Package ‘SearchTrees’

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Type Package
Title Spatial Search Trees
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Description This package provides an implementation of the QuadTree data structure. It uses this to implement fast k-Nearest Neighbor and Rectangular range lookups in 2 dimensions. The primary target is high performance interactive graphics.

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createTree

Create a Search Tree Index

Description
Create a search tree from the supplied data for use in during future lookups.

Usage
createTree(data, treeType = "quad", dataType = "point", columns = if (dataType == "point") 1:2 else 1:4, ...)

Arguments
- data: data.frame or matrix. Data to be indexed.
- treeType: Character. Indicates type of index tree to be created. Currently only "quad" (quad trees) is supported.
- dataType: Character. Indicates type of data being indexed. Currently "point", and "rect" are supported corresponding to points and rectangles, respectively. Defaults to "point".
- columns: Numeric. Indicates columns in data the information to be indexed can be found. Length depends on value of dataType (2 for "point" and 4 for "rect"). Defaults to columns 1 and 2. See Details.
- ...: Any additional/type specific parameters to be passed to the tree creation function. These include:
  - minNodeArea: Numeric. Minimum (rectangular) area to be represented by a single node. When set, this overrides maxDepth

Details
For a point based tree, the two columns specified in columns represent the x and y values of the points.
For a rectangle based tree, four columns must be specified. These columns represent the x and y coordinates of point 1 and the x and y coordinates of point 2, in that order (where point 1 and point 2 specify the rectangle to be stored).

Value
The class of the returned object depends on the tree type created, though all will inherit from the SearchTree S4 class and have the following slots:
- ref: An external pointer to the C level data structure.
- numNodes: Total number of nodes comprising the tree.
- dataNodes: Number of nodes which store at least one data point.
- maxDepth: Maximum depth of the tree.
knfLookup

maxBucket        Maximum number of data points stored in a single node.
totalData       Number of items indexed in the tree.
dataType        Type of objects stored in the tree.

Author(s)

Gabriel Becker

References


See Also

SearchTree linkS4Class(QuadTree)

Examples

x = rnorm(100)
y = rnorm(100)
dat = cbind(x,y)
tree = createTree(dat)

knnLookup(tree, newx, newy, newdat, columns = 1:2, k = 5)

Description

This function performs fast k-Nearest Neighbors lookup on a SearchTree object

Usage

knnLookup(tree, newx, newy, newdat, columns = 1:2, k = 5)

Arguments

tree         An object which inherits from the SearchTree S4 class.
newx         Numeric. Vector of x values for the points to look up neighbors for.
newy         Numeric. Vector of x values for the points to look up neighbors for.
newdat       Matrix or data.frame. Data containing x and y values of the points to look up neighbors for. Ignored if x and y are specified.
columns      Numeric. Columns x and y values can be found in within newdat.
k            Numeric. Number of neighbors to find for each point.
Value

The return value is an integer matrix indicating the indices in the original data used to create treE where the nearest neighbors were found. Row indicates the indice of the new point, while column indicates the order of the k neighbors.

Note

No defined order is specified for exact ties in distance.

Author(s)

Gabriel Becker

See Also

createtree rectLookup

Examples

```r
x = rnorm(100)
y = rnorm(100)
tree = createTree(cbind(x,y))
newx = c(0, .5)
newy = c(.5, 0)
inds = knnLookup(tree, newx, newy, k=7)

ch = rep(1, times=100)
ch[inds[1:7]] = 3
ch[inds[8:14]] = 5
cls = rep("black", times=100)
cls[inds[1:7]] = "red"
cls[inds[8:14]] ="blue"

plot(x,y, pch=ch, col = cls)
abline(v=newx[1], h = newy[1], col="red")
abline(v=newx[2], h = newy[2], col = "blue")
```

---

**knnLookup-methods**

~~ Methods for Function knnLookup in Package SearchTrees ~~

Description

~~ Methods for function knnLookup in package SearchTrees ~~

Methods

signature(tree = "QuadTree")
Description
A class representing a Quad Tree object for storing 2 dimensional points for efficient rectangular range and knn lookup.

