

Package ‘SSLR’

July 20, 2020

Type Package

Title Semi-Supervised Classification and Regression Methods

Version 0.9.2

Maintainer Francisco Jesús Palomares Alabarce <fpalomares@correo.ugr.es>

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

Description Providing a collection of techniques for semi-supervised classification and regression. 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 7.1.0

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

LinkingTo Rcpp, RcppArmadillo

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

VignetteBuilder knitr

NeedsCompilation yes

Author Francisco Jesús Palomares Alabarce [aut, cre] (<<https://orcid.org/0000-0002-0499-7034>>), José Manuel Benítez [ctb] (<<https://orcid.org/0000-0002-2346-0793>>), Isaac Triguero [ctb] (<<https://orcid.org/0000-0002-0150-0651>>), Christoph Bergmeir [ctb] (<<https://orcid.org/0000-0002-3665-9021>>), Mabel González [ctb] (<<https://orcid.org/0000-0003-0152-444X>>)

Repository CRAN

Date/Publication 2020-07-20 11:10:02 UTC

R topics documented:

abalone	4
best_split	4
best_split,DecisionTreeClassifier-method	5
breast	5
calculate_gini	6
check_value	6
check_xy_interface	7
coBC	7
coBCCombine	9
coBCG	10
coBCReg	12
coBCRegG	13
coffee	15
COREG	15
DecisionTreeClassifier-class	16
democratic	16
democraticCombine	18
democraticG	19
EMLeastSquaresClassifierSSLR	20
EMNearestMeanClassifierSSLR	22
EntropyRegularizedLogisticRegressionSSLR	23
fit.model_sslr	24
fit_decision_tree	25
fit_decision_tree,DecisionTreeClassifier-method	25
fit_random_forest,RandomForestSemisupervised-method	26
fit_xy.model_sslr	27
fit_x_u	28
fit_x_u.model_sslr	28
get_class_max_prob	29
get_class_mean_prob	29
get_function	30
get_function_generic	30
get_levels_categoric	31
get_most_frequented	31
get_value_mean	31
get_x_y	32
gini_or_variance	32
gini_prob	33
grow_tree	33
grow_tree,DecisionTreeClassifier-method	34
knn_regression	34
LaplacianSVMSSLR	35

LinearTSVMSSLR	36
load_parsnip	37
load_RANN	38
load_RSSL	38
MCNearestMeanClassifierSSLR	38
newDecisionTree	40
Node-class	40
nullOrNumericOrCharacter-class	40
oneNN	41
predict,DecisionTreeClassifier-method	41
predict,RandomForestSemisupervised-method	42
predict.coBC	42
predict.COREG	43
predict.democratic	44
predict.EMLeastSquaresClassifierSSLR	44
predict.EMNearestMeanClassifierSSLR	45
predict.EntropyRegularizedLogisticRegressionSSLR	45
predict.LaplacianSVMSSLR	46
predict.LinearTSVMSSLR	46
predict.MCNearestMeanClassifierSSLR	47
predict.model_sslr_fitted	47
predict.OneNN	48
predict.RandomForestSemisupervised_fitted	48
predict.selfTraining	49
predict.setred	50
predict.snnrce	50
predict.snnrceG	51
predict.SSLRDecisionTree_fitted	52
predict.triTraining	52
predict.TSVMSSLR	53
predict.USMLeastSquaresClassifierSSLR	53
predict.WellSVMSSLR	54
predict_inputs	54
predict_inputs,DecisionTreeClassifier-method	55
print.model_sslr	55
RandomForestSemisupervised-class	55
selfTraining	56
selfTrainingG	58
setred	61
setredG	63
snnrce	66
SSLRDecisionTree	68
SSLRRandomForest	69
train_generic	71
triTraining	72
triTrainingCombine	73
triTrainingG	74
TSVMSSLR	77

USMLEastSquaresClassifierSSLR	78
WellSVMSSLR	80
wine	81

Index	83
--------------	-----------

abalone	<i>Abalone</i>
---------	----------------

Description

Abalone

Usage

data(abalone)

Format

Predict the age of abalone from physical measurements

Source

<https://archive.ics.uci.edu/ml/datasets/Abalone>

best_split	<i>An S4 method to best split</i>
------------	-----------------------------------

Description

An S4 method to best split

Usage

best_split(object, ...)

