies (element-wise) a list of inputs.*

Description

It takes as input a list of tensors, all of the same shape, and returns a single tensor (also of the same shape).

Usage

```
layer_multiply(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`inputs`	A list of input tensors (at least 2).
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Value

A tensor, the element-wise product of the inputs.

See Also

Other merge layers: `layer_add`, `layer_average`, `layer_concatenate`, `layer_dot`, `layer_maximum`, `layer_minimum`, `layer_subtract`

layer_permute — *Permute the dimensions of an input according to a given pattern*

Description

Permute the dimensions of an input according to a given pattern

Usage

```
layer_permute(object, dims, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`dims`	List of integers. Permutation pattern, does not include the samples dimension. Indexing starts at 1. For instance, `(2, 1)` permutes the first and second dimension of the input.
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input and Output Shapes

Input shape: Arbitrary

Output shape: Same as the input shape, but with the dimensions re-ordered according to the specified pattern.

Note

Useful for e.g. connecting RNNs and convnets together.

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_repeat_vector`, `layer_reshape`

`layer_repeat_vector` *Repeats the input n times.*

Description

Repeats the input n times.

Usage

```
layer_repeat_vector(object, n, batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`n`	integer, repetition factor.
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

2D tensor of shape `(num_samples, features)`.

Output shape

3D tensor of shape `(num_samples, n, features)`.

See Also

Other core layers: `layer_activation`, `layer_activity_regularization`, `layer_dense`, `layer_dropout`, `layer_flatten`, `layer_input`, `layer_lambda`, `layer_masking`, `layer_permute`, `layer_reshape`

`layer_reshape` *Reshapes an output to a certain shape.*

Description

Reshapes an output to a certain shape.

Usage

```
layer_reshape(object, target_shape, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`target_shape`	List of integers, does not include the samples dimension (batch size).
`input_shape`	Input shape (list of integers, does not include the samples axis) which is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (float32, float64, int32...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input and Output Shapes

Input shape: Arbitrary, although all dimensions in the input shaped must be fixed.

Output shape: `(batch_size,) + target_shape`.

See Also

Other core layers: layer_activation, layer_activity_regularization, layer_dense, layer_dropout, layer_flatten, layer_input, layer_lambda, layer_masking, layer_permute, layer_repeat_vector

---

layer_separable_conv_1d

Depthwise separable 1D convolution.

Description

Separable convolutions consist in first performing a depthwise spatial convolution (which acts on each input channel separately) followed by a pointwise convolution which mixes together the resulting output channels. The `depth_multiplier` argument controls how many output channels are generated per input channel in the depthwise step. Intuitively, separable convolutions can be understood as a way to factorize a convolution kernel into two smaller kernels, or as an extreme version of an Inception block.

Usage

```
layer_separable_conv_1d(object, filters, kernel_size, strides = 1,
  padding = "valid", data_format = "channels_last",
  dilation_rate = 1, depth_multiplier = 1, activation = NULL,
  use_bias = TRUE, depthwise_initializer = "glorot_uniform",
  pointwise_initializer = "glorot_uniform", bias_initializer = "zeros",
  depthwise_regularizer = NULL, pointwise_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  depthwise_constraint = NULL, pointwise_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object
: Model or layer object

filters
: Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).

kernel_size
: An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.

strides
: An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.

padding
: one of `"valid"` or `"same"` (case-insensitive).

data_format
: A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".

dilation_rate
: an integer or list of 2 integers, specifying the dilation rate to use for dilated convolution. Can be a single integer to specify the same value for all spatial dimensions. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any stride value != 1.

depth_multiplier
: The number of depthwise convolution output channels for each input channel. The total number of depthwise convolution output channels will be equal to `filterss_in * depth_multiplier`.

activation
: Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).

use_bias
: Boolean, whether the layer uses a bias vector.

depthwise_initializer
: Initializer for the depthwise kernel matrix.

pointwise_initializer
: Initializer for the pointwise kernel matrix.

bias_initializer
: Initializer for the bias vector.

depthwise_regularizer
: Regularizer function applied to the depthwise kernel matrix.

pointwise_regularizer
: Regularizer function applied to the pointwise kernel matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

`depthwise_constraint`
: Constraint function applied to the depthwise kernel matrix.

`pointwise_constraint`
: Constraint function applied to the pointwise kernel matrix.

`bias_constraint`
: Constraint function applied to the bias vector.

`input_shape`
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

`batch_input_shape`
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

`batch_size`
: Fixed batch size for layer

`dtype`
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

`name`
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable`
: Whether the layer weights will be updated during training.

`weights`
: Initial weights for layer.

Input shape

3D tensor with shape: `(batch, channels, steps)` if data_format='channels_first' or 3D tensor with shape: `(batch, steps, channels)` if data_format='channels_last'.

Output shape

3D tensor with shape: `(batch, filters, new_steps)` if data_format='channels_first' or 3D tensor with shape: `(batch, new_steps, filters)` if data_format='channels_last'. `new_steps` values might have changed due to padding or strides.

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

---

layer_separable_conv_2d

Separable 2D convolution.

Description

Separable convolutions consist in first performing a depthwise spatial convolution (which acts on each input channel separately) followed by a pointwise convolution which mixes together the resulting output channels. The `depth_multiplier` argument controls how many output channels are generated per input channel in the depthwise step. Intuitively, separable convolutions can be understood as a way to factorize a convolution kernel into two smaller kernels, or as an extreme version of an Inception block.

Usage

```
layer_separable_conv_2d(object, filters, kernel_size, strides = c(1, 1),
  padding = "valid", data_format = NULL, dilation_rate = 1,
  depth_multiplier = 1, activation = NULL, use_bias = TRUE,
  depthwise_initializer = "glorot_uniform",
  pointwise_initializer = "glorot_uniform", bias_initializer = "zeros",
  depthwise_regularizer = NULL, pointwise_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  depthwise_constraint = NULL, pointwise_constraint = NULL,
  bias_constraint = NULL, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`filters`	Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).
`kernel_size`	An integer or list of 2 integers, specifying the width and height of the 2D convolution window. Can be a single integer to specify the same value for all spatial dimensions.
`strides`	An integer or list of 2 integers, specifying the strides of the convolution along the width and height. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any `dilation_rate` value != 1.
`padding`	one of `"valid"` or `"same"` (case-insensitive).
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`dilation_rate`	an integer or list of 2 integers, specifying the dilation rate to use for dilated convolution. Can be a single integer to specify the same value for all spatial dimensions. Currently, specifying any `dilation_rate` value != 1 is incompatible with specifying any stride value != 1.

depth_multiplier
: The number of depthwise convolution output channels for each input channel. The total number of depthwise convolution output channels will be equal to `filters_in * depth_multiplier`.

activation
: Activation function to use. If you don't specify anything, no activation is applied (ie. "linear" activation: `a(x) = x`).

use_bias
: Boolean, whether the layer uses a bias vector.

depthwise_initializer
: Initializer for the depthwise kernel matrix.

pointwise_initializer
: Initializer for the pointwise kernel matrix.

bias_initializer
: Initializer for the bias vector.

depthwise_regularizer
: Regularizer function applied to the depthwise kernel matrix.

pointwise_regularizer
: Regularizer function applied to the pointwise kernel matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

depthwise_constraint
: Constraint function applied to the depthwise kernel matrix.

pointwise_constraint
: Constraint function applied to the pointwise kernel matrix.

bias_constraint
: Constraint function applied to the bias vector.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

trainable
: Whether the layer weights will be updated during training.

weights
: Initial weights for layer.

Input shape

4D tensor with shape: `(batch, channels, rows, cols)` if data_format='channels_first' or 4D tensor with shape: `(batch, rows, cols, channels)` if data_format='channels_last'.

Output shape

4D tensor with shape: `(batch, filters, new_rows, new_cols)` if data_format='channels_first' or 4D tensor with shape: `(batch, new_rows, new_cols, filters)` if data_format='channels_last'. `rows` and `cols` values might have changed due to padding.

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

`layer_simple_rnn` *Fully-connected RNN where the output is to be fed back to input.*

Description

Fully-connected RNN where the output is to be fed back to input.