Objects from the Class
Objects can be created by calls of the form new("QuadTree", ...).

Slots
- `ref`: Object of class "externalptr" Pointer to the internal representation of the tree
- `numNodes`: Object of class "integer" Number of nodes in the tree
- `dataNodes`: Object of class "integer" Number of nodes in the tree which are storing data
- `maxDepth`: Object of class "integer" Maximum depth of the tree.
- `maxBucket`: Object of class "integer" Maximum number of data points which are stored at a single node
- `totalData`: Object of class "integer" Number of objects stored in the tree
- `dataType`: Object of class "character" Indicates type of data stored in the tree.

Extends
Class "SearchTree", directly.

Methods
- `knnLookup` signature(tree = "QuadTree"): ...
- `rectLookup` signature(tree = "QuadTree"): ...

Note
When using createIndex to create a quadTree, only two columns of the matrix/data.frame passed to the function will be used to create the tree. See the columns argument in `createTree`

Author(s)
Gabriel Becker

See Also
- `createTree`

Examples
```r
showClass("QuadTree")
```
rectLookup

Perform Rectangular Lookup in 2d Space

Description

Determine which objects, stored in a SearchTrees indexing object, fall within a given rectangle in two-dimensional space.

Usage

rectLookup(tree, ptOne, ptTwo, xlims, ylims)

Arguments

tree

SearchTree. A SearchTree object to perform the lookup on.

ptOne

Numeric. A numeric of length two indicating x and y values for one corner of the rectangle.

ptTwo

Numeric. A numeric of length two indicating x and y values for the corner of the rectangle opposite to ptOne

xlims

Numeric. A numeric vector indicating the minimum and maximum x value for the rectangle. Overrides ptOne and ptTwo

ylims

Numeric. A numeric vector indicating the minimum and maximum y value for the rectangle. Overrides ptOne and ptTwo

Details

In the case of lookup for rectangular objects, any rectangle which overlaps the query rectangle will be returned.

Value

A numeric vector indicating the indicies of the object (in the order they were in when the SearchTree object was created) which fall (at least partially) within the rectangular query.

Author(s)

Gabriel Becker

See Also

QuadTree knnLookup
Examples

```r
x = rnorm(100)
y = rnorm(100)
x2 = x + runif(100, .5, 2)
y2 = y + runif(100, .5, 2)
dat2 = cbind(x, y, x2, y2)
tree2 = createTree(dat2, dataType="rect", columns=1:4)
inrect = rectLookup(tree2, xlim = c(0,1), ylim = c(0,1))
col = rgb(0, 1, 0, alpha=.5)
plot(x, y2, col="white")
rect(x[inrect], y[inrect], x2[inrect], y2[inrect], col=col)
rect(0, 0, 1, 1, col="blue", lwd=3)
```

Description

```
Methods for Function rectLookup in Package SearchTrees
```

Methods

```
signature(tree = "QuadTree")
```

SearchTree-class

```
Class "SearchTree"
```

Description

A virtual class representing a search tree for storing geometric points in a manner designed for efficient lookup.

Objects from the Class

This is a virtual class so objects of class SearchTree cannot be created directly. No methods defined with class "SearchTree" in the signature.

Slots

- ref: Object of class "externalptr" Pointer to the internal representation of the tree.
- numNodes: Object of class "integer" Number of nodes in the tree
- dataNodes: Object of class "integer" Number of nodes in the tree which are storing data.
- maxDepth: Object of class "integer" Maximum depth of the tree
- maxBucket: Object of class "integer" Maximum number of data points stored in a single node
- totalData: Object of class "integer" Number of data objects stored in the tree.
- dataType: Object of class "character" Indicates type of data stored in the tree.
Methods

knnLookup, rectLookup

Author(s)

Gabriel Becker

See Also

QuadTree createTree
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