Arguments

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

best_split, DecisionTreeClassifier-method
Best Split function

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

breast	<i>Breast</i>
--------	---------------

Description

Breast

Usage

```
data(breast)
```

Format

: Diagnostic Wisconsin Breast Cancer Database

Source

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

calculate_gini	<i>Function calculate gini</i>
----------------	--------------------------------

Description

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

Usage

```
calculate_gini(column_factor)
```

Arguments

column_factor class values

check_value	<i>Check value in leaf</i>
-------------	----------------------------

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 \leq in numeric or *%in%* in factor

check_xy_interface	<i>Check interface x y</i>
--------------------	----------------------------

Description

Check interface

Usage

```
check_xy_interface(x, y)
```

Arguments

x	data without class labels
y	values class

coBC	<i>General Interface for CoBC model</i>
------	---

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

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

Arguments

<code>learner</code>	model from <code>parsnip</code> package for training a supervised base classifier using a set of instances. This model need to have probability predictions in classification mode
<code>N</code>	The number of classifiers used as committee members. All these classifiers are trained using the <code>gen.learner</code> function. Default is 3.
<code>perc.full</code>	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.
<code>u</code>	Number of unlabeled instances in the pool. Default is 100.
<code>max.iter</code>	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 `max.iter` parameter or the portion of unlabeled set, defined in the `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 `model.index` but the indexes are relative to `instances.index` vector.

classes The levels of `y` factor in classification.

pred The function provided in the `pred` argument.

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

References

Avrim Blum and Tom Mitchell.

Combining labeled and unlabeled data with co-training.

In Eleventh Annual Conference on Computational Learning Theory, COLT' 98, pages 92-100, New York, NY, USA, 1998. ACM. ISBN 1-58113-057-0. doi: 10.1145/279943.279962.

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

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 <- 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

```
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

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

Arguments

<code>y</code>	A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value NA.
<code>gen.learner</code>	A function for training N supervised base classifiers. This function needs two parameters, <code>indexes</code> and <code>cls</code> , where <code>indexes</code> indicates the instances to use and <code>cls</code> specifies the classes of those instances.
<code>gen.pred</code>	A function for predicting the probabilities per classes. This function must be two parameters, <code>model</code> and <code>indexes</code> , where the <code>model</code> is a classifier trained with <code>gen.learner</code> function and <code>indexes</code> indicates the instances to predict.
<code>N</code>	The number of classifiers used as committee members. All these classifiers are trained using the <code>gen.learner</code> function. Default is 3.
<code>perc.full</code>	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.
<code>u</code>	Number of unlabeled instances in the pool. Default is 100.
<code>max.iter</code>	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

```
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
```

```

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.idx") <- indexes
  m
}

gen.pred2 <- function(model, indexes) {
  tra.idx <- attr(model, "tra.idx")
  d <- dtrain[indexes, tra.idx]
  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]

```

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 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.
Semi-supervised Learning for Regression with Cotraining by Committee
 Institute of Neural Information Processing University of Ulm D-89069 Ulm, Germany

 coBCRegG

Generic Interface coBCReg model

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

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

Arguments

<code>y</code>	A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value NA.
<code>gen.learner</code>	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.
<code>gen.pred</code>	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 <code>gen.learner</code> function and indexes indicates the instances to predict.
<code>N</code>	The number of classifiers used as committee members. All these classifiers are trained using the <code>gen.learner</code> function. Default is 3.
<code>perc.full</code>	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.
<code>u</code>	Number of unlabeled instances in the pool. Default is 100.
<code>max.iter</code>	Maximum number of iterations to execute in the self-labeling process. Default is 50.
<code>gr</code>	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	<i>Time series data set</i>
--------	-----------------------------

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

https://www.cs.ucr.edu/~eamonn/time_series_data_2018/

COREG	<i>General Interface for COREG model</i>
-------	--

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

<code>max.iter</code>	maximum number of iterations to execute the self-labeling process. Default is 50.
<code>k1</code>	parameter in first KNN
<code>k2</code>	parameter in second KNN
<code>p1</code>	distance order 1. Default is 3
<code>p2</code>	distance order 1. Default is 5
<code>u</code>	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

democratic *General Interface for Democratic model*

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 weighed 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

```
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("xgboost")

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

#' \donttest{
#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)
```

Arguments

<code>y</code>	A vector with the labels of training instances. In this vector the unlabeled instances are specified with the value NA.
<code>gen.learners</code>	A list of functions for training N different supervised base classifiers. Each function needs two parameters, <code>indexes</code> and <code>cls</code> , where <code>indexes</code> indicates the instances to use and <code>cls</code> specifies the classes of those instances.
<code>gen.preds</code>	A list of functions for predicting the probabilities per classes. Each function must be two parameters, <code>model</code> and <code>indexes</code> , where the <code>model</code> is a classifier trained with <code>gen.learner</code> function and <code>indexes</code> 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. IEEE, Nov 2004. doi: 10.1109/ICTAI.2004.48.

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 labels 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
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

Krijthe, J.H. & Loog, M., 2016. Optimistic Semi-supervised Least Squares Classification. In International Conference on Pattern Recognition (To Appear).

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,]
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 maximimization

References

Dempster, A., Laird, N. & Rubin, D., 1977. Maximum likelihood from incomplete data via the EM algorithm. Journal of the Royal Statistical Society. Series B, 39(1), pp.1-38.

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

#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

