Package ‘SSLR’

Type Package

Title Semi-Supervised Classification, Regression and Clustering Methods

Version 0.9.3.3

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URL https://dicits.ugr.es/software/SSLR/

Description Providing a collection of techniques for semi-supervised classification, regression and clustering. In semi-supervised problem, both labeled and unlabeled data are used to train a classifier. The package includes a collection of semi-supervised learning techniques: self-training, co-training, democratic, decision tree, random forest, 'S3VM' ... etc, with a fairly intuitive interface that is easy to use.

License GPL-3

ByteCompile true

Depends R (>= 2.10)

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Imports stats, parsnip, plyr, dplyr (>= 0.8.0.1), magrittr, purrr, rlang (>= 0.3.1), proxy, methods, generics, utils, RANN, foreach, RSSL, conclust

LinkingTo Rcpp, RcppArmadillo

Suggests caret, tidymodels, e1071, C50, kernlab, testthat, doParallel, tidyverse, factoextra, survival, covr, kknn, randomForest, ranger, MASS, nlme, knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation yes

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Repository CRAN

Date/Publication 2021-07-22 08:10:07 UTC

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Description

Abalone

Usage

data(abalone)

Format

Predict the age of abalone from physical measurements

Source

https://archive.ics.uci.edu/ml/datasets/Abalone
Description
An S4 method to best split

Usage

best_split(object, ...)

Arguments

object: DecisionTree object
... This parameter is included for compatibility reasons.

Description
Function to get best split in Decision Tree. Find the best split for node. "Beast" means that the mean of impurity is the least possible. To find the best division. Let’s iterate through all the features. All threshold / feature pairs will be computed in the numerical features. In the features that are not numerical, We get the best group of possible values will be obtained based on an algorithm with the function get_levels_categoric

Usage

## S4 method for signature 'DecisionTreeClassifier'
best_split(object, X, y, parms)

Arguments

object: DecisionTree object
X: is data
y: is class values
parms: parms in function

Value
A list with: best_idx name of the feature with the best split or Null if it not be found best_thr: threshold found in the best split, or Null if it not be found
**calculate_gini**

---

<table>
<thead>
<tr>
<th>breast</th>
<th>Breast</th>
</tr>
</thead>
</table>

**Description**

Breast

**Usage**

data(breast)

**Format**

- Diagnostic Wisconsin Breast Cancer Database

**Source**

https://archive.ics.uci.edu/ml/datasets/Breast+Cancer+Wisconsin+(Diagnostic)

---

**Function calculate gini**

**Description**

Function to calculate gini index. Formula is: $1 - \sum_{\text{num_classes}} \text{probabilitie_class}^2$

**Usage**

calculate_gini(column_factor)

**Arguments**

column_factor class values
**Description**

Model from conclust
This function takes an unlabeled dataset and two lists of must-link and cannot-link constraints as input and produce a clustering as output.

**Usage**

```r
cclsSSLR(
  n_clusters = NULL,
  mustLink = NULL,
  cantLink = NULL,
  max_iter = 1,
  tabuIter = 100,
  tabuLength = 20
)
```

**Arguments**

- `n_clusters`: A number of clusters to be considered. Default is NULL (num classes)
- `mustLink`: A list of must-link constraints. NULL Default, constrints same label
- `cantLink`: A list of cannot-link constraints. NULL Default, constrints with different label
- `max_iter`: maximum iterations in KMeans. Default is 1
- `tabuIter`: Number of iteration in Tabu search
- `tabuLength`: The number of elements in the Tabu list

**Note**

This models only returns labels, not centers

**References**

Tran Khanh Hiep, Nguyen Minh Duc, Bui Quoc Trung
*Pairwise Constrained Clustering by Local Search*
2016

**Examples**

```r
library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)
```
data <- iris

set.seed(1)

# LABELED
cls <- which(colnames(iris) == "Species")

labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
data[-labeled.index,cls] <- NA

m <- cclsSSLR(max_iter = 1) %>% fit(Species ~ ., data)

#Get labels (assigning clusters), type = "raw" return factor
labels <- m %>% cluster_labels()
print(labels)

---

check_value  

**Check value in leaf**

---

**Description**

Function to check value in leaf from numeric until character

**Usage**

check_value(value, threshold)

**Arguments**

- **value** is the value in leaf node
- **threshold** in leaf node

**Value**

TRUE if <= in numeric or %in% in factor
check_xy_interface  

Description
Check interface

Usage
check_xy_interface(x, y)

Arguments
- x: data without class labels
- y: values class

ckmeansSSLR  

General Interface COP K-Means Algorithm

Description
Model from conclust
This function takes an unlabeled dataset and two lists of must-link and cannot-link constraints as input and produce a clustering as output.

Usage
ckmeansSSLR(n_clusters = NULL, mustLink = NULL, cantLink = NULL, max_iter = 10)

Arguments
- n_clusters: A number of clusters to be considered. Default is NULL (num classes)
- mustLink: A list of must-link constraints. NULL Default, constrints same label
- cantLink: A list of cannot-link constraints. NULL Default, constrints with different label
- max_iter: maximum iterations in KMeans. Default is 10

Note
This models only returns labels, not centers

References
Wagstaff, Cardie, Rogers, Schrodl
Constrained K-means Clustering with Background Knowledge
2001
Examples

```r
library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data <- iris

set.seed(1)
# LABELED
cls <- which(colnames(iris) == "Species")

labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
data[-labeled.index, cls] <- NA

m <- ckmeansSSLR() %>% fit(Species ~ ., data)

#Get labels (assigning clusters), type = "raw" return factor
labels <- m %>% cluster_labels()

print(labels)
```

code

class_labels

Get labels of clusters

Description

Cluster labels

Usage

`cluster_labels(object, ...)`

Arguments

- `object` object
- `...` other parameters to be passed
cluster_labels.model_sslr_fitted

Cluster labels

Description

Get labels of clusters raw returns factor or numeric values

Usage

```r
## S3 method for class 'model_sslr_fitted'
cluster_labels(object, type = "class", ...)
```

Arguments

- `object`: model_sslr_fitted model built
- `type`: of predict in principal model: class, raw
- `...`: other parameters to be passed

coBC

General Interface for CoBC model

Description

Co-Training by Committee (CoBC) is a semi-supervised learning algorithm with a co-training style. This algorithm trains \( N \) classifiers with the learning scheme defined in the `learner` argument using a reduced set of labeled examples. For each iteration, an unlabeled example is labeled for a classifier if the most confident classifications assigned by the other \( N-1 \) classifiers agree on the labeling proposed. The unlabeled examples candidates are selected randomly from a pool of size \( u \). The final prediction is the average of the estimates of the \( N \) regressors.

Usage

```r
cobC(learner, N = 3, perc.full = 0.7, u = 100, max.iter = 50)
```

Arguments

- `learner`: model from parsnip package for training a supervised base classifier using a set of instances. This model need to have probability predictions in classification mode
- `N`: The number of classifiers used as committee members. All these classifiers are trained using the `gen.learner` function. Default is 3.
- `perc.full`: A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-labeling process is stopped. Default is 0.7.
- `u`: Number of unlabeled instances in the pool. Default is 100.
- `max.iter`: Maximum number of iterations to execute in the self-labeling process. Default is 50.
Details

For regression tasks, labeling data is very expensive computationally. Its so slow. This method trains an ensemble of diverse classifiers. To promote the initial diversity the classifiers are trained from the reduced set of labeled examples by Bagging. The stopping criterion is defined through the fulfillment of one of the following criteria: the algorithm reaches the number of iterations defined in the \texttt{max.iter} parameter or the portion of unlabeled set, defined in the \texttt{perc.full} parameter, is moved to the enlarged labeled set of the classifiers.

Value

(When model fit) A list object of class "coBC" containing:

- **model** The final \(N\) base classifiers trained using the enlarged labeled set.
- **model.index** List of \(N\) vectors of indexes related to the training instances used per each classifier. These indexes are relative to the \(y\) argument.
- **instances.index** The indexes of all training instances used to train the \(N\) models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the \(y\) argument.
- **model.index.map** List of three vectors with the same information in \texttt{model.index} but the indexes are relative to \texttt{instances.index} vector.
- **classes** The levels of \(y\) factor in classification.
- **pred** The function provided in the \texttt{pred} argument.
- **pred.pars** The list provided in the \texttt{pred.pars} argument.

References

Avrim Blum and Tom Mitchell.
Combining labeled and unlabeled data with \textit{co-training}.

Mohamed Farouk Abdel-Hady, Mohamed Farouk Abdel-Hady and Günther Palm.
\textit{Semi-supervised Learning for Regression with Cotraining by Committee}
Institute of Neural Information Processing University of Ulm D-89069 Ulm, Germany

Examples

```r
library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)
data(wine)
set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]
```
cls <- which(colnames(wine) == "Wine")

# LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

# We need a model with probability predictions from parsnip
# https://tidymodels.github.io/parsnip/articles/articles/Models.html
# It should be with mode = classification

# For example, with Random Forest
rf <- rand_forest(trees = 100, mode = "classification") %>%
  set_engine("randomForest")

m <- coBC(learner = rf, N = 3,
  perc.full = 0.7,
  u = 100,
  max.iter = 3) %>% fit(Wine ~ ., data = train)

# Accuracy
predict(m, test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

---

**coBCCombine**  
*Combining the hypothesis*

**Description**

This function combines the probabilities predicted by the committee of classifiers.

**Usage**

```r
coBCCombine(h.prob, classes)
```

**Arguments**

- `h.prob`: A list of probability matrices.
- `classes`: The classes in the same order that appear in the columns of each matrix in `h.prob`.

**Value**

A probability matrix
coBCG

**CoBC generic method**

**Description**

CoBC is a semi-supervised learning algorithm with a co-training style. This algorithm trains \( N \) classifiers with the learning scheme defined in `gen.learner` using a reduced set of labeled examples. For each iteration, an unlabeled example is labeled for a classifier if the most confident classifications assigned by the other \( N-1 \) classifiers agree on the labeling proposed. The unlabeled examples candidates are selected randomly from a pool of size \( u \).

**Usage**

```r
coBCG(y, gen.learner, gen.pred, N = 3, perc.full = 0.7, u = 100, max.iter = 50)
```

**Arguments**

- `y`: A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value `NA`.
- `gen.learner`: A function for training \( N \) supervised base classifiers. This function needs two parameters, `indexes` and `cls`, where `indexes` indicates the instances to use and `cls` specifies the classes of those instances.
- `gen.pred`: A function for predicting the probabilities per classes. This function must be two parameters, `model` and `indexes`, where the `model` is a classifier trained with `gen.learner` function and `indexes` indicates the instances to predict.
- `N`: The number of classifiers used as committee members. All these classifiers are trained using the `gen.learner` function. Default is 3.
- `perc.full`: A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-labeling process is stopped. Default is 0.7.
- `u`: Number of unlabeled instances in the pool. Default is 100.
- `max.iter`: Maximum number of iterations to execute in the self-labeling process. Default is 50.

**Details**

`coBCG` can be helpful in those cases where the method selected as base classifier needs a `learner` and `pred` functions with other specifications. For more information about the general coBC method, please see `coBC` function. Essentially, `coBC` function is a wrapper of `coBCG` function.

**Value**

A list object of class "coBCG" containing:

- `model`: The final \( N \) base classifiers trained using the enlarged labeled set.
- `model.index`: List of \( N \) vectors of indexes related to the training instances used per each classifier. These indexes are relative to the `y` argument.
**instances.index** The indexes of all training instances used to train the N models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the y argument.

**model.index.map** List of three vectors with the same information in model.index but the indexes are relative to instances.index vector.

