

Package ‘NetLogoR’

January 25, 2019

Title Build and Run Spatially Explicit Agent-Based Models

Description Build and run spatially explicit agent-based models using only the R platform. 'NetLogoR' follows the same framework as the 'NetLogo' software (Wilensky, 1999 <<http://ccl.northwestern.edu/netlogo/>>) and is a translation in R of the structure and functions of 'NetLogo'. 'NetLogoR' provides new R classes to define model agents and functions to implement spatially explicit agent-based models in the R environment. This package allows benefiting of the fast and easy coding phase from the highly developed 'NetLogo' framework, coupled with the versatility, power and massive resources of the R software. Examples of three models (Ants <<http://ccl.northwestern.edu/netlogo/models/Ants>>, Butterfly (Railsback and Grimm, 2012) and Wolf-Sheep-Predation <<http://ccl.northwestern.edu/netlogo/models/WolfSheepPredation>>) written using 'NetLogoR' are available. The 'NetLogo' code of the original version of these models is provided alongside. A programming guide inspired from the 'NetLogo' Programming Guide (<<https://ccl.northwestern.edu/netlogo/docs/programming.html>>) and a dictionary of 'NetLogo' primitives (<<https://ccl.northwestern.edu/netlogo/docs/dictionary.html>>) equivalences are also available. NOTE: To increment 'time', these functions can use a for loop or can be integrated with a discrete event simulator, such as 'SpaDES' (<<https://cran.r-project.org/package=SpaDES>>). The suggested package 'fastshp' can be installed with `'install.packages("`fastshp", repos = "`https://rforge.net", type = "`source")'`.

URL <http://netlogor.predictiveecology.org>,
<https://github.com/PredictiveEcology/NetLogoR/>

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Depends R (>= 3.3.0), raster

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Suggests fastshp, knitr, magrittr, microbenchmark, rmarkdown, sf, SpaDES.core, testthat

License GPL-3

Encoding UTF-8

VignetteBuilder knitr, rmarkdown

BugReports <https://github.com/PredictiveEcology/NetLogoR/issues>

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'worldNLR-classes-methods.R' 'agentMatrix-Class-methods.R'
'agentset-functions.R' 'function-arguments.R'
'patch-functions.R' 'plot.R' 'world-functions.R' 'quickPlot.R'
'spades-functions.R' 'turtle-functions.R'

NeedsCompilation no

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NetLogoR-package	<i>The NetLogoR package</i>
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Description

The suggested package **fastshp** can be installed with `install.packages("fastshp", repos = "https://rforge.net",`

Author(s)

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- Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources Canada [copyright holder]

See Also

Useful links:

- <http://netlogor.predictiveecology.org>
- <https://github.com/PredictiveEcology/NetLogoR/>
- Report bugs at <https://github.com/PredictiveEcology/NetLogoR/issues>

`==, agentMatrix, character-method`
Relational Operators

Description

Binary operators which allow the comparison of values in an `agentMatrix`.

Usage

```
## S4 method for signature 'agentMatrix,character'
e1 == e2

## S4 method for signature 'agentMatrix,numeric'
e1 == e2
```

Arguments

<code>e1</code>	An <code>agentMatrix</code> object.
<code>e2</code>	atomic vector, symbol, call, or other object for which methods have been written.

agentClasses-class *A meta class for agentMatrix and SpatialPointsDataFrame*

Description

Both these types can be used by NetLogoR to describe turtle agents.

Both these types can be used by NetLogoR to describe turtle agents.

Author(s)

Eliot McIntire

Eliot McIntire

agentMatrix *Create a new agentMatrix object*

Description

This is a fast alternative to the SpatialPointsDataFrame. It is meant to replace that functionality, though there are not as many methods (yet). The object is primarily a numeric matrix. Any character column passed to ... will be converted to a numeric, using as.factor internally, and stored as a numeric. Methods using this class will automatically convert character queries to the correct numeric alternative.

Usage

```
agentMatrix(..., coords)

## S4 method for signature 'matrix'
agentMatrix(..., coords)

## S4 method for signature 'missing'
agentMatrix(..., coords)
```

Arguments

...	Vectors, a data.frame, or a matrix of extra columns to add to the coordinates, or a SpatialPointsDataFrame.
coords	A matrix with 2 columns representing x and y coordinates

Author(s)

Eliot McIntire

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#clear-turtles>

Examples

```
newAgent <- agentMatrix(  
  coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),  
  char = letters[c(1, 2, 6)],  
  nums2 = c(4.5, 2.6, 2343),  
  char2 = LETTERS[c(4, 24, 3)],  
  nums = 5:7)  
  
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,  
  data = runif(25))  
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
```

agentMatrix-class *The agentMatrix class*

Description

Documentation needed.

Documentation needed.

Author(s)

Eliot McIntire

Eliot McIntire

Examples

```
newAgent <- new("agentMatrix",  
  coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),  
  char = letters[c(1, 2, 6)],  
  nums2 = c(4.5, 2.6, 2343),  
  char2 = LETTERS[c(4, 24, 3)],  
  nums = 5:7)  
  
newAgent <- new("agentMatrix",  
  coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),  
  char = letters[c(1, 2, 6)],  
  nums2 = c(4.5, 2.6, 2343),  
  char2 = LETTERS[c(4, 24, 3)],  
  nums = 5:7)  
  
# compare speeds -- about 5x faster
```

```

if(require(microbenchmark)) {
  microbenchmark(times = 499,
    spdf = {SpatialPointsDataFrame(
      coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),
      data = data.frame(
        char = letters[c(1, 2, 6)],
        nums2 = c(4.5, 2.6, 2343),
        char2 = LETTERS[c(4, 24, 3)],
        nums = 5:7)}),
    agentMat = {agentMatrix(
      coords = cbind(pxcor = c(1, 2, 5),
        pycor = c(3, 4, 6)),
      char = letters[c(1, 2, 6)],
      nums2 = c(4.5, 2.6, 2343),
      char2 = LETTERS[c(4, 24, 3)],
      nums = 5:7)},
    agentMatDirect = {new("agentMatrix",
      coords = cbind(pxcor = c(1, 2, 5),
        pycor = c(3, 4, 6)),
      char = letters[c(1, 2, 6)],
      nums2 = c(4.5, 2.6, 2343),
      char2 = LETTERS[c(4, 24, 3)],
      nums = 5:7)})
}

```

 bk

Move backward

Description

Move the turtles backward of their headings' directions.

Usage

```
bk(turtles, dist, world, torus = FALSE, out = TRUE)
```

```
## S4 method for signature 'agentMatrix,numeric'
bk(turtles, dist, world, torus = FALSE,
  out = TRUE)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances to move. Must be of length 1 or of length turtles.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.
out	Logical. Determine if a turtle should move when torus = FALSE and its ending position will be outside of the world's extent. Default is out = TRUE.

Details

If `torus = FALSE` and `out = TRUE`, `world` does not need to be provided.

If a distance to move leads a turtle outside of the world's extent and `torus = TRUE`, the turtle is relocated on the other side of the world, inside its extent; if `torus = FALSE` and `out = TRUE`, the turtle moves past the world's extent; if `torus = FALSE` and `out = FALSE`, the turtle does not move at all. In the event that a turtle does not move, its previous coordinates are still updated with its position before running `bk()` (i.e., its current position).

If a given `dist` value is negative, then the turtle moves forward.

The turtles' headings are not affected by the function (i.e., the turtles do not face backward).

Value

`AgentMatrix` representing the turtles with updated coordinates and updated data for their previous coordinates `prevX` and `prevY`.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#back>

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#jump>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- createOTurtles(n = 10, world = w1)
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- fd(turtles = t1, dist = 2)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
t1 <- bk(turtles = t1, dist = 1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
t1 <- fd(turtles = t1, dist = 0.5)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

canMove	<i>Can the turtles move?</i>
---------	------------------------------

Description

Report TRUE if a turtle can move the given distance without leaving the world's extent, report FALSE otherwise.

Usage

```
canMove(world, turtles, dist)
```

```
## S4 method for signature 'worldNLR,agentMatrix,numeric'  
canMove(world, turtles, dist)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances to move. Must be of length 1 or of length turtles.

Value

Logical. Vector of length turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#can-move>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)  
t1 <- createTurtles(n = 10, world = w1)  
canMove(world = w1, turtles = t1, dist = 1:10)
```

cbind	<i>Combine R Objects by Rows or Columns</i>
-------	---

Description

Take a sequence of `agentMatrix` arguments and combine by columns or rows, respectively. This will take the coordinates of the first argument and remove the coordinates of the second object.

Usage

```
## S3 method for class 'agentMatrix'
cbind(..., deparse.level)
```

```
## S3 method for class 'agentMatrix'
rbind(..., deparse.level = 1)
```

Arguments

... Two `agentMatrix` objects
 deparse.level See [cbind](#)

cellFromPxcorPycor	<i>Cells numbers from patches coordinates</i>
--------------------	---

Description

Report the cells numbers as defined for a `Raster*` object given the patches coordinates `pxcor` and `pycor`.

Usage

```
cellFromPxcorPycor(world, pxcor, pycor)
```

```
## S4 method for signature 'worldNLR,numeric,numeric'
cellFromPxcorPycor(world, pxcor,
  pycor)
```

Arguments

`world` `WorldMatrix` or `worldArray` object.
`pxcor` Integer. Vector of patches `pxcor` coordinates. Must be of length 1 or of the same length as `pycor`.
`pycor` Integer. Vector of patches `pycor` coordinates. Must be of length 1 or of the same length as `pxcor`.

Value

Numeric. Vector of cells number.

Author(s)

Sarah Bauduin

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
cellFromPxcorPycor(world = w1, pxcor = 0, pycor = 9)
cellFromPxcorPycor(world = w1, pxcor = c(0, 1, 2), pycor = 0)
```

clearPatches

Clear world's patches

Description

Reset all patches values to NA.

Usage

```
clearPatches(world)
```

```
## S4 method for signature 'worldMatrix'
clearPatches(world)
```

```
## S4 method for signature 'worldArray'
clearPatches(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

WorldMatrix object with NA values for all patches.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#clear-patches>

Examples

```
w1 <- createWorld()
w1 <- NLset(world = w1, agents = patches(w1), val = runif(NLcount(patches(w1))))
w1Val <- of(world = w1, agents = patches(w1))
summary(w1Val)

w1 <- clearPatches(w1)
w1Val <- of(world = w1, agents = patches(w1))
summary(w1Val)
```

coordinates,agentMatrix-method

Set spatial coordinates

Description

Set spatial coordinates

Usage

```
## S4 method for signature 'agentMatrix'
coordinates(obj, ...)
```

Arguments

obj	documentation needed
...	additional arguments that may be used by particular methods description needed

createOTurtles

Create ordered turtles

Description

Create n turtles at the center of the world with their headings evenly distributed.

Usage

```
createOTurtles(n, world, breed, color)

## S4 method for signature 'numeric'
createOTurtles(n, world, breed, color)
```

Arguments

n	Integer.
world	WorldMatrix or worldArray object.
breed	Character. Vector of breed names. Must be of length 1 or of length n. If missing, breed = "turtle" for all turtles.
color	Character. Vector of color names. Must be of length n. If missing, colors are assigned using the function rainbow(n).

Details

The identity of the turtles is defined by their who number. This numbering starts at 0 and increments by 1.

The coordinates from the previous time step are stored in prevX and prevY. The initial values are NA.

Value

AgentMatrix object of length n with data for the turtles being: xcor, ycor, who, heading, prevX, prevY, breed, and color.

Author(s)

Sarah Bauduin and Eliot McIntire

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#create-ordered-turtles>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- createOTurtles(n = 10, world = w1)
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- fd(turtles = t1, dist = 1)
```

```
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

createTurtles	<i>Create turtles</i>
---------------	-----------------------

Description

Create n moving agents with a set of defined variables.

Usage

```
createTurtles(n, coords, world, heading, breed, color)
```

```
## S4 method for signature 'numeric,matrix,missing'
createTurtles(n, coords, world, heading,
  breed, color)
```

```
## S4 method for signature 'numeric,missing,ANY'
createTurtles(n, coords, world, heading,
  breed, color)
```

Arguments

n	Integer.
coords	Matrix (ncol = 2) with the first column xcor and the second column ycor representing the turtles initial locations. nrow(coords) must be equal to 1 or to n. Given coordinates must be inside the world's extent. If missing, turtles are put in the center of the world.
world	WorldMatrix or worldArray object.
heading	Numeric. Vector of values between 0 and 360. Must be of length 1 or of length n. If missing, a random heading is assigned to each turtle.
breed	Character. Vector of breed names. Must be of length 1 or of length n. If missing, breed = "turtle" for all turtles.
color	Character. Vector of color names. Must be of length n. If missing, colors are assigned using the function rainbow(n).

Details

If coords is provided, world must not be provided.

The identity of the turtles is defined by their who number. This numbering starts at 0 and increments by 1.

The coordinates from the previous time step are stored in prevX and prevY. The initial values are NA.

Value

AgentMatrix object of length n with data for the turtles being: xcor, ycor, who, heading, prevX, prevY, breed, and color.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#create-turtles>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                  data = runif(25))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

createWorld

Create a world

Description

Create a world of patches of class worldMatrix.

Usage

```
createWorld(minPxcor, maxPxcor, minPycor, maxPycor, data = NA)

## S4 method for signature 'numeric,numeric,numeric,numeric,ANY'
createWorld(minPxcor,
            maxPxcor, minPycor, maxPycor, data = NA)

## S4 method for signature 'missing,missing,missing,missing,missing'
createWorld()
```


Arguments

minPxcor	Integer. Minimum pxcor for the patches (world's left border).
maxPxcor	Integer. Maximum pxcor for the patches (world's right border).
minPycor	Integer. Minimum pycor for the patches (world's bottom border).
maxPycor	Integer. Maximum pycor for the patches (world's top border).
data	Vector of length 1 or length $(\text{maxPxcor} - \text{minPxcor} + 1) * (\text{maxPycor} - \text{minPycor} + 1)$. Default is NA.

Details

If data is provided, values are assigned by rows.

If no parameters value are provided, default values are: minPxcor = -16, maxPxcor = 16, minPycor = -16, and maxPycor = 16.

See help("worldMatrix-class") for more details on the worldMatrix class.

Value

WorldMatrix object composed of $(\text{maxPxcor} - \text{minPxcor} + 1) * (\text{maxPycor} - \text{minPycor} + 1)$ patches (i.e., matrix cells).

Author(s)

Sarah Bauduin, Eliot McIntire, and Alex Chubaty

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = 1:25)
plot(w1)
```

 die

Kill turtles

Description

Kill selected turtles.

