

Package ‘FSelector’

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Type Package

Title Selecting Attributes

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BugReports <https://github.com/larskotthoff/fselector/issues>

URL <https://github.com/larskotthoff/fselector>

Description Functions for selecting attributes from a given dataset. Attribute subset selection is the process of identifying and removing as much of the irrelevant and redundant information as possible.

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Imports digest, entropy, randomForest, RWeka

Suggests mlbench, rpart

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FSelector-package	<i>Package for selecting attributes</i>
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Description

Package containing functions for selecting attributes from a given dataset and a destination attribute.

Details

This package contains:

- -Algorithms for filtering attributes: cfs, chi.squared, information.gain, gain.ratio, symmetrical.uncertainty, linear.correlation, rank.correlation, oneR, relief, consistency, random.forest.importance
- -Algorithms for wrapping classifiers and search attribute subset space: best.first.search, backward.search, forward.search, hill.climbing.search
- -Algorithm for choosing a subset of attributes based on attributes' weights: cutoff.k, cutoff.k.percent, cutoff.biggest.diff
- -Algorithm for creating formulas: as.simple.formula

Author(s)

Piotr Romanski
Maintainer: Lars Kotthoff <larsko@uwo.edu>

as.simple.formula	<i>Converting to formulas</i>
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Description

Converts character vector of attributes' names and destination attribute's name to a simple formula.

Usage

```
as.simple.formula(attributes, class)
```

Arguments

attributes	character vector of attributes' names
class	name of destination attribute

Value

A simple formula like "class ~ attr1 + attr2"

Author(s)

Piotr Romanski

Examples

```
data(iris)
result <- cfs(Species ~ ., iris)
f <- as.simple.formula(result, "Species")
```

best.first.search	<i>Best-first search</i>
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Description

The algorithm for searching attribute subset space.

Usage

```
best.first.search(attributes, eval.fun, max.backtracks = 5)
```

Arguments

attributes	a character vector of all attributes to search in
eval.fun	a function taking as first parameter a character vector of all attributes and returning a numeric indicating how important a given subset is
max.backtracks	an integer indicating a maximum allowed number of backtracks, default is 5

Details

The algorithm is similar to [forward.search](#) besides the fact that it chooses the best node from all already evaluated ones and evaluates it. The selection of the best node is repeated approximately `max.backtracks` times in case no better node found.

Value

A character vector of selected attributes.

Author(s)

Piotr Romanski

See Also[forward.search](#), [backward.search](#), [hill.climbing.search](#), [exhaustive.search](#)**Examples**

```

library(rpart)
data(iris)

evaluator <- function(subset) {
  #k-fold cross validation
  k <- 5
  splits <- runif(nrow(iris))
  results = sapply(1:k, function(i) {
    test.idx <- (splits >= (i - 1) / k) & (splits < i / k)
    train.idx <- !test.idx
    test <- iris[test.idx, , drop=FALSE]
    train <- iris[train.idx, , drop=FALSE]
    tree <- rpart(as.simple.formula(subset, "Species"), train)
    error.rate = sum(test$Species != predict(tree, test, type="c")) / nrow(test)
    return(1 - error.rate)
  })
  print(subset)
  print(mean(results))
  return(mean(results))
}

subset <- best.first.search(names(iris)[-5], evaluator)
f <- as.simple.formula(subset, "Species")
print(f)

```

cfs

CFS filter

Description

The algorithm finds attribute subset using correlation and entropy measures for continous and discrete data.

Usage

```
cfs(formula, data)
```

Arguments

formula	a symbolic description of a model
data	data to process

Details

The algorithm makes use of [best.first.search](#) for searching the attribute subset space.

Value

a character vector containing chosen attributes

Author(s)

Piotr Romanski

See Also

[best.first.search](#)

Examples

```
data(iris)

subset <- cfs(Species~., iris)
f <- as.simple.formula(subset, "Species")
print(f)
```

chi.squared

Chi-squared filter

Description

The algorithm finds weights of discrete attributes basing on a chi-squared test.