**classes** The levels of y factor.

### Examples

```r
library(SSLR)
library(caret)

## Load Wine data set
data(wine)

cls <- which(colnames(wine) == "Wine")
x <- wine[, - cls] # instances without classes
y <- wine[, cls] # the classes
x <- scale(x) # scale the attributes

## Prepare data
set.seed(20)
# Use 50% of instances for training
tra.idx <- sample(x = length(y), size = ceiling(length(y) * 0.5))
xtrain <- x[tra.idx,] # training instances
ytrain <- y[tra.idx] # classes of training instances
# Use 70% of train instances as unlabeled set
tra.na.idx <- sample(x = length(tra.idx), size = ceiling(length(tra.idx) * 0.7))
ytrain[tra.na.idx] <- NA # remove class information of unlabeled instances

# Use the other 50% of instances for inductive testing
tst.idx <- setdiff(1:length(y), tra.idx)
xitest <- x[tst.idx,] # testing instances
yitest <- y[tst.idx] # classes of testing instances

## Example: Training from a set of instances with 1-NN (knn3) as base classifier.
gen.learner1 <- function(indexes, cls)
  caret::knn3(x = xtrain[indexes,], y = cls, k = 1)
gen.pred1 <- function(model, indexes)
  predict(model, xtrain[indexes,])
set.seed(1)

trControl_coBCG <- list(gen.learner = gen.learner1, gen.pred = gen.pred1)
md1 <- train_generic(ytrain, method = "coBCG", trControl = trControl_coBCG)

# Predict probabilities per instances using each model
h.prob <- lapply(
  X = md1$model,
  FUN = function(m) predict(m, xitest)
)

# Combine the predictions
```
```r
cls1 <- coBCCombine(h.prob, md1$classes)
table(cls1, yitest)

confusionMatrix(cls1, yitest)$overall[1]

## Example: Training from a distance matrix with 1-NN (oneNN) as base classifier.
dtrain <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
gen.learner2 <- function(indexes, cls) {
m <- SSLR::oneNN(y = cls)
attr(m, "tra.idxs") <- indexes
m
}
gen.pred2 <- function(model, indexes) {
  tra.idxs <- attr(model, "tra.idxs")
  d <- dtrain[indexes, tra.idxs]
  prob <- predict(model, d, distance.weighting = "none")
  prob
}
set.seed(1)
trControl_coBCG2 <- list(gen.learner = gen.learner2, gen.pred = gen.pred2)
md2 <- train_generic(ytrain, method = "coBCG", trControl = trControl_coBCG2)

# Predict probabilities per instances using each model
ditest <- proxy::dist(x = xitest, y = xtrain[md2$instances.index,],
                      method = "euclidean", by_rows = TRUE)

h.prob <- list()
ninstances <- nrow(dtrain)
for (i in 1:length(md2$model)) {
  m <- md2$model[[i]]
  D <- ditest[, md2$model.index.map[[i]]]
  h.prob[[i]] <- predict(m, D)
}

# Combine the predictions
cls2 <- coBCCombine(h.prob, md2$classes)
table(cls2, yitest)
confusionMatrix(cls2, yitest)$overall[1]
```

---

**General Interface coBCReg model**
coBCRegG

Description

coBCReg is based on an ensemble of N diverse regressors. At each iteration and for each regressor, the companion committee labels the unlabeled examples then the regressor select the most informative newly-labeled examples for itself, where the selection confidence is based on estimating the validation error. The final prediction is the average of the estimates of the N regressors.

Usage

coBCReg(learner, N = 3, perc.full = 0.7, u = 100, max.iter = 50)

Arguments

- **learner**: model from parsnip package for training a supervised base classifier using a set of instances. This model need to have probability predictions.
- **N**: The number of classifiers used as committee members. All these classifiers are trained using the \texttt{gen.learner} function. Default is 3.
- **perc.full**: A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-labeling process is stopped. Default is 0.7.
- **u**: Number of unlabeled instances in the pool. Default is 100.
- **max.iter**: Maximum number of iterations to execute in the self-labeling process. Default is 50.

Details

For regression tasks, labeling data is very expensive computationally. Its so slow.

References

Mohamed Farouk Abdel-Hady, Mohamed Farouk Abdel-Hady and Günther Palm.
\textit{Semi-supervised Learning for Regression with Cotraining by Committee}
Institute of Neural Information Processing University of Ulm D-89069 Ulm, Germany
Usage

coBCRegG(
  y,
  gen.learner,
  gen.pred,
  N = 3,
  perc.full = 0.7,
  u = 100,
  max.iter = 50,
  gr = 1
)

Arguments

y A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value `NA`.

gen.learner A function for training $N$ supervised base classifiers. This function needs two parameters, indexes and cls, where indexes indicates the instances to use and cls specifies the classes of those instances.

gen.pred A function for predicting the probabilities per classes. This function must be two parameters, model and indexes, where the model is a classifier trained with gen.learner function and indexes indicates the instances to predict.

N The number of classifiers used as committee members. All these classifiers are trained using the gen.learner function. Default is 3.

perc.full A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-labeling process is stopped. Default is 0.7.

u Number of unlabeled instances in the pool. Default is 100.

max.iter Maximum number of iterations to execute in the self-labeling process. Default is 50.

gr growing rate

Details

For regression tasks, labeling data is very expensive computationally. Its so slow.

References

Mohamed Farouk Abdel-Hady, Mohamed Farouk Abdel-Hady and Günther Palm.
Semi-supervised Learning for Regression with Cotraining by Committee
Institute of Neural Information Processing University of Ulm D-89069 Ulm, Germany
coffee

---

coffee  Time series data set

**Description**

A dataset containing 56 times series z-normalized. Time series length is 286.

**Usage**

data(coffee)

**Format**

A data frame with 56 rows and 287 variables including the class.

**Source**


---

correlated_kmeans  General Interface Constrained KMeans

**Description**

The initialization is the same as seeded kmeans, the difference is that in the following steps the allocation of the clusters in the labelled data does not change.

**Usage**

constrained_kmeans(max_iter = 10, method = "euclidean")

**Arguments**

- **max_iter**: maximum iterations in KMeans. Default is 10
- **method**: distance method in KMeans: "euclidean", "maximum", "manhattan", "canberra", "binary" or "minkowski"

**References**

Sugato Basu, Arindam Banerjee, Raymond Mooney
Semi-supervised clustering by seeding
July 2002 In Proceedings of 19th International Conference on Machine Learning
Examples

library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data <- iris

set.seed(1)
#% LABELED
cls <- which(colnames(iris) == "Species")

labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
data[-labeled.index,cls] <- NA

m <- constrained_kmeans() %>% fit(Species ~ ., data)

#Get labels (assign clusters), type = "raw" return factor
labels <- m %>% cluster_labels()
print(labels)

#Get centers
centers <- m %>% get_centers()
print(centers)

---

COREG General Interface for COREG model

Description

COREG is a semi-supervised learning for regression with a co-training style. This technique uses two kNN regressors with different distance metrics. For each iteration, each regressor labels the unlabeled example which can be most confidently labeled for the other learner, where the labeling confidence is estimated through considering the consistency of the regressor with the labeled example set. The final prediction is made by averaging the predictions of both the refined kNN regressors.

Usage

COREG(max.iter = 50, k1 = 3, k2 = 5, p1 = 3, p2 = 5, u = 100)
Arguments

max.iter  maximum number of iterations to execute the self-labeling process. Default is 50.
k1  parameter in first KNN
k2  parameter in second KNN
p1  distance order 1. Default is 3
p2  distance order 1. Default is 5
u  Number of unlabeled instances in the pool. Default is 100.

Details

labeling data is very expensive computationally. Its so slow. For executing this model, we need RANN installed.

References

Zhi-Hua Zhou and Ming Li.
Semi-Supervised Regression with Co-Training.
National Laboratory for Novel Software Technology Nanjing University, Nanjing 210093, China

Examples

library(SSLR)

m <- COREG(max.iter = 1)

---

**DecisionTreeClassifier-class**

*Class DecisionTreeClassifier*

**Description**

Class DecisionTreeClassifier Slots: max_depth, n_classes_, n_features_, tree_, classes, min_samples_split, min_samples_leaf
Description

Democratic Co-Learning is a semi-supervised learning algorithm with a co-training style. This algorithm trains N classifiers with different learning schemes defined in list `gen.learners`. During the iterative process, the multiple classifiers with different inductive biases label data for each other.

Usage

democratic(learners, schemes = NULL)

Arguments

- **learners**: List of models from parsnip package for training a supervised base classifier using a set of instances. This model need to have probability predictions.
- **schemes**: List of schemes (col x names in each learner). Default is null, it means that learner uses all x columns.

Details

This method trains an ensemble of diverse classifiers. To promote the initial diversity the classifiers must represent different learning schemes. When `x.inst` is FALSE all `learners` defined must be able to learn a classifier from the precomputed matrix in `x`. The iteration process of the algorithm ends when no changes occurs in any model during a complete iteration. The generation of the final hypothesis is produced via a weighted majority voting.

Value

(When model fit) A list object of class "democratic" containing:

- **W**: A vector with the confidence-weighted vote assigned to each classifier.
- **model**: A list with the final N base classifiers trained using the enlarged labeled set.
- **model.index**: List of N vectors of indexes related to the training instances used per each classifier. These indexes are relative to the y argument.
- **instances.index**: The indexes of all training instances used to train the N models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the y argument.
- **model.index.map**: List of three vectors with the same information in `model.index` but the indexes are relative to `instances.index` vector.
- **classes**: The levels of y factor.
- **preds**: The functions provided in the preds argument.
- **preds.pars**: The set of lists provided in the preds.pars argument.
- **x.inst**: The value provided in the x.inst argument.
Examples

```r
library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(wine)

set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

#% LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

#We need a model with probability predictions from parsnip
#https://tidymodels.github.io/parsnip/articles/articles/Models.html
#It should be with mode = classification

rf <- rand_forest(trees = 100, mode = "classification") %>%
  set_engine("randomForest")

bt <- boost_tree(trees = 100, mode = "classification") %>%
  set_engine("C5.0")

m <- democratic(learners = list(rf,bt)) %>% fit(Wine ~ ., data = train)

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

#With schemes
set.seed(1)
m <- democratic(learners = list(rf,bt),
  schemes = list(c("Malic.Acid","Ash"), c("Magnesium","Proline"))) %>%
  fit(Wine ~ ., data = train)

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)
```
democraticCombine

Combining the hypothesis of the classifiers

Description

This function combines the probabilities predicted by the set of classifiers.

Usage

democraticCombine(pred, W, classes)

Arguments

pred
A list with the prediction for each classifier.

W
A vector with the confidence-weighted vote assigned to each classifier during the training process.

classes
the classes.

Value

The classification proposed.

democraticG

Democratic generic method

Description

Democratic is a semi-supervised learning algorithm with a co-training style. This algorithm trains N classifiers with different learning schemes defined in list gen.learners. During the iterative process, the multiple classifiers with different inductive biases label data for each other.

Usage

democraticG(y, gen.learners, gen.preds)
**democraticG**

**Arguments**

- `y`  
  A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value `NA`.

- `gen.learners`  
  A list of functions for training N different supervised base classifiers. Each function needs two parameters, indexes and cls, where indexes indicates the instances to use and cls specifies the classes of those instances.

- `gen.preds`  
  A list of functions for predicting the probabilities per classes. Each function must be two parameters, model and indexes, where the model is a classifier trained with `gen.learner` function and indexes indicates the instances to predict.

**Details**

democraticG can be helpful in those cases where the method selected as base classifier needs a learner and pred functions with other specifications. For more information about the general democratic method, please see `democratic` function. Essentially, democratic function is a wrapper of democraticG function.

**Value**

A list object of class "democraticG" containing:

- `W`  
  A vector with the confidence-weighted vote assigned to each classifier.

- `model`  
  A list with the final N base classifiers trained using the enlarged labeled set.

- `model.index`  
  List of N vectors of indexes related to the training instances used per each classifier.
  These indexes are relative to the `y` argument.

- `instances.index`  
  The indexes of all training instances used to train the N models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the `y` argument.

- `model.index.map`  
  List of three vectors with the same information in `model.index` but the indexes are relative to `instances.index` vector.