Usage

```
die(turtles, who)

## S4 method for signature 'agentMatrix,numeric'
die(turtles, who)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
who	Integer. Vector of the who numbers for the selected turtles.

Details

The who numbers of the remaining turtles are unchanged.

Value

AgentMatrix representing the turtles with the selected ones removed.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#die>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, world = w1)
NLcount(t1)
t1 <- die(turtles = t1, who = c(2, 3, 4))
NLcount(t1)
```

diffuse	<i>Diffuse values in a world</i>
---------	----------------------------------

Description

Each patch gives an equal share of a portion of its value to its neighbor patches.

Usage

```
diffuse(world, pVar, share, nNeighbors, torus = FALSE)

## S4 method for signature 'worldMatrix,missing,numeric,numeric'
diffuse(world, share,
        nNeighbors, torus)

## S4 method for signature 'worldArray,character,numeric,numeric'
diffuse(world, pVar,
        share, nNeighbors, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
pVar	Character. If the world is a worldArray object, pVar is the name of the layer to use to define the patches values. pVar must not be provided if the world is a worldMatrix object.
share	Numeric. Value between 0 and 1 representing the portion of the patches values to be diffused among the neighbors.
nNeighbors	Integer: 4 or 8. Represents the number of neighbor patches considered.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

What is given is lost for the patches.

If torus = TRUE, all patches have nNeighbors patches around them, which some may be on the other sides of the world. If torus = FALSE, patches located on the edges of the world have less than nNeighbors patches around them. However, each neighbor still gets 1/4 or 1/8 of the shared amount and the diffusing patch keeps the leftover.

Value

WorldMatrix or worldArray object with patches values updated.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#diffuse>
<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#diffuse4>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:3, size = 25, replace = TRUE))
plot(w1)
# Diffuse 50% of each patch value to its 8 neighbors
w2 <- diffuse(world = w1, share = 0.5, nNeighbors = 8)
plot(w2)
```

downhill

Move downhill

Description

Move the turtles to their neighboring patch with the lowest value.

Usage

```
downhill(world, pVar, turtles, nNeighbors, torus = FALSE)

## S4 method for signature 'worldMatrix,missing,agentMatrix,numeric'
downhill(world,
         turtles, nNeighbors, torus)

## S4 method for signature 'worldArray,character,agentMatrix,numeric'
downhill(world, pVar,
         turtles, nNeighbors, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
pVar	Character. If the world is a worldArray object, pVar is the name of the layer to use to define the patches values. pVar must not be provided if the world is a worldMatrix object.
turtles	AgentMatrix object representing the moving agents.
nNeighbors	Integer: 4 or 8. Represents the number of neighbor patches considered.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If no neighboring patch has a smaller value than the patch where the turtle is currently located on, the turtle stays on this patch. It still moves to the patch center if it was not already on it.

If there are multiple neighboring patches with the same lowest value, the turtle chooses one patch randomly.

If a turtle is located on a patch on the edge of the world and `torus = FALSE`, it has fewer neighboring patches as options to move than `nNeighbors`; if `torus = TRUE`, the turtle can move on the other side of the world to move downhill and its choice of neighboring patches is always equals to `nNeighbors`.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their heading values and previous coordinates `prevX` and `prevY`.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#downhill>

Examples

```
w1 <- createWorld(minPxcor = 1, maxPxcor = 10, minPycor = 1, maxPycor = 10,
                 data = runif(100))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- downhill(world = w1, turtles = t1, nNeighbors = 8)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

dx	<i>x-increment</i>
----	--------------------

Description

Report the amount by which the turtles' coordinates xcor would change if the turtles were to move forward the given distances with their current headings.

Usage

```
dx(turtles, dist = 1)

## S4 method for signature 'agentMatrix,numeric'
dx(turtles, dist = 1)

## S4 method for signature 'agentMatrix,missing'
dx(turtles)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances the turtles would have to move forward to compute the increment values. Must be of length 1 or of length turtles. The default value is dist = 1.

Details

Report the sine of the turtles' heading multiplied by the dist values. Heading 0 is north and angles are calculated in degrees in a clockwise manner.

Value

Numeric. Vector of length turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#dxy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createOTurtles(world = w1, n = 10)
dx(turtles = t1)
```

dy	<i>y-increment</i>
----	--------------------

Description

Report the amount by which the turtles' coordinates ycor would change if the turtles were to move forward the given distances with their current headings.

Usage

```
dy(turtles, dist = 1)

## S4 method for signature 'agentMatrix,numeric'
dy(turtles, dist = 1)

## S4 method for signature 'agentMatrix,missing'
dy(turtles)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances the turtles would have to move forward to compute the increment values. Must be of length 1 or of length turtles. The default value is dist = 1.

Details

Report the cosine of the turtles' heading multiplied by the dist values. Heading 0 is north and angles are calculated in degrees in a clockwise manner.

Value

Numeric. Vector of length turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#dxy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createOTurtles(world = w1, n = 10)
dy(turtles = t1)
```

extent, worldNLR-method

Bounding box and extent methods for NetLogoR classes

Description

Same as [bbox](#) and [extent](#)

Usage

```
## S4 method for signature 'worldNLR'
extent(x, ...)

## S4 method for signature 'agentMatrix'
extent(x, ...)

.bboxCoords(coords)

## S4 method for signature 'agentMatrix'
bbox(obj)

bbox(obj) <- value

## S4 replacement method for signature 'agentMatrix,matrix'
bbox(obj) <- value

## S4 method for signature 'worldNLR'
bbox(obj)
```


Arguments

x	Raster* or Extent object, a matrix, or a vector of four numbers
...	Additional arguments. When x is a single number representing 'xmin', you can pass three additional numbers (xmax, ymin, ymax) When x is a Raster* object, you can pass four additional arguments to crop the extent: r1, r2, c1, c2, representing the first and last row and column number
coords	documentation needed
obj	object deriving from class "Spatial", or one of classes: "Line", "Lines", "Polygon" or "Polygons", or ANY, which requires obj to be an array with at least two columns
value	2x2 matrix representing the bounding box. See bbox

face	<i>Face something</i>
------	-----------------------

Description

Set the turtles' heading towards agents2.

Usage

```
face(turtles, agents2, world, torus = FALSE)

## S4 method for signature 'agentMatrix,matrix'
face(turtles, agents2, world,
     torus = FALSE)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
agents2	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents, or Matrix (ncol = 2) with the first column x and the second column y representing locations coordinates.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

The number of agents/locations in agents2 must be equal to 1 or to the length of turtles.

If torus = FALSE, world does not need to be provided.

If torus = TRUE and the distance from one turtles to its corresponding agent/location agents2 is smaller around the sides of the world than across it, then the direction to the agent/location agents2 going around the sides of the world is given to the turtle.

If a turtle is facing its own location, its heading does not change.

Value

AgentMatrix representing the turtles with updated headings.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#face>
<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#facexy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- face(turtles = t1, agents2 = cbind(x = 0, y = 0))
t1 <- fd(turtles = t1, dist = 0.5)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

fargs

Function arguments

Description

Function arguments

Arguments

n	Integer.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.
minPxcor	Integer. Minimum pxcor for the patches (world's left border).
maxPxcor	Integer. Maximum pxcor for the patches (world's right border).
minPycor	Integer. Minimum pycor for the patches (world's bottom border).

maxPycor	Integer. Maximum pycor for the patches (world's top border).
pxcor	Integer. Vector of patches pxcor coordinates. Must be of length 1 or of the same length as pycor.
pycor	Integer. Vector of patches pycor coordinates. Must be of length 1 or of the same length as pxcor.
cellNum	Integer. Vector of cells number.
pVar	Character. If the world is a worldArray object, pVar is the name of the layer to use to define the patches values. pVar must not be provided if the world is a worldMatrix object.
turtles	AgentMatrix object representing the moving agents.
patches	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
agents2	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents, or Matrix (ncol = 2) with the first column x and the second column y representing locations coordinates.
nNeighbors	Integer: 4 or 8. Represents the number of neighbor patches considered.
dx	Numeric. Vector of distances to the east (right) from the agents. If dx is negative, the distance to the west (left) is computed. dx must be of length 1 or of the same length as number of patches or turtles in agents.
dy	Numeric. Vector of distances to the north (up) from the agents. If dy is negative, the distance to the south is computed (down). dy must be of length 1 or of the same length as number of patches or turtles in agents.
color	Character. Vector of color names. Must be of length n. If missing, colors are assigned using the function rainbow(n).
who	Integer. Vector of the who numbers for the selected turtles.
breed	Characters. Vector of breed names for the selected turtles. If missing, there is no distinction based upon breed.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().
val	Numeric or character. Vector of any length.

fd	<i>Move forward</i>
----	---------------------

Description

Move the turtles forward with their headings as directions.

Usage

```
fd(turtles, dist, world, torus = FALSE, out = TRUE)
```

```
## S4 method for signature 'agentMatrix,numeric'
fd(turtles, dist, world, torus = FALSE,
   out = TRUE)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances to move. Must be of length 1 or of length turtles.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.
out	Logical. Determine if a turtle should move when torus = FALSE and its ending position will be outside of the world's extent. Default is out = TRUE.

Details

If torus = FALSE and out = TRUE, world does not need to be provided.

If a distance to move leads a turtle outside of the world's extent and torus = TRUE, the turtle is relocated on the other side of the world, inside its extent; if torus = FALSE and out = TRUE, the turtle moves past the world's extent; if torus = FALSE and out = FALSE, the turtle does not move at all. In the event that a turtle does not move, its previous coordinates are still updated with its position before running fd() (i.e., its current position).

If a given dist value is negative, then the turtle moves backward.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their previous coordinates prevX and prevY.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#forward>

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#jump>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- create0Turtles(n = 10, world = w1)
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- fd(turtles = t1, dist = 1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

hatch

Hatch new turtles

Description

Create new turtles from parent turtles.

Usage

```
hatch(turtles, who, n, breed)
```

```
## S4 method for signature 'agentMatrix,numeric,numeric'
```

```
hatch(turtles, who, n, breed)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
who	Integer. Vector of the who numbers for the selected turtles.
n	Integer. Vector of length 1 or of length who. Number of new turtles to create for each parent.
breed	Character. One breed name. If missing, the created turtles are of the same breed as their parent turtle.

Details

The parent turtle must be contained in the turtles.

The created turtles inherit of all the data from the parent turtle, except for the breed if specified otherwise, and for the who numbers. The who" numbers of the turtles created take on following the highest who number among the turtles.

All new hatched turtles are placed at the end of the agentMatrix object.

Value

AgentMatrix representing the turtles with the new hatched ones.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#hatch>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, world = w1)
NLcount(t1)
t1 <- hatch(turtles = t1, who = 0, n = 2)
NLcount(t1)
```

home

Return home

Description

Move the turtles back home.

Usage

```
home(world, turtles, home)
```

```
## S4 method for signature 'worldNLR,agentMatrix,character'
home(world, turtles, home)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.

home Character. Can take one of the following options to define where to relocate the turtles:

- home = "home0" will place the turtles at the location $x = 0$, $y = 0$.
- home = "center" will place the turtles at the center of the world.
- home = "pCorner" will place the turtles at the center of the patch located in the left bottom corner of the world.
- home = "corner" will place the turtles at the left bottom corner of the world.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their previous coordinates prevX and prevY.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#home>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = "black", pch = 16)

t1 <- home(world = w1, turtles = t1, home = "pCorner")
points(t1, col = "red", pch = 16)
```

Description

Report the agents within the "cone of vision" in front of each one of the turtles.

