Package ‘msr’

November 12, 2015

Version 0.4.4

Date 2015-11-08

Author Samuel Gerber <sgerber@uoregon.edu>,
Kristi Potter <kpotter@sci.utah.edu>,
Oliver Ruebel <ruebel1@llnl.gov>

Maintainer Samuel Gerber <sgerber@uoregon.edu>

Description Discrete Morse-Smale complex approximation based on kNN graph. The Morse-Smale complex provides a decomposition of the domain. This package provides methods to compute a hierarchical sequence of Morse-Smale complicies and tools that exploit this domain decomposition for regression and visualization of scalar functions.

Title Morse-Smale Approximation, Regression and Visualization

Depends R (>= 2.10)

Imports glmnet, e1071, rgl, RColorBrewer, colorspace, stats, grDevices

License GPL-2

Repository CRAN

NeedsCompilation yes

Date/Publication 2015-11-12 12:58:25

R topics documented:

`msr-package` *Data Analysis with the Morse-Smale Complex*

Description

Discrete Morse-Smale complex approximation based on k-NN graph. The Morse-Smale complex provides a decomposition of the domain. This package provides methods to compute a hierarchical sequence of Morse-Smale complicies and tools that exploit this domain decomposition for regression and visualization of scalar functions.

Details

The core functionality rests on the discrete approximation of the Morse-Smale complex from a sample of a function (see `msc.nn`, `msc.nn.svm`, `msc.nn.kd`.

Based on this functionality the regression approach in [2] (see `msc.lm` and `msc.slm`) and the explorartory data anlsysis approach based on the visualization in [3] (see `plot.msc`) is implemented.

Author(s)

Samuel Gerber, Kristi Potter, Oliver Ruebel

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

David M. Mount and Sunil Arya ANN library http://www.cs.umd.edu/~mount/ANN/

See Also

`msc.nn` `msc.nn.svm` `msc.nn.kd` `predict.msc` `plot.msc` `msc.lm` `msc.elnet` `msc.slm`, `msc.slm.elnet`,

camera_estimation *Energy Function of a Camera Estimation Problem*

Description

Given two images with point correspondences, the goal is to estimate the translation and rotation of two calibrated cameras. This problem can be formulated as a minimization of the total squared algebraic error:

$h(R, t) = f(E) = \sum_i (x_i^T E x_i')^2$

with $x_i = [x_{i1} x_{i2} 1]^T$ and $x_i' = [x_{i1}' x_{i2}' 1]^T$ being corresponding points on the image plane defined in the respective camera coordinates. The essential matrix $E = [t]_\times R$ is a 3 x 3 rank-2 matrix. In this formulation, the translation between the two cameras is described by the unit vector t, and the relative camera orientation is defined by the orthogonal rotation matrix R. Both t and R are expressed in the coordinate frame of x. Due to the formulation of the problem, E is guaranteed to have only 5 degrees of freedom: 3 to describe the rotation and 2 to determine the translation up to scale. Hence, h is defined on a 5D manifold embedded in 9D space. For more detailed information on the definition of this problem, see the manuscript by.

Usage

```
energy
```

Author(s)

Samuel Gerber

References

Peter Lindstrom and Mark Duchaineau, Factoring Algebraic Error for Relative Pose Estimation, Lawrence Livermore National Laboratory, LLNL-TR-411194, Mar. 2009

Examples

```
data(camera_estimation)
summary(energy)
```

diagonal *Diagonal Function*

Description

Diagonal Function, cosine along the diagonal of a d-dimensional hypercube with exponential enevlope orthogonal to diagonal.

$f(x) = \frac{1}{2}\cos(\frac{\sqrt(<x,v>)}{\sqrt(d) p\pi})\exp(\frac{||x||^2 - <x,v>}{d})$ with $v = \frac{\mathbf{1}}{\sqrt(d)}$the unit length digonal vector .