Usage

```
layer_simple_rnn(object, units, activation = "tanh", use_bias = TRUE,
  return_sequences = FALSE, return_state = FALSE,
  go_backwards = FALSE, stateful = FALSE, unroll = FALSE,
  kernel_initializer = "glorot_uniform",
  recurrent_initializer = "orthogonal", bias_initializer = "zeros",
  kernel_regularizer = NULL, recurrent_regularizer = NULL,
  bias_regularizer = NULL, activity_regularizer = NULL,
  kernel_constraint = NULL, recurrent_constraint = NULL,
  bias_constraint = NULL, dropout = 0, recurrent_dropout = 0,
  input_shape = NULL, batch_input_shape = NULL, batch_size = NULL,
  dtype = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`units`	Positive integer, dimensionality of the output space.
`activation`	Activation function to use. Default: hyperbolic tangent (`tanh`). If you pass `NULL`, no activation is applied (ie. "linear" activation: `a(x) = x`).
`use_bias`	Boolean, whether the layer uses a bias vector.
`return_sequences`	Boolean. Whether to return the last output in the output sequence, or the full sequence.
`return_state`	Boolean (default FALSE). Whether to return the last state in addition to the output.

go_backwards
: Boolean (default FALSE). If TRUE, process the input sequence backwards and return the reversed sequence.

stateful
: Boolean (default FALSE). If TRUE, the last state for each sample at index i in a batch will be used as initial state for the sample of index i in the following batch.

unroll
: Boolean (default FALSE). If TRUE, the network will be unrolled, else a symbolic loop will be used. Unrolling can speed-up a RNN, although it tends to be more memory-intensive. Unrolling is only suitable for short sequences.

kernel_initializer
: Initializer for the `kernel` weights matrix, used for the linear transformation of the inputs.

recurrent_initializer
: Initializer for the `recurrent_kernel` weights matrix, used for the linear transformation of the recurrent state.

bias_initializer
: Initializer for the bias vector.

kernel_regularizer
: Regularizer function applied to the `kernel` weights matrix.

recurrent_regularizer
: Regularizer function applied to the `recurrent_kernel` weights matrix.

bias_regularizer
: Regularizer function applied to the bias vector.

activity_regularizer
: Regularizer function applied to the output of the layer (its "activation")..

kernel_constraint
: Constraint function applied to the `kernel` weights matrix.

recurrent_constraint
: Constraint function applied to the `recurrent_kernel` weights matrix.

bias_constraint
: Constraint function applied to the bias vector.

dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the inputs.

recurrent_dropout
: Float between 0 and 1. Fraction of the units to drop for the linear transformation of the recurrent state.

input_shape
: Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.

batch_input_shape
: Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.

batch_size
: Fixed batch size for layer

dtype
: The data type expected by the input, as a string (`float32`, `float64`, `int32`...)

name
: An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.

`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shapes

3D tensor with shape `(batch_size, timesteps, input_dim)`, (Optional) 2D tensors with shape `(batch_size, output_dim)`.

Output shape

- if `return_state`: a list of tensors. The first tensor is the output. The remaining tensors are the last states, each with shape `(batch_size, units)`.
- if `return_sequences`: 3D tensor with shape `(batch_size, timesteps, units)`.
- else, 2D tensor with shape `(batch_size, units)`.

Masking

This layer supports masking for input data with a variable number of timesteps. To introduce masks to your data, use an embedding layer with the `mask_zero` parameter set to `TRUE`.

Statefulness in RNNs

You can set RNN layers to be 'stateful', which means that the states computed for the samples in one batch will be reused as initial states for the samples in the next batch. This assumes a one-to-one mapping between samples in different successive batches.

To enable statefulness:

- Specify `stateful=TRUE` in the layer constructor.
- Specify a fixed batch size for your model. For sequential models, pass `batch_input_shape = c(...)` to the first layer in your model. For functional models with 1 or more Input layers, pass `batch_shape = c(...)` to all the first layers in your model. This is the expected shape of your inputs *including the batch size*. It should be a vector of integers, e.g. `c(32, 10, 100)`.
- Specify `shuffle = FALSE` when calling fit().

To reset the states of your model, call `reset_states()` on either a specific layer, or on your entire model.

Initial State of RNNs

You can specify the initial state of RNN layers symbolically by calling them with the keyword argument `initial_state`. The value of `initial_state` should be a tensor or list of tensors representing the initial state of the RNN layer.

You can specify the initial state of RNN layers numerically by calling `reset_states` with the keyword argument `states`. The value of `states` should be a numpy array or list of numpy arrays representing the initial state of the RNN layer.

References

- A Theoretically Grounded Application of Dropout in Recurrent Neural Networks

See Also

Other recurrent layers: layer_cudnn_gru, layer_cudnn_lstm, layer_gru, layer_lstm

---

layer_spatial_dropout_1d
Spatial 1D version of Dropout.

Description

This version performs the same function as Dropout, however it drops entire 1D feature maps instead of individual elements. If adjacent frames within feature maps are strongly correlated (as is normally the case in early convolution layers) then regular dropout will not regularize the activations and will otherwise just result in an effective learning rate decrease. In this case, `layer_spatial_dropout_1d` will help promote independence between feature maps and should be used instead.

Usage

```
layer_spatial_dropout_1d(object, rate, batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`rate`	float between 0 and 1. Fraction of the input units to drop.
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

3D tensor with shape: `(samples, timesteps, channels)`

Output shape

Same as input

References

- Efficient Object Localization Using Convolutional Networks

See Also

Other dropout layers: layer_dropout, layer_spatial_dropout_2d, layer_spatial_dropout_3d `layer_spatial_dropout_2d`

Spatial 2D version of Dropout.

Description

This version performs the same function as Dropout, however it drops entire 2D feature maps instead of individual elements. If adjacent pixels within feature maps are strongly correlated (as is normally the case in early convolution layers) then regular dropout will not regularize the activations and will otherwise just result in an effective learning rate decrease. In this case, `layer_spatial_dropout_2d` will help promote independence between feature maps and should be used instead.

Usage

```
layer_spatial_dropout_2d(object, rate, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`rate`	float between 0 and 1. Fraction of the input units to drop.
`data_format`	'channels_first' or 'channels_last'. In 'channels_first' mode, the channels dimension (the depth) is at index 1, in 'channels_last' mode is it at index 3. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

4D tensor with shape: `(samples, channels, rows, cols)` if data_format='channels_first' or 4D tensor with shape: `(samples, rows, cols, channels)` if data_format='channels_last'.

Output shape

Same as input

References

- Efficient Object Localization Using Convolutional Networks

See Also

Other dropout layers: `layer_dropout`, `layer_spatial_dropout_1d`, `layer_spatial_dropout_3d` layer_spatial_dropout_3d

Spatial 3D version of Dropout.

Description

This version performs the same function as Dropout, however it drops entire 3D feature maps instead of individual elements. If adjacent voxels within feature maps are strongly correlated (as is normally the case in early convolution layers) then regular dropout will not regularize the activations and will otherwise just result in an effective learning rate decrease. In this case, `layer_spatial_dropout_3d` will help promote independence between feature maps and should be used instead.

Usage

```
layer_spatial_dropout_3d(object, rate, data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`rate`	float between 0 and 1. Fraction of the input units to drop.
`data_format`	'channels_first' or 'channels_last'. In 'channels_first' mode, the channels dimension (the depth) is at index 1, in 'channels_last' mode is it at index 4. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

5D tensor with shape: `(samples, channels, dim1, dim2, dim3)` if data_format='channels_first' or 5D tensor with shape: `(samples, dim1, dim2, dim3, channels)` if data_format='channels_last'.

Output shape

Same as input

References

- Efficient Object Localization Using Convolutional Networks

See Also

Other dropout layers: `layer_dropout`, `layer_spatial_dropout_1d`, `layer_spatial_dropout_2d`

layer_subtract — *Layer that subtracts two inputs.*

Description

It takes as input a list of tensors of size 2, both of the same shape, and returns a single tensor, (inputs[[1]] - inputs[[2]]), also of the same shape.

Usage

```
layer_subtract(inputs, batch_size = NULL, dtype = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

inputs	A list of input tensors (exactly 2).
batch_size	Fixed batch size for layer
dtype	The data type expected by the input, as a string (float32, float64, int32...)
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Value

A tensor, the difference of the inputs.

See Also

Other merge layers: layer_add, layer_average, layer_concatenate, layer_dot, layer_maximum, layer_minimum, layer_multiply

layer_upsampling_1d — *Upsampling layer for 1D inputs.*

Description

Repeats each temporal step size times along the time axis.

Usage

```
layer_upsampling_1d(object, size = 2L, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
size	integer. Upsampling factor.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

3D tensor with shape: `(batch, steps, features)`.

Output shape

3D tensor with shape: `(batch, upsampled_steps, features)`.

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

---

layer_upsampling_2d *Upsampling layer for 2D inputs.*

Description

Repeats the rows and columns of the data by `size[[0]]` and `size[[1]]` respectively.

