

The “Tract” Class

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1 Introduction

This class forms the basis for the actual tract on which the areal sampling is conducted. It is simple in concept, being a rectangular area with given cell resolution in which the cells themselves are always square. This last limitation was imposed by me to make things simple (one could always define another class that would allow rectangular cells.) Underneath, as we shall soon see, the class is actually very rich in functionality because it is a subclass of “RasterLayer” in the **raster** package.

Subclasses at the moment include only the “bufferedTract” class, but as we see in the diagram below (figure 1), others are planned.

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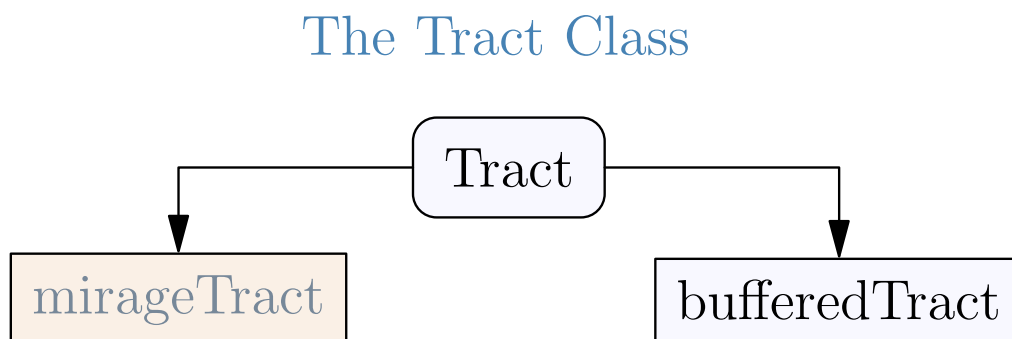


Figure 1: An overview of the “Tract” class.

fig:tract

2 The “Tract” Class

The class itself is quite basic; there are only two slots that have been added to the “RasterLayer” class—these are itemized below...

```
R> getClass('Tract')
```

```
Class "Tract" [package "sampSurf"]
```

Slots:

Name:	description	units	area	file
Class:	character	character	numeric	RasterFile

Name:	data	legend	history	extent
Class:	SingleLayerData	RasterLegend	vector	Extent

Name:	ncols	nrows	crs	layernames
Class:	integer	integer	CRS	vector

Name:	zname	zvalue	unit
Class:	character	vector	vector

Extends:

```
Class "RasterLayer", directly
```

```
Class "Raster", by class "RasterLayer", distance 2
Class "BasicRaster", by class "RasterLayer", distance 3
```

```
Known Subclasses: "bufferedTract"
```

2.1 Class slots

- *description*: Some descriptive text about this class.
- *units*: A character string specifying the units of measure. Legal values are “English” and “metric.”
- *area*: The tract area in either square meters or square feet.

However, if we look at the actual class it was derived from, we see much more detail available in the listing of slots above. There are many methods associated with “RasterLayer” objects. These are covered in the vignettes and documentation for that class. All of them are available for use on an object of class “Tract” or any of its subclasses.

2.2 Object creation

The “Tract” class has more than one constructor. The constructors are differentiated in a call to `Tract` by their signatures. The single signature argument in each case is the first argument, called `obj`.

2.2.1 GridTopology-like constructor

The first constructor allows for tract dimensions in terms of cell resolution, origin and extents in both x and y directions the way one would specify a “GridTopology” object in the `sp` package. The signature argument is of class “missing” in this case; therefore, the first three arguments shown below are used to specify the underlying tract grid.¹

In the first case, for example, we might have...

```
R> cd = c(x=200, y=200)
R> tr = Tract(cellSize = 0.5,
```

¹Please note that because the first argument is missing, you must either specify all arguments by name as in the example, or alternatively explicitly list the missing signature object as: `Tract(,0.5, cd, c(-5,-5))` to invoke the constructor.

```
+      cellDims = cd,  
+      cellCenter = c(-5,-5),  
+      data = runif(prod(cd)),  
+      description = 'a simple example tract')
```

Grid Topology...

