Package ‘tripack’

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add.constraint

Add a constraint to an triangulation object

Description

This subroutine provides for creation of a constrained Delaunay triangulation which, in some sense, covers an arbitrary connected region R rather than the convex hull of the nodes. This is achieved simply by forcing the presence of certain adjacencies (triangulation arcs) corresponding to constraint curves. The union of triangles coincides with the convex hull of the nodes, but triangles in R can be distinguished from those outside of R. The only modification required to generalize the definition of the Delaunay triangulation is replacement of property 5 (refer to tri.mesh by the following:

5') If a node is contained in the interior of the circumcircle of a triangle, then every interior point of the triangle is separated from the node by a constraint arc.

In order to be explicit, we make the following definitions. A constraint region is the open interior of a simple closed positively oriented polygonal curve defined by an ordered sequence of three or more distinct nodes (constraint nodes) P(1),P(2),...,P(K), such that P(I) is adjacent to P(I+1) for I = 1,...,K with P(K+1) = P(1). Thus, the constraint region is on the left (and may have nonfinite area) as the sequence of constraint nodes is traversed in the specified order. The constraint regions must not contain nodes and must not overlap. The region R is the convex hull of the nodes with constraint regions excluded.

Note that the terms boundary node and boundary arc are reserved for nodes and arcs on the boundary of the convex hull of the nodes.
The algorithm is as follows: given a triangulation which includes one or more sets of constraint nodes, the corresponding adjacencies (constraint arcs) are forced to be present (Fortran subroutine EDGE). Any additional new arcs required are chosen to be locally optimal (satisfy the modified circumcircle property).

Usage

```r
add.constraint(tri.obj, cstx, csty, reverse=FALSE)
```

Arguments

- `tri.obj`: object of class "tri"
- `cstx`: vector containing x coordinates of the constraint curve.
- `csty`: vector containing y coordinates of the constraint curve.
- `reverse`: if TRUE the orientation of the constraint curve is reversed.

Value

An new object of class "tri".

References


See Also

`tri`, `print.tri`, `plot.tri`, `summary.tri`, `triangles`, `convex.hull`.

Examples

```r
# we will use the simple test data from TRIPACK:
data(tritest)
tritest.tr <- tri.mesh(tritest)
opar <- par(mfrow=c(2,2))
plot(tritest.tr)
# include all points in a big triangle:
tritest.tr <- add.constraint(tritest.tr, c(-0.1,2,-0.1),
                             c(-3,0.5,3), reverse=TRUE)
# insert a small cube:
tritest.tr <- add.constraint(tritest.tr, c(0.4, 0.4, 0.6, 0.6),
                             c(0.6, 0.4, 0.4, 0.6),
                             reverse = FALSE)
par(opar)
```
cells

extract info about voronoi cells

Description

This function returns some info about the cells of a voronoi mosaic, including the coordinates of the vertices and the cell area.

Usage

cells(voronoi.obj)

Arguments

voronoi.obj object of class voronoi

Details

The function calculates the neighbourhood relations between the underlying triangulation and translates it into the neighbourhood relations between the voronoi cells.

Value

returns a list of lists, one entry for each voronoi cell which contains

- cell index
- cell 'center'
- neighbour cell indices
- 2 times nnb matrix with vertex coordinates
- cell area

Note

outer cells have area=NA, currently also nodes=NA which is not really useful – to be done later

Author(s)

A. Gebhardt

See Also

voronoi.mosaic, voronoi.area
Example

```r
data(tritest)
tritest.vm <- voronoi.mosaic(tritest$x, tritest$y)
tritest.cells <- cells(tritest.vm)
# highlight cell 12:
plot(tritest.vm)
polygon(t(tritest.cells[[12]]$nodes), col = "green")
# put cell area into cell center:
text(tritest.cells[[12]]$center[1],
     tritest.cells[[12]]$center[2],
     tritest.cells[[12]]$area)
```

Description

This function plots circles at given locations with given radii.

Usage

circles(x, y, r, ...)

Arguments

- `x` vector of x coordinates
- `y` vector of y coordinates
- `r` vector of radii
- `...` additional graphic parameters will be passed through

Note

This function needs a previous plot where it adds the circles.

Author(s)

A. Gebhardt

See Also

- `lines`, `points`

Examples

```r
x <- rnorm(10)
y <- rnorm(10)
r <- runif(10, 0, 0.5)
plot(x, y, xlim = c(-3, 3), ylim = c(-3, 3), pch = "+")
circles(x, y, r)
```
### circum

**Description**

This function returns the circumcircle of a triangle.