Usage

```
inCone(turtles, radius, angle, agents, world, torus = FALSE)

## S4 method for signature 'agentMatrix,numeric,numeric,matrix'
inCone(turtles, radius,
       angle, agents, world, torus = FALSE)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
radius	Numeric. Vector of distances from turtles to locate agents. Must be of length 1 or of length turtles.
angle	Numeric. Vector of angles to define the size of the cone of vision for the turtles. The cone of vision is defined between the direction of their headings minus $\text{angle} / 2$ to the direction of their headings plus $\text{angle} / 2$. Must be of length 1 or of length turtles.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

agents are reported if there are within radius distance of the turtle and their direction from the turtle is within $[-\text{angle}, + \text{angle}]$ of the turtle's heading.

Distances to patches are calculated to their center.

If torus = FALSE, world does not need to be provided.

If torus = TRUE, the radius distances are calculated around the sides of the world to select agents.

Value

Matrix (ncol = 3) with the first column pxcor and the second column pycor representing the coordinates of the patches among agents2 within the cone of vision of each of the turtles which are represented by the id column, if agents are patches, or

Matrix (ncol = 2) with the first column who representing the who numbers of the turtles among agents2 within the cone of vision of each of the turtles which are represented by the id column, if agents are turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#in-cone>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))

p1 <- inCone(turtles = t1, radius = 2, agents = patches(w1), angle = 90)
t2 <- inCone(turtles = turtle(t1, who = 0), radius = 2, angle = 90, agents = t1)
```

```
initialize,agentMatrix-method
      Initialize for agentMatrix Class
```

Description

To create a new agentMatrix object.

Usage

```
## S4 method for signature 'agentMatrix'
initialize(.Object = "agentMatrix", coords, ...,
          levelsAM)
```

Arguments

.Object	An object: see the “Initialize Methods” section.
coords	2 column matrix of coordinates
...	arguments to specify properties of the new object, to be passed to initialize().
levelsAM	A list with named character vectors. Each name should match with elements in ..., and each character vector should be the length of unique elements in the ... element.

inRadius	<i>Agents in radius</i>
----------	-------------------------

Description

Report the patches or turtles among agents2 within given distances of each of the agents. Currently, this function multiplies radius by 1.0000001 so that the response of inRadius is inclusive.

Usage

```
inRadius(agents, radius, agents2, world, torus = FALSE)
```

```
## S4 method for signature 'matrix,numeric,matrix'
inRadius(agents, radius, agents2, world,
         torus = FALSE)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
radius	Numeric. Vector of distances from agents to locate agents2. Must be of length 1 or of length agents.
agents2	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

Distances from/to patches are calculated from/to their center.

If torus = FALSE, world does not need to be provided.

If torus = TRUE, the radius distances are calculated around the sides of the world to select agents2.

Value

Matrix (ncol = 3) with the first column pxcor and the second column pycor representing the coordinates of the patches among agents2 within radius distances for each agents which are represented by the id column, if agents2 are patches, or

Matrix (ncol = 2) with the first column who representing the who numbers of the turtles among agents2 within radius distances for each agents which are represented by the id column, if agents2 are turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#in-radius>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))

p1 <- inRadius(agents = patch(w1, 0, 0), radius = 2, agents2 = patches(w1))
t2 <- inRadius(agents = patch(w1, 0, 0), radius = 2, agents2 = t1)
p2 <- inRadius(agents = t1, radius = 2, agents2 = patches(w1))
t3 <- inRadius(agents = turtle(t1, who = 0), radius = 2, agents2 = t1)
```

inspect

Inspect turtles

Description

Display all variables values for the selected individuals among the turtles.

Usage

```
inspect(turtles, who)

## S4 method for signature 'agentMatrix,numeric'
inspect(turtles, who)
```

Arguments

turtles AgentMatrix object representing the moving agents.
who Integer. Vector of the who numbers for the selected turtles.

Value

Dataframe (nrow = length(who)) of the variables of the selected individuals among the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#inspect>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createOTurtles(world = w1, n = 10)
inspect(turtles = t1, who = c(2, 3))
```

isNLclass

Type of object

Description

Report TRUE if the agents is of the class tested, report FALSE otherwise.

Usage

```
isNLclass(agents, class)
```

```
## S4 method for signature 'matrix,character'
isNLclass(agents, class)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
class	Character. Can take one of the following options to define the class: "agent", "agentset", "patch", "patchset". "turtle" or "turtleset".

Details

Careful! The class tested does not correspond to actual R classes.

agents is "patch" if it is a matrix (ncol = 2) with the first column pxcor and the second column pycor with only one row. agents is "patcheset" if the matrix has more than one row.

agents is "turtle" if it is an agentMatrix containing only one turtle. agents is "turtleset" if the agentMatrix contains more than one turtle.

agents is "agent" if it is either "patch" or "turtle". agents is "agentset" if it is either "patcheset" or "turtleset".

Value

Logical. TRUE if agents is of the class tested.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#is-of-type>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:3, size = 10, replace= TRUE))
isNLclass(agents = patches(w1), class = "patch")
isNLclass(agents = patches(w1), class = "patcheset")
isNLclass(agents = t1, class = "agentset")
isNLclass(agents = t1, class = "turtleset")
```

layoutCircle

Layout turtles on a circle

Description

Relocate the turtles on a circle centered on the world.

Usage

```
layoutCircle(world, turtles, radius, torus = FALSE)

## S4 method for signature 'worldNLR,agentMatrix,numeric'
layoutCircle(world, turtles,
             radius, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
radius	Numeric. Radius of the circle.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

The turtles point outwards.

If the radius value leads turtles outside of the world's extent and torus = TRUE, they are relocated on the other sides of the world, inside its extent; if torus = FALSE, the turtles are located past the world's extent.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their heading values and previous coordinates prevX and prevY.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#layout-circle>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9,
                 data = runif(100))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = "black", pch = 16)

t1 <- layoutCircle(world = w1, turtles = t1, radius = 3)
points(t1, col = "red", pch = 16)
```

left	<i>Rotate to the left</i>
------	---------------------------

Description

Rotate the turtles's headings to the left of angle degrees.

Usage

```
left(turtles, angle)

## S4 method for signature 'agentMatrix,numeric'
left(turtles, angle)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
angle	Numeric. Vector of angles in degrees by which to rotate the turtles' headings. Must be of length 1 or of length turtles.

Details

If a given angle value is negative, then the turtle rotates to the right.

Value

AgentMatrix representing the turtles with updated heading values.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#left>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, world = w1)
of(agents = t1, var = "heading")
t1 <- left(turtles = t1, angle = 180)
of(agents = t1, var = "heading")
```

maxNof

N agents *with maximum*

Description

Report the n patches or turtles among agents which have their variable among the maximum values.

Usage

```
maxNof(agents, n, world, var)
```

```
## S4 method for signature 'matrix,numeric,worldMatrix,missing'
maxNof(agents, n, world)
```

```
## S4 method for signature 'matrix,numeric,worldArray,character'
maxNof(agents, n, world,
      var)
```

```
## S4 method for signature 'agentMatrix,numeric,missing,character'
maxNof(agents, n, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
n	Integer.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

If there is a tie that would make the number of returned patches or turtles larger than n, it is broken randomly.

Value

Matrix (ncol = 2, nrow = n) with the first column pxcor and the second column pycor representing the coordinates of the n patches among the agents which have their variable values among the maximum values among the agents, or

AgentMatrix of length n representing the turtles among the agents which have their var values among the maximum values among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#max-n-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:10, size = 25, replace = TRUE))
plot(w1)
p1 <- maxNof(agents = patches(w1), n = 6, world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:5, size = 10, replace = TRUE))
t2 <- maxNof(agents = t1, n = 5, var = "heading")
```

maxOneOf	<i>One agent with maximum</i>
----------	-------------------------------

Description

Report one patch or one turtle among agents which has its variable equals to the maximum value.

Usage

```
maxOneOf(agents, world, var)

## S4 method for signature 'matrix,worldMatrix,missing'
maxOneOf(agents, world)

## S4 method for signature 'matrix,worldArray,character'
maxOneOf(agents, world, var)

## S4 method for signature 'agentMatrix,missing,character'
maxOneOf(agents, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

If there are several patches or turtles among agents with their variable equal to the maximum value, one is chosen randomly. To access to all patches or turtles among agents which have their variable equal to the maximum value, use withMax().

Value

Matrix (ncol = 2, nrow = 1) with the first column pxcor and the second column pycor representing the coordinates of the patch (or of one of the patches) among the agents which has its variable equals to the maximum value among the agents, or

AgentMatrix of length 1 representing the turtle (or one of the turtles) among the agents which has its variable var equals to the maximum value among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#max-one-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:5, size = 25, replace = TRUE))
plot(w1)
p1 <- maxOneOf(agents = patches(w1), world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:3, size = 10, replace = TRUE))
t2 <- maxOneOf(agents = t1, var = "heading")
```

maxPxcor

Maximum pxcor

Description

Report the patches maximum pxcor in the world.

Usage

```
maxPxcor(world)

## S4 method for signature 'worldNLR'
maxPxcor(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#max-pcor>

Examples

```
w1 <- createWorld()
maxPycor(w1)
```

maxPycor

Maximum pycor

Description

Report the patches maximum pycor in the world.

Usage

```
maxPycor(world)

## S4 method for signature 'worldNLR'
maxPycor(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#max-pcor>

Examples

```
w1 <- createWorld()
maxPycor(w1)
```

minNof	N agents <i>with minimum</i>
--------	------------------------------

Description

Report the n patches or turtles among agents which have their variable among the minimum values.

Usage

```
minNof(agents, n, world, var)

## S4 method for signature 'matrix,numeric,worldMatrix,missing'
minNof(agents, n, world)

## S4 method for signature 'matrix,numeric,worldArray,character'
minNof(agents, n, world,
      var)

## S4 method for signature 'agentMatrix,numeric,missing,character'
minNof(agents, n, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
n	Integer.

`world` WorldMatrix or worldArray object.

`var` Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to `xcor`, `ycor`, any of the variables created when turtles were created, as well as any variable created using `turtlesOwn()`.

Details

world must not be provided if agents are turtles.

If there is a tie that would make the number of returned patches or turtles larger than n, it is broken randomly.

Value

Matrix (`ncol = 2`, `nrow = n`) with the first column `pxcor` and the second column `pycor` representing the coordinates of the n patches among the agents which have their variable values among the minimum values among the agents, or

AgentMatrix of length n representing the turtles among the agents which have their var values among the minimum values among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#min-n-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:10, size = 25, replace = TRUE))
plot(w1)
p1 <- minNof(agents = patches(w1), n = 6, world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:5, size = 10, replace = TRUE))
t2 <- minNof(agents = t1, n = 5, var = "heading")
```

minOneOf	<i>One agent with minimum</i>
----------	-------------------------------

Description

Report one patch or one turtle among agents which has its variable equals to the minimum value.

Usage

```
minOneOf(agents, world, var)

## S4 method for signature 'matrix,worldMatrix,missing'
minOneOf(agents, world)

## S4 method for signature 'matrix,worldArray,character'
minOneOf(agents, world, var)

## S4 method for signature 'agentMatrix,missing,character'
minOneOf(agents, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

If there are several patches or turtles among agents with their variable equal to the minimum value, one is chosen randomly. To access to all patches or turtles among agents which have their variable equal to the minimum value, use withMin().

Value

Matrix (ncol = 2, nrow = 1) with the first column pxcor and the second column pycor representing the coordinates of the patch (or of one of the patches) among the agents which has its variable equals to the minimum value among the agents, or

AgentMatrix of length 1 representing the turtle (or one of the turtles) among the agents which has its variable var equals to the minimum value among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#min-one-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                  data = sample(1:5, size = 25, replace = TRUE))

plot(w1)
p1 <- minOneOf(agents = patches(w1), world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                   heading = sample(1:3, size = 10, replace = TRUE))
t2 <- minOneOf(agents = t1, var = "heading")
```

minPxcor

Minimum pxcor

Description

Report the patches minimum pxcor in the world.

Usage

```
minPxcor(world)

## S4 method for signature 'worldNLR'
minPxcor(world)
```


Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#min-pcor>

Examples

```
w1 <- createWorld()
minPycor(w1)
```

minPycor	<i>Minimum</i> pycor
----------	----------------------

Description

Report the patches minimum pycor in the world.

Usage

```
minPycor(world)

## S4 method for signature 'worldNLR'
minPycor(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#min-pcor>

Examples

```
w1 <- createWorld()
minPycor(w1)
```

moveTo

Move to

Description

Move the turtles to the agents' locations.

Usage

```
moveTo(turtles, agents)

## S4 method for signature 'agentMatrix,matrix'
moveTo(turtles, agents)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.

Details

The number of agents must be equal to 1 or to length turtles.

The turtle's headings are not affected with this function.

If a turtle is moving to a patch location, it will be located at the patch center.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their previous coordinates prevX and prevY.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#move-to>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9,
                 data = runif(100))
t1 <- createTurtles(n = 5, coords = randomXYcor(w1, n = 5))
plot(w1)
points(t1, col = "black", pch = 16)

t1 <- moveTo(turtles = t1, agents = turtle(t1, who = 0))
points(t1, col = "red", pch = 16)

t1 <- moveTo(turtles = t1, agents = patch(w1, 9, 9))
points(t1, col = "blue", pch = 16)
```

neighbors

Neighbors patches

Description

Report the coordinates of the neighbors patches around the agents.