Usage

```
chi.squared(formula, data)
```

Arguments

formula	a symbolic description of a model
data	a symbolic description of a model

Details

The result is equal to Cramer's V coefficient between source attributes and destination attribute.

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski

Examples

```
library(mlbench)
data(HouseVotes84)

weights <- chi.squared(Class~., HouseVotes84)
print(weights)
subset <- cutoff.k(weights, 5)
f <- as.simple.formula(subset, "Class")
print(f)
```

consistency

Consistency-based filter

Description

The algorithm finds attribute subset using consistency measure for continuous and discrete data.

Usage

```
consistency(formula, data)
```

Arguments

formula	a symbolic description of a model
data	data to process

Details

The algorithm makes use of [best.first.search](#) for searching the attribute subset space.

Value

a character vector containing chosen attributes

Author(s)

Piotr Romanski

See Also

[best.first.search](#)

Examples

```
## Not run:
library(mlbench)
data(HouseVotes84)

subset <- consistency(Class~., HouseVotes84)
f <- as.simple.formula(subset, "Class")
print(f)

## End(Not run)
```

correlation

<i>Correlation filter</i>

Description

The algorithm finds weights of continuous attributes basing on their correlation with continuous class attribute.

Usage

```
linear.correlation(formula, data)
rank.correlation(formula, data)
```

Arguments

formula	a symbolic description of a model
data	data to process

Details

linear.correlation uses Pearson's correlation
rank.correlation uses Spearman's correlation
Rows with NA values are not taken into consideration.

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski

Examples

```
library(mlbench)
data(BostonHousing)
d=BostonHousing[-4] # only numeric variables

weights <- linear.correlation(medv~., d)
print(weights)
subset <- cutoff.k(weights, 3)
f <- as.simple.formula(subset, "medv")
print(f)

weights <- rank.correlation(medv~., d)
print(weights)
subset <- cutoff.k(weights, 3)
f <- as.simple.formula(subset, "medv")
print(f)
```

cutoff	<i>Cutoffs</i>
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Description

The algorithms select a subset from a ranked attributes.

Usage

```
cutoff.k(attrs, k)
cutoff.k.percent(attrs, k)
cutoff.biggest.diff(attrs)
```

Arguments

- attrs a data.frame containing ranks for attributes in the first column and their names as row names
- k a positive integer in case of cutoff.k and a numeric between 0 and 1 in case of cutoff.k.percent

Details

- cutoff.k chooses k best attributes
- cutoff.k.percent chooses best k * 100% of attributes
- cutoff.biggest.diff chooses a subset of attributes which are significantly better than other.

Value

A character vector containing selected attributes.

Author(s)

Piotr Romanski

Examples

```
data(iris)

weights <- information.gain(Species~., iris)
print(weights)

subset <- cutoff.k(weights, 1)
f <- as.simple.formula(subset, "Species")
print(f)

subset <- cutoff.k.percent(weights, 0.75)
f <- as.simple.formula(subset, "Species")
print(f)

subset <- cutoff.biggest.diff(weights)
f <- as.simple.formula(subset, "Species")
print(f)
```

entropy.based

Entropy-based filters

Description

The algorithms find weights of discrete attributes basing on their correlation with continous class attribute.

Usage

```
information.gain(formula, data, unit)
gain.ratio(formula, data, unit)
symmetrical.uncertainty(formula, data, unit)
```

Arguments

formula	A symbolic description of a model.
data	Data to process.
unit	Unit for computing entropy (passed to entropy . Default is "log".