Usage

```
layer_upsampling_2d(object, size = c(2L, 2L), data_format = NULL,
  interpolation = "nearest", batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
size	int, or list of 2 integers. The upsampling factors for rows and columns.
data_format	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".

interpolation	A string, one of nearest or bilinear. Note that CNTK does not support yet the bilinear upscaling and that with Theano, only size=(2, 2) is possible.
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

4D tensor with shape:

- If data_format is "channels_last": (batch, rows, cols, channels)
- If data_format is "channels_first": (batch, channels, rows, cols)

Output shape

4D tensor with shape:

- If data_format is "channels_last": (batch, upsampled_rows, upsampled_cols, channels)
- If data_format is "channels_first": (batch, channels, upsampled_rows, upsampled_cols)

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_upsampling_3d *Upsampling layer for 3D inputs.*

Description

Repeats the 1st, 2nd and 3rd dimensions of the data by size[[0]], size[[1]] and size[[2]] respectively.

Usage

```
layer_upsampling_3d(object, size = c(2L, 2L, 2L), data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
size	int, or list of 3 integers. The upsampling factors for dim1, dim2 and dim3.
data_format	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

5D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, dim1, dim2, dim3, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, dim1, dim2, dim3)`

Output shape

5D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, upsampled_dim1, upsampled_dim2, upsampled_dim3, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, upsampled_dim1, upsampled_dim2, upsampled_dim3`

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_zero_padding_1d`, `layer_zero_padding_2d`, `layer_zero_padding_3d`

`layer_zero_padding_1d` *Zero-padding layer for 1D input (e.g. temporal sequence).*

Description

Zero-padding layer for 1D input (e.g. temporal sequence).

Usage

```
layer_zero_padding_1d(object, padding = 1L, batch_size = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

object	Model or layer object
padding	int, or list of int (length 2) • If int: How many zeros to add at the beginning and end of the padding dimension (axis 1). • If list of int (length 2): How many zeros to add at the beginning and at the end of the padding dimension ((left_pad, right_pad)).
batch_size	Fixed batch size for layer
name	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
trainable	Whether the layer weights will be updated during training.
weights	Initial weights for layer.

Input shape

3D tensor with shape (batch, axis_to_pad, features)

Output shape

3D tensor with shape (batch, padded_axis, features)

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_2d, layer_zero_padding_3d

---

layer_zero_padding_2d *Zero-padding layer for 2D input (e.g. picture).*

Description

This layer can add rows and columns of zeros at the top, bottom, left and right side of an image tensor.

Usage

```
layer_zero_padding_2d(object, padding = c(1L, 1L), data_format = NULL,
  batch_size = NULL, name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`padding`	int, or list of 2 ints, or list of 2 lists of 2 ints. • If int: the same symmetric padding is applied to width and height. • If list of 2 ints: interpreted as two different symmetric padding values for height and width: `(symmetric_height_pad, symmetric_width_pad)`. • If list of 2 lists of 2 ints: interpreted as `((top_pad, bottom_pad), (left_pad, right_pad))`
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, height, width, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, height, width)`. It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

4D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, rows, cols, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, rows, cols)`

Output shape

4D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, padded_rows, padded_cols, channels)`
- If `data_format` is `"channels_first"`: `(batch, channels, padded_rows, padded_cols)`

See Also

Other convolutional layers: `layer_conv_1d`, `layer_conv_2d_transpose`, `layer_conv_2d`, `layer_conv_3d_transpose`, `layer_conv_3d`, `layer_conv_lstm_2d`, `layer_cropping_1d`, `layer_cropping_2d`, `layer_cropping_3d`, `layer_depthwise_conv_2d`, `layer_separable_conv_1d`, `layer_separable_conv_2d`, `layer_upsampling_1d`, `layer_upsampling_2d`, `layer_upsampling_3d`, `layer_zero_padding_1d`, `layer_zero_padding_3d` `layer_zero_padding_3d` *Zero-padding layer for 3D data (spatial or spatio-temporal).*

Description

Zero-padding layer for 3D data (spatial or spatio-temporal).

Usage

```
layer_zero_padding_3d(object, padding = c(1L, 1L, 1L),
  data_format = NULL, batch_size = NULL, name = NULL,
  trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`padding`	int, or list of 3 ints, or list of 3 lists of 2 ints. • If int: the same symmetric padding is applied to width and height. • If list of 3 ints: interpreted as three different symmetric padding values: `(symmetric_dim1_pad, symmetric_dim2_pad, symmetric_dim3_pad)`. • If list of 3 lists of 2 ints: interpreted as `((left_dim1_pad, right_dim1_pad), (left_dim2_pad, r`
`data_format`	A string, one of `channels_last` (default) or `channels_first`. The ordering of the dimensions in the inputs. `channels_last` corresponds to inputs with shape `(batch, spatial_dim1, spatial_dim2, spatial_dim3, channels)` while `channels_first` corresponds to inputs with shape `(batch, channels, spatial_dim1, spatial_dim2` It defaults to the `image_data_format` value found in your Keras config file at `~/.keras/keras.json`. If you never set it, then it will be "channels_last".
`batch_size`	Fixed batch size for layer
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Input shape

5D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, first_axis_to_pad, second_axis_to_pad, third_axis_to_pad`
- If `data_format` is `"channels_first"`: `(batch, depth, first_axis_to_pad, second_axis_to_pad, third_axis`

Output shape

5D tensor with shape:

- If `data_format` is `"channels_last"`: `(batch, first_padded_axis, second_padded_axis, third_axis_to_pad`
- If `data_format` is `"channels_first"`: `(batch, depth, first_padded_axis, second_padded_axis, third_axis`

See Also

Other convolutional layers: layer_conv_1d, layer_conv_2d_transpose, layer_conv_2d, layer_conv_3d_transpose, layer_conv_3d, layer_conv_lstm_2d, layer_cropping_1d, layer_cropping_2d, layer_cropping_3d, layer_depthwise_conv_2d, layer_separable_conv_1d, layer_separable_conv_2d, layer_upsampling_1d, layer_upsampling_2d, layer_upsampling_3d, layer_zero_padding_1d, layer_zero_padding_2d

---

`loss_mean_squared_error`

Model loss functions

Description

Model loss functions

Usage

```
loss_mean_squared_error(y_true, y_pred)

loss_mean_absolute_error(y_true, y_pred)

loss_mean_absolute_percentage_error(y_true, y_pred)

loss_mean_squared_logarithmic_error(y_true, y_pred)

loss_squared_hinge(y_true, y_pred)

loss_hinge(y_true, y_pred)

loss_categorical_hinge(y_true, y_pred)

loss_logcosh(y_true, y_pred)

loss_categorical_crossentropy(y_true, y_pred)

loss_sparse_categorical_crossentropy(y_true, y_pred)

loss_binary_crossentropy(y_true, y_pred)

loss_kullback_leibler_divergence(y_true, y_pred)

loss_poisson(y_true, y_pred)

loss_cosine_proximity(y_true, y_pred)
```

Arguments

`y_true`	True labels (Tensor)
`y_pred`	Predictions (Tensor of the same shape as `y_true`)

Details

Loss functions are to be supplied in the `loss` parameter of the `compile.keras.engine.training.Model()` function.

Loss functions can be specified either using the name of a built in loss function (e.g. 'loss = binary_crossentropy'), a reference to a built in loss function (e.g. 'loss = loss_binary_crossentropy()') or by passing an artitrary function that returns a scalar for each data-point and takes the following two arguments:

- `y_true` True labels (Tensor)
- `y_pred` Predictions (Tensor of the same shape as `y_true`)

The actual optimized objective is the mean of the output array across all datapoints.

Categorical Crossentropy

When using the categorical_crossentropy loss, your targets should be in categorical format (e.g. if you have 10 classes, the target for each sample should be a 10-dimensional vector that is all-zeros except for a 1 at the index corresponding to the class of the sample). In order to convert integer targets into categorical targets, you can use the Keras utility function `to_categorical()`:

`categorical_labels <- to_categorical(int_labels, num_classes = NULL)`

loss_logcosh

`log(cosh(x))` is approximately equal to `(x ** 2) / 2` for small `x` and to `abs(x) - log(2)` for large `x`. This means that 'logcosh' works mostly like the mean squared error, but will not be so strongly affected by the occasional wildly incorrect prediction. However, it may return NaNs if the intermediate value `cosh(y_pred - y_true)` is too large to be represented in the chosen precision.

See Also

`compile.keras.engine.training.Model()`

`make_sampling_table` *Generates a word rank-based probabilistic sampling table.*

Description

Generates a word rank-based probabilistic sampling table.

Usage