Usage

```
neighbors(world, agents, nNeighbors, torus = FALSE)

## S4 method for signature 'worldNLR,matrix,numeric'
neighbors(world, agents, nNeighbors,
          torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
nNeighbors	Integer: 4 or 8. Represents the number of neighbor patches considered.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

The patch around which the neighbors are identified, or the patch where the turtle is located on around which the neighbors are identified, is not returned.

If torus = FALSE, agents located on the edges of the world have less than nNeighbors patches around them. If torus = TRUE, all agents located on the edges of the world have nNeighbors patches around them, which some may be on the other sides of the world.

Value

Matrix (ncol = 3) with the first column pxcor and the second column pycor representing the coordinates of the neighbors patches around the agents and the third column id representing the id of the agents in the order provided.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#neighbors>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
neighbors(world = w1, agents = patch(w1, c(0,9), c(0,7)), nNeighbors = 8)
t1 <- createTurtles(n = 3, coords = randomXYcor(w1, n = 3))
neighbors(world = w1, agents = t1, nNeighbors = 4)
```

NLall *All agents?*

Description

Report TRUE if all agents have their variable equal to a given value, report FALSE otherwise.

Usage

```
NLall(agents, world, var, val)
```

```
## S4 method for signature 'matrix,worldMatrix,missing'
NLall(agents, world, val)
```

```
## S4 method for signature 'matrix,worldArray,character'
NLall(agents, world, var, val)
```

```
## S4 method for signature 'agentMatrix,missing,character'
NLall(agents, var, val)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().
val	Numeric or character. Vector of any length.

Details

world must not be provided if agents are turtles.

Value

Logical. TRUE if all the agents have their variable equal to val, FALSE otherwise.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#all>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = runif(25))
NLall(agents = patches(w1), world = w1, val = 5)
w2 <- w1
w2 <- NLset(world = w1, agents = patches(w1), val = 5)
NLall(agents = patches(w2), world = w2, val = 5)

# Turtles
t1 <- createTurtles(n = 5, coords = cbind(xcor = 1, ycor = 1), heading = c(1, 2, 2, 1, 2))
NLall(agents = t1, var = "xcor", val = 1)
NLall(agents = t1, var = "heading", val = 2)
```

NLany

Any agents?

Description

Report TRUE if agents is non empty, report FALSE otherwise.

Usage

```
NLany(agents)
```

```
## S4 method for signature 'matrix'
NLany(agents)
```

Arguments

agents Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.

Value

Logical. TRUE if there is at least one patch or one turtle in the agents, FALSE otherwise.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#any>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
p1 <- noPatches()
p2 <- patch(w1, 0, 0)
NLany(p1)
NLany(p2)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
t2 <- noTurtles()
NLany(t1)
NLany(t2)
```

NLcount

Count agents

Description

Report the number of patches or turtles inside agents.

Usage

```
NLcount(agents)
```

```
## S4 method for signature 'matrix'
NLcount(agents)
```

Arguments

agents Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#count>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
p1 <- patches(w1)
NLcount(p1) # 25 patches

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
NLcount(t1) # 10 turtles
```

NLdist

Distances between agents

Description

Report the distances between agents and agents2.

Usage

```
NLdist(agents, agents2, world, torus = FALSE, allPairs = FALSE)

## S4 method for signature 'matrix,matrix'
NLdist(agents, agents2, world, torus = FALSE,
      allPairs = FALSE)
```


Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
agents2	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents, or Matrix (ncol = 2) with the first column x and the second column y representing locations coordinates.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.
allPairs	Logical. Only relevant if the number of agents/locations in agents and agents2 are the same. If allPairs = FALSE, the distance between each agents with the corresponding agents2 is returned. If allPairs = TRUE, a full distance matrix is returned. Default is allPairs = FALSE.

Details

Distances from/to a patch are measured from/to its center.

If torus = FALSE, world does not need to be provided.

If torus = TRUE, a distance around the sides of the world is reported only if smaller than the one across the world.

Value

Numeric. Vector of distances between agents and agents2 if agents and/or agents2 contained one agent/location, or if agents and agents2 contained the same number of agents/locations and allPairs = FALSE, or

Matrix of distances between agents (rows) and agents2 (columns) if agents and agents2 are of different lengths, or of same length and allPairs = TRUE.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#distance>

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#distancexy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
NLdist(agents = patch(w1, 0, 0), agents2 = patch(w1, c(1, 9), c(1, 9)))
NLdist(agents = patch(w1, 0, 0), agents2 = patch(w1, c(1, 9), c(1, 9)),
       world = w1, torus = TRUE)
t1 <- createTurtles(n = 2, coords = randomXYcor(w1, n = 2))
NLdist(agents = t1, agents2 = patch(w1, c(1,9), c(1,9)), allPairs = TRUE)
```

NLset

Set an agents variable

Description

Assign values to the agents for the selected variables.

Usage

```
NLset(world, turtles, agents, var, val)

## S4 method for signature 'missing,agentMatrix,agentMatrix,character'
NLset(turtles,
      agents, var, val)

## S4 method for signature 'worldMatrix,missing,matrix,missing'
NLset(world, agents, val)

## S4 method for signature 'worldArray,missing,matrix,character'
NLset(world, agents, var,
      val)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
var	Character. Vector of the names of the selected agents variables. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layers to use to define the patches values. If agents are turtles, var is some of the turtles' variable and can be any of the variables created when turtles were created, as well as any variable created with turtlesOwn().

`val` Numeric or character. Vector of length 1 or length `NLcount(agents)` if `length(var) == 1`, or
Matrix or Dataframe (`ncol = length(var)`, `nrow = NLcount(agents)`). Columns must be in the same order as `var`.

Details

If agents are patches, `world` must be provided and `turtles` must not be provided. If agents are turtles, `turtles` must be provided and `world` must not be provided.

Value

WorldMatrix or worldArray object with the values `val` assigned to the patches variables `var` for the agents, or

AgentMatrix representing the turtles with the values `val` assigned to the variables `var` for the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#set>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
w1 <- NLset(world = w1, agents = patches(w1), val = 1)
# Set the patch[0,4] to 0
w1 <- NLset(world = w1, agents = patch(w1, 0, 4), val = 0)
of(world = w1, agents = patches(w1))

t1 <- createTurtles(n = 3, world = w1, heading = 0)
# Set the heading of turtle 0 to 180
t2 <- NLset(turtles = t1, agents = turtle(t1, who = 0), var = "heading", val = 180)
of(agents = t2, var = "heading") # c(180, 0, 0)
```

NLwith	Agents <i>with</i>
--------	--------------------

Description

Report the patches or the turtles among agents which have their variable equals to specific values.

Usage

```
NLwith(agents, world, var, val)

## S4 method for signature 'matrix,worldMatrix,missing'
NLwith(agents, world, val)

## S4 method for signature 'matrix,worldArray,character'
NLwith(agents, world, var, val)

## S4 method for signature 'agentMatrix,missing,character'
NLwith(agents, var, val)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().
val	Numeric or character. Vector of any length.

Details

world must not be provided if agents are turtles.
This is equivalent in R to subsetting.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches among the agents which have their variable equals to any val, or AgentMatrix representing the turtles among the agents which have their variable var equals to any val.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#with>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:5, size = 25, replace = TRUE))
plot(w1)
p2 <- NLwith(agents = patches(w1), world = w1, val = 2)

# Turtles
t1 <- createTurtles(n = 5, coords = randomXYcor(w1, n = 5),
                  breed = c("sheep", "sheep", "wolf", "sheep", "sheperd"))
t2 <- NLwith(agents = t1, var = "breed", val = "sheep")
t3 <- NLwith(agents = t1, var = "breed", val = c("sheep", "wolf"))
```

NLworldIndex

WorldMatrix *indices from vector indices*

Description

Convert vector indices or Raster* cell numbers into worldMatrix indices.

Usage

```
NLworldIndex(world, cellNum)

## S4 method for signature 'worldMatrix,numeric'
NLworldIndex(world, cellNum)
```

Arguments

world WorldMatrix or worldArray object.
cellNum Integer. Vector of cells number.

Value

Numeric. Vector of worldMatrix indices.

Author(s)

Eliot McIntire

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9, data = 1:100)
w1Ras <- world2raster(w1)
index <- 24
pxpy <- PxcorPycorFromCell(world = w1, cellNum = index)

rasValue <- as.integer(unnamed(w1Ras[index]))
# Not correct index:
identical(w1[index], rasValue)

# Correct index
identical(w1[NLworldIndex(w1, index)], rasValue)
```

nOf

N random agents

Description

Report n patches or turtles randomly selected among agents.

Usage

```
nOf(agents, n)

## S4 method for signature 'matrix,numeric'
nOf(agents, n)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or Matrix (ncol = 3) with the first column "pxcor and the second column pycor representing the patches coordinates and the third column id, or AgentMatrix object representing the moving agents, or Matrix (ncol = 2) with the first column whoTurtles and the second column id.
n	Integer. Number of patches or turtles to select from agents.

Details

n must be less or equal the number of patches or turtles in agents.

If agents is a matrix with ncol = 3, the selection of n random patches is done per individual "id". The order of the patches coordinates returned follow the order of "id". If agents is a matrix (ncol = 2) with columns whoTurtles and id, the selection of n random turtles (defined by their whoTurtles) is done per individual "id". The order of the who numbers returned follow the order of "id".

Value

Matrix (ncol = 2, nrow = n) with the first column pxcor and the second column pycor representing the coordinates of the selected patches from agents, or

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the selected patches from agents, n per individual "id", or

AgentMatrix (nrow = n) representing the turtles selected from agents,

Integer. Vector of who numbers for the selected turtles from agents, n per individual "id".

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#n-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
pSelect <- nOf(agents = patches(w1), n = 5)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
tSelect <- nOf(agents = t1, n = 2)
```

noPatches	<i>No patches</i>
-----------	-------------------

Description

Report an empty patch agentset.

Usage

```
noPatches()
```

Value

Matrix (ncol = 2, nrow = 0) with the first column pxcor and the second column pycor.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#no-patches>

Examples

```
p1 <- noPatches()  
NLcount(p1)
```

noTurtles	<i>No turtles</i>
-----------	-------------------

Description

Report an empty turtle agentset.

Usage

```
noTurtles()
```


Value

AgentMatrix with the turtle variables defined as when using createTurtles() but with 0 turtle.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#no-turtles>

Examples

```
t1 <- noTurtles()
NLcount(t1)
```

numLayers,worldArray-method
Methods for quickPlot

Description

These are required to create plotting methods to work with **quickPlot**.

Usage

```
## S4 method for signature 'worldArray'
numLayers(x)

## S4 method for signature 'agentMatrix'
.plotGrob(grobToPlot, col = NULL, real = FALSE,
  size = unit(5, "points"), minv, maxv, legend = TRUE,
  legendText = NULL, length = NULL, gp = gpar(), gpText = gpar(),
  pch = 19, speedup = 1, name = character(), vp = list(), ...)

## S4 method for signature 'worldArray'
layerNames(object)

## S4 method for signature 'worldArray,.quickPlotGrob'
.identifyGrobToPlot(toPlot, sGrob,
  takeFromPlotObj)
```

Arguments

<code>x</code>	A <code>.quickPlotObjects</code> object or list of these.
<code>grobToPlot</code>	<code>Raster*</code> , <code>SpatialLines*</code> , <code>SpatialPoints*</code> , or <code>SpatialPolygons*</code> object.
<code>col</code>	Currently only used for the legend of a <code>Raster*</code> object.
<code>real</code>	Logical indicating whether the data are real numbers (i.e., as opposed to integer or factor).
<code>size</code>	The size of the <code>SpatialPoints</code> .
<code>minv</code>	The minimum value on a <code>Raster*</code> . Required because not all <code>Rasters</code> have this defined internally.
<code>maxv</code>	The maximum value on a <code>Raster*</code> . Required because not all <code>Rasters</code> have this defined internally.
<code>legend</code>	Logical indicating whether a legend should be drawn. Default <code>TRUE</code> .
<code>legendText</code>	Vector of values to use for legend value labels. Defaults to <code>NULL</code> which results in a pretty numeric representation. If <code>Raster*</code> has a <code>Raster Attribute Table</code> (<code>rat</code> ; see raster package), this will be used by default. Currently, only a single vector is accepted.
<code>length</code>	Numeric.
<code>gp</code>	grid parameters, usually the output of a call to <code>gpar</code> .
<code>gpText</code>	<code>gpar</code> object for legend label text.
<code>pch</code>	Point character for <code>SpatialPoints</code> , as <code>par</code> .
<code>speedup</code>	Numeric. The factor by which the number of vertices in <code>SpatialPolygons</code> and <code>SpatialLines*</code> will be subsampled. The vertices are already subsampled by default to make plotting faster.
<code>name</code>	Character string of name of object being plotted.
<code>vp</code>	whole viewport tree of <code>quickPlotGrob</code>
<code>...</code>	Additional arguments. None currently implemented.
<code>object</code>	A <code>Raster*</code> , <code>SpatialPoints*</code> , <code>SpatialLines*</code> , or <code>SpatialPolygons*</code> object; or list of these.
<code>toPlot</code>	The object to plot. Should be a single layer if from a multi-layer object such as a <code>RasterStack</code> .
<code>sGrob</code>	<code>quickPlot</code> grob object
<code>takeFromPlotObj</code>	Logical. Should the data come from the argument passed into <code>Plot</code> (<code>TRUE</code>), or from the <code>(.quickPlotEnv)</code> (<code>FALSE</code>).

of *Values of an agents variable*

Description

Report the agents values for the requested variable.