- `classes`  
  The levels of `y` factor.

**References**

Yan Zhou and Sally Goldman.  
*Democratic co-learning.*  
In IEEE 16th International Conference on Tools with Artificial Intelligence (ICTAI), pages 594-602.  
EMLeastSquaresClassifierSSLR

General Interface for EMLeastSquaresClassifier model

Description

model from RSSL package
An Expectation Maximization like approach to Semi-Supervised Least Squares Classification
As studied in Krijthe & Loog (2016), minimizes the total loss of the labeled and unlabeled objects
by finding the weight vector and labels that minimize the total loss. The algorithm proceeds similar
to EM, by subsequently applying a weight update and a soft labeling of the unlabeled objects. This
is repeated until convergence.
By default (method="block") the weights of the classifier are updated, after which the unknown la-
bels are updated. method="simple" uses LBFGS to do this update simultaneously. Objective="responsibility"
corresponds to the responsibility based, instead of the label based, objective function in Krijthe &
Loog (2016), which is equivalent to hard-label self-learning.

Usage

EMLeastSquaresClassifierSSLR(
  x_center = FALSE,
  scale = FALSE,
  verbose = FALSE,
  intercept = TRUE,
  lambda = 0,
  eps = 1e-09,
  y_scale = FALSE,
  alpha = 1,
  beta = 1,
  init = "supervised",
  method = "block",
  objective = "label",
  save_all = FALSE,
  max_iter = 1000
)

Arguments

x_center logical; Should the features be centered?
scale Should the features be normalized? (default: FALSE)
verbose logical; Controls the verbosity of the output
intercept logical; Whether an intercept should be included
lambda numeric; L2 regularization parameter
eps Stopping criterion for the minimization
EMLeastSquaresClassifierSSLR

y_scale logical; whether the target vector should be centered

alpha numeric; the mixture of the new responsibilities and the old in each iteration of the algorithm (default: 1)

beta numeric; value between 0 and 1 that determines how much to move to the new solution from the old solution at each step of the block gradient descent

init objective character; "random" for random initialization of labels, "supervised" to use supervised solution as initialization or a numeric vector with a coefficient vector to use to calculate the initialization

method character; one of "block", for block gradient descent or "simple" for LBFGS optimization (default="block")

objective character; "responsibility" for hard label self-learning or "label" for soft-label self-learning

save_all logical; saves all classifiers trained during block gradient descent

max_iter integer; maximum number of iterations

References


Examples

library(tidyverse)
#' \donttest{
library(tidymodels)
library(caret)
library(SSLR)
data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,

#% LABELED
test <- breast[-train.index,

cls <- which(colnames(breast) == "Class")

#% Labeled
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- EMLeastSquaresClassifierSSLR() %>% fit(Class ~ ., data = train)

# Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Class", estimate = .pred_class)
EMNearestMeanClassifierSSLR

General Interface for EMNearestMeanClassifier model

Description

model from RSSL package Semi-Supervised Nearest Mean Classifier using Expectation Maximization

Expectation Maximization applied to the nearest mean classifier assuming Gaussian classes with a spherical covariance matrix.

Starting from the supervised solution, uses the Expectation Maximization algorithm (see Dempster et al. (1977)) to iteratively update the means and shared covariance of the classes (Maximization step) and updates the responsibilities for the unlabeled objects (Expectation step).

Usage

EMNearestMeanClassifierSSLR(method = "EM", scale = FALSE, eps = 1e-04)

Arguments

method character; Currently only "EM"

scale Should the features be normalized? (default: FALSE)

eps Stopping criterion for the maximinimization

References


Examples

library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,]
test <- breast[-train.index,]
```r
cls <- which(colnames(breast) == "Class")

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- EMNearestMeanClassifierSSLR() %>% fit(Class ~ ., data = train)

#Accessing model from RSSL
model <- m$model

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Class", estimate = .pred_class)
```

---

**EntropyRegularizedLogisticRegressionSSLR**

*General Interface for EntropyRegularizedLogisticRegression model*

**Description**

Model from RSSL package R Implementation of entropy regularized logistic regression implementation as proposed by Grandvalet & Bengio (2005). An extra term is added to the objective function of logistic regression that penalizes the entropy of the posterior measured on the unlabeled examples.

**Usage**

```r
EntropyRegularizedLogisticRegressionSSLR(
  lambda = 0,
  lambda_entropy = 1,
  intercept = TRUE,
  init = NA,
  scale = FALSE,
  x_center = FALSE
)
```

**Arguments**

- `lambda` : I2 Regularization
- `lambda_entropy` : Weight of the labeled observations compared to the unlabeled observations
- `intercept` : logical; Whether an intercept should be included
- `init` : Initial parameters for the gradient descent
- `scale` : logical; Should the features be normalized? (default: FALSE)
- `x_center` : logical; Should the features be centered?
References


Examples

```r
library(tidyverse)
library(caret)
library(tidymodels)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,]

set.seed(1)
training.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
training <- breast[-training.index,]

cls <- which(colnames(breast) == "Class")

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
training[, cls] <- NA

m <- EntropyRegularizedLogisticRegressionSSLR() %>% fit(Class ~ ., data = training)

predict(m, test) %>%
  bind_cols(test) %>%
  metrics(truth = "Class", estimate = .pred_class)
```

---

fit.model_sslr

**Fit with formula and data**

Description

Function to fit through the formula

Usage

```r
## S3 method for class 'model_sslr'
fit(object, formula = NULL, data = NULL, ...)
```
Arguments

object is the model
formula is the formula
data is the total data train
... unused in this case

Description

An S4 method to fit decision tree.

Usage

fit_decision_tree(object, ...)

Arguments

object DecisionTree object
... This parameter is included for compatibility reasons.

Description

method in class DecisionTreeClassifier used to build a Decision Tree

Usage

## S4 method for signature 'DecisionTreeClassifier'
fit_decision_tree(  
  object,  
  X,  
  y,  
  min_samples_split = 20,  
  min_samples_leaf = ceiling(min_samples_split/3),  
  w = 0.5  
)
Arguments

object  A DecisionTreeClassifier object
X  A object that can be coerced as data.frame. Training instances
y  A vector with the labels of the training instances. In this vector the unlabeled instances are specified with the value NA.
min_samples_split  the minimum number of observations to do split
min_samples_leaf  the minimum number of any terminal leaf node
w  weight parameter ranging from 0 to 1

Description

method in class RandomForestSemisupervised used to build a Decision Tree

Usage

## S4 method for signature 'RandomForestSemisupervised'
fitted_random_forest(
  object,
  X,
  y,
  mtry = 2,
  trees = 500,
  min_n = 2,
  w = 0.5,
  replace = TRUE,
  tree_max_depth = Inf,
  sampsize = if (replace) nrow(X) else ceiling(0.632 * nrow(X)),
  min_samples_leaf = if (!is.null(y) && !is.factor(y)) 5 else 1,
  allowParallel = TRUE
)

Arguments

object  A RandomForestSemisupervised object
X  A object that can be coerced as data.frame. Training instances
y  A vector with the labels of the training instances. In this vector the unlabeled instances are specified with the value NA.
mtry  number of features in each decision tree
trees number of trees. Default is 5
min_n number of minimum samples in each tree
w weight parameter ranging from 0 to 1
replace replacing type in sampling
tree_max_depth maximum tree depth. Default is Inf
sampsize Size of sample. Default if (replace) nrow(x) else ceiling(.632*nrow(x))
min_samples_leaf the minimum number of any terminal leaf node
allowParallel Execute Random Forest in parallel if doParallel is loaded. Default is TRUE

Value

list of decision trees

**Description**

Function to fit with \( x \) and \( y \)

**Usage**

```r
## S3 method for class 'model_sslr'
fit_xy(object, x = NULL, y = NULL, ...)
```

**Arguments**

- `object` is the model
- `x` is a data frame or matrix with train dataset without objective feature. \( X \) have labeled and unlabeled data
- `y` is objective feature with labeled values and NA values in unlabeled data
- `...` unused in this case
**Description**

fit_x_u

**Usage**

```
fit_x_u(object, ...)  
```

**Arguments**

- `object` : object
- `...` : other parameters to be passed

---

**Description**

Fit with x, y (labeled data) and unlabeled data (x_U)

**Usage**

```
## S3 method for class 'model_sslr'
fit_x_u.model_sslr(object, x = NULL, y = NULL, x_U = NULL, ...)  
```

**Arguments**

- `object` : is the model
- `x` : is a data frame or matrix with train dataset without objective feature. X only have labeled data
- `y` : is objective feature with labeled values
- `x_U` : train unlabeled data without objective feature
- `...` : This parameter is included for compatibility reasons.
get_centers

Get centers model of clustering

Description
Centers clustering

Usage
get_centers(object, ...)

Arguments
object: object
...: other parameters to be passed

get_centers.model_sslr_fitted

Cluster labels

Description
Get labels of clusters raw returns factor or numeric values

Usage
## S3 method for class 'model_sslr_fitted'
get_centers(object, ...)

Arguments
object: model_sslr_fitted model built
...: other parameters to be passed
**get_class_max_prob**  
*Get most frequented*

**Description**

Get value most frequented in vector Used in predictions. It calls a predict with type = "prob" in Decision Tree

**Usage**

```r
get_class_max_prob(trees, input)
```

**Arguments**

- **trees**: trees list
- **input**: is input to be predicted

---

**get_class_mean_prob**  
*Get mean probability over all trees as prob vector*

**Description**

Get mean probability over all trees as prob vector. It calls a predict with type = "prob" in Decision Tree

**Usage**

```r
get_class_mean_prob(trees, input)
```

**Arguments**

- **trees**: trees list
- **input**: is input to be predicted
get_function  FUNCTION TO GET FUNCTION METHOD

Description
FUNCTION TO GET FUNCTION METHOD SPECIFIC

Usage
get_function(met)

Arguments
met character

Value
method_train (function)

get_function_generic  FUNCTION TO GET FUNCTION METHOD

Description
FUNCTION TO GET FUNCTION METHOD GENERIC

Usage
get_function_generic(met)

Arguments
met character

Value
method_train (function)
**get_levels_categorical**  
*Function to get group from gini index*

**Description**  
Function to get group from gini index. Used in categorical variable. From: [https://freakonometrics.hypotheses.org/20736](https://freakonometrics.hypotheses.org/20736)

**Usage**  
```r
get_levels_categorical(column, Y)
```

**Arguments**
- `column` is the column
- `Y` values

**get_most_frequented**  
*Get most frequented*

**Description**  
Get value most frequented in vector. Used in predictions.

**Usage**  
```r
get_most_frequented(elements)
```

**Arguments**
- `elements` vector with values

**get_value_mean**  
*Get value mean*

**Description**  
Get value most frequented in vector. Used in predictions. It calls a predict with type = "numeric" in Decision Tree.

**Usage**  
```r
get_value_mean(trees, input)
```

**Arguments**
- `trees` trees list
- `input` is input to be predicted
**get_x_y**

*FUNCTION TO GET REAL X AND Y WITH FORMULA AND DATA*

**Description**

FUNCTION TO GET REAL X AND Y WITH FORMULA AND DATA

**Usage**

get_x_y(form, data)

**Arguments**

- **form**
  - formula
- **data**
  - data values, matrix, dataframe..

**Value**

x (matrix, dataframe...) and y(factor)

---

**gini_or_variance**

*Gini or Variance by column*

**Description**

function used to calculate the gini coefficient or variance according to the type of the column. This function is called for the creation of the decision tree

**Usage**

gini_or_variance(X)

**Arguments**

- **X**
  - column to calculate variance or gini
**gini_prob**  
*Function to compute Gini index*

**Description**

Function to compute Gini index From: https://freakonometrics.hypotheses.org/20736

**Usage**

```r
gini_prob(y, classe)
```

**Arguments**

- `y`: values
- `classe`: classes

---

**GRFClassifierSSLR**  
*General Interface for GRFClassifier (Label propagation using Gaussian Random Fields and Harmonic) model*

**Description**

Model from RSSL package Implements the approach proposed in Zhu et al. (2003) to label propagation over an affinity graph. Note, as in the original paper, we consider the transductive scenario, so the implementation does not generalize to out of sample predictions. The approach minimizes the squared difference in labels assigned to different objects, where the contribution of each difference to the loss is weighted by the affinity between the objects. The default in this implementation is to use a knn adjacency matrix based on euclidean distance to determine this weight. Setting `adjacency="heat"` will use an RBF kernel over euclidean distances between objects to determine the weights.