Value

returns N samples form the diagonal function

Author(s)

Samuel Gerber

Examples

```
data(diagonal)

d <- diagonal()

d <- diagonal(d = 3, p = 4, N=2000)
```

`fourpeaks` *Fourpeaks Function*

Description

Fourpeaks is a two-dimensional, additively separable function of four Gaussian peaks $f(x) = \frac{1}{2}\left(e^{-(x_1-\frac{1}{4})^2/0.3^2} + e^{-(x_2-\frac{1}{4})^2/0.3^2} + e^{-(x[,1]-\frac{3}{4})^2/0.1^2} + e^{-(x_2-\frac{3}{4})^2/0.1^2}\right)$. On $[0,1]^2$ the function has 4 maxima and 9 minima

Value

returns N samples form the fourpeaks function

Author(s)

Samuel Gerber

Examples

```
data(fourpeaks)

d <- fourpeaks()

d <- fourpeaks(2000)

d <- fourpeaks(N=2000, phi=pi/4)
```

msc.level.ind *Compute Indicies for Morse Smale Complex Level*

Description

For a given partition id, compute the indices into ms$x belonging to this partition based on a given Morse-Smale complex `msLevel`.

Usage

```
msc.level.ind(msLevel, pId, addExtrema=TRUE)
```

Arguments

`msLevel`	Morse-Smale complex level object.
`pId`	Partition id number to compute indices for.
`addExtrema`	Add the extrema indices of this parttion (default TRUE)

Value

The indicies into `ms$x` for crystal index.

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

See Also

`msc.nn`

Examples

```
data(fourpeaks)
d <- fourpeaks()
ms <- msc.nn(y=d[,1], x=d[, 2:3], knn=10, pLevelP = 0.1)
#compute the indices belonging to partition Id 2 at Morse-Smale persistence
ind <- msc.level.ind(ms$level[[1]], 2)

ms <- msc.nn(y=d[,1], x=d[, 2:3], knn=10, nLevels=10)
#compute the indices belonging to partition Id 2 at Morse-Smale persistence level 3
ind <- msc.level.ind(ms$level[[3]], 2)
```

---

msc.lm *Morse Smale Complex Linear Regression*

Description

Piecewise linear regression on the decomposition of the domain based on the partion induced by the Morse-Smale complex. For `msc.elnet` an elastic net is fitted insetad of a simple lienar regression.

For prediction the linear model are either avergaed based on weighting the contributions from each partition for a predicting point or predicted based on the linear model corresponding to the highest partition probability. The weights for each partition are computed depending on the underlying Morse-Smale complex type (see `msc.nn`). The functions can be called with `msc.nn` without predictive capacities, then prediction of unseen data is not supported.

Usage

```
msc.lm(ms, nfold = 10, modelSelect=FALSE, blend=FALSE, verbose=FALSE)
msc.elnet(ms, nfold = 10, blend=FALSE)
```

Arguments

`ms`	A Morse-Smale complex object, see `msc.nn`.
`nfold`	Number of folds for crossvlaidation, used for selecting an appropriate persitence level if the underlying Morse-Smale complex objects has multiple levels.
`modelSelect`	Do a forward stepwise model selection for each linear model (for each parttion ther eis on linear model)
`blend`	Use blending for model preidtcion. FALSE results in pecewise linear model.
`verbose`	Print model fitting information

Value

An object of class `c("msc.lm")` or `c("msc.elnet")`, that can be used for prediction with `predict`.

The object `c("msc.lm")` has the following components:

`ms`	The Morse-Smale complex, see `msc.nn`
`lms`	The linear models and crossvalidation results for each level in ms.

blend Use blending for model prediction.

The object `c("msc.elnet")` has the following components:

ms The Morse-Smale complex, see msc.nn

elnet The elastic net models and crossvalidation results for each level in ms.

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

See Also

msc.nn, predict.msc.lm, glmnet

Examples

```
#create Morse-Smale complex  regression of fourpeaks2d data set
data(fourpeaks)
d <- fourpeaks()
#build Morse-Smale complex
ms <- msc.nn.svm(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 10)
msr <- msc.lm(ms)
#show slected persitence level by cross validtaion
msr$ms$predictLevel
#print mean squared crossvalidated error
msr$lms[[msr$ms$predictLevel]]$cv
#predict
fp <- predict(msr, d[, 2:3])

#fit an elastic model insteaed
msr <- msc.elnet(ms)
#prediction for ealstic model
fp <- predict(msr, d[, 2:3])
```

msc.nn *Nearest Neighbor Morse Smale Complex*

Description

Compute a hierarchy of Morse-Smale complex of the scattered data x using a neareast neighbor based approach at the requested persistence levels. The persistence is a threshold for merging neighboring extrema. If the difference of lower function value of the extrema and the saddle connecting them is below `persistence` the extrema are merged. The `msc.nn.svm` and `msc.nn.kd` construct Morse-Smale complex that allow probabilistic preditcion (using `predict`) pf the partion assignment of unseen data points, see also `predict.msc`. The nearest neighbor computation uses the ANN library by David M. Mount and Sunil Arya (`http://www.cs.umd.edu/~mount/ANN/`).