Usage

```
of(world, agents, var)
```

```
## S4 method for signature 'missing,agentMatrix,character'
of(agents, var)
```

```
## S4 method for signature 'worldMatrix,matrix,missing'
of(world, agents)
```

```
## S4 method for signature 'worldArray,matrix,character'
of(world, agents, var)
```

Arguments

world	WorldMatrix or worldArray object.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
var	Character. Vector of the names of the selected agents variables. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layers to use to define the patches values. If agents are turtles, var is some of the turtles' variable and can be any of the variables created when turtles were created, as well as any variable created with turtlesOwn().

Details

world must be provided only if agents are patches.

Value

Vector of values for the agents if one variable is requested. The class depends of the variable class. The order of the vector follows the order of the agents, or

Matrix or Dataframe (ncol = length(var), nrow = NLcount(agents)) if more than one variable is requested. The row order follows the order of the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = 1:25)
of(world = w1, agents = patch(w1, c(0, 0), c(4, 0)))

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
of(agents = t1, var = "heading")
```

oneOf

One random agent

Description

Report one patch or turtle randomly selected among agents.

Usage

```
oneOf(agents)

## S4 method for signature 'matrix'
oneOf(agents)
```

Arguments

agents Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or
 Matrix (ncol = 3) with the first column "pxcor and the second column pycor representing the patches coordinates and the third column id, or
 AgentMatrix object representing the moving agents, or
 Matrix (ncol = 2) with the first column whoTurtles and the second column id.

Details

If `agents` is a matrix with `ncol = 3`, the selection of one random patch is done per individual `id`. The order of the patches coordinates returned follow the order of `id`. If `agents` is a matrix (`ncol = 2`) with columns `whoTurtles` and `id`, the selection of one random turtle (defined by their `whoTurtles`) is done per individual `id`. The order of the who numbers returned follow the order of `id`.

Value

Matrix (`ncol = 2`, `nrow = 1`) with the first column `pxcor` and the second column `pycor` representing the coordinates of the selected patch from `agents`, or

Matrix (`ncol = 2`) with the first column `pxcor` and the second column `pycor` representing the coordinates of the selected patches from `agents`, one per individual `id`, or

AgentMatrix object representing the turtle selected from `agents`, or

Integer. Vector of who numbers for the selected turtles from `agents`, one per individual `id`.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#one-of>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
pSelect <- oneOf(agents = patches(w1))

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
tSelect <- oneOf(agents = t1)
```

 other

Others

Description

Report an agentset of the agents except specific ones.

Usage

```
other(agents, except)
```

```
## S4 method for signature 'matrix,matrix'
other(agents, except)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
except	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.

Details

Both agents and except must be of the same class (e.g., both patches or both turtles).

Warning: this function removes turtles only based on similar who numbers and breed names.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches in agents without the ones in except, or

AgentMatrix representing the turtles in agents without the ones in except.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#other>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
p1 <- other(agents = patches(w1), except = patch(w1, 0, 0))
NLcount(p1) # 99 patches

# Turtles
t1 <- createTurtles(n = 10, coords = cbind(xcor = 0, ycor = 0))
t2 <- other(agents = t1, except = turtle(t1, who = 0))
NLcount(t2) # 9 turtles
```

patch	Patches <i>coordinates</i>
-------	----------------------------

Description

Report the coordinates of the patches at the given [x, y] locations.

Usage

```
patch(world, x, y, duplicate = FALSE, torus = FALSE, out = FALSE)
```

```
## S4 method for signature 'worldNLR,numeric,numeric'
patch(world, x, y,
      duplicate = FALSE, torus = FALSE, out = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
x	Numeric. Vector of x coordinates. Must be of same length as y.
y	Numeric. Vector of y coordinates. Must be of same length as x.
duplicate	Logical. If more than one location [x, y] fall into the same patch and duplicate == TRUE, the patch coordinates are returned the number of times the locations. If duplicate == FALSE, the patch coordinates are only returned once. Default is duplicate == FALSE.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.
out	Logical. If out = FALSE, no patch coordinates are returned for patches outside of the world's extent, if out = TRUE, NA are returned. Default is out = FALSE.

Details

If a location [x, y] is outside the world's extent and torus = FALSE and out = FALSE, no patch coordinates are returned; if torus = FALSE and out = TRUE, NA are returned; if torus = TRUE, the patch coordinates from a wrapped world are returned.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates at [x, y].

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
patch(world = w1, x = c(0, 9.1, 8.9, 5, 5.3), y = c(0, 0, -0.1, 12.4, 12.4))
patch(world = w1, x = c(0, 9.1, 8.9, 5, 5.3), y = c(0, 0, -0.1, 12.4, 12.4),
      duplicate = TRUE)
patch(world = w1, x = c(0, 9.1, 8.9, 5, 5.3), y = c(0, 0, -0.1, 12.4, 12.4),
      torus = TRUE)
patch(world = w1, x = c(0, 9.1, 8.9, 5, 5.3), y = c(0, 0, -0.1, 12.4, 12.4),
      torus = TRUE, duplicate = TRUE)
```

patchAhead

Patches *ahead*

Description

Report the coordinates of the patches at the given distances of the turtles in the direction of their headings.

Usage

```
patchAhead(world, turtles, dist, torus = FALSE)
```

```
## S4 method for signature 'worldNLR,agentMatrix,numeric'
patchAhead(world, turtles, dist,
           torus = FALSE)
```


Arguments

<code>world</code>	WorldMatrix or worldArray object.
<code>turtles</code>	AgentMatrix object representing the moving agents.
<code>dist</code>	Numeric. Vector of distances from the turtles. <code>dist</code> must be of length 1 or of length <code>turtles</code> .
<code>torus</code>	Logical to determine if the world is wrapped. Default is <code>torus = FALSE</code> .

Details

If `torus = FALSE` and the patch at distance `dist` of a turtle is outside the world's extent, NA are returned for the patch coordinates. If `torus = TRUE`, the patch coordinates from a wrapped world are returned.

Value

Matrix (`ncol = 2`) with the first column `pxcor` and the second column `pycor` representing the coordinates of the patches at the distances `dist` and turtles's headings directions of turtles. The order of the patches follows the order of the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-ahead>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
patchAhead(world = w1, turtles = t1, dist = 1)
```

patchAt	Patches <i>at</i>
---------	-------------------

Description

Report the coordinates of the patches at (dx, dy) distances of the agents.

Usage

```
patchAt(world, agents, dx, dy, torus = FALSE)
```

```
## S4 method for signature 'worldNLR,matrix,numeric,numeric'
patchAt(world, agents, dx, dy,
        torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
dx	Numeric. Vector of distances to the east (right) from the agents. If dx is negative, the distance to the west (left) is computed. dx must be of length 1 or of the same length as number of patches or turtles in agents.
dy	Numeric. Vector of distances to the north (up) from the agents. If dy is negative, the distance to the south is computed (down). dy must be of length 1 or of the same length as number of patches or turtles in agents.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If the patch at distance (dx, dy) of an agent is outside of the world's extent and torus = FALSE, NA are returned for the patch coordinates; if torus = TRUE, the patch coordinates from a wrapped world are returned.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches at (dx, dy) distances of the agents. The order of the patches follows the order of the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-at>
<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#at-points>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
patchCorner <- patchAt(world = w1, agents = patch(w1, 0, 0), dx = 1, dy = 1)
t1 <- createTurtles(n = 1, coords = cbind(xcor = 0, ycor = 0))
patchCorner <- patchAt(world = w1, agents = t1, dx = 1, dy = 1)
```

patchDistDir	<i>Patches at given distances and directions</i>
--------------	--

Description

Report the coordinates of the patches at the given distances and directions from the agents.

Usage

```
patchDistDir(world, agents, dist, angle, torus = FALSE)

## S4 method for signature 'worldNLR,matrix,numeric,numeric'
patchDistDir(world, agents,
             dist, angle, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances from the agents. Must be of length 1 or of the same length as the number of agents.
angle	Numeric. Absolute directions from the agents. angle must be of length 1 or of the same length as the number of agents. Angles are in degrees with 0 being North.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If `torus = FALSE` and the patch at distance `dist` and direction angle of an agent is outside the world's extent, NA are returned for the patch coordinates. If `torus = TRUE`, the patch coordinates from a wrapped world are returned.

If agents are turtles, their headings are not taken into account; the given directions angle are used. To find a patch at certain distance from a turtle using the turtle's heading, look at `patchAhead()`, `patchLeft()` or `patchRight()`.

Value

Matrix (`ncol = 2`) with the first column `pxcor` and the second column `pycor` representing the coordinates of the patches at the distances `dist` and directions angle of agents. The order of the patches follows the order of the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-at-heading-and-distance>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
p1 <- patchDistDir(world = w1, agents = patch(w1, 0, 0), dist = 1, angle = 45)
t1 <- createTurtles(n = 1, coords = cbind(xcor = 0, ycor = 0), heading = 315)
p2 <- patchDistDir(world = w1, agents = t1, dist = 1, angle = 45)
```

patches

All the patches in a world

Description

Report the coordinates of all the patches in the world.

Usage

```
patches(world)
```

```
## S4 method for signature 'worldNLR'
patches(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates. The order of the patches follows the order of the cells numbers as defined for a Raster* object.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patches>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
allPatches <- patches(world = w1)
NLcount(allPatches) # 100 patches
```

patchHere

Patches *here*

Description

Report the coordinates of the patches under the turtles locations.

Usage

```
patchHere(world, turtles)

## S4 method for signature 'worldNLR,agentMatrix'
patchHere(world, turtles)
```

Arguments

world WorldMatrix or worldArray object.
 turtles AgentMatrix object representing the moving agents.

Details

If a turtle is located outside of the world's extent, NA are returned for the patch coordinates.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches at the turtles location. The order of the patches follows the order of the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-here>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
patchHere(world = w1, turtles = t1)
```

patchLeft

Patches *on the left*

Description

Report the coordinates of the patches at the given distances of the turtles and given angle left of their headings.

Usage

```
patchLeft(world, turtles, dist, angle, torus = FALSE)
```

```
## S4 method for signature 'worldNLR,agentMatrix,numeric,numeric'
patchLeft(world, turtles,
  dist, angle, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances from the turtles. dist must be of length 1 or of length turtles.
angle	Numeric. Vector of angles in degrees by which the turtle's headings should rotate to locate the patches. Must be of length 1 or of length turtles.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If a given dist value is negative, then the turtle would look backward. If a given angle value is negative, then the turtle would look to the right.

If torus = FALSE and the patch at distance dist of a turtle and angle degrees to the left of its heading is outside the world's extent, NA are returned for the patch coordinates. If torus = TRUE, the patch coordinates from a wrapped world are returned.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches at dist distances of the turtles and angle to the left of their headings. The order of the patches follows the order of the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-lr-and-ahead>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 1, coords = cbind(xcor = 2, ycor = 2), heading = 90)
patchLeft(world = w1, turtles = t1, dist = 2, angle = 90)
```

 patchRight

 Patches *on the right*

Description

Report the coordinates of the patches at the given distances of the turtles and given angle right of their headings.

Usage

```
patchRight(world, turtles, dist, angle, torus = FALSE)
```

```
## S4 method for signature 'worldNLR,agentMatrix,numeric,numeric'
patchRight(world, turtles,
  dist, angle, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
dist	Numeric. Vector of distances from the turtles. dist must be of length 1 or of length turtles.
angle	Numeric. Vector of angles in degrees by which the turtle's headings should rotate to locate the patches. Must be of length 1 or of length turtles.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If a given dist value is negative, then the turtle would look backward. If a given angle value is negative, then the turtle would look to the left.

If torus = FALSE and the patch at distance dist of a turtle and angle degrees to the right of its heading is outside the world's extent, NA are returned for the patch coordinates. If torus = TRUE, the patch coordinates from a wrapped world are returned.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches at dist distances of the turtles and angle to the right of their headings. The order of the patches follows the order of the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-lr-and-ahead>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 1, coords = cbind(xcor = 2, ycor = 2), heading = 90)
patchRight(world = w1, turtles = t1, dist = 2, angle = 90)
```

patchSet

Patch *set*

Description

Report the patch coordinates of all the unique patches contained in the inputs.

Usage

```
patchSet(...)

## S4 method for signature 'matrix'
patchSet(...)
```

Arguments

... Matrices (ncol = 2) of patches coordinates with the first column pxcor and the second column pycor.