**Usage**

\[
\text{circum}(x, y)
\]

**Arguments**

- `x` Vector of three elements, giving the x coordinates of the triangle nodes.
- `y` Vector of three elements, giving the y coordinates of the triangle nodes.

**Details**

This is an interface to the Fortran function CIRCUM found in TRIPACK.

**Value**

- `x` 'x' coordinate of center
- `y` 'y' coordinate of center
- `radius` circumcircle radius
- `signed.area` signed area of triangle (positive iff nodes are numbered counter clockwise)
- `aspect.ratio` ratio "radius of inscribed circle"/"radius of circumcircle", varies between 0 and 0.5
  - 0 means collinear points, 0.5 equilateral triangle.

**Note**

This function is mainly intended to be used by `circumcircle`.

---

**circtest**

**circertest / sample data**

**Description**

Sample data for the `circumcircle` function.

`circtest` are points sampled from a circle with some jitter added, i.e. they represent the most complicated case for the `circumcircle` function.
**circumcircle**

**Author(s)**
Fortran code: R. J. Renka, R code: A. Gebhardt

**References**

**See Also**
circumcircle

**Examples**
circum(c(0,1,0),c(0,0,1))

circumcircle Determine the circumcircle of a set of points

**Description**
This function returns the (smallest) circumcircle of a set of n points.

**Usage**
circumcircle(x, y = NULL, num.touch = 2, plot = FALSE, debug = FALSE)

**Arguments**
x vector containing x coordinates of the data. If y is missing x should contain two elements $x$ and $y$.
y vector containing y coordinates of the data.
num.touch How often should the resulting circle touch the convex hull of the given points? default: 2 possible values: 2 or 3
Note: The circumcircle of a triangle is usually defined to touch at 3 points, this function searches by default the minimum circle, which may be only touching at 2 points. Set parameter num.touch accordingly if you dont want the default behaviour!
plot Logical, produce a simple plot of the result.
default: FALSE
debug Logical, more plots, only needed for debugging.
default: FALSE
Details

This is a (naive implemented) algorithm which determines the smallest circumcircle of n points:
First step: Take the convex hull.
Second step: Determine two points on the convex hull with maximum distance for the diameter of
the set.
Third step: Check if the circumcircle of these two points already contains all other points (of the
convex hull and hence all other points).
If not or if 3 or more touching points are desired (num.touch=3), search a point with minimum
enclosing circumcircle among the remaining points of the convex hull.
If such a point cannot be found (e.g. for data(circtest2)), search the remaining triangle combi-
nations of points from the convex hull until an enclosing circle with minimum radius is found.
The last search uses an upper and lower bound for the desired miniumum radius:
Any enclosing rectangle and its circumcircle gives an upper bound (the axis-parallel rectangle is
used).
Half the diameter of the set from step 1 is a lower bound.

Value

x 'x' coordinate of circumcircle center
y 'y' coordinate of circumcircle center
radius radius of circumcircle

Author(s)

Albrecht Gebhardt

See Also

convex.hull

Examples

data(circtest)
# smallest circle:
circumcircle(circtest,num.touch=2,plot=TRUE)

# smallest circle with maximum touching points (3):
circumcircle(circtest,num.touch=3,plot=TRUE)

# some stress test for this function,
data(circtest2)
# circtest2 was generated by:
# 100 random points almost one a circle:
# alpha <- runif(100,0,2*pi)
# x <- cos(alpha)
# y <- sin(alpha)
# circtest2<-list(x=cos(alpha)+runif(100,0,0.1),
convex.hull

# y=sin(alpha)+runif(100,0,0.1))
# circumcircle(circtest2,plot=TRUE)

circumcircle(circtest2,plot=TRUE)

convex.hull

Return the convex hull of a triangulation object

Description

Given a triangulation tri.obj of n points in the plane, this subroutine returns two vectors containing the coordinates of the nodes on the boundary of the convex hull.

Usage

convex.hull(tri.obj, plot.it=FALSE, add=FALSE,...)

Arguments

tri.obj object of class "tri"
plot.it logical, if TRUE the convex hull of tri.obj will be plotted.
add logical, if TRUE (and plot.it=TRUE), add to a current plot.
... additional plot arguments

Value

x x coordinates of boundary nodes.
y y coordinates of boundary nodes.