Usage

```
msc.nn(y, x, knn = ncol(x), pLevelP = 0.2, pLevel,
       nLevels, type = 1, smooth = FALSE, eps=0.01)
msc.nn.kd(y, x, knn = ncol(x)*3, pLevelP = 0.2, pLevel, nLevels,
          bw, type = 1, smooth = FALSE, eps=0.01)
msc.nn.svm(y, x, knn = 3*ncol(x), pLevelP = 0.2, pLevel, nLevels,
           cost = 1,  type = 1, smooth=FALSE, precompute = FALSE, eps=0.01 )
msc.graph(y, x, knn, knnd, nLevels, smooth = FALSE)
```

Arguments

`y`	Function values at observations x. A numeric vector is expected.
`x`	Observations, a numeric marix is expected.
`knn`	Number of nearest neighbors for graph computation or matrix with nn indicies
`knnd`	Squared nearest nieghbor distances has to be same size as knn
`pLevel`	Compute the Morse-Smale complex for a single persistence level given by pLevel. Here, extrema with persistence less than `pLevel` are ignored.
`pLevelP`	Same as pLevel, but instead of an absolute persistence value, the persistence level is expressed as a percentage of `max(y) - min(y)`
`nLevels`	If specified computes a hierarchical sequence of Morse-Smale complicies for 2 to `nLevels`$+1$ extrema. I.e. from the highest persistence level with a single minimum and maximum to a persitence level with `nLevels`$+1$ extrema.
`type`	If 1 use classical persistence for merging based on function value difference at saddle points. For other valuse use R^2 measure, i.e. merge partitions that results in the most increase in adj. R^2 value.
`smooth`	If the data is very noise many extrema are introduced. If `smooth` is set to true the steepest ascent/descent is not computed based on the raw function values y but based on the function value obtained by averaging the function values of the k neareast neighbors. Effectively, a smoothing of the observed function.

eps — The knn computation is based on an approximation. The parameter eps specifices how close the approximation should be, i.e, the ratio of distance to approximate neareast neighbor to true neareast neigbor is at most $1 + $ eps (see the ANN webpage for more details http://www.cs.umd.edu/~mount/ANN/)

bw — Bandwidth for kernel density estimation in each partition.

precompute — Indicates for each level the SVM should be computed and stored. This is useful for speedup if repeated predictions at different levels are required.

cost — Cost for svm for partition classification (see also svm).

Value

An object of class "msc", "msc.kd" or "msc.svn" with the following components:

level — Containing the Morse-Smale complex at each persistence level.

persistence — Sorted persistence levels at which two extrema merge.

predictLevel — For the plot.msc, predict.msc methods the persistence level of the Morse-Smale hierarchy at which prediction/plotting is done

nLevels — number of persistence levels computed, if pLevel or pLevelP is specified this will be 1.

with "msc$level" the following components:

mins — Indicies into x of mimima for each partition.

maxs — Indicies into x of maxmima for each partition.

partition — Partition assignment for each observation in x

partitionSize — Number of points in each partition

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

David M. Mount and Sunil Arya ANN library http://www.cs.umd.edu/~mount/ANN/

See Also

predict.msc plot.msc msc.lm msc.elnet msc.slm, msc.slm.elnet,

Examples

```
data(fourpeaks)
d <- fourpeaks()

#build Morse-Smale complex of m
ms <- msc.nn(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 15)
ms.kd <- msc.nn.kd(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 15, bw=0.1)
ms.svm <- msc.nn.svm(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 15)

#predict partition assignments
p1 <- predict(ms.kd, d[, 2:3])
p2 <- predict(ms.svm, d[, 2:3])
```

---

msc.slm *Morse Smale Complex Simultaneous Linear Regression*

Description

Fit a simoultaneous linear model using the Morse-Smale decomposition of the domain. For each crystal a new varibale is introduced, each observation for the variables is weighted by the weight of belonging to that crystal. The weights are computed depening on the underlying Morse-Samle complex type (see `msc.nn`).