```

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

```

Arguments

lambda	l2 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

Grandvalet, Y. & Bengio, Y., 2005. Semi-supervised learning by entropy minimization. In L. K. Saul, Y. Weiss, & L. Bottou, eds. *Advances in Neural Information Processing Systems 17*. Cambridge, MA: MIT Press, pp. 529-536.

Examples

```
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 <- EntropyRegularizedLogisticRegressionSSLR() %>% fit(Class ~ ., data = train)

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

fit.model_sslr	<i>Fit with formula and data</i>
----------------	----------------------------------

Description

Funtion to fit through the formula

Usage

```
## 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

fit_decision_tree *An S4 method to fit decision tree.*

Description

An S4 method to fit decision tree.

Usage

```
fit_decision_tree(object, ...)
```

Arguments

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

fit_decision_tree, DecisionTreeClassifier-method
Fit decision tree

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

fit_random_forest, RandomForestSemisupervised-method
Fit Random Forest

Description

method in classRandomForestSemisupervised used to build a Decision Tree

Usage

```
## S4 method for signature 'RandomForestSemisupervised'
fit_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

fit_xy.model_sslr	<i>Fit with x and y</i>
-------------------	-------------------------

Description

Funtion to fit with x and y

Usage

```
## 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

fit_x_u	<i>fit_x_u object</i>
---------	-----------------------

Description

fit_x_u

Usage

fit_x_u(object, ...)

Arguments

object	object
...	other parameters to be passed

fit_x_u.model_sslr	<i>Fit with x , y (labeled data) and unlabeled data (x_U)</i>
--------------------	---

Description

Funtion to fit with x and y and x_U. Function calcule y with NA values and append in y param

Usage

```
## S3 method for class 'model_sslr'
fit_x_u(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_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

```
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

```
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_categoric *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>

Usage

```
get_levels_categoric(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

```
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

```
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	<i>Function to compute Gini index</i>
-----------	---------------------------------------

Description

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

Usage

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

Arguments

y	values
classe	classes

grow_tree	<i>An S4 method to grow tree.</i>
-----------	-----------------------------------

Description

An S4 method to grow tree.

Usage

```
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

```
## 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 *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

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 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

Belkin, M., Niyogi, P. & Sindhwani, V., 2006. Manifold regularization: A geometric framework for learning from labeled and unlabeled examples. *Journal of Machine Learning Research*, 7, pp.2399-2434.

Examples

```

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

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

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

```

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

```

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

Examples

```

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

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

```

load_parsnip

Load parsnip

Description

function to load parsnip package

Usage

```
load_parsnip()
```

load_RANN	<i>Load parsnip</i>
-----------	---------------------

Description

function to load parsnip package

Usage

```
load_RANN()
```

load_RSSL	<i>Load RSSL</i>
-----------	------------------

Description

function to load RSSL package

Usage

```
load_RSSL()
```

MCNearestMeanClassifierSSLR	<i>General Interface for MCNearestMeanClassifier (Moment Constrained Semi-supervised Nearest Mean Classifier) model</i>
-----------------------------	---

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

Loog, M., 2010. Constrained Parameter Estimation for Semi-Supervised Learning: The Case of the Nearest Mean Classifier. In Proceedings of the 2010 European Conference on Machine learning and Knowledge Discovery in Databases. pp. 291-304.

Examples

```
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)

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

newDecisionTree	<i>Function to create DecisionTree</i>
-----------------	--

Description

Function to create DecisionTree

Usage

```
newDecisionTree(max_depth)
```

Arguments

max_depth	max depth in tree
-----------	-------------------

Node-class	<i>Class Node for Decision Tree</i>
------------	-------------------------------------

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	<i>An S4 class to represent a class with more types values: null, numeric or character</i>
--------------------------------	--

Description

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

 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

```
## 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 probabilties 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

```
## 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

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

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.

predict.COREG	<i>Predictions of the COREG method</i>
---------------	--

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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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

```
## 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_clas
...	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

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

Arguments

object	SNNRCE model built with the snnrce 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 [snnrce](#) examples.