Author(s)

A. Gebhardt

References


See Also

tri, print.tri, plot.tri, summary.tri, triangles, add.constraint.
Examples

# rather simple example from TRIPACK:
data(tritest)
tr<-tri.mesh(tritest$x,tritest$y)
convex.hull(tr,plot.it=TRUE)
# random points:
rand.tr<-tri.mesh(runif(10),runif(10))
plot(rand.tr)
rand.ch<--convex.hull(rand.tr, plot.it=TRUE, add=TRUE, col="red")
# use a part of the quakes data set:
data(quakes)
quakes.part<-quakes[(quakes[,1]<=-17 & quakes[,1]>=-19.0 &
    quakes[,2]<=182.0 & quakes[,2]>=180.0),]
quakes.tri<-tri.mesh(quakes.part$lon, quakes.part$lat, duplicate="remove")
plot(quakes.tri)
convex.hull(quakes.tri, plot.it=TRUE, add=TRUE, col="red")

identify.tri  
Identify points in a triangulation plot

Description

Identify points in a plot of "x" with its coordinates. The plot of "x" must be generated with plot.tri.

Usage

## S3 method for class 'tri'
identify(x,...)

Arguments

x  
object of class "tri"

...  
additional paramters for identify

Value

an integer vector containing the indexes of the identified points.

Author(s)

A. Gebhardt

See Also

tri.print.tri,plot.tri,summaruy.tri
in.convex.hull

Examples

data(tritest)
tritest.tr<-tri.mesh(tritest$x, tritest$y)
plot(tritest.tr)
identify.tri(tritest.tr)

in.convex.hull

Determines if points are in the convex hull of a triangulation object

Description

Given a triangulation \texttt{tri.obj} of \( n \) points in the plane, this subroutine returns a logical vector indicating if the points \((x_i, y_i)\) are contained within the convex hull of \texttt{tri.obj}.

Usage

\texttt{in.convex.hull(tri.obj, x, y)}

Arguments

- \texttt{tri.obj} : object of class "\texttt{tri}"
- \texttt{x} : vector of x-coordinates of points to locate
- \texttt{y} : vector of y-coordinates of points to locate

Value

Logical vector.

Author(s)

A. Gebhardt

References


See Also

\texttt{tri}, \texttt{print.tri}, \texttt{plot.tri}, \texttt{summary.tri}, \texttt{triangles}, \texttt{add.constraint}, \texttt{convex.hull}. 
Examples

```r
# example from TRIPACK:
data(tritest)
tr<-tri.mesh(tritest$x, tritest$y)
in.convex.hull(tr, 0.5, 0.5)
in.convex.hull(tr, c(0.5, -1, 1), c(0.5, 1, 1))
# use a part of the quakes data set:
data(quakes)
quakes.part<-quakes[(quakes[,1]<-10.78 & quakes[,1]>=-19.4 &
                      quakes[,2]<-182.29 & quakes[,2]>=165.77),]
q.tri<-tri.mesh(quakes.part$lon, quakes.part$lat, duplicate="remove")
in.convex.hull(q.tri, quakes$lon[900:1000], quakes$lat[900:1000])
```

left

Determines whether given points are left of a directed edge.

Description

This function returns a logical vector indicating which elements of the given points P0 are left of the directed edge P1->P2.

Usage

```r
left(x0, y0, x1, y1, x2, y2)
```

Arguments

- `x0` Numeric vector, 'x' coordinates of points P0 to check
- `y0` Numeric vector, 'y' coordinates of points P0 to check, same length as 'x'.
- `x1` 'x' coordinate of point P1
- `y1` 'y' coordinate of point P1
- `x2` 'x' coordinate of point P2
- `y2` 'y' coordinate of point P2

Value

Logical vector.

Note

This is an interface to the Fortran function VLEFT, which is modeled after TRIPACK's LEFT function but accepts more than one point P0.

Author(s)

A. Gebhardt
neighbours

See Also

in.convex.hull

Examples

left(c(0,0,1,1),c(0,1,0,1),0,0,1,1)

---

neighbours  List of neighbours from a triangulation object

Description

Extract a list of neighbours from a triangulation object

Usage

neighbours(tri.obj)

Arguments

tri.obj  object of class "tri"

Value

nested list of neighbours per point

Author(s)

A. Gebhardt

References


See Also

ti,print.tri,plot.tri,summary.tri,triangles

Examples

data(tritest)
tritest.tr<-tri.mesh(tritest$x, tritest$y)
tritest.nb<-neighbours(tritest.tr)
on.convex.hull

Determines if points are on the convex hull of a triangulation object

Description

Given a triangulation tri.obj of \( n \) points in the plane, this subroutine returns a logical vector indicating if the points \((x_i, y_i)\) lay on the convex hull of tri.obj.