**Usage**

```r
GRFClassifierSSLR(
  adjacency = "nn",
  adjacency_distance = "euclidean",
  adjacency_k = 6,
  adjacency_sigma = 0.1,
  class_mass_normalization = TRUE,
  scale = FALSE,
  x_center = FALSE
)
```
**Arguments**

- **adjacency** character; "nn" for nearest neighbour graph or "heat" for radial basis adjacency matrix
- **adjacency_distance** character; distance metric for nearest neighbour adjacency matrix
- **adjacency_k** integer; number of neighbours for the nearest neighbour adjacency matrix
- **adjacency_sigma** double; width of the rbf adjacency matrix
- **class_mass_normalization** logical; Should the Class Mass Normalization heuristic be applied? (default: TRUE)
- **scale** logical; Should the features be normalized? (default: FALSE)
- **x_center** logical; Should the features be centered?

**References**


**Examples**

```r
library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data(wine)

cls <- which(colnames(wine) == "Wine")

# LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
wine[-labeled.index,cls] <- NA

m <- GRFClassifierSSLR() %>% fit(Wine ~ ., data = wine)

#Accessing model from RSSL
model <- m$model

#Predictions of unlabeled
preds_unlabeled <- m %>% predictions()
print(preds_unlabeled)

preds_unlabeled <- m %>% predictions(type = "raw")
print(preds_unlabeled)
```
#Total
y_total <- wine[,cls]
y_total[-labeled.index] <- preds_unlabeled

---

grow_tree  

An S4 method to grow tree.

---

Description

An S4 method to grow tree.

Usage

```r
grow_tree(object, ...)
```

Arguments

- **object**: DecisionTree object
- **...**: This parameter is included for compatibility reasons.

---

grow_tree,DecisionTreeClassifier-method  

Function grow tree

---

Description

Function to grow tree in Decision Tree

Usage

```r
## S4 method for signature 'DecisionTreeClassifier'
grow_tree(object, X, y, parms, depth = 0)
```

Arguments

- **object**: DecisionTree instance
- **X**: data values
- **y**: classes
- **parms**: parameters for grow tree
- **depth**: depth in tree
**knn_regression**

**Description**
create model knn

**Usage**
knn_regression(k, x, y, p)

**Arguments**
- **k**: parameter in KNN model
- **x**: data
- **y**: vector labeled data
- **p**: distance order

---

**LaplacianSVMSSLR**

**General Interface for LaplacianSVM model**

**Description**
model from RSSL package Manifold regularization applied to the support vector machine as proposed in Belkin et al. (2006). As an adjacency matrix, we use the k nearest neighbour graph based on a chosen distance (default: euclidean).

**Usage**
LaplacianSVMSSLR(
  lambda = 1,
  gamma = 1,
  scale = TRUE,
  kernel = kernlab::vanilladot(),
  adjacency_distance = "euclidean",
  adjacency_k = 6,
  normalized_laplacian = FALSE,
  eps = 1e-09
)
Arguments

- **lambda** numeric; L2 regularization parameter
- **gamma** numeric; Weight of the unlabeled data
- **scale** logical; Should the features be normalized? (default: FALSE)
- **kernel** kernlab::kernel to use
- **adjacency_distance** character; distance metric used to construct adjacency graph from the dist function. Default: "euclidean"
- **adjacency_k** integer; Number of neighbours used to construct adjacency graph.
- **normalized_laplacian** logical; If TRUE use the normalized Laplacian, otherwise, the Laplacian is used
- **eps** numeric; Small value to ensure positive definiteness of the matrix in the QP formulation

References


Examples

```r
library(tidyverse)
library(caret)
library(tidymodels)
library(SSLR)
data(breast)
set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

library(kernlab)
m <- LaplacianSVMSSLR(kernel=kernlab::vanilladot()) %>%
  fit(Class ~ ., data = train)

#Accessing model from RSSL
model <- m$model

#Accuracy
```
<script>
  predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Class", estimate = .pred_class)
</script>

---

**lcvqeSSLR**  

**General LCVQE Algorithm**

**Description**

Model from conclust  
This function takes an unlabeled dataset and two lists of must-link and cannot-link constraints as input and produce a clustering as output.

**Usage**

```
lcvqeSSLR(n_clusters = NULL, mustLink = NULL, cantLink = NULL, max_iter = 2)
```

**Arguments**

- `n_clusters`  
  A number of clusters to be considered. Default is NULL (num classes)

- `mustLink`  
  A list of must-link constraints. NULL Default, constrints same label

- `cantLink`  
  A list of cannot-link constraints. NULL Default, constrints with different label

- `max_iter`  
  maximum iterations in KMeans. Default is 2

**Note**

This models only returns labels, not centers

**References**

Dan Pelleg, Dorit Baras  
*K-means with large and noisy constraint sets*  
2007

**Examples**

```
library(tidyverse)  
library(caret)  
library(SSLR)  
library(tidymodels)  

data <- iris  
set.seed(1)  
#% LABLED  
cls <- which(colnames(iris) == "Species")  

labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
```
data[-labeled.index,cls] <- NA

m <- lcvqeSSLR(max_iter = 1) %>% fit(Species ~ ., data)

#Get labels (assigning clusters), type = "raw" return factor
labels <- m %>% cluster_labels()

print(labels)

---

**LinearTSVMSSLR**  
*General Interface for LinearTSVM model*

**Description**

model from RSSL package  
Implementation of the Linear Support Vector Classifier. Can be solved in the Dual formulation, which is equivalent to SVM or the Primal formulation.

**Usage**

```r
LinearTSVMSSLR(
  C = 1,
  Cstar = 0.1,
  s = 0,
  x_center = FALSE,
  scale = FALSE,
  eps = 1e-06,
  verbose = FALSE,
  init = NULL
)
```

**Arguments**

- **C**  
  Cost variable

- **Cstar**  
  numeric; Cost parameter of the unlabeled objects

- **s**  
  numeric; parameter controlling the loss function of the unlabeled objects

- **x_center**  
  logical; Should the features be centered?

- **scale**  
  Whether a z-transform should be applied (default: TRUE)

- **eps**  
  Small value to ensure positive definiteness of the matrix in QP formulation

- **verbose**  
  logical; Controls the verbosity of the output

- **init**  
  numeric; Initial classifier parameters to start the convex concave procedure
load_conclust

Examples

```r
library(tidyverse)
library(caret)
library(tidymodels)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,]
test <- breast[-train.index,]

cls <- which(colnames(breast) == "Class")

# % LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- LinearTSVMSSLR() %>% fit(Class ~ ., data = train)

# Accessing model from RSSL
model <- m$model
```

load_conclust

Description

function to load conclust package

Usage

```r
load_conclust()
```

load_parsnip

Description

function to load parsnip package

Usage

```r
load_parsnip()
```
load_RANN  

**Load parsnip**

**Description**
function to load parsnip package

**Usage**
load_RANN()

load_RSSL  

**Load RSSL**

**Description**
function to load RSSL package

**Usage**
load_RSSL()

---

**MCNearestMeanClassifierSSLR**

*General Interface for MCNearestMeanClassifier (Moment Constrained Semi-supervised Nearest Mean Classifier) model*

**Description**
model from RSSL package Update the means based on the moment constraints as defined in Loog (2010). The means estimated using the labeled data are updated by making sure their weighted mean corresponds to the overall mean on all (labeled and unlabeled) data. Optionally, the estimated variance of the classes can be re-estimated after this update is applied by setting update_sigma to TRUE. To get the true nearest mean classifier, rather than estimate the class priors, set them to equal priors using, for instance prior=matrix(0.5,2).

**Usage**
MCNearestMeanClassifierSSLR(
    update_sigma = FALSE,
    prior = NULL,
    x_center = FALSE,
    scale = FALSE
)


Arguments

- `update_sigma`: logical; Whether the estimate of the variance should be updated after the means have been updated using the unlabeled data
- `prior`: matrix; Class priors for the classes
- `x_center`: logical; Should the features be centered?
- `scale`: logical; Should the features be normalized? (default: FALSE)

References


Examples

```r
library(tidyverse)
library(caret)
library(tidymodels)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[ train.index,]
test <- breast[-train.index,]

cls <- which(colnames(breast) == "Class")

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- MCNearestMeanClassifierSSLR() %>% fit(Class ~ ., data = train)

#Accesing model from RSSL
model <- m$model

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Class", estimate = .pred_class)
```

mpckmSSLR

**General Interface MPC K-Means Algorithm**
Description

Model from conclust
This function takes an unlabeled dataset and two lists of must-link and cannot-link constraints as input and produce a clustering as output.

Usage

mpckmSSLR(n_clusters = NULL, mustLink = NULL, cantLink = NULL, max_iter = 10)

Arguments

n_clusters A number of clusters to be considered. Default is NULL (num classes)
mustLink A list of must-link constraints. NULL Default, constraints same label
cantLink A list of cannot-link constraints. NULL Default, constraints with different label
max_iter maximum iterations in KMeans. Default is 10

Note
This models only returns labels, not centers

References

Bilenko, Basu, Mooney
Integrating Constraints and Metric Learning in Semi-Supervised Clustering
2004

Examples

library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data <- iris

set.seed(1)
#% LABELED
cls <- which(colnames(iris) == "Species")

labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
data[-labeled.index,cls] <- NA

m <- mpckmSSLR() %>% fit(Species ~ ., data)

#Get labels (assigning clusters), type = "raw" return factor
labels <- m %>% cluster_labels()

print(labels)
newDecisionTree  

**Function to create Decision Tree**

**Description**

Function to create DecisionTree

**Usage**

newDecisionTree(max_depth)

**Arguments**

max_depth  

max depth in tree

---

**Node-class**  

**Class Node for Decision Tree**

**Description**

Class Node for Decision Tree Slots: gini, num_samples, num_samples_per_class, predicted_class_value, feature_index threshold, left, right, probabilities

---

**nullOrNumericOrCharacter-class**  

An S4 class to represent a class with more types values: null, numeric or character

**Description**

An S4 class to represent a class with more types values: null, numeric or character
52

oneNN  
*1-NN supervised classifier builder*

**Description**

Build a model using the given data to be able to predict the label or the probabilities of other instances, according to 1-NN algorithm.

**Usage**

```
oneNN(x = NULL, y)
```

**Arguments**

- **x**: This argument is not used, the reason why he gets is to fulfill an agreement
- **y**: a vector with the labels of training instances

**Value**

A model with the data needed to use 1-NN

---

**predict,DecisionTreeClassifier-method**

*Function to predict inputs in Decision Tree*

**Description**

Function to predict inputs in Decision Tree

**Usage**

```r
## S4 method for signature 'DecisionTreeClassifier'
predict(object, inputs, type = "class")
```

**Arguments**

- **object**: The Decision Tree object
- **inputs**: data to be predicted
- **type**: Is param to define the type of predict. It can be "class", to get class labels Or "prob" to get probabilities for class in each input. Default is "class"
**predict.RandomForestSemisupervised-method**

*Function to predict inputs in Decision Tree*

---

### Description

Function to predict inputs in Decision Tree

### Usage

```r
## S4 method for signature 'RandomForestSemisupervised'
predict(  
  object,  
  inputs,  
  type = "class",  
  confident = "max_prob",  
  allowParallel = TRUE  
)
```

### Arguments

- **object**: The Decision Tree object
- **inputs**: data to be predicted
- **type**: class raw
- **confident**: Is param to define the type of predict. It can be "max_prob", to get class with sum of probability is the maximum Or "vote" to get the most frequented class in all trees. Default is "max_prob"
- **allowParallel**: Execute Random Forest in parallel if doParallel is loaded.