```
make_sampling_table(size, sampling_factor = 1e-05)
```

Arguments

`size`	Int, number of possible words to sample.
`sampling_factor`	The sampling factor in the word2vec formula.

Details

Used for generating the `sampling_table` argument for `skipgrams()`. `sampling_table[[i]]` is the probability of sampling the word i-th most common word in a dataset (more common words should be sampled less frequently, for balance).

The sampling probabilities are generated according to the sampling distribution used in word2vec:

`p(word) = min(1, sqrt(word_frequency / sampling_factor) / (word_frequency / sampling_factor))`

We assume that the word frequencies follow Zipf's law (s=1) to derive a numerical approximation of frequency(rank):

`frequency(rank) ~ 1/(rank * (log(rank) + gamma) + 1/2 - 1/(12*rank))`

where `gamma` is the Euler-Mascheroni constant.

Value

An array of length `size` where the ith entry is the probability that a word of rank i should be sampled.

Note

The word2vec formula is: p(word) = min(1, sqrt(word.frequency/sampling_factor) / (word.frequency/sampling_factor))

See Also

Other text preprocessing: `pad_sequences`, `skipgrams`, `text_hashing_trick`, `text_one_hot`, `text_to_word_sequence`

`metric_binary_accuracy` *Model performance metrics*

Description

Model performance metrics

Usage

```
metric_binary_accuracy(y_true, y_pred)

metric_binary_crossentropy(y_true, y_pred)

metric_categorical_accuracy(y_true, y_pred)

metric_categorical_crossentropy(y_true, y_pred)

metric_cosine_proximity(y_true, y_pred)

metric_hinge(y_true, y_pred)

metric_kullback_leibler_divergence(y_true, y_pred)

metric_mean_absolute_error(y_true, y_pred)

metric_mean_absolute_percentage_error(y_true, y_pred)

metric_mean_squared_error(y_true, y_pred)

metric_mean_squared_logarithmic_error(y_true, y_pred)

metric_poisson(y_true, y_pred)

metric_sparse_categorical_crossentropy(y_true, y_pred)

metric_squared_hinge(y_true, y_pred)

metric_top_k_categorical_accuracy(y_true, y_pred, k = 5)

metric_sparse_top_k_categorical_accuracy(y_true, y_pred, k = 5)

custom_metric(name, metric_fn)
```

Arguments

`y_true`	True labels (tensor)
`y_pred`	Predictions (tensor of the same shape as y_true).
`k`	An integer, number of top elements to consider.
`name`	Name of custom metric
`metric_fn`	Custom metric function

Custom Metrics

You can provide an arbitrary R function as a custom metric. Note that the `y_true` and `y_pred` parameters are tensors, so computations on them should use backend tensor functions.

Use the `custom_metric()` function to define a custom metric. Note that a name ('mean_pred') is provided for the custom metric function: this name is used within training progress output. See below for an example.

If you want to save and load a model with custom metrics, you should also specify the metric in the call the `load_model_hdf5()`. For example: `load_model_hdf5("my_model.h5", c('mean_pred' = metric_mean_pred))`.

Alternatively, you can wrap all of your code in a call to `with_custom_object_scope()` which will allow you to refer to the metric by name just like you do with built in keras metrics.

Documentation on the available backend tensor functions can be found at https://keras.rstudio.com/articles/backend.html#backend-functions.

Metrics with Parameters

To use metrics with parameters (e.g. `metric_top_k_categorical_accurary()`) you should create a custom metric that wraps the call with the parameter. See below for an example.

Note

Metric functions are to be supplied in the `metrics` parameter of the `compile.keras.engine.training.Model()` function.

Examples

```
## Not run:

# create metric using backend tensor functions
metric_mean_pred <- custom_metric("mean_pred", function(y_true, y_pred) {
  k_mean(y_pred)
})

model %>% compile(
  optimizer = optimizer_rmsprop(),
  loss = loss_binary_crossentropy,
  metrics = c('accuracy', metric_mean_pred)
)

# create custom metric to wrap metric with parameter
metric_top_3_categorical_accuracy <-
  custom_metric("top_3_categorical_accuracy", function(y_true, y_pred) {
    metric_top_k_categorical_accuracy(y_true, y_pred, k = 3)
  })

model %>% compile(
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = metric_top_3_categorical_accuracy
)

## End(Not run)
```

model_to_json — *Model configuration as JSON*

Description

Save and re-load models configurations as JSON. Note that the representation does not include the weights, only the architecture.

Usage

```
model_to_json(object)

model_from_json(json, custom_objects = NULL)
```

Arguments

`object`	Model object to save
`json`	JSON with model configuration
`custom_objects`	Optional named list mapping names to custom classes or functions to be considered during deserialization.

See Also

Other model persistence: `get_weights`, `model_to_yaml`, `save_model_hdf5`, `save_model_weights_hdf5`, `serialize_model`

model_to_yaml — *Model configuration as YAML*

Description

Save and re-load models configurations as YAML Note that the representation does not include the weights, only the architecture.

Usage

```
model_to_yaml(object)

model_from_yaml(yaml, custom_objects = NULL)
```

Arguments

`object`	Model object to save
`yaml`	YAML with model configuration
`custom_objects`	Optional named list mapping names to custom classes or functions to be considered during deserialization.

See Also

Other model persistence: get_weights, model_to_json, save_model_hdf5, save_model_weights_hdf5, serialize_model

---

multi_gpu_model *Replicates a model on different GPUs.*

Description

Replicates a model on different GPUs.

Usage

```
multi_gpu_model(model, gpus = NULL, cpu_merge = TRUE,
  cpu_relocation = FALSE)
```

Arguments

model	A Keras model instance. To avoid OOM errors, this model could have been built on CPU, for instance (see usage example below).
gpus	NULL to use all available GPUs (default). Integer >= 2 or list of integers, number of GPUs or list of GPU IDs on which to create model replicas.
cpu_merge	A boolean value to identify whether to force merging model weights under the scope of the CPU or not.
cpu_relocation	A boolean value to identify whether to create the model's weights under the scope of the CPU. If the model is not defined under any preceding device scope, you can still rescue it by activating this option.

Details

Specifically, this function implements single-machine multi-GPU data parallelism. It works in the following way:

- Divide the model's input(s) into multiple sub-batches.
- Apply a model copy on each sub-batch. Every model copy is executed on a dedicated GPU.
- Concatenate the results (on CPU) into one big batch.

E.g. if your `batch_size` is 64 and you use `gpus=2`, then we will divide the input into 2 sub-batches of 32 samples, process each sub-batch on one GPU, then return the full batch of 64 processed samples.

This induces quasi-linear speedup on up to 8 GPUs.

This function is only available with the TensorFlow backend for the time being.

Value

A Keras model object which can be used just like the initial model argument, but which distributes its workload on multiple GPUs.

Model Saving

To save the multi-gpu model, use save_model_hdf5() or save_model_weights_hdf5() with the template model (the argument you passed to multi_gpu_model), rather than the model returned by multi_gpu_model.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, pop_layer, predict.keras.engine.training.Model, predict_generator, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

Examples

```
## Not run:

library(keras)
library(tensorflow)

num_samples <- 1000
height <- 224
width <- 224
num_classes <- 1000

# Instantiate the base model (or "template" model).
# We recommend doing this with under a CPU device scope,
# so that the model's weights are hosted on CPU memory.
# Otherwise they may end up hosted on a GPU, which would
# complicate weight sharing.
with(tf$device("/cpu:0"), {
  model <- application_xception(
    weights = NULL,
    input_shape = c(height, width, 3),
    classes = num_classes
  )
})

# Replicates the model on 8 GPUs.
# This assumes that your machine has 8 available GPUs.
parallel_model <- multi_gpu_model(model, gpus = 8)
parallel_model %>% compile(
  loss = "categorical_crossentropy",
  optimizer = "rmsprop"
)
```

```
# Generate dummy data.
x <- array(runif(num_samples * height * width*3),
           dim = c(num_samples, height, width, 3))
y <- array(runif(num_samples * num_classes),
           dim = c(num_samples, num_classes))

# This `fit` call will be distributed on 8 GPUs.
# Since the batch size is 256, each GPU will process 32 samples.
parallel_model %>% fit(x, y, epochs = 20, batch_size = 256)

# Save model via the template model (which shares the same weights):
model %>% save_model_hdf5("my_model.h5")

## End(Not run)
```

`normalize` *Normalize a matrix or nd-array*

Description

Normalize a matrix or nd-array

Usage

```
normalize(x, axis = -1, order = 2)
```

Arguments

`x`	Matrix or array to normalize
`axis`	Axis along which to normalize. Axis indexes are 1-based (pass -1 to select the last axis).
`order`	Normalization order (e.g. 2 for L2 norm)

Value

A normalized copy of the array.

optimizer_adadelta   *Adadelta optimizer.*

Description

Adadelta optimizer as described in ADADELTA: An Adaptive Learning Rate Method.

Usage

```
optimizer_adadelta(lr = 1, rho = 0.95, epsilon = NULL, decay = 0,
  clipnorm = NULL, clipvalue = NULL)
```

Arguments

lr	float >= 0. Learning rate.
rho	float >= 0. Decay factor.
epsilon	float >= 0. Fuzz factor. If NULL, defaults to k_epsilon().
decay	float >= 0. Learning rate decay over each update.
clipnorm	Gradients will be clipped when their L2 norm exceeds this value.
clipvalue	Gradients will be clipped when their absolute value exceeds this value.

Note

It is recommended to leave the parameters of this optimizer at their default values.

See Also

Other optimizers: optimizer_adagrad, optimizer_adamax, optimizer_adam, optimizer_nadam, optimizer_rmsprop, optimizer_sgd

optimizer_adagrad   *Adagrad optimizer.*

Description

Adagrad optimizer as described in Adaptive Subgradient Methods for Online Learning and Stochastic Optimization.

Usage

```
optimizer_adagrad(lr = 0.01, epsilon = NULL, decay = 0,
  clipnorm = NULL, clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`epsilon`	float >= 0. Fuzz factor. If `NULL`, defaults to `k_epsilon()`.
`decay`	float >= 0. Learning rate decay over each update.
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

Note

It is recommended to leave the parameters of this optimizer at their default values.