Usage

```
on.convex.hull(tri.obj, x, y)
```

Arguments

- `tri.obj` object of class "tri"
- `x` vector of x-coordinates of points to locate
- `y` vector of y-coordinates of points to locate

Value

Logical vector.

Author(s)

A. Gebhardt

References


See Also

`tri`, `print.tri`, `plot.tri`, `summary.tri`, `triangles`, `add.constraint`, `convex.hull`, `in.convex.hull`.

Examples

```
# example from TRIPACK:
data(tritest)
tr<-tri.mesh(tritest$x, tritest$y)
on.convex.hull(tr, 0.5, 0.5)
on.convex.hull(tr, c(0.5, -1, 1), c(0.5, 1, 1))
# use a part of the quakes data set:
data(quakes)
q.tri<-tri.mesh(quakes.part$lon, quakes.part$lat, duplicate="remove")
on.convex.hull(q.tri, quakes.part$lon[1:20], quakes.part$lat[1:20])
```
**outer.convhull**

Version of outer which operates only in a convex hull

**Description**

This version of outer evaluates FUN only on that part of the grid \(c_{x \times y}\) that is enclosed within the convex hull of the points \((px, py)\).

This can be useful for spatial estimation if no extrapolation is wanted.

**Usage**

```r
outer.convhull(cx, cy, px, py, FUN, duplicate = "remove", ...)
```

**Arguments**

- **cx**: x coordinates of grid
- **cy**: y coordinates of grid
- **px**: vector of x coordinates of points
- **py**: vector of y coordinates of points
- **FUN**: function to be evaluated over the grid
- **duplicate**: indicates what to do with duplicate \((px_i, py_i)\) points, default "remove".
- **...**: additional arguments for FUN

**Value**

Matrix with values of FUN (NAs if outside the convex hull).

**Author(s)**

A. Gebhardt

**See Also**

`in.convex.hull`

**Examples**

```r
x <- runif(20)
y <- runif(20)
z <- runif(20)
z.lm <- lm(z ~ x + y)
f.pred <- function(x, y)
  (predict(z.lm, data.frame(x = as.vector(x), y = as.vector(y))))
xg <- seq(0, 1, 0.05)
yg <- seq(0, 1, 0.05)
image(xg, yg, outer.convhull(xg, yg, x, y, f.pred))
points(x, y)
```
plot.tri

Plot a triangulation object

Description
plots the triangulation "x"

Usage
## S3 method for class 'tri'
plot(x, add=FALSE,xlim=range(x$x),ylim=range(x$y),
do.points=TRUE, do.labels = FALSE, isometric=FALSE,...)

Arguments

- **x**: object of class "tri"
- **add**: logical, if TRUE, add to a current plot.
- **do.points**: logical, indicates if points should be plotted.
- **do.labels**: logical, indicates if points should be labelled
- **xlim, ylim**: x/y ranges for plot
- **isometric**: generate an isometric plot (default FALSE)
- **...**: additional plot parameters

Value

None

Author(s)

A. Gebhardt

References


See Also

tri, print.tri, summary.tri
Examples

# random points
plot(tri.mesh(rpois(100, lambda=20), rpois(100, lambda=20), duplicate="remove"))
# use a part of the quakes data set:
data(quakes)
quakes.part<-quakes[(quakes[,1]<=-10.78 & quakes[,1]>=-19.4 &
  quakes[,2]<=182.29 & quakes[,2]>=165.77),]
quakes.tri<-tri.mesh(quakes.part$lon, quakes.part$lat, duplicate="remove")
plot(quakes.tri)
# use the whole quakes data set
# (will not work with standard memory settings, hence commented out)
#plot(tri.mesh(quakes$lon, quakes$lat, duplicate="remove"), do.points=F)

plot.voronoi

Plot a voronoi object

Description

Plots the mosaic "x".
Dashed lines are used for outer tiles of the mosaic.

Usage

## S3 method for class 'voronoi'
plot(x, add=FALSE,
    xlim=c(min(x$tri$x),
          0.1*diff(range(x$tri$x)),
          max(x$tri$x)+
          0.1*diff(range(x$tri$x))),
    ylim=c(min(x$tri$y),
          0.1*diff(range(x$tri$y)),
          max(x$tri$y)+
          0.1*diff(range(x$tri$y))),
    all=FALSE,
    do.points=TRUE,
    main="Voronoi mosaic",
    sub=deparse(substitute(x)),
    isometric=FALSE,
    ...)
plot.voronoi

all show all (including dummy points in the plot
do.points logical, indicates if points should be plotted.
main plot title
sub plot subtitle
isometric generate an isometric plot (default FALSE)
... additional plot parameters