---

**predict.coBC**

*Predictions of the coBC method*

---

### Description

Predicts the label of instances according to the coBC model.

### Usage

```r
## S3 method for class 'coBC'
predict(object, x, ...)  
```
predict.COREG

Arguments

object  coBC model built with the coBC function.

x  An object that can be coerced to a matrix. Depending on how the model was built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.

...  This parameter is included for compatibility reasons.

Details

For additional help see coBC examples.

Value

Vector with the labels assigned.

Predictions of the COREG method

predict.COREG

Description

Predicts the label of instances according to the COREG model.

Usage

## S3 method for class 'COREG'
predict(object, x, type = "numeric", ...)

Arguments

object  Self-training model built with the COREG function.

x  A object that is data

type  of predict in principal model (numeric)

...  This parameter is included for compatibility reasons.

Details

For additional help see COREG examples.

Value

Vector with the labels assigned (numeric).
**predict.democratic**  
*Predictions of the Democratic method*

**Description**
Predicts the label of instances according to the democratic model.

**Usage**
```r
## S3 method for class 'democratic'
predict(object, x, ...)
```

**Arguments**
- `object`: Democratic model built with the `democratic` function.
- `x`: A object that can be coerced as matrix. Depending on how was the model built, 
  `x` is interpreted as a matrix with the distances between the unseen instances and 
  the selected training instances, or a matrix of instances.
- `...`: This parameter is included for compatibility reasons.

**Details**
For additional help see `democratic` examples.

**Value**
Vector with the labels assigned.

---

**predict.EMLeastSquaresClassifierSSLR**  
*Predict EMLeastSquaresClassifierSSLR*

**Description**
Predict `EMLeastSquaresClassifierSSLR`

**Usage**
```r
## S3 method for class 'EMLeastSquaresClassifierSSLR'
predict(object, x, ...)
```

**Arguments**
- `object`: is the object
- `x`: is the dataset
- `...`: This parameter is included for compatibility reasons.
predict.EMNearestMeanClassifierSSLR

*Predict EMNearestMeanClassifierSSLR*

**Description**

Predict EMNearestMeanClassifierSSLR

**Usage**

```r
## S3 method for class 'EMNearestMeanClassifierSSLR'
predict(object, x, ...)
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.

predict.EntropyRegularizedLogisticRegressionSSLR

*Predict EntropyRegularizedLogisticRegressionSSLR*

**Description**

Predict EntropyRegularizedLogisticRegressionSSLR

**Usage**

```r
## S3 method for class 'EntropyRegularizedLogisticRegressionSSLR'
predict(object, x, ...)
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.
predict.LaplacianSVMSSLR

*Predict LaplacianSVMSSLR*

---

**Description**

Predict LaplacianSVMSSLR

**Usage**

```r
## S3 method for class 'LaplacianSVMSSLR'
predict(object, x, ...)
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.

---

predict.LinearTSVMSSLR

*Predict LinearTSVMSSLR*

---

**Description**

Predict LinearTSVMSSLR

**Usage**

```r
## S3 method for class 'LinearTSVMSSLR'
predict(object, x, ...)
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.
predict.MCNearestMeanClassifierSSLR

*Predict* MCNearestMeanClassifierSSLR

**Description**

Predict MCNearestMeanClassifierSSLR

**Usage**

```r
## S3 method for class 'MCNearestMeanClassifierSSLR'
predict(object, x, ...) 
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.

predict.model_sslr_fitted

*Predictions of model_sslr_fitted class*

**Description**

Predicts from model. There are different types: class, prob, raw class returns tibble with one column
prob returns tibble with probabilities class columns raw returns factor or numeric values

**Usage**

```r
## S3 method for class 'model_sslr_fitted'
predict(object, x, type = NULL, ...) 
```

**Arguments**

- `object` model_sslr_fitted model built.
- `x` A object that can be coerced as matrix. Depending on how was the model built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- `type` of predict in principal model: class, raw, prob, vote, max_prob, numeric
- `...` This parameter is included for compatibility reasons.

**Value**
tibble or vector.
**predict.OneNN**

Model Predictions

**Description**

This function predicts the class label of instances or its probability of pertaining to each class based on the distance matrix.

**Usage**

```r
## S3 method for class 'OneNN'
predict(object, dists, type = "prob", ...)
```

**Arguments**

- `object`: A model of class OneNN built with `oneNN`
- `dists`: A matrix of distances between the instances to classify (by rows) and the instances used to train the model (by column)
- `type`: A string that can take two values: "class" for computing the class of the instances or "prob" for computing the probabilities of belonging to each class.
- `...`: Currently not used.

**Value**

If `type` is equal to "class" a vector of length equal to the rows number of matrix `dists`, containing the predicted labels. If `type` is equal to "prob" it returns a matrix which has `nrow(dists)` rows and a column for every class, where each cell represents the probability that the instance belongs to the class, according to 1NN.

**predict.RandomForestSemisupervised_fitted**

Predictions of the `SSLRDecisionTree_fitted` method

**Description**

Predicts the label of instances according to the RandomForestSemisupervised_fitted model.

**Usage**

```r
## S3 method for class 'RandomForestSemisupervised_fitted'
predict(object, x, type = "class", confident = "max_prob", ...)
```
Arguments

- **object**: RandomForestSemisupervised_fitted.
- **x**: A object that can be coerced as matrix. Depending on how was the model built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- **type**: of predict in principal model
- **confident**: Is param to define the type of predict. It can be "max_prob", to get class with sum of probability is the maximum Or "vote" to get the most frequented class in all trees. Default is "max_prob"
- **...**: This parameter is included for compatibility reasons.

Value

Vector with the labels assigned.

---

**predict.selfTraining**  
*Predictions of the Self-training method*

Description

Predicts the label of instances according to the selfTraining model.

Usage

```r
## S3 method for class 'selfTraining'
predict(object, x, type = "class", ...)
```

Arguments

- **object**: Self-training model built with the `selfTraining` function.
- **x**: A object that can be coerced as matrix. Depending on how was the model built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- **type**: of predict in principal model
- **...**: This parameter is included for compatibility reasons.

Details

For additional help see `selfTraining` examples.

Value

Vector with the labels assigned.
**predict.setred**

Predictions of the SETRED method

**Description**

Predicts the label of instances according to the setred model.

**Usage**

```r
## S3 method for class 'setred'
predict(object, x, col_name = ".pred_class", ...)
```

**Arguments**

- `object`: SETRED model built with the `setred` function.
- `x`: A object that can be coerced as matrix. Depending on how was the model built, `x` is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- `col_name`: is the colname from returned tibble in class type. The same from parsnip and tidymodels Default is `.pred_class`
- `...`: This parameter is included for compatibility reasons.

**Details**

For additional help see `setred` examples.

**Value**

Vector with the labels assigned.

---

**predict.snnrce**

Predictions of the SNNRCE method

**Description**

Predicts the label of instances according to the snnrce model.

**Usage**

```r
## S3 method for class 'snnrce'
predict(object, x, ...)
```
## predict.snnrceG

Predictions of the SNNRCE method

### Description

Predicts the label of instances according to the `snnrceG` model.

### Usage

```r
## S3 method for class 'snnrceG'
predict(object, D, ...)
```

### Arguments

- `object`: model instance
- `D`: distance matrix
- `...`: This parameter is included for compatibility reasons.

### Details

For additional help see `snnrce` examples.

### Value

Vector with the labels assigned.
**predict.SSLRDecisionTree_fitted**  
*Predictions of the SSLRDecisionTree_fitted method*

**Description**

Predicts the label of instances SSLRDecisionTree_fitted model.

**Usage**

```r
## S3 method for class 'SSLRDecisionTree_fitted'
predict(object, x, type = "class", ...)
```

**Arguments**

- **object**: model SSLRDecisionTree_fitted.
- **x**: A object that can be coerced as matrix. Depending on how was the model built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- **type**: of predict in principal model
- **...**: This parameter is included for compatibility reasons.

**Value**

Vector with the labels assigned.

---

**predict.triTraining**  
*Predictions of the Tri-training method*

**Description**

Predicts the label of instances according to the triTraining model.

**Usage**

```r
## S3 method for class 'triTraining'
predict(object, x, ...)
```

**Arguments**

- **object**: Tri-training model built with the triTraining function.
- **x**: A object that can be coerced as matrix. Depending on how was the model built, x is interpreted as a matrix with the distances between the unseen instances and the selected training instances, or a matrix of instances.
- **...**: This parameter is included for compatibility reasons.
Details

For additional help see triTraining examples.

Value

Vector with the labels assigned.

details.predict.USMLeastSquaresClassifierSSLR

Usage

## S3 method for class 'USMLeastSquaresClassifierSSLR'
predict(object, x, ...)

Arguments

object is the object
x is the dataset
... This parameter is included for compatibility reasons.

description.predict.USMLeastSquaresClassifierSSLR

Usage

## S3 method for class 'USMLeastSquaresClassifierSSLR'
predict(object, x, ...)

Arguments

object is the object
x is the dataset
... This parameter is included for compatibility reasons.
predict.WellSVMSSLR

**Description**

Predict WellSVMSSLR

**Usage**

```r
## S3 method for class 'WellSVMSSLR'
predict(object, x, ...)
```

**Arguments**

- `object` is the object
- `x` is the dataset
- `...` This parameter is included for compatibility reasons.

**predictions**

`predictions(object, ...)`

**Arguments**

- `object` object
- `...` other parameters to be passed
Predictions of unlabeled data

Description
Predictions

Usage
## S3 method for class 'GRFClassifierSSLR'
predictions(object, ...)

Arguments
- object: object
- ...: other parameters to be passed

Predictions of unlabeled data (transductive) raw returns factor or numeric values

Usage
## S3 method for class 'model_sslr_fitted'
predictions(object, type = "class", ...)

Arguments
- object: model_sslr_fitted model built
- type: of predict in principal model: class, raw
- ...: other parameters to be passed
predict_inputs

An S4 method to predict inputs.

**Description**

An S4 method to predict inputs.

**Usage**

```r
predict_inputs(object, ...)```

**Arguments**

- `object`: DecisionTree object
- `...`: This parameter is included for compatibility reasons.

---

predict_inputs,DecisionTreeClassifier-method

*Predict inputs Decision Tree*

**Description**

Function to predict one input in Decision Tree

**Usage**

```r
## S4 method for signature 'DecisionTreeClassifier'
predict_inputs(object, inputs, type = "class")
```

**Arguments**

- `object`: DecisionTree object
- `inputs`: inputs to be predicted
- `type`: type prediction, class or prob
print.model_sslr  
*Print model SSLR*

Description

Print model SSLR

Usage

```r
## S3 method for class 'model_sslr'
print(object)
```

Arguments

- `object`  
  model_sslr object to print

RandomForestSemisupervised-class

*Class Random Forest*

Description

Class Random Forest Slots: mtry, trees, min_n, w, classes, mode

seeded_kmeans

*General Interface Seeded KMeans*

Description

The difference with traditional Kmeans is that in this method implemented, at initialization, there are as many clusters as the number of classes that exist of the labelled data, the average of the labelled data of a given class

Usage

```r
seeded_kmeans(max_iter = 10, method = "euclidean")
```

Arguments

- `max_iter`  
  maximum iterations in KMeans. Default is 10
- `method`  
  distance method in KMeans: "euclidean", "maximum", "manhattan", "canberra", "binary" or "minkowski"
References
Sugato Basu, Arindam Banerjee, Raymond Mooney
Semi-supervised clustering by seeding
July 2002 In Proceedings of 19th International Conference on Machine Learning

Examples

```r
library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data <- iris

set.seed(1)
#% LABELED
cls <- which(colnames(iris) == "Species")
labeled.index <- createDataPartition(data$Species, p = .2, list = FALSE)
data[-labeled.index,cls] <- NA

m <- seeded_kmeans() %>% fit(Species ~ ., data)

#Get labels (assign clusters), type = "raw" return factor
labels <- m %>% cluster_labels()
print(labels)

#Get centers
centers <- m %>% get_centers()
print(centers)
```

selfTraining

*General Interface for Self-training model*

**Description**
Self-training is a simple and effective semi-supervised learning classification method. The self-training classifier is initially trained with a reduced set of labeled examples. Then it is iteratively retrained with its own most confident predictions over the unlabeled examples. Self-training follows a wrapper methodology using a base supervised classifier to establish the possible class of unlabeled instances.