See Also

Other optimizers: `optimizer_adadelta`, `optimizer_adamax`, `optimizer_adam`, `optimizer_nadam`, `optimizer_rmsprop`, `optimizer_sgd`

---

optimizer_adam — *Adam optimizer*

Description

Adam optimizer as described in Adam - A Method for Stochastic Optimization.

Usage

```
optimizer_adam(lr = 0.001, beta_1 = 0.9, beta_2 = 0.999,
  epsilon = NULL, decay = 0, amsgrad = FALSE, clipnorm = NULL,
  clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`beta_1`	The exponential decay rate for the 1st moment estimates. float, 0 < beta < 1. Generally close to 1.
`beta_2`	The exponential decay rate for the 2nd moment estimates. float, 0 < beta < 1. Generally close to 1.
`epsilon`	float >= 0. Fuzz factor. If `NULL`, defaults to `k_epsilon()`.
`decay`	float >= 0. Learning rate decay over each update.
`amsgrad`	Whether to apply the AMSGrad variant of this algorithm from the paper "On the Convergence of Adam and Beyond".
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

References

- Adam - A Method for Stochastic Optimization
- On the Convergence of Adam and Beyond

Note

Default parameters follow those provided in the original paper.

See Also

Other optimizers: `optimizer_adadelta`, `optimizer_adagrad`, `optimizer_adamax`, `optimizer_nadam`, `optimizer_rmsprop`, `optimizer_sgd`

`optimizer_adamax` *Adamax optimizer*

Description

Adamax optimizer from Section 7 of the Adam paper. It is a variant of Adam based on the infinity norm.

Usage

```
optimizer_adamax(lr = 0.002, beta_1 = 0.9, beta_2 = 0.999,
  epsilon = NULL, decay = 0, clipnorm = NULL, clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`beta_1`	The exponential decay rate for the 1st moment estimates. float, 0 < beta < 1. Generally close to 1.
`beta_2`	The exponential decay rate for the 2nd moment estimates. float, 0 < beta < 1. Generally close to 1.
`epsilon`	float >= 0. Fuzz factor. If `NULL`, defaults to `k_epsilon()`.
`decay`	float >= 0. Learning rate decay over each update.
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

See Also

Other optimizers: `optimizer_adadelta`, `optimizer_adagrad`, `optimizer_adam`, `optimizer_nadam`, `optimizer_rmsprop`, `optimizer_sgd` `optimizer_nadam` *Nesterov Adam optimizer*

Description

Much like Adam is essentially RMSprop with momentum, Nadam is Adam RMSprop with Nesterov momentum.

Usage

```
optimizer_nadam(lr = 0.002, beta_1 = 0.9, beta_2 = 0.999,
  epsilon = NULL, schedule_decay = 0.004, clipnorm = NULL,
  clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`beta_1`	The exponential decay rate for the 1st moment estimates. float, 0 < beta < 1. Generally close to 1.
`beta_2`	The exponential decay rate for the 2nd moment estimates. float, 0 < beta < 1. Generally close to 1.
`epsilon`	float >= 0. Fuzz factor. If `NULL`, defaults to `k_epsilon()`.
`schedule_decay`	Schedule deacy.
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

Details

Default parameters follow those provided in the paper. It is recommended to leave the parameters of this optimizer at their default values.

See Also

On the importance of initialization and momentum in deep learning.

Other optimizers: `optimizer_adadelta`, `optimizer_adagrad`, `optimizer_adamax`, `optimizer_adam`, `optimizer_rmsprop`, `optimizer_sgd`

optimizer_rmsprop *RMSProp optimizer*

Description

RMSProp optimizer

Usage

```
optimizer_rmsprop(lr = 0.001, rho = 0.9, epsilon = NULL, decay = 0,
  clipnorm = NULL, clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`rho`	float >= 0. Decay factor.
`epsilon`	float >= 0. Fuzz factor. If `NULL`, defaults to `k_epsilon()`.
`decay`	float >= 0. Learning rate decay over each update.
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

Note

It is recommended to leave the parameters of this optimizer at their default values (except the learning rate, which can be freely tuned).

This optimizer is usually a good choice for recurrent neural networks.

See Also

Other optimizers: `optimizer_adadelta`, `optimizer_adagrad`, `optimizer_adamax`, `optimizer_adam`, `optimizer_nadam`, `optimizer_sgd`

optimizer_sgd *Stochastic gradient descent optimizer*

Description

Stochastic gradient descent optimizer with support for momentum, learning rate decay, and Nesterov momentum.

Usage

```
optimizer_sgd(lr = 0.01, momentum = 0, decay = 0, nesterov = FALSE,
  clipnorm = NULL, clipvalue = NULL)
```

Arguments

`lr`	float >= 0. Learning rate.
`momentum`	float >= 0. Parameter that accelerates SGD in the relevant direction and dampens oscillations.
`decay`	float >= 0. Learning rate decay over each update.
`nesterov`	boolean. Whether to apply Nesterov momentum.
`clipnorm`	Gradients will be clipped when their L2 norm exceeds this value.
`clipvalue`	Gradients will be clipped when their absolute value exceeds this value.

Value

Optimizer for use with `compile.keras.engine.training.Model`.

See Also

Other optimizers: `optimizer_adadelta`, `optimizer_adagrad`, `optimizer_adamax`, `optimizer_adam`, `optimizer_nadam`, `optimizer_rmsprop`

`pad_sequences` *Pads sequences to the same length*

Description

Pads sequences to the same length

Usage

```
pad_sequences(sequences, maxlen = NULL, dtype = "int32",
  padding = "pre", truncating = "pre", value = 0)
```

Arguments

`sequences`	List of lists where each element is a sequence
`maxlen`	int, maximum length of all sequences
`dtype`	type of the output sequences
`padding`	'pre' or 'post', pad either before or after each sequence.
`truncating`	'pre' or 'post', remove values from sequences larger than maxlen either in the beginning or in the end of the sequence
`value`	float, padding value

Details

This function transforms a list of `num_samples` sequences (lists of integers) into a matrix of shape `(num_samples, num_timesteps)`. `num_timesteps` is either the `maxlen` argument if provided, or the length of the longest sequence otherwise.

Sequences that are shorter than `num_timesteps` are padded with `value` at the end.

Sequences longer than `num_timesteps` are truncated so that they fit the desired length. The position where padding or truncation happens is determined by the arguments `padding` and `truncating`, respectively.

Pre-padding is the default.

Value

Matrix with dimensions (number_of_sequences, maxlen)

See Also

Other text preprocessing: `make_sampling_table`, `skipgrams`, `text_hashing_trick`, `text_one_hot`, `text_to_word_sequence`

---

plot.keras_training_history

Plot training history

Description

Plots metrics recorded during training.

Usage

```
## S3 method for class 'keras_training_history'
plot(x, y, metrics = NULL,
  method = c("auto", "ggplot2", "base"),
  smooth = getOption("keras.plot.history.smooth", TRUE),
  theme_bw = getOption("keras.plot.history.theme_bw", FALSE), ...)
```

Arguments

`x`	Training history object returned from `fit.keras.engine.training.Model()`.
`y`	Unused.
`metrics`	One or more metrics to plot (e.g. `c('loss', 'accuracy')`). Defaults to plotting all captured metrics.
`method`	Method to use for plotting. The default "auto" will use **ggplot2** if available, and otherwise will use base graphics.

smooth	Whether a loess smooth should be added to the plot, only available for the ggplot2 method. If the number of epochs is smaller than ten, it is forced to false.
theme_bw	Use ggplot2::theme_bw() to plot the history in black and white.
...	Additional parameters to pass to the plot() method.