Value

None

Author(s)

A. Gebhardt

References


See Also

voronoi, print.voronoi, summary.voronoi

Examples

```r
# plot a random mosaic
plot(voronoi.mosaic(runif(100),runif(100),duplicate="remove"))

# use isometric=TRUE and all=TRUE to see the complete mosaic
# including extreme outlier points:
plot(voronoi.mosaic(runif(100),runif(100),duplicate="remove"),
     all=TRUE, isometric=TRUE)

# use a part of the quakes data set:
data(quakes)
quakes.part<-quakes[(quakes[,1]<[-17 & quakes[,1]>=-19.0 &
                      quakes[,2]<182.0 & quakes[,2]>=180.0),]
quakes.vm<-voronoi.mosaic(quakes.part$lon, quakes.part$lat,
                          duplicate="remove")
plot(quakes.vm, isometric=TRUE)

# use the whole quakes data set
# (will not work with standard memory settings, hence commented out here)
#plot(voronoi.mosaic(quakes$lon, quakes$lat, duplicate="remove"), isometric=TRUE)
```
Description

plots an `voronoi.polygons` object

Usage

```r
## S3 method for class 'voronoi.polygons'
plot(x, which, color=TRUE, ...)
```

Arguments

- `x` object of class `voronoi.polygons`
- `which` index vector selecting which polygons to plot
- `color` logical, determines if plot should be colored, default: `TRUE`
- `...` additional plot arguments

Author(s)

A. Gebhardt

See Also

`voronoi.polygons`

Examples

```r
##---- Should be DIRECTLY executable !!! ----
##-- => Define data, use random,
##-- or do help(data=index) for the standard data sets.
data(tritest)
tritest.vm <- voronoi.mosaic(tritest$x, tritest$y)
tritest vp <- voronoi.polygons(tritest.vm)
plot(tritest vp)
plot(tritest vp, which=c(1,3,5))
```
print.summary.tri  

Print a summary of a triangulation object

Description

Prints some information about tri.obj

Usage

```r
# S3 method for class 'summary.tri'
print(x, ...)
```

Arguments

- `x`: object of class "summary.tri", generated by `summary.tri`.
- `...`: additional parameters for `print`

Value

None

Author(s)

A. Gebhardt

References


See Also

`tri.tri.mesh, print.tri, plot.tri, summary.tri`.

print.summary.voronoi  

Print a summary of a voronoi object

Description

Prints some information about x

Usage

```r
# S3 method for class 'summary.voronoi'
print(x, ...)
```
### print.tri

**Arguments**
- `x` object of class "summary.voronoi". generated by `summary.voronoi`.  
- `...` additional parameters for `print`

**Value**
None

**Author(s)**
A. Gebhardt

**References**

**See Also**
norono, voronoi.mosaic, print.voronoi, plot.voronoi, summary.voronoi.

---

### print.tri

*Print a triangulation object*

**Description**
prints a adjacency list of "x"

**Usage**
```r
## S3 method for class 'tri'
print(x, ...)
```

**Arguments**
- `x` object of class "tri"
- `...` additional parameters for `print`

**Value**
None

**Author(s)**
A. Gebhardt
References


See Also

tri, plot.tri, summary.tri

print.voronoi  
Print a voronoi object

Description

prints a summary of "x"

Usage

## S3 method for class 'voronoi'
print(x, ...)

Arguments

x  
object of class "voronoi"

...  
additional parameters for print

Value

None

Author(s)

A. Gebhardt

References


See Also

voronoi, plot.voronoi, summary.voronoi
summary.tri

Return a summary of a triangulation object

Description

Returns some information (number of nodes, triangles, arcs, boundary nodes and constraints) about object.

Usage

## S3 method for class 'tri'
summary(object,...)

Arguments

object  object of class "tri"
...  additional parameters for summary

Value

An object of class "summary.tri", to be printed by print.summary.tri.

It contains the number of nodes (n), of arcs (na), of boundary nodes (nb), of triangles (nt) and constraints (nc).

Author(s)

A. Gebhardt

References


See Also

tri, print.tri, plot.tri, print.summary.tri.
summary.voronoi

Return a summary of a voronoi object

Description

Returns some information about object

Usage

```r
## S3 method for class 'voronoi'
summary(object,...)
```

Arguments

- `object` object of class "voronoi"
- `...` additional parameters for summary

Value

Object of class "summary.voronoi". It contains the number of nodes (nn) and dummy nodes (nd).