**Usage**

`selfTraining(learner, max.iter = 50, perc.full = 0.7, thr.conf = 0.5)`
Arguments

learner  model from parsnip package for training a supervised base classifier using a set of instances. This model need to have probability predictions (or optionally a distance matrix) and it’s corresponding classes.

max.iter  maximum number of iterations to execute the self-labeling process. Default is 50.

perc.full  A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-training process is stopped. Default is 0.7.

thr.conf  A number between 0 and 1 that indicates the confidence threshold. At each iteration, only the newly labelled examples with a confidence greater than this value (thr.conf) are added to the training set.

Details

For predicting the most accurate instances per iteration, `selfTraining` uses the predictions obtained with the learner specified. To train a model using the learner function, it is required a set of instances (or a precomputed matrix between the instances if `x.inst` parameter is FALSE) in conjunction with the corresponding classes. Additional parameters are provided to the learner function via the learner.pars argument. The model obtained is a supervised classifier ready to predict new instances through the pred function. Using a similar idea, the additional parameters to the pred function are provided using the pred.pars argument. The pred function returns the probabilities per class for each new instance. The value of the thr.conf argument controls the confidence of instances selected to enlarge the labeled set for the next iteration.

The stopping criterion is defined through the fulfillment of one of the following criteria: the algorithm reaches the number of iterations defined in the max.iter parameter or the portion of the unlabeled set, defined in the perc.full parameter, is moved to the labeled set. In some cases, the process stops and no instances are added to the original labeled set. In this case, the user must assign a more flexible value to the thr.conf parameter.

Value

(When model fit) A list object of class "selfTraining" containing:

model  The final base classifier trained using the enlarged labeled set.

instances.index  The indexes of the training instances used to train the model. These indexes include the initial labeled instances and the newly labeled instances. Those indexes are relative to x argument.

classes  The levels of y factor.

pred  The function provided in the pred argument.

pred.pars  The list provided in the pred.pars argument.

References

Examples

```r
library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(wine)

set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

#% LABELED
labeled.index <- createDataPartition(train$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

#We need a model with probability predictions from parsnip
#https://tidymodels.github.io/parsnip/articles/articles/Models.html
#It should be with mode = classification

#For example, with Random Forest
rf <- rand_forest(trees = 100, mode = "classification") %>%
  set_engine("randomForest")

m <- selfTraining(learner = rf,
  perc.full = 0.7,
  thr.conf = 0.5, max.iter = 10) %>%
  fit(Wine ~ ., data = train)

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)
```

---

**selfTrainingG**  
*Self-training generic method*

Description

Self-training is a simple and effective semi-supervised learning classification method. The self-training classifier is initially trained with a reduced set of labeled examples. Then it is iteratively retrained with its own most confident predictions over the unlabeled examples. Self-training follows a wrapper methodology using one base supervised classifier to establish the possible class of unlabeled instances.
Usage

```r
selfTrainingG(
  y,
  gen.learner,
  gen.pred,
  max.iter = 50,
  perc.full = 0.7,
  thr.conf = 0.5
)
```

Arguments

- **y**: A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value `NA`.
- **gen.learner**: A function for training a supervised base classifier. This function needs two parameters, indexes and cls, where indexes indicates the instances to use and cls specifies the classes of those instances.
- **gen.pred**: A function for predicting the probabilities per classes. This function must be two parameters, model and indexes, where the model is a classifier trained with `gen.learner` function and indexes indicates the instances to predict.
- **max.iter**: Maximum number of iterations to execute the self-labeling process. Default is 50.
- **perc.full**: A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-training process is stopped. Default is 0.7.
- **thr.conf**: A number between 0 and 1 that indicates the confidence threshold. At each iteration, only the newly labelled examples with a confidence greater than this value (`thr.conf`) are added to the training set.

Details

SelfTrainingG can be helpful in those cases where the method selected as base classifier needs other specifications. For more information about the general self-training method, please see the `selfTraining` function. Essentially, the `selfTraining` function is a wrapper of the `selfTrainingG` function.

Value

A list object of class "selfTrainingG" containing:

- **model**: The final base classifier trained using the enlarged labeled set.
- **instances.index**: The indexes of the training instances used to train the `model`. These indexes include the initial labeled instances and the newly labeled instances. Those indexes are relative to the `y` argument.
Examples

library(SSLR)

## Load Wine data set
data(wine)
cls <- which(colnames(wine) == "Wine")
x <- wine[, - cls] # instances without classes
y <- wine[, cls] # the classes
x <- scale(x)
set.seed(20)

# Use 50% of instances for training
tra.idx <- sample(x = length(y), size = ceiling(length(y) * 0.5))
xtrain <- x[tra.idx,]
ytrain <- y[tra.idx]

# Use 70% of train instances as unlabeled set
tra.na.idx <- sample(x = length(tra.idx), size = ceiling(length(tra.idx) * 0.7))
ytrain[tra.na.idx] <- NA

# Use the other 50% of instances for inductive testing
tst.idx <- setdiff(1:length(y), tra.idx)
xtest <- x[tst.idx,] # testing instances
ytest <- y[tst.idx] # classes of instances in xtest
# Use the unlabeled examples for transductive testing
xttest <- x[tra.idx[tra.na.idx],] # transductive testing instances
yttest <- y[tra.idx[tra.na.idx]] # classes of instances in xttest
library(caret)

#PREPARE DATA
data <- cbind(xtrain, Class = ytrain)
dtrain <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
ditest <- as.matrix(proxy::dist(x = xtest, y = xtrain, method = "euclidean", by_rows = TRUE))

ddata <- cbind(dtrain, Class = ytrain)
ddata <- as.data.frame(ddata)
ktrain <- as.matrix(exp(-0.048 * dtrain ^ 2))
kdata <- cbind(ktrain, Class = ytrain)
kdata <- as.data.frame(kdata)

ktrain <- as.matrix(exp(-0.048 * dtrain ^ 2))
ktest <- as.matrix(exp(-0.048 * ditest ^ 2))
## Example: Training from a set of instances with 1-NN (knn3) as base classifier.

```r
gen.learner <- function(indexes, cls)
  caret::knn3(x = xtrain[indexes,], y = cls, k = 1)
gen.pred <- function(model, indexes)
  predict(model, xtrain[indexes,])

trControl_selfTrainingG1 <- list(gen.learner = gen.learner, gen.pred = gen.pred)
md1 <- train_generic(ytrain, method = "selfTrainingG", trControl = trControl_selfTrainingG1)
p1 <- predict(md1$model, xitest, type = "class")
table(p1, yitest)
confusionMatrix(p1, yitest)$overall[1]
```

## Example: Training from a distance matrix with 1-NN (oneNN) as base classifier.

```r
dtrain <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
gen.learner <- function(indexes, cls)
  {
    m <- SSLR::oneNN(y = cls)
    attr(m, "tra.idxs") <- indexes
    m
  }

gen.pred <- function(model, indexes)
  {
    tra.idxs <- attr(model, "tra.idxs")
    d <- dtrain[indexes, tra.idxs]
    prob <- predict(model, d, distance.weighting = "none")
    prob
  }

trControl_selfTrainingG2 <- list(gen.learner = gen.learner, gen.pred = gen.pred)
md2 <- train_generic(ytrain, method = "selfTrainingG", trControl = trControl_selfTrainingG2)
ditest <- proxy::dist(x = xitest, y = xtrain[md2$instances.index,],
  method = "euclidean", by_rows = TRUE)
p2 <- predict(md2$model, ditest, type = "class")
table(p2, yitest)
confusionMatrix(p2, yitest)$overall[1]
```

---

### Description

SETRED (SElf-TRaining with EDiting) is a variant of the self-training classification method (as implemented in the function `selfTraining`) with a different addition mechanism. The SETRED classifier is initially trained with a reduced set of labeled examples. Then, it is iteratively retrained
with its own most confident predictions over the unlabeled examples. SETRED uses an amending
scheme to avoid the introduction of noisy examples into the enlarged labeled set. For each iteration,
the mislabeled examples are identified using the local information provided by the neighborhood
graph.

Usage

```r
setred(
  dist = "Euclidean",
  learner,
  theta = 0.1,
  max.iter = 50,
  perc.full = 0.7,
  D = NULL
)
```

Arguments

dist A distance function or the name of a distance available in the proxy package to
compute. Default is "Euclidean" the distance matrix in the case that D is NULL.

learner model from parsnip package for training a supervised base classifier using a set
of instances. This model need to have probability predictions (or optionally a
distance matrix) and it's corresponding classes.

theta Rejection threshold to test the critical region. Default is 0.1.

max.iter maximum number of iterations to execute the self-labeling process. Default is
50.

perc.full A number between 0 and 1. If the percentage of new labeled examples reaches
this value the self-training process is stopped. Default is 0.7.

D A distance matrix between all the training instances. This matrix is used to
construct the neighborhood graph. Default is NULL, this means the method
create a matrix with dist param

Details

SETRED initiates the self-labeling process by training a model from the original labeled set. In each
iteration, the learner function detects unlabeled examples for which it makes the most confident
prediction and labels those examples according to the pred function. The identification of misla-
beled examples is performed using a neighborhood graph created from the distance matrix. Most
examples possess the same label in a neighborhood. So if an example locates in a neighborhood
with too many neighbors from different classes, this example should be considered problematic.
The value of the theta argument controls the confidence of the candidates selected to enlarge the
labeled set. The lower this value is, the more restrictive is the selection of the examples that are con-
sidered good. For more information about the self-labeled process and the rest of the parameters,
please see selfTraining.

Value

(When model fit) A list object of class "setred" containing:
model  The final base classifier trained using the enlarged labeled set.

instances.index  The indexes of the training instances used to train the model. These indexes include the initial labeled instances and the newly labeled instances. Those indexes are relative to x argument.

classes  The levels of y factor.

pred  The function provided in the pred argument.

pred.pars  The list provided in the pred.pars argument.

References

Ming Li and ZhiHua Zhou.  
Setred: Self-training with editing.  

Examples

```r
library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)
data(wine)
set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]
cls <- which(colnames(wine) == "Wine")

# Labeled
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

# We need a model with probability predictions from parsnip
# https://tidymodels.github.io/parsnip/articles/articles/Models.html
# It should be with mode = classification

# For example, with Random Forest
rf <- rand_forest(trees = 100, mode = "classification") %>%
  set_engine("randomForest")

m <- setred(learner = rf,
            theta = 0.1,
            max.iter = 2,
            perc.full = 0.7) %>% fit(Wine ~ ., data = train)
```
#Accuracy
predict(m, test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

#Another example, with dist matrix

distance <- as.matrix(proxy::dist(train[, -cls], method = "Euclidean",
    by_rows = TRUE, diag = TRUE, upper = TRUE))

m <- setred(learner = rf,
  theta = 0.1,
  max.iter = 2,
  perc.full = 0.7,
  D = distance) %>% fit(Wine ~ ., data = train)

#Accuracy
predict(m, test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

---

setredG  

**SETRED generic method**

**Description**

SETRED is a variant of the self-training classification method ([selfTraining](#)) with a different addition mechanism. The SETRED classifier is initially trained with a reduced set of labeled examples. Then it is iteratively retrained with its own most confident predictions over the unlabeled examples. SETRED uses an amending scheme to avoid the introduction of noisy examples into the enlarged labeled set. For each iteration, the mislabeled examples are identified using the local information provided by the neighborhood graph.