Details

Duplicate patches among the inputs are removed in the returned matrix.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#patch-set>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
p1 <- patchAt(world = w1, agents = patch(w1, c(0,1,2), c(0,0,0)), dx = 1, dy = 1)
p2 <- patchDistDir(world = w1, agents = patch(w1, 0, 0), dist = 1, angle = 45)
p3 <- patch(world = w1, x = 4.3, y = 8)
p4 <- patchSet(p1, p2, p3)
```

pExist

Do the patches exist?

Description

Report TRUE if a patch exists inside the world's extent, report FALSE otherwise.

Usage

```
pExist(world, pxcor, pycor)
```

```
## S4 method for signature 'worldNLR,numeric,numeric'
pExist(world, pxcor, pycor)
```

Arguments

world	WorldMatrix or worldArray object.
pxcor	Integer. Vector of patches pxcor coordinates. Must be of length 1 or of the same length as pycor.
pycor	Integer. Vector of patches pycor coordinates. Must be of length 1 or of the same length as pxcor.

Value

Logical.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#member>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
pExist(world = w1, pxcor = -1, pycor = 2)
```

plot.agentMatrix	<i>Basic plot methods for agentMatrix, worldMatrix, worldArray</i>
------------------	--

Description

These pass to plot, as a matrix of points (agentMatrix), as a raster (worldMatrix), or a rasterStack (worldArray). They can be modified.

Usage

```
## S3 method for class 'agentMatrix'
plot(x, ...)

## S3 method for class 'worldMatrix'
plot(x, ...)

## S3 method for class 'worldArray'
plot(x, ...)

## S3 method for class 'agentMatrix'
points(x, ...)
```

Arguments

x	an agentMatrix, worldMatrix or worldArray object
...	arguments passed to plot methods for matrix (agentMatrix) or raster (world*)

Examples

```

# agentMatrix
newAgent <- new("agentMatrix",
  coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),
  char = letters[c(1, 2, 6)],
  nums2 = c(4.5, 2.6, 2343),
  char2 = LETTERS[c(4, 24, 3)],
  nums = 5:7)
plot(newAgent)

## worldMatrix
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9, data = 1:100)
plot(w1)

## worldArray
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = 1:25)
w2 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = 25:1)
w3 <- stackWorlds(w1, w2)
plot(w3)

# agentMatrix
newAgent <- new("agentMatrix",
  coords = cbind(pxcor = c(1, 2, 5), pycor = c(3, 4, 6)),
  char = letters[c(1, 2, 6)],
  nums2 = c(4.5, 2.6, 2343),
  char2 = LETTERS[c(4, 24, 3)],
  nums = 5:7)
points(newAgent)

```

PxcorPycorFromCell Patches *coordinates from cells numbers*

Description

Report the patches coordinates pxcor and pycor given the cells numbers as defined for a Raster* object.

Usage

```

PxcorPycorFromCell(world, cellNum)

## S4 method for signature 'worldNLR,numeric'
PxcorPycorFromCell(world, cellNum)

```

Arguments

world WorldMatrix or worldArray object.
cellNum Integer. Vector of cells number.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor in the order of the given cellNum.

Author(s)

Sarah Bauduin

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
cellNum <- cellFromPxcorPycor(world = w1, pxcor = 0, pycor = 9)
PxcorPycorFromCell(world = w1, cellNum = cellNum)
cellNum <- cellFromPxcorPycor(world = w1, pxcor = c(0, 1, 2), pycor = 0)
PxcorPycorFromCell(world = w1, cellNum = cellNum)
```

randomPxcor

Random pxcor

Description

Report n random pxcor coordinates within the world's extent.

Usage

```
randomPxcor(world, n)
```

```
## S4 method for signature 'worldNLR,numeric'
randomPxcor(world, n)
```

Arguments

world WorldMatrix or worldArray object.
n Integer.

Value

Integer. Vector of length n of pxcor coordinates.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#random-pcor>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
pxcor <- randomPxcor(world = w1, n = 10)
```

randomPycor

Random pycor

Description

Report *n* random pycor coordinates within the world's extent.

Usage

```
randomPycor(world, n)
```

```
## S4 method for signature 'worldNLR,numeric'
randomPycor(world, n)
```

Arguments

world	WorldMatrix or worldArray object.
n	Integer.

Value

Integer. Vector of length *n* of pycor coordinates.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#random-pcor>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
pycor <- randomPycor(world = w1, n = 10)
```

randomXcor	<i>Random xcor</i>
------------	--------------------

Description

Report n random xcor coordinates within the world's extent.

Usage

```
randomXcor(world, n)

## S4 method for signature 'worldNLR,numeric'
randomXcor(world, n)
```

Arguments

world	WorldMatrix or worldArray object.
n	Integer.

Value

Numeric. Vector of length n of xcor coordinates.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#random-cor>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                  data = runif(25))
t1 <- createTurtles(n = 10, coords = cbind(xcor = randomXcor(world = w1, n = 10),
                                           ycor = randomYcor(world = w1, n = 10)))

plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

randomXYcor

Random turtles coordinates

Description

Report n random $xcor$ and $ycor$ coordinates within the world's extent.

Usage

```
randomXYcor(world, n)

## S4 method for signature 'worldNLR,numeric'
randomXYcor(world, n)
```

Arguments

world WorldMatrix or worldArray object.
n Integer.

Value

Matrix ($ncol = 2$, $nrow = n$) with the first column $xcor$ and the second column $ycor$.

Author(s)

Sarah Bauduin

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                  data = runif(25))
t1 <- createTurtles(n = 10, coords = randomXYcor(world = w1, n = 10))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

randomYcor	<i>Random ycor</i>
------------	--------------------

Description

Report n random ycor coordinates within the world's extent.

Usage

```
randomYcor(world, n)

## S4 method for signature 'worldNLR,numeric'
randomYcor(world, n)
```

Arguments

world	WorldMatrix or worldArray object.
n	Integer.

Value

Numeric. Vector of length n of ycor coordinates.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#random-cor>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = runif(25))
t1 <- createTurtles(n = 10, coords = cbind(xcor = randomXcor(world = w1, n = 10),
                                          ycor = randomYcor(world = w1, n = 10)))

plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

raster2world *Convert a Raster* object into a worldMatrix or worldArray object*

Description

Convert a RasterLayer object into a worldMatrix object or a RasterStack object into a worldArray object.

Usage

```
raster2world(raster, method)
```

```
## S4 method for signature 'RasterLayer,character'  
raster2world(raster, method)
```

```
## S4 method for signature 'RasterStack,character'  
raster2world(raster, method)
```

Arguments

raster RasterLayer or RasterStack object.
method "ngb or bilinear for the resample method.

Details

See help("worldMatrix-class") or help("worldArray-class") for more details on the classes. The raster is resampled to match the coordinates system and resolution of a worldMatrix or worldArray using the chosen method. The extent will be bigger by 1 on the width and on the height.

Value

WorldMatrix or worldArray object depending on the input raster. Patches value are retained from the raster.

Author(s)

Sarah Bauduin

Examples

```
r1 <- raster(extent(c(0, 10, 0, 10)), nrows = 10, ncols = 10)  
r1[] <- runif(100)  
w1 <- raster2world(r1, method = "ngb")  
plot(r1)  
plot(w1)
```

right	<i>Rotate to the right</i>
-------	----------------------------

Description

Rotate the turtles's headings to the right of angle degrees.

Usage

```
right(turtles, angle)
```

```
## S4 method for signature 'agentMatrix,numeric'  
right(turtles, angle)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
angle	Numeric. Vector of angles in degrees by which to rotate the turtles' headings. Must be of length 1 or of length turtles.

Details

If a given angle value is negative, then the turtle rotates to the left.

Value

AgentMatrix representing the turtles with updated heading values.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#right>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
t1 <- createTurtles(n = 10, world = w1)
of(agents = t1, var = "heading")
t1 <- right(turtles = t1, angle = 180)
of(agents = t1, var = "heading")
```

setXY

Set turtles' locations

Description

Set the turtles xcor and ycor coordinates.

Usage

```
setXY(turtles, xcor, ycor, world, torus = FALSE)

## S4 method for signature 'agentMatrix,numeric,numeric,missing,ANY'
setXY(turtles, xcor,
      ycor, torus)

## S4 method for signature 'agentMatrix,numeric,numeric,worldNLR,logical'
setXY(turtles,
      xcor, ycor, world, torus = FALSE)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
xcor	Numeric. Vector of x coordinates. Must be of length 1 or of length turtles.
ycor	Numeric. Vector of y coordinates. Must be of length 1 or of length turtles.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

world must be provided only if torus = TRUE.

If the given coordinates [xcor, ycor] are located outside of the world's extent and torus = TRUE, then the coordinates assigned to the turtle are the ones from a wrapped word; if torus = FALSE, the turtle is located outside of the world's extent with the given coordinates.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their previous coordinates prevX and prevY.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#setxy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9,
                 data = runif(100))
t1 <- createTurtles(n = 5, coords = randomXYcor(w1, n = 5))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- setXY(turtles = t1, xcor = 1:5, ycor = 1:5)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

show,agentMatrix-method

Key base R functions for agentMatrix class

Description

Slight modifications from the default versions.

Usage

```
## S4 method for signature 'agentMatrix'
show(object)

## S4 method for signature 'agentMatrix'
length(x)

## S4 method for signature 'agentMatrix'
nrow(x)

## S3 method for class 'agentMatrix'
head(x, n = 6L, ...)

## S3 method for class 'agentMatrix'
tail(x, n = 6L, ...)
```

Arguments

object	An agentMatrix object.
x	An agentMatrix object.
n	documentation needed
...	documentation needed

show,worldArray-method

Key base R functions for worldNLR classes

Description

Slight modifications from the default versions.

Usage

```
## S4 method for signature 'worldArray'
show(object)

## S4 method for signature 'worldMatrix'
show(object)
```

Arguments

object	An agentMatrix object.
--------	------------------------

sortOn

Sort agents

Description

Return the agents sorted according to their value.

Usage

```
sortOn(agents, world, var)

## S4 method for signature 'matrix,worldMatrix,missing'
sortOn(agents, world)

## S4 method for signature 'matrix,worldArray,character'
sortOn(agents, world, var)

## S4 method for signature 'agentMatrix,missing,character'
sortOn(agents, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

The sorting of the agents is done in a increasing order.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches sorted according to their values, if agents are patches, or

AgentMatrix representing the turtles sorted according to their var values, if agents are turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#sort-on>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:5, size = 25, replace = TRUE))
plot(w1)
p1 <- sortOn(agents = patches(w1), world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
sortHeadingT1 <- sortOn(agents = t1, var = "heading")
```

`spdf2turtles`*From SpatialPointsDataFrame to agentMatrix*

Description

Convert a `SpatialPointsDataFrame` object into an `agentMatrix` object.

Usage

```
spdf2turtles(spdf)
```

```
## S4 method for signature 'SpatialPointsDataFrame'  
spdf2turtles(spdf)
```

Arguments

`spdf` `SpatialPointsDataFrame` object representing moving agents.

Details

If the `spdf` does not contain the variables created with `createTurtles()`, these variables will be created with the default values as in `createTurtles()`.

Value

`AgentMatrix` object representing the moving agents (coordinates and data) as contained in `spdf`.

Author(s)

Sarah Bauduin

Examples

```
sp1 <- SpatialPointsDataFrame(coords = cbind(x = c(1, 2, 3), y = c(1, 2, 3)),  
                             data = cbind.data.frame(age = c(0, 0, 3),  
                                                    sex = c("F", "F", "M")))  
t1 <- spdf2turtles(spdf = sp1)
```

sprout	<i>Sprout new turtles</i>
--------	---------------------------

Description

Create n new turtles on specific patches.

Usage

```
sprout(n, patches, breed, heading, color, turtles)
```

```
## S4 method for signature 'numeric,matrix'
sprout(n, patches, breed, heading, color,
       turtles)
```

Arguments

n	Integer. Vector of length 1 or of length the number of patches. Number of new turtles to create on each patch.
patches	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates.
breed	Character. Vector of breed names. Must be of length 1 or of length the number of patches. If missing, breed = turtle for all the sprouted turtles.
heading	Numeric. Vector of values between 0 and 360. Must be of length 1 or of length the number of patches. If missing, a random heading is assigned to each sprouted turtle.
color	Character. Vector of color names. Must be of length 1, of length the number of patches or of length sum(n). If missing, colors are assigned using the function rainbow(n).
turtles	AgentMatrix object representing the moving agents.

Details

nrow(patches) must be equal to 1 or to n.

If turtles is provided, the new turtles are added to the turtles when returned. The who numbers of the sprouted turtles therefore follow the ones from the turtles. All new sprouted turtles are placed at the end of the agentMatrix object. If no turtles is provided, a new agentMatrix is created and the who numbers start at 0.

If turtles is provided and had additional variables created with turtlesOwn(), NA is given for these variables for the new sprouted turtles.

Value

AgentMatrix including the new sprouted turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#sprout>

Examples

```
t1 <- sprout(patches = cbind(pxcor = 2, pycor = 2), n = 3)
t2 <- sprout(patches = cbind(pxcor = 3, pycor = 3), n = 3, turtles = t1)
```

stackWorlds

Stack worlds

Description

Stack multiple worldMatrix into a worldArray.

Usage

```
stackWorlds(...)
```

```
## S4 method for signature 'worldMatrix'
stackWorlds(...)
```

Arguments

... worldMatrix objects.