Value

Vector with the labels assigned.

predict.snnrceG

Predictions of the SNNRCE method

Description

Predicts the label of instances according to the snnrceG model.

Usage

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

Arguments

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

```
predict.SSLRDecisionTree_fitted
```

Predictions of the SSLRDecisionTree_fitted method

Description

Predicts the label of instances SSLRDecisionTree_fitted model.

Usage

```
## 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

```
## 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.

predict.TSVMSSLR	<i>Predict TSVMSSLR</i>
------------------	-------------------------

Description

Predict TSVMSSLR

Usage

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

Arguments

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

predict.USMLeastSquaresClassifierSSLR	<i>Predict USMLeastSquaresClassifierSSLR</i>
---------------------------------------	--

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 *Predict WellSVMSSLR*

Description

Predict WellSVMSSLR

Usage

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

Arguments

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

predict_inputs *An S4 method to predict inputs.*

Description

An S4 method to predict inputs.

Usage

```
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

```
## 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

```
## 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

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

David Yarowsky.

Unsupervised word sense disambiguation rivaling supervised methods.

In Proceedings of the 33rd annual meeting on Association for Computational Linguistics, pages 189-196. Association for Computational Linguistics, 1995.

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(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

```
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 learner and pred functions with 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)
xitest <- x[tst.idx,] # testing instances
yitest <- y[tst.idx] # classes of instances in xitest
# 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 = xitest, 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))
kitest <- as.matrix(exp(-0.048 * ditest ^ 2))

## 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_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.
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.idx") <- indexes
  m
}

gen.pred <- function(model, indexes) {
  tra.idx <- attr(model, "tra.idx")
  d <- dtrain[indexes, tra.idx]
  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]

```

setred

General Interface for SETRED model

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

```

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

```

Arguments

<code>dist</code>	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 <code>D</code> is <code>NULL</code> .
<code>learner</code>	model from <code>parsnip</code> 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.
<code>theta</code>	Rejection threshold to test the critical region. Default is 0.1.
<code>max.iter</code>	maximum number of iterations to execute the self-labeling process. Default is 50.
<code>perc.full</code>	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.
<code>D</code>	A distance matrix between all the training instances. This matrix is used to construct the neighborhood graph. Default is <code>NULL</code> , this means the method create a matrix with <code>dist</code> 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 mislabeled 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 considered 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.

In *Advances in Knowledge Discovery and Data Mining*, volume 3518 of *Lecture Notes in Computer Science*, pages 611-621. Springer Berlin Heidelberg, 2005. ISBN 978-3-540-26076-9. doi: 10.1007/11430919_71.

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 <- 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

```
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 NA.
D	A distance matrix between all the training instances. This matrix is used to construct the neighborhood graph.
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.
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.

Details

SetredG 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 setred method, please see [setred](#) function. Essentially, setred function is a wrapper of setredG function.

Value

A list object of class "setredG" 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)
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

# 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.idx") <- indexes
  m
}

gen.pred <- function(model, indexes) {
  tra.idx <- attr(model, "tra.idx")
  d <- D[indexes, tra.idx]
  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]

```

snnrce

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 missclassified examples.

Usage

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

Arguments

<code>x.inst</code>	A boolean value that indicates if <code>x</code> is or not an instance matrix. Default is <code>TRUE</code> .
<code>dist</code>	A distance function available in the <code>proxy</code> package to compute the distance matrix in the case that <code>x.inst</code> is <code>TRUE</code> .
<code>alpha</code>	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 missclassified 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.
 Knowledge-Based Systems, 23(6):547-554, 2010. ISSN 0950-7051. doi: <http://dx.doi.org/10.1016/j.knosys.2010.03.012>.

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

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)

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

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 use Semi supervised Decision Trees It can be used in classification or regression. If Y is numeric is for regression, classification in another case

Usage

```
SSLRRandomForest(
  mtry = NULL,
  trees = 500,
  min_n = NULL,
  w = 0.5,
  replace = TRUE,
  tree_max_depth = Inf,
  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
sampsize	Size of sample. Default if (replace) $nrow(x)$ else $\text{ceiling}(.632 * nrow(x))$
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(wine$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.

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.
 IEEE Transactions on Knowledge and Data Engineering, 17(11):1529-1541, Nov 2005. ISSN 1041-4347. doi: 10.1109/TKDE.2005. 186.

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	<i>Tri-training generic method</i>
--------------	------------------------------------

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.idx") <- indexes
  m
}

gen.pred <- function(model, indexes) {
  tra.idx <- attr(model, "tra.idx")
  d <- dtrain[indexes, tra.idx]
  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

General Interface for TSVM (Transductive SVM classifier using the convex concave procedure) model

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 C_{star} 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
C_{star}	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 maximimization
max_iter	integer; Maximum number of iterations
verbose	logical; print debugging messages, only works for vanilladot() kernel (default: FALSE)

References

Collobert, R. et al., 2006. Large scale transductive SVMs. *Journal of Machine Learning Research*, 7, pp.1687-1712.