**Usage**

```r
setredG(
  y,
  D,
  gen.learner,
  gen.pred,
  theta = 0.1,
  max.iter = 50,
  perc.full = 0.7
)
```
Arguments

\(y\)  
A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value \(\text{NA}\).

\(D\)  
A distance matrix between all the training instances. This matrix is used to construct the neighborhood graph.

\(\text{gen.learner}\)  
A function for training a supervised base classifier. This function needs two parameters, indexes and \(\text{cls}\), where \(\text{indexes}\) indicates the instances to use and \(\text{cls}\) specifies the classes of those instances.

\(\text{gen.pred}\)  
A function for predicting the probabilities per classes. This function must be two parameters, model and indexes, where the model is a classifier trained with \(\text{gen.learner}\) function and indexes indicates the instances to predict.

\(\text{theta}\)  
Rejection threshold to test the critical region. Default is 0.1.

\(\text{max.iter}\)  
Maximum number of iterations to execute the self-labeling process. Default is 50.

\(\text{perc.full}\)  
A number between 0 and 1. If the percentage of new labeled examples reaches this value the self-training process is stopped. Default is 0.7.

Details

SetredG can be helpful in those cases where the method selected as base classifier needs a \(\text{learner}\) and \(\text{pred}\) functions with other specifications. For more information about the general setred method, please see \texttt{setred} function. Essentially, \texttt{setred} function is a wrapper of \texttt{setredG} function.

Value

A list object of class "setredG" containing:

- \textbf{model}  
The final base classifier trained using the enlarged labeled set.

- \textbf{instances.index}  
The indexes of the training instances used to train the \texttt{model}. These indexes include the initial labeled instances and the newly labeled instances. Those indexes are relative to the \(y\) argument.

Examples

```r
library(SSLR)
library(caret)

## Load Wine data set
data(wine)

cls <- which(colnames(wine) == "Wine")
x <- wine[, - cls] # instances without classes
y <- wine[, cls] # the classes
x <- scale(x) # scale the attributes

## Prepare data
set.seed(20)
# Use 50% of instances for training
```

setredG

tra.idx <- sample(x = length(y), size = ceiling(length(y) * 0.5))
xtrain <- x[tra.idx,] # training instances
ytrain <- y[tra.idx] # classes of training instances
# Use 70% of train instances as unlabeled set
tra.na.idx <- sample(x = length(tra.idx), size = ceiling(length(tra.idx) * 0.7))
ytrain[tra.na.idx] <- NA # remove class information of unlabeled instances
# Use the other 50% of instances for inductive testing
tst.idx <- setdiff(1:length(y), tra.idx)
xitest <- x[tst.idx,] # testing instances
yitest <- y[tst.idx] # classes of testing instances
# Compute distances between training instances
D <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
## Example: Training from a set of instances with 1-NN (knn3) as base classifier.
# Compute distances between training instances
D <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
## Example: Training from a set of instances with 1-NN (knn3) as base classifier.
gen.learner <- function(indexes, cls) {
caret::knn3(x = xtrain[indexes,], y = cls, k = 1)
gen.pred <- function(model, indexes) {
predict(model, xtrain[indexes,])
}
}
trControl_SETRED1 <- list(D = D, gen.learner = gen.learner, gen.pred = gen.pred)
md1 <- train_generic(ytrain, method = "setredG", trControl = trControl_SETRED1)
'md1 <- setredG(y = ytrain, D, gen.learner, gen.pred)'
cls1 <- predict(md1$model, xitest, type = "class")
table(cls1, yitest)
confusionMatrix(cls1, yitest)$overall[1]
## Example: Training from a distance matrix with 1-NN (oneNN) as base classifier
gen.learner <- function(indexes, cls) {
m <- SSLR::oneNN(y = cls)
attr(m, "tra.idxs") <- indexes
m
}

gen.pred <- function(model, indexes) {
tra.idxs <- attr(model, "tra.idxs")
d <- D[indexes, tra.idxs]
prob <- predict(model, d, distance.weighting = "none")
prob
}
trControl_SETRED2 <- list(D = D, gen.learner = gen.learner, gen.pred = gen.pred)
md2 <- train_generic(ytrain, method = "setredG", trControl = trControl_SETRED2)

ditest <- proxy::dist(x = xitest, y = xtrain[md2$instances.index,],
                      method = "euclidean", by_rows = TRUE)

cls2 <- predict(md2$model, ditest, type = "class")
table(cls2, yitest)

confusionMatrix(cls2, yitest)$overall[1]

---

### snrce

**General Interface for SNNRCE model**

#### Description

SNNRCE (Self-training Nearest Neighbor Rule using Cut Edges) is a variant of the self-training classification method ([selfTraining](#)) with a different addition mechanism and a fixed learning scheme (1-NN). SNNRCE uses an amending scheme to avoid the introduction of noisy examples into the enlarged labeled set. The mislabeled examples are identified using the local information provided by the neighborhood graph. A statistical test using cut edge weight is used to modify the labels of the misclassified examples.

#### Usage

```r
snrce(x.inst = TRUE, dist = "Euclidean", alpha = 0.1)
```

#### Arguments

- `x.inst`: A boolean value that indicates if `x` is or not an instance matrix. Default is `TRUE`.
- `dist`: A distance function available in the `proxy` package to compute the distance matrix in the case that `x.inst` is `TRUE`.
- `alpha`: Rejection threshold to test the critical region. Default is 0.1.

#### Details

SNNRCE initiates the self-labeling process by training a 1-NN from the original labeled set. This method attempts to reduce the noise in examples by labeling those instances with no cut edges in the initial stages of self-labeling learning. These highly confident examples are added into the training set. The remaining examples follow the standard self-training process until a minimum number of examples will be labeled for each class. A statistical test using cut edge weight is used to modify the labels of the misclassified examples. The value of the `alpha` argument defines the critical region where the candidates examples are tested. The higher this value is, the more relaxed it is the selection of the examples that are considered mislabeled.
Value

(When model fit) A list object of class "snnrce" containing:

- **model** The final base classifier trained using the enlarged labeled set.
- **instances.index** The indexes of the training instances used to train the model. These indexes include the initial labeled instances and the newly labeled instances. Those indexes are relative to x argument.
- **classes** The levels of y factor.
- **x.inst** The value provided in the x.inst argument.
- **dist** The value provided in the dist argument when x.inst is TRUE.
- **xtrain** A matrix with the subset of training instances referenced by the indexes instances.index when x.inst is TRUE.

References

Yu Wang, Xiaoyan Xu, Haifeng Zhao, and Zhongsheng Hua.
*Semisupervised learning based on nearest neighbor rule and cut edges.*

Examples

```r
library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(wine)
set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
train <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

#% LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- snnrce(x.inst = TRUE,
            dist = "Euclidean",
            alpha = 0.1) %>% fit(Wine ~ ., data = train)

predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)
```
**SSLRDecisionTree**

**General Interface Decision Tree model**

### Description

Decision Tree is a simple and effective semi-supervised learning method. Based on the article "Semi-supervised classification trees". It also offers many parameters to modify the behavior of this method. It is the same as the traditional Decision Tree algorithm, but the difference is how the gini coefficient is calculated (classification). In regression we use SSE metric (different from the original investigation). It can be used in classification or regression. If Y is numeric is for regression, classification in another case.

### Usage

```
SSLRDecisionTree(  
  max_depth = 30,  
  w = 0.5,  
  min_samples_split = 20,  
  min_samples_leaf = ceiling(min_samples_split/3)  
)
```

### Arguments

- **max_depth**: A number from 1 to Inf. Is the maximum number of depth in Decision Tree  
  Default is 30
- **w**: weight parameter ranging from 0 to 1. Default is 0.5
- **min_samples_split**: the minimum number of observations to do split. Default is 20
- **min_samples_leaf**: the minimum number of any terminal leaf node. Default is ceiling(min_samples_split/3)

### Details

In this model we can make predictions with prob type

### References

Jurica Levati, Michelangelo Ceci, Dragi Kocev, Saso Dzeroski.  
*Semi-supervised classification trees*.  
Published online: 25 March 2017 © Springer Science Business Media New York 2017

### Examples

```
library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)
```
```r
data(wine)
set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
train <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

# LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- SSLRDecisionTree(min_samples_split = round(length(labeled.index) * 0.25),
                       w = 0.3,
                       ) %>% fit(Wine ~ ., data = train)

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

#For probabilities
predict(m,test, type = "prob")
```

### Description

Random Forest is a simple and effective semi-supervised learning method. It is the same as the traditional Random Forest algorithm, but the difference is that it uses Semi-supervised Decision Trees. It can be used in classification or regression. If Y is numeric, it is for regression, classification in another case.

### Usage

```r
SSLRRandomForest(  
mtry = NULL,  
trees = 500,  
min_n = NULL,  
w = 0.5,  
replace = TRUE,  
tree_max_depth = Inf,
```

SSLRRandomForest

sampsize = NULL,
min_samples_leaf = NULL,
allowParallel = TRUE
)

Arguments

mtry  number of features in each decision tree. Default is null. This means that mtry = \log(n\_features) + 1
trees  number of trees. Default is 500
min\_n  number of minimum samples in each tree Default is null. This means that uses all training data
w  weight parameter ranging from 0 to 1. Default is 0.5
replace  replacing type in sampling. Default is true
tree\_max\_depth  maximum tree depth. Default is Inf
tsampsize  Size of sample. Default if \( \text{replace} \) nrow(x) else ceiling(.632*nrow(x))
min\_samples\_leaf  the minimum number of any terminal leaf node. Default is 1
allowParallel  Execute Random Forest in parallel if doParallel is loaded. Default is TRUE

Details

We can use paralleling processing with doParallel package and allowParallel = TRUE.

References

Jurica Levati, Michelangelo Ceci, Dragi Kocev, Saso Dzeroski.
Semi-supervised classification trees.
Published online: 25 March 2017 © Springer Science Business Media New York 2017

Examples

library(tidyverse)
library(caret)
library(SSLR)
library(tidymodels)

data(wine)

set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

#% LABELED
labeled.index <- createDataPartition(train$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- SSLRRandomForest(trees = 5, w = 0.3) %>% fit(Wine ~ ., data = train)

#Accuracy
predict(m, test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

#For probabilities
predict(m, test, type = "prob")

---

**train_generic**

*FUNCTION TO TRAIN GENERIC MODEL*

**Description**

FUNCTION TO TRAIN GENERIC MODEL

**Usage**

`train_generic(y, ...)`

**Arguments**

- `y` (optional) factor (classes)
- `...` list parms trControl (method...)

**Value**

model trained

---

**triTraining**

*General Interface for Tri-training model*

**Description**

Tri-training is a semi-supervised learning algorithm with a co-training style. This algorithm trains three classifiers with the same learning scheme from a reduced set of labeled examples. For each iteration, an unlabeled example is labeled for a classifier if the other two classifiers agree on the labeling proposed.
triTraining

Usage

triTraining(learner)

Arguments

learner model from parsnip package for training a supervised base classifier using a set of instances. This model need to have probability predictions (or optionally a distance matrix) and it's corresponding classes.

Details

Tri-training initiates the self-labeling process by training three models from the original labeled set, using the learner function specified. In each iteration, the algorithm detects unlabeled examples on which two classifiers agree with the classification and includes these instances in the enlarged set of the third classifier under certain conditions. The generation of the final hypothesis is produced via the majority voting. The iteration process ends when no changes occur in any model during a complete iteration.

Value

A list object of class "triTraining" containing:

- **model** The final three base classifiers trained using the enlarged labeled set.
- **model.index** List of three vectors of indexes related to the training instances used per each classifier. These indexes are relative to the y argument.
- **instances.index** The indexes of all training instances used to train the three models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the y argument.
- **model.index.map** List of three vectors with the same information in model.index but the indexes are relative to instances.index vector.
- **classes** The levels of y factor.
- **pred** The function provided in the pred argument.
- **pred.pars** The list provided in the pred.pars argument.
- **x.inst** The value provided in the x.inst argument.