Details

information.gain is

$$H(Class) + H(Attribute) - H(Class, Attribute)$$

.

gain.ratio is

$$\frac{H(Class) + H(Attribute) - H(Class, Attribute)}{H(Attribute)}$$

symmetrical.uncertainty is

$$2 \frac{H(Class) + H(Attribute) - H(Class, Attribute)}{H(Attribute) + H(Class)}$$

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski, Lars Kotthoff

Examples

```
data(iris)

weights <- information.gain(Species~., iris)
print(weights)
subset <- cutoff.k(weights, 2)
f <- as.simple.formula(subset, "Species")
print(f)

weights <- information.gain(Species~., iris, unit = "log2")
print(weights)

weights <- gain.ratio(Species~., iris)
print(weights)
subset <- cutoff.k(weights, 2)
f <- as.simple.formula(subset, "Species")
print(f)

weights <- symmetrical.uncertainty(Species~., iris)
print(weights)
subset <- cutoff.biggest.diff(weights)
f <- as.simple.formula(subset, "Species")
print(f)
```

exhaustive.search	<i>Exhaustive search</i>
-------------------	--------------------------

Description

The algorithm for searching attribute subset space.

Usage

```
exhaustive.search(attributes, eval.fun)
```

Arguments

attributes	a character vector of all attributes to search in
eval.fun	a function taking as first parameter a character vector of all attributes and returning a numeric indicating how important a given subset is

Details

The algorithm searches the whole attribute subset space in breadth-first order.

Value

A character vector of selected attributes.

Author(s)

Piotr Romanski

See Also

[forward.search](#), [backward.search](#), [best.first.search](#), [hill.climbing.search](#)

Examples

```
library(rpart)
data(iris)

evaluator <- function(subset) {
  #k-fold cross validation
  k <- 5
  splits <- runif(nrow(iris))
  results = sapply(1:k, function(i) {
    test.idx <- (splits >= (i - 1) / k) & (splits < i / k)
    train.idx <- !test.idx
    test <- iris[test.idx, , drop=FALSE]
    train <- iris[train.idx, , drop=FALSE]
    tree <- rpart(as.simple.formula(subset, "Species"), train)
    error.rate = sum(test$Species != predict(tree, test, type="c")) / nrow(test)
  })
}
```

```

        return(1 - error.rate)
    })
    print(subset)
    print(mean(results))
    return(mean(results))
}

subset <- exhaustive.search(names(iris)[-5], evaluator)
f <- as.simple.formula(subset, "Species")
print(f)

```

greedy.search

Greedy search

Description

The algorithms for searching attribute subset space.

Usage

```
backward.search(attributes, eval.fun)
forward.search(attributes, eval.fun)
```

Arguments

<code>attributes</code>	a character vector of all attributes to search in
<code>eval.fun</code>	a function taking as first parameter a character vector of all attributes and returning a numeric indicating how important a given subset is

Details

These algorithms implement greedy search. At first, the algorithms expand starting node, evaluate its children and choose the best one which becomes a new starting node. This process goes only in one direction. `forward.search` starts from an empty and `backward.search` from a full set of attributes.

Value

A character vector of selected attributes.

Author(s)

Piotr Romanski

See Also

[best.first.search](#), [hill.climbing.search](#), [exhaustive.search](#)

Examples

```

library(rpart)
data(iris)

evaluator <- function(subset) {
  #k-fold cross validation
  k <- 5
  splits <- runif(nrow(iris))
  results = sapply(1:k, function(i) {
    test.idx <- (splits >= (i - 1) / k) & (splits < i / k)
    train.idx <- !test.idx
    test <- iris[test.idx, , drop=FALSE]
    train <- iris[train.idx, , drop=FALSE]
    tree <- rpart(as.simple.formula(subset, "Species"), train)
    error.rate = sum(test$Species != predict(tree, test, type="c")) / nrow(test)
    return(1 - error.rate)
  })
  print(subset)
  print(mean(results))
  return(mean(results))
}

subset <- forward.search(names(iris)[-5], evaluator)
f <- as.simple.formula(subset, "Species")
print(f)

```

hill.climbing.search *Hill climbing search*

Description

The algorithm for searching attribute subset space.