Author(s)

A. Gebhardt

References


See Also

- `voronoi`, `voronoi.mosaic`, `print.voronoi`, `plot.voronoi`, `print.summary.voronoi`
tri

A triangulation object

Description

R object that represents the triangulation of a set of 2D points, generated by tri.mesh or add.constraint.

Arguments

- **n**: Number of nodes
- **x**: x coordinates of the triangulation nodes
- **y**: y coordinates of the triangulation nodes
- **tlist**: Set of nodal indexes which, along with tlptr, tlend, and tlnew, define the triangulation as a set of \( n \) adjacency lists – counterclockwise-ordered sequences of neighboring nodes such that the first and last neighbors of a boundary node are boundary nodes (the first neighbor of an interior node is arbitrary). In order to distinguish between interior and boundary nodes, the last neighbor of each boundary node is represented by the negative of its index.
- **tlptr**: Set of pointers in one-to-one correspondence with the elements of tlist. tlist[tlptr[i]] indexes the node which follows tlist[i] in cyclical counterclockwise order (the first neighbor follows the last neighbor).
- **tlend**: Set of pointers to adjacency lists. tlend[k] points to the last neighbor of node \( k \) for \( k = 1, \ldots, n \). Thus, tlist[tlend[k]]<0 if and only if \( k \) is a boundary node.
- **tlnew**: Pointer to the first empty location in tlist and tlptr (list length plus one).
- **nc**: number of constraints
- **lc**: starting indices of constraints in x and y
- **call**: call, which generated this object

Note

The elements tlist, tlptr, tlend and tlnew are mainly intended for internal use in the appropriate Fortran routines.

Author(s)

A. Gebhardt

References


See Also

tri.mesh, print.tri, plot.tri, summary.tri
Compute the Delaunay segment lengths

Description

Return a vector of Delaunay segment lengths for the voronoi object. The Delaunay triangles connected to sites contained in exceptions vector are ignored (unless inverse is TRUE, when only those Delaunay triangles are accepted).

The exceptions vector is provided so that sites at the border of a region can be removed, as these tend to bias the distribution of Delaunay segment lengths. exceptions can be created by voronoi.findrejectsites.

Usage

tri.dellens(voronoi.obj, exceptions = NULL, inverse = FALSE)

Arguments

- voronoi.obj: object of class "voronoi"
- exceptions: a numerical vector
- inverse: Logical

Value

A vector of Delaunay segment lengths.

Author(s)

S. J. Eglen

See Also

voronoi.findrejectsites, voronoi.mosaic

Examples

data(tritest)
tritest.vm <- voronoi.mosaic(tritest$x, tritest$y)
tritest.vm.rejects <- voronoi.findrejectsites(tritest.vm, 0, 1, 0, 1)
trilens.all <- tri.dellens(tritest.vm)
trilens.acc <- tri.dellens(tritest.vm, tritest.vm.rejects)
trilens.rej <- tri.dellens(tritest.vm, tritest.vm.rejects, inverse=TRUE)

par(mfrow=c(3,1))
dotchart(trilens.all, main="all Delaunay segment lengths")
dotchart(trilens.acc, main="excluding border sites")
dotchart(trilens.rej, main="only border sites")
tri.find

*tri.find*  
*Locate a point in a triangulation*

**Description**

This subroutine locates a point *P*=(*x*,*y*) relative to a triangulation created by *tri.mesh*. If *P* is contained in a triangle, the three vertex indexes are returned. Otherwise, the indexes of the rightmost and leftmost visible boundary nodes are returned.

**Usage**

```
tri.find(tri.obj,x,y)
```

**Arguments**

- **tri.obj**: an triangulation object
- **x**: *x*-coordinate of the point
- **y**: *y*-coordinate of the point

**Value**

A list with elements *i1*,*i2*,*i3* containing nodal indexes, in counterclockwise order, of the vertices of a triangle containing *P*=(*x*,*y*), or, if *P* is not contained in the convex hull of the nodes, *i1* indexes the rightmost visible boundary node, *i2* indexes the leftmost visible boundary node, and *i3* = 0. Rightmost and leftmost are defined from the perspective of *P*, and a pair of points are visible from each other if and only if the line segment joining them intersects no triangulation arc. If *P* and all of the nodes lie on a common line, then *i1=i2=i3=0* on output.