References

ZhiHua Zhou and Ming Li.
Tri-training: exploiting unlabeled data using three classifiers.

Examples

library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)
data(wine)

set.seed(1)
train.index <- createDataPartition(wine$Wine, p = .7, list = FALSE)
train <- wine[train.index,]
test <- wine[-train.index,]

cls <- which(colnames(wine) == "Wine")

# LABELED
labeled.index <- createDataPartition(wine$Wine, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

# We need a model with probability predictions from parsnip
# https://tidymodels.github.io/parsnip/articles/articles/Models.html
# It should be with mode = classification

# For example, with Random Forest
rf <- rand_forest(trees = 100, mode = "classification") %>%
  set_engine("randomForest")

m <- triTraining(learner = rf) %>% fit(Wine ~ ., data = train)

# Accuracy
predict(m,test) %>%
  bind_cols(test) %>%
  metrics(truth = "Wine", estimate = .pred_class)

---

**triTrainingCombine**

*Combining the hypothesis*

**Description**

This function combines the predictions obtained by the set of classifiers.

**Usage**

`triTrainingCombine(pred)`

**Arguments**

- `pred` A list with the predictions of each classifiers

**Value**

A vector of classes
triTrainingG

Tri-training generic method

Description

Tri-training is a semi-supervised learning algorithm with a co-training style. This algorithm trains three classifiers with the same learning scheme from a reduced set of labeled examples. For each iteration, an unlabeled example is labeled for a classifier if the other two classifiers agree on the labeling proposed.

Usage

triTrainingG(y, gen.learner, gen.pred)

Arguments

- **y**: A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value `NA`.
- **gen.learner**: A function for training three supervised base classifiers. This function needs two parameters, indexes and cls, where indexes indicates the instances to use and cls specifies the classes of those instances.
- **gen.pred**: A function for predicting the probabilities per classes. This function must be two parameters, model and indexes, where the model is a classifier trained with gen.learner function and indexes indicates the instances to predict.

Details

TriTrainingG can be helpful in those cases where the method selected as base classifier needs a learner and pred functions with other specifications. For more information about the general triTraining method, please see the triTraining function. Essentially, the triTraining function is a wrapper of the triTrainingG function.

Value

A list object of class "triTrainingG" containing:

- **model**: The final three base classifiers trained using the enlarged labeled set.
- **model.index**: List of three vectors of indexes related to the training instances used per each classifier. These indexes are relative to the y argument.
- **instances.index**: The indexes of all training instances used to train the three models. These indexes include the initial labeled instances and the newly labeled instances. These indexes are relative to the y argument.
- **model.index.map**: List of three vectors with the same information in model.index but the indexes are relative to instances.index vector.
Examples

library(SSLR)
library(caret)

## Load Wine data set
data(wine)

cls <- which(colnames(wine) == "Wine")
x <- wine[, - cls] # instances without classes
y <- wine[, cls] # the classes
x <- scale(x) # scale the attributes

## Prepare data
set.seed(20)
# Use 50% of instances for training
tra.idx <- sample(x = length(y), size = ceiling(length(y) * 0.5))
xtrain <- x[tra.idx,] # training instances
ytrain <- y[tra.idx] # classes of training instances
# Use 70% of train instances as unlabeled set
tra.na.idx <- sample(x = length(tra.idx), size = ceiling(length(tra.idx) * 0.7))
ytrain[tra.na.idx] <- NA # remove class information of unlabeled instances
# Use the other 50% of instances for inductive testing
tst.idx <- setdiff(1:length(y), tra.idx)
xitest <- x[tst.idx,] # testing instances
yitest <- y[tst.idx] # classes of testing instances

## Example: Training from a set of instances with 1-NN (knn3) as base classifier.
gen.learner <- function(indexes, cls)
caret::knn3(x = xtrain[indexes,], y = cls, k = 1)
gen.pred <- function(model, indexes)
predict(model, xtrain[indexes])

# Train
set.seed(1)
trControl_triTraining1 <- list(gen.learner = gen.learner,
gen.pred = gen.pred)
md1 <- train_generic(ytrain, method = "triTrainingG", trControl = trControl_triTraining1)

# Predict testing instances using the three classifiers
pred <- lapply(
  X = md1$model,
  FUN = function(m) predict(m, xitest, type = "class")
)
# Combine the predictions
cls1 <- triTrainingCombine(pred)
table(cls1, yitest)
confusionMatrix(cls1, yitest)$overall[1]
## Example: Training from a distance matrix with 1-NN (oneNN) as base classifier.
dtrain <- as.matrix(proxy::dist(x = xtrain, method = "euclidean", by_rows = TRUE))
gen.learner <- function(indexes, cls) {
  m <- SSLR::oneNN(y = cls)
  attr(m, "tra.idxs") <- indexes
  m
}

gen.pred <- function(model, indexes) {
  tra.idxs <- attr(model, "tra.idxs")
  d <- dtrain[indexes, tra.idxs]
  prob <- predict(model, d, distance.weighting = "none")
  prob
}

# Train
set.seed(1)
trControl_triTraining2 <- list(gen.learner = gen.learner,
    gen.pred = gen.pred)
md2 <- train_generic(ytrain, method = "triTrainingG", trControl = trControl_triTraining2)

# Predict
ditest <- proxy::dist(x = xitest, y = xtrain[md2$instances.index,],
    method = "euclidean", by_rows = TRUE)

# Predict testing instances using the three classifiers
pred <- mapply(FUN = function(m, indexes) {
  D <- ditest[, indexes]
  predict(m, D, type = "class"),
},
  m = md2$model,
  indexes = md2$model.index.map,
  SIMPLIFY = FALSE
)

# Combine the predictions
cls2 <- triTrainingCombine(pred)
table(cls2, yitest)

confusionMatrix(cls2, yitest)$overall[1]
TSVMSSLR

Description
model from RSSL package Transductive SVM using the CCCP algorithm as proposed by Collobert et al. (2006) implemented in R using the quadprog package. The implementation does not handle large datasets very well, but can be useful for smaller datasets and visualization purposes. C is the cost associated with labeled objects, while Cstar is the cost for the unlabeled objects. s control the loss function used for the unlabeled objects: it controls the size of the plateau for the symmetric ramp loss function. The balancing constraint makes sure the label assignments of the unlabeled objects are similar to the prior on the classes that was observed on the labeled data.

Usage
TSVMSSLR(
  C = 1,
  Cstar = 0.1,
  kernel = kernlab::vanilladot(),
  balancing_constraint = TRUE,
  s = 0,
  x_center = TRUE,
  scale = FALSE,
  eps = 1e-09,
  max_iter = 20,
  verbose = FALSE
)

Arguments
C numeric; Cost parameter of the SVM
Cstar numeric; Cost parameter of the unlabeled objects
kernel kernlab::kernel to use
balancing_constraint logical; Whether a balancing constraint should be enforced that causes the fraction of objects assigned to each label in the unlabeled data to be similar to the label fraction in the labeled data.
s numeric; parameter controlling the loss function of the unlabeled objects (generally values between -1 and 0)
x_center logical; Should the features be centered?
scale If TRUE, apply a z-transform to all observations in X and X_u before running the regression
eps numeric; Stopping criterion for the maximinimization
max_iter integer; Maximum number of iterations
verbose logical; print debugging messages, only works for vanilladot() kernel (default: FALSE)

References
library(tidyverse)
library(caret)
library(tidymodels)
library(SSLR)
data(breast)
set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[ train.index,]
test <- breast[-train.index,]

cls <- which(colnames(breast) == "Class")

labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

library(kernlab)
m <- TSVMSSLR(kernel = kernlab::vanilladot()) %>% fit(Class ~ ., data = train)

#Accessing model from RSSL
model <- m$model

USMLeastSquaresClassifierSSLR

General Interface for USMLeastSquaresClassifier (Updated Second Moment Least Squares Classifier) model

Description

model from RSSL package This methods uses the closed form solution of the supervised least squares problem, except that the second moment matrix (X'X) is exchanged with a second moment matrix that is estimated based on all data. See for instance Shaffer1991, where in this implementation we use all data to estimate E(X'X), instead of just the labeled data. This method seems to work best when the data is first centered x_center=TRUE and the outputs are scaled using y_scale=TRUE.

Usage

USMLeastSquaresClassifierSSLR(
  lambda = 0,
  intercept = TRUE,
  x_center = FALSE,
  scale = FALSE,
  y_scale = FALSE,
USMLeastSquaresClassifierSSLR

..., use_Xu_for_scaling = TRUE
)

Arguments

lambda numeric; L2 regularization parameter
intercept logical; Whether an intercept should be included
x_center logical; Should the features be centered?
scale logical; Should the features be normalized? (default: FALSE)
y_scale logical; whether the target vector should be centered
... Not used
use_Xu_for_scaling logical; whether the unlabeled objects should be used to determine the mean and scaling for the normalization

References


Examples

library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[train.index,]
test <- breast[-train.index,]

cls <- which(colnames(breast) == "Class")

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- USMLeastSquaresClassifierSSLR() %>% fit(Class ~ ., data = train)

#Accessing model from RSSL
model <- m$model

#Accuracy
predict(m,test) %>%
  bind_cols(test) %>%

metrics(truth = "Class", estimate = .pred_class)

WellSVMSSLR

General Interface for WellSVM model

Description

model from RSSL package WellSVM is a minimax relaxation of the mixed integer programming problem of finding the optimal labels for the unlabeled data in the SVM objective function. This implementation is a translation of the Matlab implementation of Li (2013) into R.

Usage

WellSVMSSLR(
  C1 = 1,
  C2 = 0.1,
  gamma = 1,
  x_center = TRUE,
  scale = FALSE,
  use_Xu_for_scaling = FALSE,
  max_iter = 20
)

Arguments

C1 double; A regularization parameter for labeled data, default 1;
C2 double; A regularization parameter for unlabeled data, default 0.1;
gamma double; Gaussian kernel parameter, i.e., k(x,y) = exp(-gamma^2||x-y||^2/avg) where avg is the average distance among instances; when gamma = 0, linear kernel is used. default gamma = 1;
x_center logical; Should the features be centered?
scale logical; Should the features be normalized? (default: FALSE)
use_Xu_for_scaling logical; whether the unlabeled objects should be used to determine the mean and scaling for the normalization
max_iter integer; Maximum number of iterations

References


Examples

library(tidyverse)
library(tidymodels)
library(caret)
library(SSLR)

data(breast)

set.seed(1)
train.index <- createDataPartition(breast$Class, p = .7, list = FALSE)
train <- breast[ train.index,]
test <- breast[-train.index,]

cls <- which(colnames(breast) == "Class")

#% LABELED
labeled.index <- createDataPartition(breast$Class, p = .2, list = FALSE)
train[-labeled.index,cls] <- NA

m <- WellSVMSSLR() %>% fit(Class ~ ., data = train)

#Accessing model from RSSL
model <- m$model

#Accuracy
predict(m,test) %>%
bind_cols(test) %>%
metrics(truth = "Class", estimate = .pred_class)

wine

Wine recognition data

Description

This dataset is the result of a chemical analysis of wine grown in the same region in Italy but derived
from three different cultivars. The analysis determined the quantities of 13 constituents found in
each of the three types of wines.

Usage

data(wine)

Format

A data frame with 178 rows and 14 variables including the class.
Details

The dataset is taken from the UCI data repository, to which it was donated by Riccardo Leardi, University of Genova. The attributes are as follows:

- Alcohol
- Malic acid
- Ash
- Alcalinity of ash
- Magnesium
- Total phenols
- Flavanoids
- Nonflavanoid phenols
- Proanthocyanins
- Color intensity
- Hue
- OD280/OD315 of diluted wines
- Proline
- Wine (class)

Source

https://archive.ics.uci.edu/ml/datasets/Wine
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