Details

The worldMatrix objects must all have the same extents.

Value

worldArray object.

Author(s)

Sarah Bauduin

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = 1:25)
w2 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4, data = 25:1)
w3 <- stackWorlds(w1, w2)
plot(w3)
```

subHeadings

Subtract headings

Description

Compute the difference between headings.

Usage

```
subHeadings(angle1, angle2, range360 = FALSE)

## S4 method for signature 'numeric,numeric'
subHeadings(angle1, angle2, range360 = FALSE)

## S4 method for signature 'agentMatrix,numeric'
subHeadings(angle1, angle2,
  range360 = FALSE)

## S4 method for signature 'numeric,agentMatrix'
subHeadings(angle1, angle2,
  range360 = FALSE)

## S4 method for signature 'agentMatrix,agentMatrix'
subHeadings(angle1, angle2,
  range360 = FALSE)
```

Arguments

angle1	AgentMatrix object representing the moving agents, or Numeric. Vector of angles.
angle2	AgentMatrix object representing the moving agents, or Numeric. Vector of angles.
range360	Logical. If range360 = TRUE, returned values are between 0 and 360 degrees; if range360 = FALSE, returned values are between -180 and 180 degrees. Default is range360 = FALSE.

Details

This function does the opposite as the one in NetLogo where angle1 is the target heading. angle1 and angle2 must be of the same length or if different, one of them must be of length 1. Positive values mean clockwise rotations, negative value mean counterclockwise rotations.

Value

Numeric. Vector of the smallest angles in degrees by which angle1 could be rotated to produce angle2 (i.e., the target heading).

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#subtract-headings>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createOTurtles(n = 10, world = w1)
subHeadings(angle1 = t1, angle2 = 0)
```

tExist

Do the turtle exist?

Description

Report TRUE if a turtle exists inside the turtles, report FALSE otherwise.

Usage

```
tExist(turtles, who, breed)

## S4 method for signature 'agentMatrix,numeric,missing'
tExist(turtles, who)

## S4 method for signature 'agentMatrix,numeric,character'
tExist(turtles, who, breed)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
who	Integer. Vector of the who numbers for the selected turtles.
breed	Characters. Vector of breed names for the selected turtles. If missing, there is no distinction based upon breed.

Value

Logical. Vector of TRUE or FALSE if the who numbers with any of the breed, if provided, exist or not inside the turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#member>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  breed = c(rep("sheep", 5), rep("wolf", 5)))
tExist(turtles = t1, who = 3, breed = "sheep")
tExist(turtles = t1, who = 9, breed = "sheep")
tExist(turtles = t1, who = 9, breed = c("sheep", "wolf"))
tExist(turtles = t1, who = c(3, 9))
```

towards

Directions towards

Description

Report the directions of each agents towards each corresponding agents2.

Usage

```
towards(agents, agents2, world, torus = FALSE)
```

```
## S4 method for signature 'matrix,matrix'
towards(agents, agents2, world, torus = FALSE)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
agents2	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents, or Matrix (ncol = 2) with the first column x and the second column y representing locations coordinates.
world	WorldMatrix or worldArray object.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

agents and agents2 must have the same number of agents/locations or if different, one of them must have only one agent/location. If agents and agents2 have the same number of agents/locations, the directions are calculated for each pair agents[i] and agents2[i] and not for each agents towards every single agents2.

If torus = FALSE, world does not need to be provided.

If torus = TRUE and the distance from one agents to its corresponding agents2 is smaller around the sides of the world than across it, then the direction to agents2 going around the sides of the world is returned.

The direction from a patch to its location returns 0; the direction from a turtle to its location returns the turtle's heading.

Value

Numeric. Vector of angles in degrees of length equal to the largest number of agents/locations between agents and agents2.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#towards>

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#towardsxy>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4)
towards(agents = patches(w1), agents2 = cbind(x = 0, y = 0))
t1 <- createTurtles(n = 10, world = w1)
towards(agents = t1, agents2 = cbind(x = 0, y = 0))
```

turtle	<i>Select turtles</i>
--------	-----------------------

Description

Report the individuals among turtles based on their who numbers and breed.

Usage

```
turtle(turtles, who, breed)

## S4 method for signature 'agentMatrix,numeric,missing'
turtle(turtles, who)

## S4 method for signature 'agentMatrix,numeric,character'
turtle(turtles, who, breed)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
who	Integer. Vector of the who numbers for the selected turtles.
breed	Characters. Vector of breed names for the selected turtles. If missing, there is no distinction based upon breed.

Details

If no turtle matches the given who numbers, with potentially one of the given breed, inside turtles, then an empty agentMatrix is returned.

If there are duplicates who numbers among the turtles, the first matching turtle with the requested who number is returned.

Value

AgentMatrix of the selected turtles sorted in the order of the who numbers requested. If breed was provided, the turtles selected are of one of the breed.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#turtle>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
t2 <- turtle(t1, who = 2)
```

turtles2spdf

From agentMatrix to SpatialPointsDataFrame

Description

Convert an agentMatrix object into a SpatialPointsDataFrame object.

Usage

```
turtles2spdf(turtles)
```

```
## S4 method for signature 'agentMatrix'
turtles2spdf(turtles)
```

Arguments

turtles AgentMatrix object representing the moving agents.

Value

SpatialPointsDataFrame object representing the moving agents (coordinates and data) as contained in turtles.

Author(s)

Sarah Bauduin

Examples

```
t1 <- createTurtles(n = 10, coords = cbind(xcor = 1:10, ycor = 1:10))
sp1 <- turtles2spdf(turtles = t1)
```

turtlesAt	Turtles <i>at</i>
-----------	-------------------

Description

Report the individuals among turtles that are located on the patches at (dx, dy) distances of the agents.

Usage

```
turtlesAt(world, turtles, agents, dx, dy, breed, torus = FALSE)
```

```
## S4 method for signature
## 'worldNLR,agentMatrix,matrix,numeric,numeric,missing'
turtlesAt(world,
  turtles, agents, dx, dy, torus)
```

```
## S4 method for signature
## 'worldNLR,agentMatrix,matrix,numeric,numeric,character'
turtlesAt(world,
  turtles, agents, dx, dy, breed, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
dx	Numeric. Vector of distances to the east (right) from the agents. If dx is negative, the distance to the west (left) is computed. dx must be of length 1 or of the same length as number of patches or turtles in agents.
dy	Numeric. Vector of distances to the north (up) from the agents. If dy is negative, the distance to the south is computed (down). dy must be of length 1 or of the same length as number of patches or turtles in agents.
breed	Characters. Vector of breed names for the selected turtles. If missing, there is no distinction based upon breed.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If the patch at distance (dx, dy) of an agent is outside of the world's extent and torus = FALSE, no turtle is returned; if torus = TRUE, the turtle located on the patch whose coordinates are defined from the wrapped world is returned.

Value

AgentMatrix representing the individuals among turtles of any of the given breed, if specified, which are located on the patches at (dx, dy) distances of the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#turtles-at>
<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#at-points>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = cbind(xcor = 0:9, ycor = 0:9),
                breed = c(rep("sheep", 5), rep("wolf", 5)))
t2 <- turtlesAt(world = w1, turtles = t1, agents = turtle(t1, who = 0),
                dx = 1, dy = 1)
t3 <- turtlesAt(world = w1, turtles = t1,
                agents = patch(w1, c(3,4,5), c(3,4,5)), dx = 1, dy = 1,
                breed = "sheep")
```

turtleSet

Create a turtle agentset

Description

Report a turtle agentset containing all unique turtles provided in the inputs.

Usage

```
turtleSet(...)

## S4 method for signature 'agentMatrix'
turtleSet(...)
```

Arguments

... AgentMatrix objects representing the moving agents.

Details

Duplicated turtles are identified based only on their who numbers. The turtle chosen for a who number is the first one given in the inputs. To keep all turtles from the inputs, use `NLset()` to reassign who numbers in some of the inputs, prior using `turtleSet()`, to avoid turtles with duplicated who numbers.

Value

AgentMatrix object containing all the unique turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#turtle-set>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9)
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10), breed = "sheep")
t2 <- createTurtles(n = 2, coords = randomXYcor(w1, n = 2), breed = "wolf")
t2 <- NLset(turtles = t2, agents = t2, var = "who", val = c(10, 11))
t3 <- createTurtles(n = 1, coords = randomXYcor(w1, n = 1), breed = "sheperd")
t3 <- NLset(turtles = t3, agents = t3, var = "who", val = 12)
t4 <- turtleSet(t1, t2, t3)
```

turtlesOn

Turtles *on*

Description

Report the individuals among turtles that are on the same patches as the agents.

Usage

```
turtlesOn(world, turtles, agents, breed, simplify = TRUE)

## S4 method for signature 'worldNLR,agentMatrix,matrix,missing'
turtlesOn(world, turtles,
  agents, simplify)

## S4 method for signature 'worldNLR,agentMatrix,matrix,character'
turtlesOn(world, turtles,
  agents, breed, simplify = TRUE)
```

Arguments

world	WorldMatrix or worldArray object.
turtles	AgentMatrix object representing the moving agents.
agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
breed	Characters. Vector of breed names for the selected turtles. If missing, there is no distinction based upon breed.
simplify	Logical. If simplify = TRUE, all turtles on the same patches as any agents are returned; if simplify = FALSE, the turtles are evaluated for each agents's patches individually.

Details

The agents must be located inside the world's extent.

Value

AgentMatrix representing any individuals from turtles of any of the given breed, if specified, located on the same patches as any of the agents, if simplify = TRUE, or

Matrix (ncol = 2) with the first column whoTurtles and the second column id showing which turtles are on the same patches as which agents represented by id, if simplify = FALSE. id represents and follows the order of the agents. id does not represent the who numbers of the agents if agents are turtles.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#turtles-on>

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9,
                 data = runif(100))
t1 <- createTurtles(n = 500, coords = randomXYcor(w1, n = 500))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t2 <- turtlesOn(world = w1, turtles = t1, agents = patch(w1, 2, 2))
```

turtlesOwn

New turtles variable

Description

Create a new variable for the turtles.

Usage

```
turtlesOwn(turtles, tVar, tVal)

## S4 method for signature 'agentMatrix,character,missing'
turtlesOwn(turtles, tVar)

## S4 method for signature 'agentMatrix,character,ANY'
turtlesOwn(turtles, tVar, tVal)
```

Arguments

turtles	AgentMatrix object representing the moving agents.
tVar	Character. the name of the turtles variable to create.
tVal	Vector representing the values of tVar. Must be of length 1 or of length turtles. If missing, NA is given.

Value

AgentMatrix representing the turtles with the new variable tVar added.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#turtles-own>

Examples

```
t1 <- createTurtles(n = 5, coords = cbind(xcor = 0, ycor = 0))
t1 <- turtlesOwn(turtles = t1, tVar = "sex", tVal = c("F", "F", "F", "M", "M"))
```

updateList

Update elements of a named list with elements of a second named list

Description

Merge two named list based on their named entries. Where any element matches in both lists, the value from the second list is used in the updated list. Subelements are not examined and are simply replaced. If one list is empty, then it returns the other one, unchanged.

Usage

```
updateList(x, y)

## S4 method for signature 'list,list'
updateList(x, y)

## S4 method for signature '`NULL`,list'
updateList(x, y)

## S4 method for signature 'list,`NULL`'
updateList(x, y)

## S4 method for signature '`NULL`,`NULL`'
updateList(x, y)
```

Arguments

x, y a named list

Value

A named list, with elements sorted by name. The values of matching elements in list y replace the values in list x.

Author(s)

Alex Chubaty

Examples

```
L1 <- list(a = "hst", b = NA_character_, c = 43)
L2 <- list(a = "gst", c = 42, d = list(letters))
updateList(L1, L2)

updateList(L1, NULL)
updateList(NULL, L2)
updateList(NULL, NULL) # should return empty list
```

uphill

*Move uphill***Description**

Move the turtles to their neighboring patch with the highest value.

Usage

```
uphill(world, pVar, turtles, nNeighbors, torus = FALSE)

## S4 method for signature 'worldMatrix,missing,agentMatrix,numeric'
uphill(world, turtles,
        nNeighbors, torus)

## S4 method for signature 'worldArray,character,agentMatrix,numeric'
uphill(world, pVar,
        turtles, nNeighbors, torus = FALSE)
```

Arguments

world	WorldMatrix or worldArray object.
pVar	Character. If the world is a worldArray object, pVar is the name of the layer to use to define the patches values. pVar must not be provided if the world is a worldMatrix object.
turtles	AgentMatrix object representing the moving agents.
nNeighbors	Integer: 4 or 8. Represents the number of neighbor patches considered.
torus	Logical to determine if the world is wrapped. Default is torus = FALSE.

Details

If no neighboring patch has a larger value than the patch where the turtle is currently located on, the turtle stays on this patch. It still moves to the patch center if it was not already on it.

If there are multiple neighboring patches with the same highest value, the turtle chooses one patch randomly.

If a turtle is located on a patch on the edge of the world and `torus = FALSE`, it has fewer neighboring patches as options to move than `nNeighbors`; if `torus = TRUE`, the turtle can move on the other side of the world to move uphill and its choice of neighboring patches is always equals to `nNeighbors`.