Usage

```
msc.slm(ms, nfold = 10, modelSelect = FALSE)
msc.slm.elnet(ms, nfold = 10)
```

Arguments

ms	A Morse-Smale complex object, see `msc.nn`.
nfold	Number of folds for crossvlaidation, used for selecting an appropriate persitence level if the underlying Morse-Smale complex objects has multiple levels.
modelSelect	Do a forward stepwise model selection for each linear model (for each parttion ther eis on linear model)

Value

An object of class `c("msc.slm")`, that can be used for prediction with `predict`.

The object has the following components:

ms	The Morse-Smale complex, see `msc.nn.kd`
slm	The linear model based on the weighted observation and variables for each crystals.

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

See Also

predict.msc.slm msc.nn, glmnet

Examples

```
#create Morse-Smale complex  regression of fourpeaks2d data set
data(fourpeaks)
d <- fourpeaks()
#build Morse-Smale complex
ms <- msc.nn.svm(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 10)
#build model using Morse-Smale decomposition ms
msr <- msc.slm(ms)
#print simultaneous linear model cv error
msr$slm[[msr$ms$predictLevel]]$cv
#predict for all data points
fp <- predict(msr, d[, 2:3])

#use elastic net for fitting instead
msr <- msc.slm.elnet(ms)
fp <- predict(msr, d[, 2:3])
```

---

msc.sublevels *Extract levels from Morse Smale Complex*

Description

Extract a subset of the levels of the current hierarchical levels of the Morse-Smale complex. This is usefull to save computational time for example for building regression models for only a single or smaller range sof persistence level of the Morse-Samle hierarchy.

Usage

```
msc.sublevels(ms, startLevel = ms$predictLevel, endLevel = startLevel)
```

Arguments

ms	Morse-Smale complex object
startLevel	First Level to include in the new hierarchy
endLevel	Last level to include in the new hierarchy

Value

An object of class msc with hierarchy levels from startLevel to endLevel of the input Morse-Smale object.

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

Examples

```
data(fourpeaks)
d <- fourpeaks()

#build Morse-Smale complex of m
ms <- msc.nn(y=d[, 1], x=d[, 2:3], nLevels = 15, knn = 15)

#extract levels 9 through 14
ms <- msc.sublevels(ms, 9, 14)
```

---

plot.msc *Visualization of the Morse-Smale Summary of High-Dimensional Scalar Functions*

Description

Visualize the Morse-Smale summary description of a high-dimensional scalar function $y = f(\mathbf{x})$ with parameters $\mathbf{x} \in R^n$. For each partition of the Morse-Smale complex, an inverse regression curve is computed that summarizes the domain in that partition. This forms a network of regression curves that connect the extremal points of the function. This network is then embedded in 2D for visualization. The function value of the regression curves is encoded by color and by height in the 3rd dimension for each regression curve. Optional tubes around the regression curves indicate the standard deviation along the curve, representing the approximate extent of the partition. An additional window plots the regression curve for each parameter in $\mathbf{x}$, which allows to examine the behaviour of each partition. Users can select, by mouse-click on the corresponding regression curve, which partitions the plots of the underlying parameters will be shown. In addition, a subset of the parameters $\mathbf{x}$ can be selected using `mscPlot$plotList`.

Usage

```
## S3 method for class 'msc'
plot(x, drawStdDev=FALSE, span=0.5, nsamples=50,
plot=TRUE, colorMap=0, ...)
## S3 method for class 'msc.kd'
plot(x, drawStdDev=FALSE, span=0.5, nsamples=50,  plot=TRUE, colorMap=0, ...)
## S3 method for class 'msc.svm'
plot(x, drawStdDev=FALSE, span=0.5, nsamples=50,
plot=TRUE,  colorMap=0, ...)
## S3 method for class 'mscPlot'
plot(x, drawStdDev=FALSE, axesOn=TRUE, ...)
```

