Title Supervised Data Transformation by Means of Neural Network Hidden Layer

Version 0.1.4

Description A supervised transformation of datasets is performed. The aim is similar to that of Principal Component Analysis (PCA), that is, to carry out data transformation and dimensionality reduction, but in a supervised way. This is achieved by first training a 3-layer Multi-Layer Perceptron and then using the activations of the hidden layer as a transformation of the input features. In fact, it takes advantage of the change of representation provided by the hidden layer of a neural network. This can be useful as data pre-processing for Machine Learning methods in general, specially for those that do not work well with many irrelevant or redundant features. It uses the nnet package under the hood.


Depends R (>= 3.2.4),
Imports nnet, NeuralNetTools, FNN, pracma
Suggests dplyr, knitr, rmarkdown, ggplot2, ggridges, tidyr, forcats, mlr, mlrCPO
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doughnut  Doughnut shaped dataset

Description

Doughnut-shaped two-class 2-dimensional classification problem. V1 and V2 are the input features, normalized to 0-1. V3 is the output (TRUE / FALSE).

Usage

  data(doughnut)

Format

An object of class data.frame with 10000 rows and 3 columns.

Examples

  data(doughnut)
  plot(doughnut$V1, doughnut$V2, col=doughnut$V3)
**doughnutRand**

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**doughnutRand**  
*Doughnut shaped dataset with 8 extra random attributes*

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**Description**

V1 to V8 are the extra random features (in the range 0-1) V9 and V10 are the original input features, normalized to 0-1 V11 is the output (TRUE / FALSE)

**Usage**

```r
data(doughnutRand)
```

**Format**

An object of class `data.frame` with 10000 rows and 11 columns.

**Examples**

```r
data(doughnutRand)
plot(doughnutRand$V9, doughnutRand$V10, col=doughnutRand$V11)
```

---

**doughnutRandRotated**  
*Doughnut shaped dataset with 8 extra random attributes and rotated*

---

**Description**

doughnutRandRotated randomly rotated

**Usage**

```r
data(doughnutRandRotated)
```

**Format**

An object of class `data.frame` with 10000 rows and 11 columns.
nntrf: a supervised transformation function based on neural networks
(Neural Net based Transformations)

Description

This function transforms a dataset into the activations of the neurons of the hidden layer of a neural network. This is done by training a neural network and then computing the activations of the neural network for each input pattern. It uses the nnet package under the hood.

Usage

nntrf(keep_nn = TRUE, repetitions = 1, random_seed = NULL, ...)

Arguments

- **keep_nn** (default TRUE) Keep NN model. In most cases, the actual NN and associated results obtained by nnet is not required.
- **repetitions** (default 1) Repeat nnet several times with different random seeds and select the best run using nnet’s minimum value. This is useful because some random initialization of weights may lead to local minima.
- **random_seed** (default NULL)
- **...** See nnet params. Most important:
  - **formula**
  - **data**: dataframe with data. The last column must be the dependent variable. The dependent variable must be a factor for classification problems and numeric for regression problems. The input/independent variables must contain numeric values only.
  - **size**: number of units in the hidden layer.
  - **maxit**: the number of iterations of the net.

Value

list of:

- **trf**: a function that transforms the input dataset using the weights of the hidden layer. This function has three arguments:
  - **x**: the input numeric **matrix** or **data.frame** to be transformed. Only numeric values.
  - **use_sigmoid** (default TRUE): Whether the sigmoid function should be used for the transformation. nnet uses the sigmoid in the hidden layer, but in some cases better results could be obtained with use_sigmoid=FALSE.
  - **norm** (default FALSE): If TRUE, this function’s output is normalized (scaled) to range 0-1.
- **mod**: values returned by nnet (this includes the neural network trained by nnet). If keep_nn=FALSE, then NULL is returned here.
- **matrix1**: weights of hidden layer
- **matrix2**: weights of output layer
See Also

nnet

Examples

data("doughnutRandRotated")
rd <- doughnutRandRotated

# Make sure it is a classification problem
rd[,ncol(rd)] <- as.factor(rd[,ncol(rd)])
n <- nrow(rd)

# Split data into training and test
set.seed(0)
training_index <- sample(1:n, round(0.6*n))
train <- rd[training_index,]
test <- rd[-training_index,]
x_train <- train[,ncol(train)]
y_train <- train[,ncol(train)]
x_test <- test[,ncol(test)]
y_test <- test[,ncol(test)]

# Train nntrf transformation
set.seed(0)
nmono <- nntrf(formula=V11~.,
data=train,
size=4, maxit=50, trace=TRUE)

# Apply nntrf transformation to the train and test splits
trf_x_train <- nmono$trf(x=x_train, use_sigmoid=FALSE)
trf_x_test <- nmono$trf(x=x_test, use_sigmoid=FALSE)

# Compute the success rate of KNN on the transformed feature space
outputs <- FNN::knn(trf_x_train, trf_x_test, y_train)
success <- mean(outputs == y_test)
print(success)

nntrf_doughnut

Description

This function compares KNN with data untransformed vs. data transformed with nntrf. In order to see what it does, check the code: nntrf::nntrf_doughnut

Usage

nntrf_doughnut(verbose = TRUE)
Arguments

verbose (default TRUE) Print results to the console.

Value

list of:

- Accuracies of KNN on the Doughnut Dataset: with no nntrf, with nntrf and no sigmoid, and with nntrf and no sigmoid and 5 repetitions
- Accuracies of KNN on the DoughnutRand Dataset: with no nntrf, with nntrf and no sigmoid, and with nntrf and no sigmoid and 5 repetitions
- Accuracies of KNN on the DoughnutRandRotated Dataset: with no nntrf, with nntrf and no sigmoid, and with nntrf and no sigmoid and 5 repetitions

Description

This function compares KNN with data untransformed vs. data transformed with nntrf. In order to see what it does, check the code: nntrf::nntrf_iris

Usage

nntrf_iris(Verbose = TRUE)

Arguments

verbose (default TRUE) Print results to the console.

Value

Accuracies of KNN on the Iris Dataset: with no nntrf, and with nntrf and no sigmoid
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