---

pop_layer *Remove the last layer in a model*

Description

Remove the last layer in a model

Usage

```
pop_layer(object)
```

Arguments

object	Keras model object

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, multi_gpu_model, predict.keras.engine.training.Model, predict_generator, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

---

predict.keras.engine.training.Model *Generate predictions from a Keras model*

Description

Generates output predictions for the input samples, processing the samples in a batched way.

Usage

```
## S3 method for class 'keras.engine.training.Model'
predict(object, x,
  batch_size = NULL, verbose = 0, steps = NULL, ...)
```

Arguments

object	Keras model
x	Input data (vector, matrix, or array)
batch_size	Integer. If unspecified, it will default to 32.
verbose	Verbosity mode, 0 or 1.
steps	Total number of steps (batches of samples) before declaring the evaluation round finished. Ignored with the default value of NULL.
...	Unused

Value

vector, matrix, or array of predictions

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, multi_gpu_model, pop_layer, predict_generator, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

---

predict_generator — *Generates predictions for the input samples from a data generator.*

Description

The generator should return the same kind of data as accepted by predict_on_batch().

Usage

```
predict_generator(object, generator, steps, max_queue_size = 10,
  workers = 1, verbose = 0)
```

Arguments

object	Keras model object
generator	Generator yielding batches of input samples.
steps	Total number of steps (batches of samples) to yield from generator before stopping.
max_queue_size	Maximum size for the generator queue. If unspecified, max_queue_size will default to 10.
workers	Maximum number of threads to use for parallel processing. Note that parallel processing will only be performed for native Keras generators (e.g. flow_images_from_directory()) as R based generators must run on the main thread.
verbose	verbosity mode, 0 or 1.

Value

Numpy array(s) of predictions.

Raises

ValueError: In case the generator yields data in an invalid format.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, multi_gpu_model, pop_layer, predict.keras.engine.training.Model, predict_on_batch, predict_proba, summary.keras.engine.training.Model, train_on_batch

---

predict_on_batch *Returns predictions for a single batch of samples.*

Description

Returns predictions for a single batch of samples.

Usage

```
predict_on_batch(object, x)
```

Arguments

object	Keras model object
x	Input data (vector, matrix, or array)

Value

array of predictions.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, multi_gpu_model, pop_layer, predict.keras.engine.training.Model, predict_generator, predict_proba, summary.keras.engine.training.Model, train_on_batch

predict_proba	*Generates probability or class probability predictions for the input samples.*

Description

Generates probability or class probability predictions for the input samples.

Usage

```
predict_proba(object, x, batch_size = NULL, verbose = 0,
  steps = NULL)

predict_classes(object, x, batch_size = NULL, verbose = 0,
  steps = NULL)
```

Arguments

object	Keras model object
x	Input data (vector, matrix, or array)
batch_size	Integer. If unspecified, it will default to 32.
verbose	Verbosity mode, 0 or 1.
steps	Total number of steps (batches of samples) before declaring the evaluation round finished. The default NULL is equal to the number of samples in your dataset divided by the batch size.

Details

The input samples are processed batch by batch.

See Also

Other model functions: compile.keras.engine.training.Model, evaluate.keras.engine.training.Model, evaluate_generator, fit.keras.engine.training.Model, fit_generator, get_config, get_layer, keras_model_sequential, keras_model, multi_gpu_model, pop_layer, predict.keras.engine.training.Model, predict_generator, predict_on_batch, summary.keras.engine.training.Model, train_on_batch `regularizer_l1` *L1 and L2 regularization*

Description

L1 and L2 regularization

Usage

```
regularizer_l1(l = 0.01)

regularizer_l2(l = 0.01)

regularizer_l1_l2(l1 = 0.01, l2 = 0.01)
```

Arguments

`l`	Regularization factor.
`l1`	L1 regularization factor.
`l2`	L2 regularization factor.

`reset_states` *Reset the states for a layer*

Description

Reset the states for a layer

Usage

```
reset_states(object)
```

Arguments

`object`	Model or layer object

See Also

Other layer methods: `count_params`, `get_config`, `get_input_at`, `get_weights` save_model_hdf5 *Save/Load models using HDF5 files*

Description

Save/Load models using HDF5 files

Usage

```
save_model_hdf5(object, filepath, overwrite = TRUE,
  include_optimizer = TRUE)

load_model_hdf5(filepath, custom_objects = NULL, compile = TRUE)
```

Arguments

`object`	Model object to save
`filepath`	File path
`overwrite`	Overwrite existing file if necessary
`include_optimizer`	If `TRUE`, save optimizer's state.
`custom_objects`	Mapping class names (or function names) of custom (non-Keras) objects to class/functions (for example, custom metrics or custom loss functions).
`compile`	Whether to compile the model after loading.

Details

The following components of the model are saved:

- The model architecture, allowing to re-instantiate the model.
- The model weights.
- The state of the optimizer, allowing to resume training exactly where you left off. This allows you to save the entirety of the state of a model in a single file.

Saved models can be reinstantiated via `load_model_hdf5()`. The model returned by `load_model_hdf5()` is a compiled model ready to be used (unless the saved model was never compiled in the first place or `compile = FALSE` is specified).

As an alternative to providing the `custom_objects` argument, you can execute the definition and persistence of your model using the `with_custom_object_scope()` function.

Note

The `serialize_model()` function enables saving Keras models to R objects that can be persisted across R sessions.

See Also

Other model persistence: get_weights, model_to_json, model_to_yaml, save_model_weights_hdf5, serialize_model

---

save_model_weights_hdf5

Save/Load model weights using HDF5 files

Description

Save/Load model weights using HDF5 files

Usage

```
save_model_weights_hdf5(object, filepath, overwrite = TRUE)

load_model_weights_hdf5(object, filepath, by_name = FALSE,
  skip_mismatch = FALSE, reshape = FALSE)
```

Arguments

`object`	Model object to save/load
`filepath`	Path to the file
`overwrite`	Whether to silently overwrite any existing file at the target location
`by_name`	Whether to load weights by name or by topological order.
`skip_mismatch`	Logical, whether to skip loading of layers where there is a mismatch in the number of weights, or a mismatch in the shape of the weight (only valid when `by_name = FALSE`).
`reshape`	Reshape weights to fit the layer when the correct number of values are present but the shape does not match.

Details

The weight file has:

- `layer_names` (attribute), a list of strings (ordered names of model layers).
- For every layer, a `group` named `layer.name`
- For every such layer group, a group attribute `weight_names`, a list of strings (ordered names of weights tensor of the layer).
- For every weight in the layer, a dataset storing the weight value, named after the weight tensor.

For `load_model_weights()`, if `by_name` is `FALSE` (default) weights are loaded based on the network's topology, meaning the architecture should be the same as when the weights were saved. Note that layers that don't have weights are not taken into account in the topological ordering, so adding or removing layers is fine as long as they don't have weights.

If `by_name` is `TRUE`, weights are loaded into layers only if they share the same name. This is useful for fine-tuning or transfer-learning models where some of the layers have changed.

See Also

Other model persistence: get_weights, model_to_json, model_to_yaml, save_model_hdf5, serialize_model

---

save_text_tokenizer — *Save a text tokenizer to an external file*

Description

Enables persistence of text tokenizers alongside saved models.

Usage

```
save_text_tokenizer(object, filename)

load_text_tokenizer(filename)
```

Arguments

object	Text tokenizer fit with fit_text_tokenizer()
filename	File to save/load

Details

You should always use the same text tokenizer for training and prediction. In many cases however prediction will occur in another session with a version of the model loaded via load_model_hdf5().

In this case you need to save the text tokenizer object after training and then reload it prior to prediction.

See Also

Other text tokenization: fit_text_tokenizer, sequences_to_matrix, text_tokenizer, texts_to_matrix, texts_to_sequences_generator, texts_to_sequences

Examples

```
## Not run:

# vectorize texts then save for use in prediction
tokenizer <- text_tokenizer(num_words = 10000) %>%
fit_text_tokenizer(tokenizer, texts)
save_text_tokenizer(tokenizer, "tokenizer")

# (train model, etc.)

# ...later in another session
tokenizer <- load_text_tokenizer("tokenizer")
```

```
# (use tokenizer to preprocess data for prediction)

## End(Not run)
```

`sequences_to_matrix` *Convert a list of sequences into a matrix.*

Description

Convert a list of sequences into a matrix.

Usage

```
sequences_to_matrix(tokenizer, sequences, mode = c("binary", "count",
  "tfidf", "freq"))
```

Arguments

`tokenizer`	Tokenizer
`sequences`	List of sequences (a sequence is a list of integer word indices).
`mode`	one of "binary", "count", "tfidf", "freq".