Usage

```
hill.climbing.search(attributes, eval.fun)
```

Arguments

<code>attributes</code>	a character vector of all attributes to search in
<code>eval.fun</code>	a function taking as first parameter a character vector of all attributes and returning a numeric indicating how important a given subset is

Details

The algorithm starts with a random attribute set. Then it evaluates all its neighbours and chooses the best one. It might be susceptible to local maximum.

Value

A character vector of selected attributes.

Author(s)

Piotr Romanski

See Also

[forward.search](#), [backward.search](#), [best.first.search](#), [exhaustive.search](#)

Examples

```
library(rpart)
data(iris)

evaluator <- function(subset) {
  #k-fold cross validation
  k <- 5
  splits <- runif(nrow(iris))
  results = sapply(1:k, function(i) {
    test.idx <- (splits >= (i - 1) / k) & (splits < i / k)
    train.idx <- !test.idx
    test <- iris[test.idx, , drop=FALSE]
    train <- iris[train.idx, , drop=FALSE]
    tree <- rpart(as.simple.formula(subset, "Species"), train)
    error.rate = sum(test$Species != predict(tree, test, type="c")) / nrow(test)
    return(1 - error.rate)
  })
  print(subset)
  print(mean(results))
  return(mean(results))
}

subset <- hill.climbing.search(names(iris)[-5], evaluator)
f <- as.simple.formula(subset, "Species")
print(f)
```

Description

The algorithms find weights of discrete attributes basing on very simple association rules involving only one attribute in condition part.

Usage

```
oneR(formula, data)
```

Arguments

formula	a symbolic description of a model
data	data to process

Details

The algorithm uses OneR classifier to find out the attributes' weights. For each attribute it creates a simple rule based only on that attribute and then calculates its error rate.

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski

Examples

```
library(mlbench)
data(HouseVotes84)

weights <- oneR(Class~., HouseVotes84)
print(weights)
subset <- cutoff.k(weights, 5)
f <- as.simple.formula(subset, "Class")
print(f)
```

random.forest.importance

RandomForest filter

Description

The algorithm finds weights of attributes using RandomForest algorithm.

Usage

```
random.forest.importance(formula, data, importance.type = 1)
```

Arguments

formula	a symbolic description of a model
data	data to process
importance.type	either 1 or 2, specifying the type of importance measure (1=mean decrease in accuracy, 2=mean decrease in node impurity)

Details

This is a wrapper for [importance](#).

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski

Examples

```
library(mlbench)
data(HouseVotes84)

weights <- random.forest.importance(Class~, HouseVotes84, importance.type = 1)
print(weights)
subset <- cutoff.k(weights, 5)
f <- as.simple.formula(subset, "Class")
print(f)
```

relief

RReliefF filter

Description

The algorithm finds weights of continous and discrete attributes basing on a distance between instances.

Usage

```
relief(formula, data, neighbours.count = 5, sample.size = 10)
```

Arguments

formula	a symbolic description of a model
data	data to process
neighbours.count	number of neighbours to find for every sampled instance
sample.size	number of instances to sample

Details

The algorithm samples instances and finds their nearest hits and misses. Considering that result, it evaluates weights of attributes.

Value

a data.frame containing the worth of attributes in the first column and their names as row names

Author(s)

Piotr Romanski

References

- -Igor Kononenko: Estimating Attributes: Analysis and Extensions of RELIEF. In: European Conference on Machine Learning, 171-182, 1994.
- -Marko Robnik-Sikonja, Igor Kononenko: An adaptation of Relief for attribute estimation in regression. In: Fourteenth International Conference on Machine Learning, 296-304, 1997.

Examples

```
data(iris)

weights <- relief(Species~., iris, neighbours.count = 5, sample.size = 20)
print(weights)
subset <- cutoff.k(weights, 2)
f <- as.simple.formula(subset, "Species")
print(f)
```

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