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hilbertCurve  calculate finite approximations of the Hilbert curve

Description

These functions calculate the Hilbert curve in its finite approximations. hilbertCurvePoint
gives the coordinates of one point and hilbertCurve returns an array with the coordinates of
all $4^lv$ points. The functions are not needed for hilbertImage and only provided for demon-
stration purposes. plotHilbertCurve makes use of them.

Usage

hilbertCurve( lv )
hilbertCurvePoint( t, lv )

Arguments

lv  The iteration level. A Hilbert curve of level $lv$ spans a square with side length
    $2^lv$ (coordinates ranging from 0 to $2^lv-1$) and has $4^lv$ points.

Value

hilbertCurvePoint returns a vector of two integer numbers, both in the range 0:($2^lv$-1),
indicating the coordinates of point t. hilbertCurve returns a matrix with $4^lv$ rows and 2
columns, giving all points of the curve at level $lv$. 
hilbertImage

Description

Calculate a Hilbert curve visualization of a long data vector and return it as a square matrix.

Usage

hilbertImage(data, level = 9, mode = "absmax")

Arguments

data A (potentially very long) vector of numerical data.
level The level of the Hilbert curve, determining the size of the returned matrix
mode The binning mode. See shrinkVector for details.

Details

See the package vignette for an explanation of this visualization technique.

Value

A matrix of dimension $2^\text{level} \times 2^\text{level}$. Each matrix element corresponds to a bin of consecutive elements of the data vector, the bins arranged to follow the Hilbert curve of the given level. By default, the value of a matrix element is either the largest or smallest element in the bin, whichever is larger by absolute value. (See shrinkVector for other possible binning modes.)

To display such a matrix graphically, you can use the standard functions image or levelplot but the function showHilbertImage may be more convenient.

Note

For an interactive GUI to explore a Hilbert curve visualisation, use the function hilbertDisplay in the HilbertVisGUI package.

Author(s)

Simon Anders, EMBL-EBI, sanders@fs.tum.de
**Examples**

```r
# Get a vector with example data
dataVec <- makeRandomTestData()

# Plot it in conventional (linear) fashion
plotLongVector( dataVec )

# Note how the peaks look quite uniform

# Get the Hilbert curve matrix
hMat <- hilbertImage( dataVec )

# Plot it with the 'showHilbertImage' function
showHilbertImage( hMat )

# Note how you can now see the non-uniformity hidden in the previous plot.
# Note also the ugly aliasing when you change the size of the plot window.
# Using EBImage allows to display in each matrix element as one pixel:

# if( require ( EBImage ) )
#   showHilbertImage( hMat, mode="EBImage" )
```

**Description**

This function generates a long numeric vector and fills it with many narrow Gaussian peaks of varying width and position. Around 30 the distribution of peak width is changed to be substantially larger. This feature is easily visible with the Hilbert curve visualization but much harder to spot with conventional 1D plots.

**Usage**

```r
makeRandomTestData(len = 1e+07, numPeaks = 500)
```

**Arguments**

- `len` Length of the vector
- `numPeaks` Number of peaks to be placed in the vector

**Value**

A vector, of type `numeric`, with sample data.

**Author(s)**

Simon Anders, EMBL-EBI, sanders@fs.tum.de

**Examples**

```r
# See the help page of function 'hilbertImage' for an example.
```
**makeWiggleVector**

generate a "wiggle vector" from start/end/value data

**Description**

Given intervals in the form of a "start" and an "end" vectors and corresponding values, generate a "wiggle vector" of a given length that contains the specified values in the vector elements indicated by the intervals.

**Usage**

```r
makeWiggleVector(start, end, value, chrlength )
```

**Arguments**

- **start**: The start coordinates of the intervals. As usual in R, these are 1-based.
- **end**: The end coordinates of the intervals. As usual, the end points are included.
- **value**: The values to be put in the wiggle vector. Where intervals overlap, the values are added.
- **chrlength**: The desired length of the returned vector.

**Value**

A vector as described above.

**Author(s)**

Simon Anders, EMBL-EBI, sandersfs.tum.de

**See Also**

For a value vector containing only ones, this function acts similar as the `pileup` function in the ShortRead package.