Value

A matrix

See Also

Other text tokenization: `fit_text_tokenizer`, `save_text_tokenizer`, `text_tokenizer`, `texts_to_matrix`, `texts_to_sequences_generator`, `texts_to_sequences`

`serialize_model` *Serialize a model to an R object*

Description

Model objects are external references to Keras objects which cannot be saved and restored across R sessions. The `serialize_model()` and `unserialize_model()` functions provide facilities to convert Keras models to R objects for persistence within R data files.

Usage

```
serialize_model(model, include_optimizer = TRUE)

unserialize_model(model, custom_objects = NULL, compile = TRUE)
```

Arguments

- `model` Keras model or R "raw" object containing serialized Keras model.
- `include_optimizer` If `TRUE`, save optimizer's state.
- `custom_objects` Mapping class names (or function names) of custom (non-Keras) objects to class/functions (for example, custom metrics or custom loss functions).
- `compile` Whether to compile the model after loading.

Value

`serialize_model()` returns an R "raw" object containing an hdf5 version of the Keras model. `unserialize_model()` returns a Keras model.

Note

The `save_model_hdf5()` function enables saving Keras models to external hdf5 files.

See Also

Other model persistence: `get_weights`, `model_to_json`, `model_to_yaml`, `save_model_hdf5`, `save_model_weights_hdf5`

---

skipgrams *Generates skipgram word pairs.*

Description

Generates skipgram word pairs.

Usage

```
skipgrams(sequence, vocabulary_size, window_size = 4,
  negative_samples = 1, shuffle = TRUE, categorical = FALSE,
  sampling_table = NULL, seed = NULL)
```

Arguments

- `sequence` A word sequence (sentence), encoded as a list of word indices (integers). If using a `sampling_table`, word indices are expected to match the rank of the words in a reference dataset (e.g. 10 would encode the 10-th most frequently occuring token). Note that index 0 is expected to be a non-word and will be skipped.
- `vocabulary_size` Int, maximum possible word index + 1
- `window_size` Int, size of sampling windows (technically half-window). The window of a word `w_i` will be `[i-window_size, i+window_size+1]`

`negative_samples`
: float >= 0. 0 for no negative (i.e. random) samples. 1 for same number as positive samples.

`shuffle`
: whether to shuffle the word couples before returning them.

`categorical`
: bool. if `FALSE`, labels will be integers (eg. `[0, 1, 1 .. ]`), if `TRUE` labels will be categorical eg. `[[1,0],[0,1],[0,1] .. ]`

`sampling_table`
: 1D array of size `vocabulary_size` where the entry i encodes the probabibily to sample a word of rank i.

`seed`
: Random seed

Details

This function transforms a list of word indexes (lists of integers) into lists of words of the form:

- (word, word in the same window), with label 1 (positive samples).
- (word, random word from the vocabulary), with label 0 (negative samples).

Read more about Skipgram in this gnomic paper by Mikolov et al.: Efficient Estimation of Word Representations in Vector Space

Value

List of `couples`, `labels` where:

- `couples` is a list of 2-element integer vectors: `[word_index, other_word_index]`.
- `labels` is an integer vector of 0 and 1, where 1 indicates that `other_word_index` was found in the same window as `word_index`, and 0 indicates that `other_word_index` was random.
- if `categorical` is set to `TRUE`, the labels are categorical, ie. 1 becomes `[0,1]`, and 0 becomes `[1, 0]`.

See Also

Other text preprocessing: `make_sampling_table`, `pad_sequences`, `text_hashing_trick`, `text_one_hot`, `text_to_word_sequence`

`summary.keras.engine.training.Model` *Print a summary of a Keras model*

Description

Print a summary of a Keras model

Usage

```
## S3 method for class 'keras.engine.training.Model'
summary(object,
  line_length = getOption("width"), positions = NULL, ...)
```

Arguments

`object`	Keras model instance
`line_length`	Total length of printed lines
`positions`	Relative or absolute positions of log elements in each line. If not provided, defaults to `c(0.33, 0.55, 0.67, 1.0)`.
`...`	Unused

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training.Model`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `train_on_batch`

`texts_to_matrix` *Convert a list of texts to a matrix.*

Description

Convert a list of texts to a matrix.

Usage

```
texts_to_matrix(tokenizer, texts, mode = c("binary", "count", "tfidf",
  "freq"))
```

Arguments

`tokenizer`	Tokenizer
`texts`	Vector/list of texts (strings).
`mode`	one of "binary", "count", "tfidf", "freq".

Value

A matrix

See Also

Other text tokenization: `fit_text_tokenizer`, `save_text_tokenizer`, `sequences_to_matrix`, `text_tokenizer`, `texts_to_sequences_generator`, `texts_to_sequences`

texts_to_sequences — *Transform each text in texts in a sequence of integers.*

Description

Only top "num_words" most frequent words will be taken into account. Only words known by the tokenizer will be taken into account.

Usage

```
texts_to_sequences(tokenizer, texts)
```

Arguments

`tokenizer`	Tokenizer
`texts`	Vector/list of texts (strings).

See Also

Other text tokenization: `fit_text_tokenizer`, `save_text_tokenizer`, `sequences_to_matrix`, `text_tokenizer`, `texts_to_matrix`, `texts_to_sequences_generator`

texts_to_sequences_generator — *Transforms each text in texts in a sequence of integers.*

Description

Only top "num_words" most frequent words will be taken into account. Only words known by the tokenizer will be taken into account.

Usage

```
texts_to_sequences_generator(tokenizer, texts)
```

Arguments

`tokenizer`	Tokenizer
`texts`	Vector/list of texts (strings).

Value

Generator which yields individual sequences

See Also

Other text tokenization: `fit_text_tokenizer`, `save_text_tokenizer`, `sequences_to_matrix`, `text_tokenizer`, `texts_to_matrix`, `texts_to_sequences` text_hashing_trick   *Converts a text to a sequence of indexes in a fixed-size hashing space.*

Description

Converts a text to a sequence of indexes in a fixed-size hashing space.

Usage

```
text_hashing_trick(text, n, hash_function = NULL,
  filters = "!\"#$%&()*+,-./:;<=>?@[\\]^_`{|}~\t\n",
  lower = TRUE, split = " ")
```

Arguments

text	Input text (string).
n	Dimension of the hashing space.
hash_function	if NULL uses python hash function, can be 'md5' or any function that takes in input a string and returns a int. Note that hash is not a stable hashing function, so it is not consistent across different runs, while 'md5' is a stable hashing function.
filters	Sequence of characters to filter out such as punctuation. Default includes basic punctuation, tabs, and newlines.
lower	Whether to convert the input to lowercase.
split	Sentence split marker (string).

Details

Two or more words may be assigned to the same index, due to possible collisions by the hashing function.

Value

A list of integer word indices (unicity non-guaranteed).

See Also

Other text preprocessing: make_sampling_table, pad_sequences, skipgrams, text_one_hot, text_to_word_sequence

text_one_hot	*One-hot encode a text into a list of word indexes in a vocabulary of size n.*

Description

One-hot encode a text into a list of word indexes in a vocabulary of size n.

Usage

```
text_one_hot(text, n,
  filters = "!\"#$%&()*+,-./:;<=>?@[\\]^_`{|}~\t\n",
  lower = TRUE, split = " ")
```

Arguments

text	Input text (string).
n	Size of vocabulary (integer)
filters	Sequence of characters to filter out such as punctuation. Default includes basic punctuation, tabs, and newlines.
lower	Whether to convert the input to lowercase.
split	Sentence split marker (string).

Value

List of integers in `[1, n]`. Each integer encodes a word (unicity non-guaranteed).

See Also

Other text preprocessing: make_sampling_table, pad_sequences, skipgrams, text_hashing_trick, text_to_word_sequence

text_tokenizer	*Text tokenization utility*

Description

Vectorize a text corpus, by turning each text into either a sequence of integers (each integer being the index of a token in a dictionary) or into a vector where the coefficient for each token could be binary, based on word count, based on tf-idf...

Usage

```
text_tokenizer(num_words = NULL,
  filters = "!\"#$%&()*+,-./:;<=>?@[\\]^_`{|}~\t\n",
  lower = TRUE, split = " ", char_level = FALSE, oov_token = NULL)
```

Arguments

num_words	the maximum number of words to keep, based on word frequency. Only the most common num_words words will be kept.
filters	a string where each element is a character that will be filtered from the texts. The default is all punctuation, plus tabs and line breaks, minus the ' character.
lower	boolean. Whether to convert the texts to lowercase.
split	character or string to use for token splitting.
char_level	if TRUE, every character will be treated as a token
oov_token	NULL or string If given, it will be added to 'word_index" and used to replace out-of-vocabulary words during text_to_sequence calls.