Arguments

`x`	The Morse-Smale complex object for `plot.msc` or the `mscPlot` object for `plot.mscPlot`.
`drawStdDev`	Draw the standard deviation tubes around the plots (default FALSE).
`axesOn`	Draw the alignment axes (default TRUE).
`nsamples`	NUmber of samples for piecewise linear approximation to regression curve in each partition
`span`	Span argument of `loess` for computIng regression curves
`plot`	Show visualization (TRUE) or just return the plotting object (FALSE)
`colorMap`	The choice of colormap. 0 = Blue-Green-Red, 1 = Blue-White-Red, 2 = Purple-White-Green
`...`	additional args have no effect

Value

An object of class `mscPlot` is used to plot the Morse-Smale summary and allows to manipulate the plotting behaviour. The object `mscPlot` has the following components:

`geom`	which describes the geometry of the summary.
`scene`	which describes the components of the visualization scene.
`plotList`	which defines the specific plots to compare. This is a list containing the plot numbers.

Author(s)

Kristin Potter and Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

See Also

`msc.nn`, `msc.nn.svm`, `msc.nn.kd`

Examples

```
data(fourpeaks)
d <- fourpeaks()

#Build Morse-Smale complex of d
ms <- msc.nn(y=d[,1], x=d[, 2:3], pLevel=0.1, knn = 15)

# Plot the ms summary
p <- plot(ms)

# Change the plots to compare
p$plotList <- c(1)

# Re-plot the summary
plot(p)
```

---

predict.msc — *Preditcion of partition probabilites of Morse-Smale Complex or regression prediction for Morse-Smale regression models*

Description

For `msc.kd` and `msc.svm` ompute probabilities for each crystal in the Morse-Smale complex for each point in X based on a kernel density estimat or and one-against all `svm`. For `msc.lm`,`msc.slm` and `msc.slm.elnet` the prediction based on the fitted regression models.

Usage

```
## S3 method for class 'msc.kd'
predict(object, newdata, addExtrema=TRUE, ...)
## S3 method for class 'msc.svm'
predict(object, newdata, ...)
## S3 method for class 'msc.lm'
predict(object, newdata, ...)
## S3 method for class 'msc.slm'
predict(object, newdata, ...)
## S3 method for class 'msc.slm.elnet'
predict(object, newdata, ...)
```

Arguments

`object`	Morse-Smale complex object.
`newdata`	Observations to predict, if missing the sample form the Morse-Smale complex are used.
`addExtrema`	Add the extrema indices of this partion (default TRUE)
`...`	Further arguments are ignored in these functions

Value

For Morse-Smale complex objects a (number of points) x (number of partitions) matrix with probabilities $p(C_i|x)$ of belonging to each crystal. For regression model objects the predicted function values.

Author(s)

Samuel Gerber

References

[1] Samuel Gerber and Kristin Potter The Morse-Smale Complex for Data Analysis, Journal of Statistical Software, 2012, vol. 50, no. 2, pp 1-22

[2] Samuel Gerber, Oliver Ruebel Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Morse-Smale Regression, Journal of Computational and Graphical Statistics, 2012

[3] Samuel Gerber, Peer-Timo Bremer, Valerio Pascucci, Ross Whitaker, Visual Exploration of High Dimensional Scalar Functions, IEEE Transactions on Visualization and Computer Graphics, vol. 16, no. 6, pp 1271-1280, Nov.-Dec. 2010.

David M. Mount and Sunil Arya ANN library http://www.cs.umd.edu/~mount/ANN/

See Also

`msc.nn` `msc.lm` `msc.slm`

Examples

```
data(fourpeaks)
d <- fourpeaks()
#build Morse-Smale complex
ms <- msc.nn.svm(y=d[,1], x=d[, 2:3], nLevels=15, knn = 10)
#predict parttion assignments at level 15
ms$predictLevel = 13
p <- predict(ms, d[, 2:3])
```

---

uci_crime_subset *UCI coummunity and crimes subset*

Description

Subset of the UCI communities and crime data set~http://archive.ics.uci.edu/ml/datasets/Communities+and+Crime. The data set contains 100 variables, with some of the original values with many missing values removed.

From the UCI website:\ Communities within the United States. The data combines socio-economic data from the 1990 US Census, law enforcement data from the 1990 US LEMAS survey, and crime data from the 1995 FBI UCR.

More detail on the individual variables can be found on the website.

Usage

```
crimes
```

Author(s)

Samuel Gerber

Examples

```
data(uci_crime_subset)
summary(crimes)
```

Index