**Author(s)**

A. Gebhardt

**References**


**See Also**

`tri.print.tri, plot.tri, summary.tri, triangles, convex.hull`
Examples

```r
data(tritest)
tritest.tr<-tri.mesh(tritest$x, tritest$y)
plot(tritest.tr)
pnt<-list(x=0.3, y=0.4)
triangle.with.pnt<-tri.find(tritest.tr, pnt$x, pnt$y)
attach(triangle.with.pnt)
lines(tritest$x[c(i1, i2, i3, i1)], tritest$y[c(i1, i2, i3, i1)], col="red")
points(pnt$x, pnt$y)
```

---

**tri.mesh**  
*Create a delaunay triangulation*

### Description

This subroutine creates a Delaunay triangulation of a set of N arbitrarily distributed points in the plane referred to as nodes. The Delaunay triangulation is defined as a set of triangles with the following five properties:

1) The triangle vertices are nodes.
2) No triangle contains a node other than its vertices.
3) The interiors of the triangles are pairwise disjoint.
4) The union of triangles is the convex hull of the set of nodes (the smallest convex set which contains the nodes).
5) The interior of the circumcircle of each triangle contains no node.

The first four properties define a triangulation, and the last property results in a triangulation which is as close as possible to equiangular in a certain sense and which is uniquely defined unless four or more nodes lie on a common circle. This property makes the triangulation well-suited for solving closest point problems and for triangle-based interpolation.

The triangulation can be generalized to a constrained Delaunay triangulation by a call to `add.constraint`. This allows for user-specified boundaries defining a nonconvex and/or multiply connected region.

The operation count for constructing the triangulation is close to O(N) if the nodes are presorted on X or Y components. Also, since the algorithm proceeds by adding nodes incrementally, the triangulation may be updated with the addition (or deletion) of a node very efficiently. The adjacency information representing the triangulation is stored as a linked list requiring approximately 13N storage locations.

### Usage

```r
tri.mesh(x, y = NULL, duplicate = "error")
```
triangles

Arguments

x vector containing x coordinates of the data. If y is missing x should contain two elements $x$ and $y$.

y vector containing y coordinates of the data.

duplicate flag indicating how to handle duplicate elements. Possible values are: "error" – default, "strip" – remove all duplicate points, "remove" – leave one point of duplicate points.

Value

An object of class "tri"

References


See Also

tri, print.tri, plot.tri, summary.tri, triangles, convex.hull, neighbours, add.constraint.

Examples

data(tritest)
tritest.tr<-tri.mesh(tritest$x, tritest$y)
tritest.tr

triangles

Extract a list of triangles from a triangulation object

Description

This function extracts a triangulation data structure from an triangulation object created by tri.mesh. The vertices in the returned matrix (let’s denote it with retval) are ordered counterclockwise with the first vertex taken to be the one with smallest index. Thus, retval[i,"node2"] and retval[i,"node3"] are larger than retval[i,"node3"] and index adjacent neighbors of node retval[i,"node1"]. The columns trx and arcx, x=1,2,3 index the triangle and arc, respectively, which are opposite (not shared by) node nodex, with trix=0 if arcx indexes a boundary arc. Vertex indexes range from 1 to N, triangle indexes from 0 to NT, and, if included, arc indexes from 1 to NA = NT+N-1. The triangles are ordered on first (smallest) vertex indexes, except that the sets of constraint triangles (triangles contained in the closure of a constraint region) follow the non-constraint triangles.

Usage

triangles(tri.obj)
Arguments

tri.obj object of class "tri"

Value

A matrix with columns node1,node2,node3, representing the vertex nodal indexes, tr1,tr2,tr3, representing neighboring triangle indexes and arc1,arc2,arc3 representing arc indexes.

Each row represents one triangle.

Author(s)

A. Gebhardt

References


See Also

tri,print.tri,plot.tri,summary.tri,triangles

Examples

# use a slightly modified version of data(tritest)
data(tritest2)
tritest2.tr<-tri.mesh(tritest2$x,tritest2$y)
triangles(tritest2.tr)

tripack-internal Internal functions

Description

Internal tripack functions

Details

These functions are not intended to be called by the user.
Description

A very simply set set of points to test the tripack functions, taken from the FORTRAN original. tritest2 is a slight modification by adding runif(-0.1,0.1) random numbers to the coordinates.