Details

By default, all punctuation is removed, turning the texts into space-separated sequences of words (words maybe include the ' character). These sequences are then split into lists of tokens. They will then be indexed or vectorized. 0 is a reserved index that won't be assigned to any word.

Attributes

The tokenizer object has the following attributes:

- word_counts — named list mapping words to the number of times they appeared on during fit. Only set after fit_text_tokenizer() is called on the tokenizer.
- word_docs — named list mapping words to the number of documents/texts they appeared on during fit. Only set after fit_text_tokenizer() is called on the tokenizer.
- word_index — named list mapping words to their rank/index (int). Only set after fit_text_tokenizer() is called on the tokenizer.
- document_count — int. Number of documents (texts/sequences) the tokenizer was trained on. Only set after fit_text_tokenizer() is called on the tokenizer.

See Also

Other text tokenization: fit_text_tokenizer, save_text_tokenizer, sequences_to_matrix, texts_to_matrix, texts_to_sequences_generator, texts_to_sequences

---

text_to_word_sequence *Convert text to a sequence of words (or tokens).*

Description

Convert text to a sequence of words (or tokens).

Usage

```
text_to_word_sequence(text,
  filters = "!\"#$%&()*+,-./:;<=>?@[\\]^_`{|}~\t\n",
  lower = TRUE, split = " ")
```

Arguments

text	Input text (string).
filters	Sequence of characters to filter out such as punctuation. Default includes basic punctuation, tabs, and newlines.
lower	Whether to convert the input to lowercase.
split	Sentence split marker (string).

Value

Words (or tokens)

See Also

Other text preprocessing: make_sampling_table, pad_sequences, skipgrams, text_hashing_trick, text_one_hot

---

timeseries_generator   *Utility function for generating batches of temporal data.*

Description

Utility function for generating batches of temporal data.

Usage

```
timeseries_generator(data, targets, length, sampling_rate = 1,
  stride = 1, start_index = 0, end_index = NULL, shuffle = FALSE,
  reverse = FALSE, batch_size = 128)
```

Arguments

data	Object containing consecutive data points (timesteps). The data should be 2D, and axis 1 is expected to be the time dimension.
targets	Targets corresponding to timesteps in `data`. It should have same length as `data`.
length	Length of the output sequences (in number of timesteps).
sampling_rate	Period between successive individual timesteps within sequences. For rate `r`, timesteps `data[i]`, `data[i-r]`, ... `data[i - length]` are used for create a sample sequence.

`stride`	Period between successive output sequences. For stride `s`, consecutive output samples would be centered around `data[i]`, `data[i+s]`, `data[i+2*s]`, etc.
`start_index, end_index`	Data points earlier than `start_index` or later than `end_index` will not be used in the output sequences. This is useful to reserve part of the data for test or validation.
`shuffle`	Whether to shuffle output samples, or instead draw them in chronological order.
`reverse`	Boolean: if `true`, timesteps in each output sample will be in reverse chronological order.
`batch_size`	Number of timeseries samples in each batch (except maybe the last one).

Value

An object that can be passed to generator based training functions (e.g. `fit_generator()`).ma

---

`time_distributed` *Apply a layer to every temporal slice of an input.*

Description

The input should be at least 3D, and the dimension of index one will be considered to be the temporal dimension.

Usage

```
time_distributed(object, layer, input_shape = NULL,
  batch_input_shape = NULL, batch_size = NULL, dtype = NULL,
  name = NULL, trainable = NULL, weights = NULL)
```

Arguments

`object`	Model or layer object
`layer`	A layer instance.
`input_shape`	Dimensionality of the input (integer) not including the samples axis. This argument is required when using this layer as the first layer in a model.
`batch_input_shape`	Shapes, including the batch size. For instance, `batch_input_shape=c(10, 32)` indicates that the expected input will be batches of 10 32-dimensional vectors. `batch_input_shape=list(NULL, 32)` indicates batches of an arbitrary number of 32-dimensional vectors.
`batch_size`	Fixed batch size for layer
`dtype`	The data type expected by the input, as a string (`float32`, `float64`, `int32`...)
`name`	An optional name string for the layer. Should be unique in a model (do not reuse the same name twice). It will be autogenerated if it isn't provided.
`trainable`	Whether the layer weights will be updated during training.
`weights`	Initial weights for layer.

Details

Consider a batch of 32 samples, where each sample is a sequence of 10 vectors of 16 dimensions. The batch input shape of the layer is then `(32, 10, 16)`, and the `input_shape`, not including the samples dimension, is `(10, 16)`. You can then use `time_distributed` to apply a `layer_dense` to each of the 10 timesteps, independently.

See Also

Other layer wrappers: `bidirectional`

`to_categorical` *Converts a class vector (integers) to binary class matrix.*

Description

Converts a class vector (integers) to binary class matrix.

Usage

```
to_categorical(y, num_classes = NULL, dtype = "float32")
```

Arguments

`y`	Class vector to be converted into a matrix (integers from 0 to num_classes).
`num_classes`	Total number of classes.
`dtype`	The data type expected by the input, as a string

Details

E.g. for use with `loss_categorical_crossentropy()`.

Value

A binary matrix representation of the input.

`train_on_batch` *Single gradient update or model evaluation over one batch of samples.*

Description

Single gradient update or model evaluation over one batch of samples.

Usage

```
train_on_batch(object, x, y, class_weight = NULL, sample_weight = NULL)

test_on_batch(object, x, y, sample_weight = NULL)
```

Arguments

object	Keras model object
x	input data, as an array or list of arrays (if the model has multiple inputs).
y	labels, as an array.
class_weight	named list mapping classes to a weight value, used for scaling the loss function (during training only).
sample_weight	sample weights, as an array.

Value

Scalar training or test loss (if the model has no metrics) or list of scalars (if the model computes other metrics). The property `model$metrics_names` will give you the display labels for the scalar outputs.

See Also

Other model functions: `compile.keras.engine.training.Model`, `evaluate.keras.engine.training.Model`, `evaluate_generator`, `fit.keras.engine.training.Model`, `fit_generator`, `get_config`, `get_layer`, `keras_model_sequential`, `keras_model`, `multi_gpu_model`, `pop_layer`, `predict.keras.engine.training.Model`, `predict_generator`, `predict_on_batch`, `predict_proba`, `summary.keras.engine.training.Model`

`use_implementation` *Select a Keras implementation and backend*

Description

Select a Keras implementation and backend

Usage

```
use_implementation(implementation = c("keras", "tensorflow"))

use_backend(backend = c("tensorflow", "cntk", "theano", "plaidml"))
```

Arguments

implementation	One of "keras" or "tensorflow" (defaults to "keras").
backend	One of "tensorflow", "cntk", or "theano" (defaults to "tensorflow")

Details

Keras has multiple implementations (the original keras implementation and the implementation native to TensorFlow) and supports multiple backends ("tensorflow", "cntk", "theano", and "plaidml"). These functions allow switching between the various implementations and backends.

The functions should be called after `library(keras)` and before calling other functions within the package (see below for an example).

The default implementation and backend should be suitable for most use cases. The "tensorflow" implementation is useful when using Keras in conjunction with TensorFlow Estimators (the **tfestimators** R package).

Examples

```
## Not run:
# use the tensorflow implementation
library(keras)
use_implementation("tensorflow")

# use the cntk backend
library(keras)
use_backend("theano")

## End(Not run)
```

`with_custom_object_scope` *Provide a scope with mappings of names to custom objects*

Description

Provide a scope with mappings of names to custom objects

Usage

```
with_custom_object_scope(objects, expr)
```

Arguments

`objects`	Named list of objects
`expr`	Expression to evaluate

Details

There are many elements of Keras models that can be customized with user objects (e.g. losses, metrics, regularizers, etc.). When loading saved models that use these functions you typically need to explicitily map names to user objects via the `custom_objects` parmaeter.

The `with_custom_object_scope()` function provides an alternative that lets you create a named alias for a user object that applies to an entire block of code, and is automatically recognized when loading saved models.

Examples

```
## Not run:
# define custom metric
metric_top_3_categorical_accuracy <-
  custom_metric("top_3_categorical_accuracy", function(y_true, y_pred) {
    metric_top_k_categorical_accuracy(y_true, y_pred, k = 3)
  })

with_custom_object_scope(c(top_k_acc = sparse_top_k_cat_acc), {

  # ...define model...

  # compile model (refer to "top_k_acc" by name)
  model %>% compile(
    loss = "binary_crossentropy",
    optimizer = optimizer_nadam(),
    metrics = c("top_k_acc")
  )

  # save the model
  save_model_hdf5("my_model.h5")

  # loading the model within the custom object scope doesn't
  # require explicitly providing the custom_object
  load_model_hdf5("my_model.h5")
})

## End(Not run)
```

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