Examples

```
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

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

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

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,
  ...,
  use_Xu_for_scaling = TRUE
)
```

Arguments

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

References

Shaffer, J.P., 1991. The Gauss-Markov Theorem and Random Regressors. *The American Statistician*, 45(4), pp.269-273.

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)

#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., $k(x,y) = \exp(-\text{gamma}^2 \ x-y\ ^2 / \text{avg})$ 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

Y.-F. Li, I. W. Tsang, J. T. Kwok, and Z.-H. Zhou. Scalable and Convex Weakly Labeled SVMs. *Journal of Machine Learning Research*, 2013.

R.-E. Fan, P.-H. Chen, and C.-J. Lin. Working set selection using second order information for training SVM. *Journal of Machine Learning Research* 6, 1889-1918, 2005.

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)

#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>

Index

- * **datasets**
 - abalone, 4
 - breast, 5
 - coffee, 15
 - wine, 81
- abalone, 4
- best_split, 4
- best_split, DecisionTreeClassifier-method, 5
- breast, 5
- calculate_gini, 6
- check_value, 6
- check_xy_interface, 7
- coBC, 7, 10, 43
- coBCCombine, 9
- coBCG, 10
- coBCReg, 12
- coBCRegG, 13
- coffee, 15
- COREG, 15, 43
- DecisionTreeClassifier-class, 16
- democratic, 16, 19, 44
- democraticCombine, 18
- democraticG, 19
- EMLeastSquaresClassifierSSLR, 20
- EMNearestMeanClassifierSSLR, 22
- EntropyRegularizedLogisticRegressionSSLR, 23
- fit.model_sslr, 24
- fit_decision_tree, 25
- fit_decision_tree, DecisionTreeClassifier-method, 25
- fit_random_forest, RandomForestSemisupervised-method, 26
- fit_x_u, 28
- fit_x_u.model_sslr, 28
- fit_xy.model_sslr, 27
- get_class_max_prob, 29
- get_class_mean_prob, 29
- get_function, 30
- get_function_generic, 30
- get_levels_categoric, 31
- get_most_frequented, 31
- get_value_mean, 31
- get_x_y, 32
- gini_or_variance, 32
- gini_prob, 33
- grow_tree, 33
- grow_tree, DecisionTreeClassifier-method, 34
- knn_regression, 34
- LaplacianSVMSSLR, 35
- LinearTSVMSSLR, 36
- load_parsnip, 37
- load_RANN, 38
- load_RSSL, 38
- MCNearestMeanClassifierSSLR, 38
- newDecisionTree, 40
- Node-class, 40
- nullOrNumericOrCharacter-class, 40
- oneNN, 41, 48
- predict, DecisionTreeClassifier-method, 41
- predict, RandomForestSemisupervised-method, 42
- predict.coBC, 42
- predict.COREG, 43
- predict.democratic, 44

predict.EMLeastSquaresClassifierSSLR,
44

predict.EMNearestMeanClassifierSSLR,
45

predict.EntropyRegularizedLogisticRegressionSSLR,
45

predict.LaplacianSVMSSLR, 46

predict.LinearTSVMSSLR, 46

predict.MCNearestMeanClassifierSSLR,
47

predict.model_sslr_fitted, 47

predict.OneNN, 48

predict.RandomForestSemisupervised_fitted,
48

predict.selfTraining, 49

predict.setred, 50

predict.snnrce, 50

predict.snnrceG, 51

predict.SSLRDecisionTree_fitted, 52

predict.triTraining, 52

predict.TSVMSSLR, 53

predict.USMLeastSquaresClassifierSSLR,
53

predict.WellSVMSSLR, 54

predict_inputs, 54

predict_inputs, DecisionTreeClassifier-method,
55

print.model_sslr, 55

RandomForestSemisupervised-class, 55

selfTraining, 49, 56, 59, 61–63, 66

selfTrainingG, 58

setred, 50, 61, 64

setredG, 63

snnrce, 51, 66

SSLRDecisionTree, 68

SSLRRandomForest, 69

SVM, 36

train_generic, 71

triTraining, 52, 53, 72, 74

triTrainingCombine, 73

triTrainingG, 74

TSVMSSLR, 77

USMLeastSquaresClassifierSSLR, 78

WellSVMSSLR, 80

wine, 81