References


voronoi

Voronoi object

Description

An voronoi object is created with voronoi.mosaic

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x,y</td>
<td>x and y coordinates of nodes of the voronoi mosaic. Each node is a circumcircle center of some triangle from the Delaunay triangulation.</td>
</tr>
<tr>
<td>node</td>
<td>logical vector, indicating real nodes of the voronoi mosaic. These nodes are the centers of circumcircles of triangles with positive area of the delaunay triangulation. If node[i]=FALSE, (c[i],x[i]) belongs to a triangle with area 0.</td>
</tr>
<tr>
<td>n1,n2,n3</td>
<td>indices of neighbour nodes. Negative indices indicate dummy points as neighbours.</td>
</tr>
<tr>
<td>tri</td>
<td>triangulation object, see tri.</td>
</tr>
<tr>
<td>area</td>
<td>area of triangle i. area[i]=1 indicates a removed triangle with area 0 at the border of the triangulation.</td>
</tr>
<tr>
<td>ratio</td>
<td>aspect ratio (inscribed radius/circumradius) of triangle i.</td>
</tr>
<tr>
<td>radius</td>
<td>circumradius of triangle i.</td>
</tr>
<tr>
<td>dummy.x,dummy.y</td>
<td>x and y coordinates of dummy points. They are used for plotting of unbounded tiles.</td>
</tr>
</tbody>
</table>

Author(s)

A. Gebhardt
See Also

voronoi.mosaic.plot.voronoi

Description

Computes the area of each Voronoi polygon. For some sites at the edge of the region, the Voronoi polygon is not bounded, and so the area of those sites cannot be calculated, and hence will be NA.

Usage

voronoi.area(voronoi.obj)

Arguments

voronoi.obj object of class "voronoi"

Value

A vector of polygon areas.

Author(s)

S. J. Eglen

See Also

voronoi,

data(tritest)
tritest.vm <- voronoi.mosaic(tritest$x, tritest$y)
tritest.vm.areas <- voronoi.area(tritest.vm)
plot(tritest.vm)
text(tritest$x, tritest$y, tritest.vm.areas)
Find the Voronoi sites at the border of the region (to be rejected).

Description

Find the sites in the Voronoi tesselation that lie at the edge of the region. A site is at the edge if any of the vertices of its Voronoi polygon lie outside the rectangle with corners (xmin,ymin) and (xmax,ymax).

Usage

```r
voronoi.findrejectsites(voronoi.obj, xmin, xmax, ymin, ymax)
```

Arguments

- `voronoi.obj`: object of class "voronoi"
- `xmin`: minimum x-coordinate of sites in the region
- `xmax`: maximum x-coordinate of sites in the region
- `ymin`: minimum y-coordinate of sites in the region
- `ymax`: maximum y-coordinate of sites in the region

Value

A logical vector of the same length as the number of sites. If the site is a reject, the corresponding element of the vector is set to TRUE.

Author(s)

S. J. Eglen

See Also

`tri.dellens`
Description

This function creates a Voronoi mosaic.
It creates first a Delaunay triangulation, determines the circumcircle centers of its triangles, and
connects these points according to the neighbourhood relations between the triangles.

Usage

```
voronoi.mosaic(x,y=NULL,duplicate="error")
```

Arguments

- `x` vector containing x coordinates of the data. If y is missing x should contain two
elements $x$ and $y$.
- `y` vector containing y coordinates of the data.
- `duplicate` flag indicating how to handle duplicate elements. Possible values are: "error" –
default,"strip" – remove all duplicate points,"remove" – leave one point of
duplicate points.

Value

An object of class `voronoi`.

Author(s)

A. Gebhardt

See Also

`voronoi`, `voronoi.mosaic`, `print.voronoi`, `plot.voronoi`

Examples

```
# example from TRIPACK:
data(tritest)
tritest.vm<-voronoi.mosaic(tritest$x,tritest$y)
tritest.vm

# use a part of the quakes data set:
data(quakes)
quakes.part<-quakes[(quakes[,1]<-17 & quakes[,1]>=-19.0 &
quakes[,2]<182.0 & quakes[,2]>=180.0),]
quakes.vm<-voronoi.mosaic(quakes.part$lon, quakes.part$lat, duplicate="remove")
quakes.vm
```
voronoi.polygons extract polygons from a voronoi mosaic

Description

This functions extracts polygons from a voronoi.mosaic object.

Usage

voronoi.polygons(voronoi.obj)

Arguments

voronoi.obj object of class voronoi.mosaic

Value

Returns an object of class voronoi.polygons with unnamed list elements for each polygon. These list elements are matrices with columns x and y.

Author(s)

Denis White

See Also

plot.voronoi.polygons,voronoi.mosaic

Examples

# Should be DIRECTLY executable !! ----
# Define data, use random,
# or do help(data=index) for the standard data sets.

data(tritest)
tritest.vm <- voronoi.mosaic(tritest$x,tritest$y)
tritest.vp <- voronoi.polygons(tritest.vm)
tritest.vp
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