Value

AgentMatrix representing the turtles with updated coordinates and updated data for their heading values and previous coordinates `prevX` and `prevY`.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#uphill>

Examples

```
w1 <- createWorld(minPxcor = 1, maxPxcor = 10, minPycor = 1, maxPycor = 10,
                 data = runif(100))
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10))
plot(w1)
points(t1, col = of(agents = t1, var = "color"), pch = 16)

t1 <- uphill(world = w1, turtles = t1, nNeighbors = 8)
points(t1, col = of(agents = t1, var = "color"), pch = 16)
```

withMax	<i>Agents with maximum</i>
---------	----------------------------

Description

Report the patches or turtles among agents which have their variable equals to the maximum value.

Usage

```
withMax(agents, world, var)

## S4 method for signature 'matrix,worldMatrix,missing'
withMax(agents, world)

## S4 method for signature 'matrix,worldArray,character'
withMax(agents, world, var)

## S4 method for signature 'agentMatrix,missing,character'
withMax(agents, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches among the agents which have their variable equal to the maximum value among the agents, or

AgentMatrix representing the turtles among the agents which have their variable var equal to the maximum value among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#with-max>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:5, size = 25, replace = TRUE))
plot(w1)
p1 <- withMax(agents = patches(w1), world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:3, size = 10, replace= TRUE))
t2 <- withMax(agents = t1, var = "heading")
```

withMin

Agents *with minimum*

Description

Report the patches or turtles among agents which have their variable equals to the minimum value.

Usage

```
withMin(agents, world, var)

## S4 method for signature 'matrix,worldMatrix,missing'
withMin(agents, world)

## S4 method for signature 'matrix,worldArray,character'
withMin(agents, world, var)

## S4 method for signature 'agentMatrix,missing,character'
withMin(agents, var)
```

Arguments

agents	Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the patches coordinates, or AgentMatrix object representing the moving agents.
world	WorldMatrix or worldArray object.
var	Character. The name of the selected agents variable. If agents are patches and the world is a worldMatrix object, var must not be provided. If agents are patches and the world is a worldArray object, var is the name of the layer to use to define the patches values. If agents are turtles, var is one of the turtles' variable and can be equal to xcor, ycor, any of the variables created when turtles were created, as well as any variable created using turtlesOwn().

Details

world must not be provided if agents are turtles.

Value

Matrix (ncol = 2) with the first column pxcor and the second column pycor representing the coordinates of the patches among the agents which have their variable equal to the minimum value among the agents, or

AgentMatrix representing the turtles among the agents which have their variable var equal to the minimum value among the agents.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#with-min>

Examples

```
# Patches
w1 <- createWorld(minPxcor = 0, maxPxcor = 4, minPycor = 0, maxPycor = 4,
                 data = sample(1:5, size = 25, replace = TRUE))

plot(w1)
p1 <- withMin(agents = patches(w1), world = w1)

# Turtles
t1 <- createTurtles(n = 10, coords = randomXYcor(w1, n = 10),
                  heading = sample(1:3, size = 10, replace = TRUE))
```

```
t2 <- withMin(agents = t1, var = "heading")
```

world2raster	<i>Convert a worldMatrix or worldArray object into a Raster* object</i>
--------------	---

Description

Convert a worldMatrix object into a RasterLayer object or a worldArray object into a RasterStack object

Usage

```
world2raster(world)

## S4 method for signature 'worldMatrix'
world2raster(world)

## S4 method for signature 'worldArray'
world2raster(world)
```

Arguments

world WorldMatrix or worldArray object.

Details

The Raster* returned has the same extent and resolution as the world with round coordinates at the center of the cells and coordinates x.5 at the edges of the cells.

Value

RasterLayer or RasterStack object depending on the input world. Patches value are retained from the world.

Author(s)

Sarah Bauduin

Examples

```
w1 <- createWorld(minPxcor = 0, maxPxcor = 9, minPycor = 0, maxPycor = 9, data = runif(100))
r1 <- world2raster(w1)
plot(r1)
```

worldArray-class	<i>The worldArray class</i>
------------------	-----------------------------

Description

This is an s4 class extension of array. It is a collection of several worldMatrix objects with the same extent (i.e., same values for all their slots) stacked together. It is used to keep more than one value per patch.

Author(s)

Sarah Bauduin, Eliot McIntire, and Alex Chubaty

See Also

[worldMatrix](#)

worldHeight	<i>World height</i>
-------------	---------------------

Description

Report the height of the world in patch number.

Usage

```
worldHeight(world)
```

```
## S4 method for signature 'worldNLR'  
worldHeight(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#world-dim>

Examples

```
w1 <- createWorld()
worldHeight(w1)
```

worldMatrix-class *The worldMatrix class*

Description

This is an `s4` class extension of `matrix` with 7 additional slots. A `worldMatrix` object can be viewed as a grid composed of squared patches (i.e., matrix cells). Patches have two spatial coordinates `pxcor` and `pycor`, representing the location of their center. `pxcor` and `pycor` are always integer and increment by 1. `pxcor` increases as you move right and `pycor` increases as you move up. `pxcor` and `pycor` can be negative if there are patches to the left or below the patch [`pxcor = 0`, `pycor = 0`].

Details

The first four slots of the `worldMatrix` are: `minPxcor`, `maxPxcor`, `minPycor`, `maxPycor` which represent the minimum and maximum patches coordinates in the `worldMatrix`. The slot `extent` is similar to a `Raster*` extent. Because `pxcor` and `pycor` represent the spatial location at the center of the patches and the resolution of them is 1, the extent of the `worldMatrix` is equal to `xmin = minPxcor - 0.5`, `xmax = maxPxcor + 0.5`, `ymin = minPycor - 0.5`, and `ymax = maxPycor + 0.5`. The number of patches in a `worldMatrix` is equal to $((\text{maxPxcor} - \text{minPxcor}) + 1) * ((\text{maxPycor} - \text{minPycor}) + 1)$. The slot `res` is equal to 1 as it is the spatial resolution of the patches. The last slot `pCoords` is a matrix representing the patches coordinates of all the matrix cells in the order of cells in a `Raster*` (i.e., by rows).

Careful: The methods `[]` and `[] <-` retrieve or assign values for the patches in the given order of the patches coordinates provided. When no patches coordinates are provided, the values retrieved or assigned is done in the order of the cell numbers as defined in in `Raster*` objects (i.e., by rows).

Author(s)

Sarah Bauduin, Eliot McIntire, and Alex Chubaty

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

[worldArray](#)

worldNLR-class	<i>The worldNLR class</i>
----------------	---------------------------

Description

The worldNLR class is the union of the worldMatrix and worldArray classes. Mostly used for building function purposes.

Author(s)

Sarah Bauduin, and Eliot McIntire

worldWidth	World <i>width</i>
------------	--------------------

Description

Report the width of the world in patch number.

Usage

```
worldWidth(world)

## S4 method for signature 'worldNLR'
worldWidth(world)
```

Arguments

world WorldMatrix or worldArray object.

Value

Integer.

Author(s)

Sarah Bauduin

References

Wilensky, U. 1999. NetLogo. <http://ccl.northwestern.edu/netlogo/>. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL.

See Also

<https://ccl.northwestern.edu/netlogo/docs/dictionary.html#world-dim>

Examples

```
w1 <- createWorld()
worldWidth(w1)
```

wrap

Wrap coordinates or pixels in a torus-like fashion

Description

Generally for model development purposes.

Usage

```
wrap(obj, bounds, withHeading)

## S4 method for signature 'matrix,Extent,missing'
wrap(obj, bounds)

## S4 method for signature 'SpatialPoints,ANY,missing'
wrap(obj, bounds)

## S4 method for signature 'matrix,Raster,missing'
wrap(obj, bounds)

## S4 method for signature 'matrix,Raster,missing'
wrap(obj, bounds)

## S4 method for signature 'matrix,matrix,missing'
wrap(obj, bounds)

## S4 method for signature 'SpatialPointsDataFrame,Extent,logical'
wrap(obj, bounds,
      withHeading)

## S4 method for signature 'SpatialPointsDataFrame,Raster,logical'
wrap(obj, bounds,
      withHeading)

## S4 method for signature 'SpatialPointsDataFrame,matrix,logical'
wrap(obj, bounds,
      withHeading)
```


Arguments

obj	A <code>SpatialPoints*</code> object, or matrix of coordinates.
bounds	Either a <code>Raster*</code> , <code>Extent</code> , or <code>bbox</code> object defining bounds to wrap around.
withHeading	Logical. If <code>TRUE</code> , then the previous points must be wrapped also so that the subsequent heading calculation will work. Default <code>FALSE</code> . See details.

Details

If `withHeading` used, then `obj` must be a `SpatialPointsDataFrame` that contains two columns, `x1` and `y1`, with the immediately previous agent locations.

Value

Same class as `obj`, but with coordinates updated to reflect the wrapping.

Author(s)

Eliot McIntire

Examples

```
library(quickPlot)
library(raster)

xrange <- yrange <- c(-50, 50)
hab <- raster(extent(c(xrange, yrange)))
hab[] <- 0

# initialize agents
N <- 10

# previous points
x1 <- rep(0, N)
y1 <- rep(0, N)
# initial points
starts <- cbind(x = stats::runif(N, xrange[1], xrange[2]),
                y = stats::runif(N, yrange[1], yrange[2]))

# create the agent object
agent <- SpatialPointsDataFrame(coords = starts, data = data.frame(x1, y1))

ln <- rlnorm(N, 1, 0.02) # log normal step length
sd <- 30 # could be specified globally in params

if (interactive()) {
  clearPlot()
  Plot(hab, zero.color = "white", axes = "L")
}
if (requireNamespace("SpaDES.tools")) {
  for (i in 1:10) {
```

```

agent <- SpaDES.tools::crw(agent = agent,
                          extent = extent(hab), stepLength = 1n,
                          stddev = sd, lonlat = FALSE, torus = TRUE)
if (interactive()) Plot(agent, addTo = "hab", axes = TRUE)
}
}

```

[

*Extract or Replace Parts of an Object***Description**

Operators acting on vectors, matrices, arrays and lists to extract or replace parts.

Usage

```
## S4 method for signature 'worldMatrix,numeric,numeric,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 method for signature 'worldMatrix,missing,missing,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 replacement method for signature 'worldMatrix,numeric,numeric,ANY'
x[i, j] <- value
```

```
## S4 replacement method for signature 'worldMatrix,missing,missing,ANY'
x[i, j] <- value
```

```
## S4 method for signature 'worldArray,numeric,numeric,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 method for signature 'worldArray,missing,missing,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 replacement method for signature 'worldArray,numeric,numeric,matrix'
x[i, j] <- value
```

```
## S4 replacement method for signature 'worldArray,missing,missing,matrix'
x[i, j] <- value
```

```
## S4 method for signature 'agentMatrix,numeric,numeric,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 method for signature 'agentMatrix,logical,missing,ANY'
x[i, j, ..., drop = TRUE]
```

```
## S4 method for signature 'agentMatrix,numeric,missing,ANY'
x[i, j, ..., drop = TRUE]

## S4 method for signature 'agentMatrix,missing,missing,missing'
x[i, j, ...,
  drop = TRUE]

## S4 method for signature 'agentMatrix,missing,character,ANY'
x[i, j, ...,
  drop = TRUE]

## S4 method for signature 'agentMatrix,numeric,character,ANY'
x[i, j, ...,
  drop = TRUE]

## S4 method for signature 'agentMatrix,missing,numeric,ANY'
x[i, j, ..., drop = TRUE]

## S4 replacement method for signature 'agentMatrix,numeric,numeric,numeric'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,missing,numeric,numeric'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,numeric,missing,numeric'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,numeric,character,data.frame'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,numeric,numeric,character'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,missing,numeric,character'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,missing,character,character'
x[i, j] <- value

## S4 replacement method for signature 'agentMatrix,numeric,character,character'
x[i, j] <- value

## S4 method for signature 'agentMatrix'
x$name
```

Arguments

x A `agentMatrix` object from which to extract element(s) or in which to replace element(s).

i	Indices specifying elements to extract or replace.
j	see i.
...	other named arguments
drop	not implemented
value	Any R object
name	documentation needed

Note

Extract methods for `agentMatrix` class will generally maintain the `agentMatrix` class. This means that there will still be coordinates, character columns represented as numerics etc. `$` is for extracting the raw columns and does not maintain the `agentMatrix` class. `[]` will extract all values, and result in a `data.frame` with the correct character and numeric columns.

[[*Subsetting for worldArray class*

Description

These function similarly to `[]` for `RasterStack` objects

Usage

```
## S4 method for signature 'worldArray,ANY,ANY'
x[[i]]

## S4 replacement method for signature 'worldArray,ANY,ANY,ANY'
x[[i]] <- value

## S4 method for signature 'worldArray'
x$name
```

Arguments

x	A <code>worldArray</code> object.
i	Index number or layer name specifying a subset of layer(s) from the <code>worldArray</code> .
value	A replacement <code>worldMatrix</code> layer for one of the current layers in the <code>worldArray</code> .
name	Layer name, normally without back ticks, unless has symbols.

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