Package ‘FSelector’

August 29, 2016

Type    Package
Title   Selecting Attributes
Version 0.21
Date    2016-06-29
Author  Piotr Romanski, Lars Kotthoff
Maintainer Lars Kotthoff <larsko@cs.ubc.ca>
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.
License GPL-2
Imports randomForest, RWeka, digest, entropy
Suggests mlbench, rpart
LazyLoad yes
NeedsCompilation no
Repository CRAN
Date/Publication 2016-06-30 17:56:47

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FSelector-package

Package for selecting attributes

Description

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

Details

Package: FSelector
Type: Package
Version: 0.19
Date: 2013-02-28
License: GPL
LazyLoad: yes

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
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as.simple.formula

Converting to formulas

Description

Converts character vector of attributes’ names and destination attribute’s name to a simple formula.
best.first.search

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**  
*Best-first search*

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

```r
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 continuous and discrete data.
**Usage**

```r
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**

```r
data(iris)

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

---

**Description**

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

**Usage**

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

**Arguments**

- `formula`: a symbolic description of a model
- `data`: a symbolic description of a model
consistency

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)

Description
The algorithm finds attribute subset using consistency measure for continous 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
correlation

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

Correlation filter

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

```r
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

<table>
<thead>
<tr>
<th>cutoff</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The algorithms select a subset from a ranked attributes.</td>
</tr>
</tbody>
</table>

Usage

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

Arguments

<table>
<thead>
<tr>
<th>attr</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attrs</td>
<td>a data.frame containing ranks for attributes in the first column and their names as row names</td>
</tr>
<tr>
<td>k</td>
<td>a positive integer in case of cutoff.k and a numeric between 0 and 1 in case of cutoff.k.percent</td>
</tr>
</tbody>
</table>

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.
entropy.based

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 continuous 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

\[
\text{information.gain is} \\
H(\text{Class}) + H(\text{Attribute}) - H(\text{Class, Attribute})
\]

\[
\text{gain.ratio is} \\
\frac{H(\text{Class}) + H(\text{Attribute}) - H(\text{Class, Attribute})}{H(\text{Attribute})}
\]

\[
\text{symmetrical.uncertainty is} \\
\frac{2H(\text{Class}) + H(\text{Attribute}) - H(\text{Class, Attribute})}{H(\text{Attribute}) + H(\text{Class})}
\]

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  Exhaustive search

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)
  })
  error.rate
}
greedy.search

Description

The algorithms for searching attribute subset space.

Usage

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

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

```r
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)
```

Description

The algorithm for searching attribute subset space.

Usage

```r
hill.climbing.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 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]
    train <- iris[train.idx]
    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)

---

OneR

OneR algorithm

Description

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

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 continuous 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
relief

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


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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