**Examples**

```r
intervalStarts <- c(3,10,17,22)
intervalEnds <- c(7,13,20,26)
values <- c(2, 1.5, .3, 4)
chrlength <- 30
wig <- makeWiggleVector( intervalStarts, intervalEnds, values, chrlength )
# The same effect can be achieved with the following R code, which, however # is much slower:
wig2 <- numeric(chrlength)
for( i in 1:length(values) )
  wig2[ intervalStarts[i]:intervalEnds[i] ] <-
    wig2[ intervalStarts[i]:intervalEnds[i] ] + values[i]
# Let's check that we got the same:
all( wig == wig2 )
```
plotHilbertCurve

Plotting the Hilbert curve (for demonstration purposes).

Description

This function plots the Hilbert curve fractal at a chosen iteration level in order to give you an impression how it looks like.

Usage

plotHilbertCurve( lv, new.page = TRUE )

Arguments

lv
The iteration level. A Hilbert curve of level \( lv \) spans a square with side length \( 2^{lv} \) (coordinates ranging from 0 to \( 2^{lv}-1 \)) and has \( 4^{lv} \) points. Values \( lv > 7 \) will take very long and yield a cluttered mesh of indistinguishable lines.

new.page
Boolean indicating whether to start a new graphics page (default: yes).

Value

An invisible NULL is returned. Furthermore, a plot is created.

Author(s)

Simon Anders, EMBL-EBI, ⟨sanders@fs.tum.de⟩

See Also

hilbertCurve

Examples

plotHilbertCurve( 3 )

plotLongVector

A simple function to plot a very long vector.

Description

This function does basically the same as just calling plot( vec ) but is much faster in case of a very long vector. This is because it first calls shrinkVector.

Usage

plotLongVector(vec, offset = 1, shrinkLength = 4000, xlab = "", ylab = "", ...)
showHilbertImage

Arguments

vec  The numerical vector to be plotted.
offset  The x axis is labelled with numbers from offset to offset+length(vec)-1.
shrinkLength  To which length to shrink the vector before plotting it. Should be at least the width of your plot in pixels.
xlab  The label of the x axis, to be passed to plot.
ylab  The label of the y axis, to be passed to plot.
...  Further arguments to be passed to plot.

Value

Invisible Null and a plot.

Author(s)

Simon Anders, EMBL-EBI, sanders@fs.tum.de

Examples

plotLongVector( rep( 1:100000, 20 ) )

showHilbertImage  display a hilbert

Description

A convenient wrapper around levelplot to display a hilbert image matrix as it is returned by hilbertImage. Alternatively to levelplot, EBImage is available as well.

Usage

showHilbertImage( mat,
  palettePos = colorRampPalette(c("white", "red"))(300),
  paletteNeg = colorRampPalette(c("white", "blue"))(300),
  maxPaletteValue = max(abs(mat)),
  mode = c("lattice", "EBImage", "EBImage-batch") )

Arguments

mat  The matrix to be displayed. In principle this can be any matrix, but typically, it is one returned by hilbertImage.
palettePos  The colour palette to be used for the positive entries in mat (including 0).
paletteNeg  The colour palette to be used for the negative entries in mat.
maxPaletteValue  The absolute value to which the right end of the palettes should correspond. (The left ends correspond to 0.)
For mode "lattice", the function `levelplot` from the `lattice` package is used. An (invisible) lattice object is returned that can be displayed with `show`. In interactive mode, the image is displayed automatically. For mode "EBImage" the image is displayed with the `EBImage` package, and for "EBImage-batch", the same image is produced and not displayed but rather returned as a value suitable to be passed to `EBImage`'s `display` function.

Value

A lattice or EBImage graphics object. For all modes except “EBImage-batch” it is marked “invisible”.

Author(s)

Simon Anders, EMBL-EBI (sandersfs.tum.de)

See Also

`hilbertImage`

Examples

```r
# See ?hilbertImage for examples.
```

### Description

Given a (potentially very long) vector, the vector is partitioned into a given number of (up to rounding errors) equally long bins, and a vector summarizing each of the bins with one number it returned.

#### Usage

```r
shrinkVector(vec, newLength, mode = c("max", "min", "absmax", "mean"))
```

#### Arguments

- `vec` The vector to be shrunk. May be numeric or integer.
- `newLength` The desired size of the return vector, i.e., the number of partitions
- `mode` the summarization mode: ’max’: take the maximal value of each bin; ’min’: take the minimal value of each bin; ’absmax’: take the value with largest absolute value; ’mean’: take the mean of the bin values.

#### Value

A vector of length `newLength` with the summary values of each of the bin of vector.

Author(s)

Simon Anders, EMBL-EBI (sandersfs.tum.de)
See Also

plotLongVector, ShortRead::pileup, HilbertVisGui::simpleLinPlot

Examples

shrinkVector( 100000 + 1:1000, 17 )
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