	x	y
cellcentre.offset	-5.0	-5.0
cellsize	0.5	0.5
cells.dim	200.0	200.0

```
R> validObject(tr)
```

```
[1] TRUE
```

```
R> tr
```

```
-----  
a simple example tract  
-----
```

Measurement units = metric

Area in square meters = 10000 (1 hectares)

```
class      : Tract  
filename    :  
nrow       : 200  
ncol       : 200  
ncell      : 40000  
min value  : 6.0021412e-06  
max value  : 0.999979  
projection  : NA  
xmin       : -5.25  
xmax       : 94.75  
ymin       : -5.25  
ymax       : 94.75  
xres       : 0.5  
yres       : 0.5
```

```
R> is(tr, 'RasterLayer')
```

```
[1] TRUE
```

```
R> summary(tr)
```

```
Object of class: Tract
```

```
-----  
a simple example tract  
-----
```

```
Cells: 40000
```

```
NAs : 0
```

```
Min. 6.0021e-06
```

```
1st Qu. 2.4671e-01
```

```
Median 5.0074e-01
```

```
Mean 4.9831e-01
```

```
3rd Qu. 7.4792e-01
```

```
Max. 9.9998e-01
```

Here we have created a 200 by 200 cell raster grid with resolution of 0.5 meters (i.e., 1 hectare), origin at $(-5, -5)$ meters. The data values for all cells are initialized to zero by default. However, here we have shown how you can initialize them with a vector of correct length, in this case simply random uniform values.

It is trivial to plot the object, and there is not much to show in this case, but it’s more interesting than a zero-valued surface at least...

```
R> plot(tr)
```

Note that the origin is expressed in terms of the center of the cell that holds it. You can see this in the above by noting the x, y extents in comparison to the `cellCenter` argument specified. This particular arrangement for the constructor actually derives from the `sp` package and the construction of “SpatialGridDataFrame” objects (simply because I did it this way in [Gove and Van Deusen \(2011\)](#), I have kept it this way here—but it may change to follow that of a “RasterLayer” constructor in the future).

2.2.2 Maximum extents constructor

In the second constructor the signature argument should be a numeric vector of length two with names “x” and “y.” These specify the overall *maximum* limits in these coordinates, the minimum

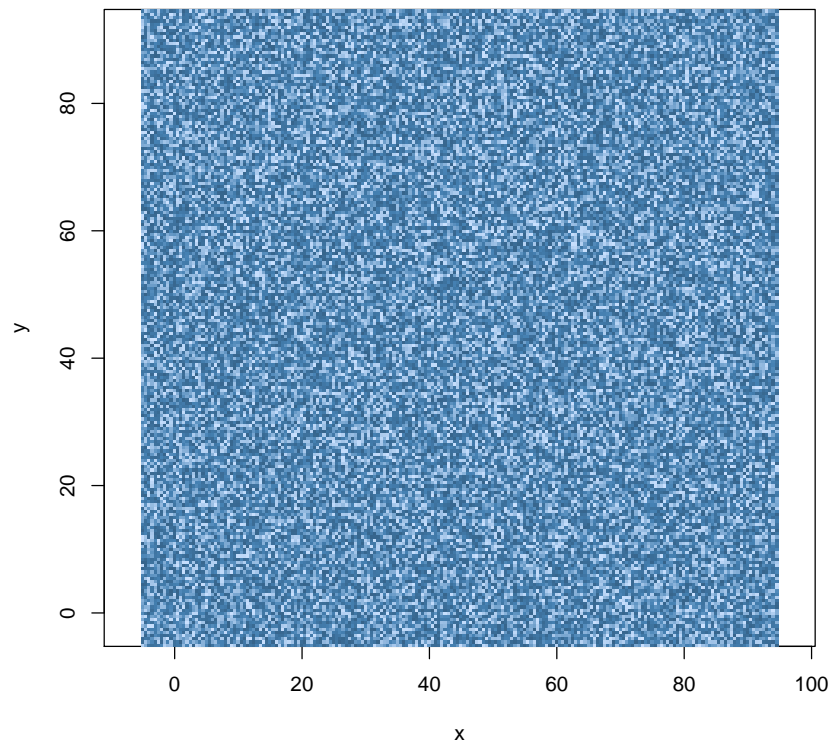


Figure 2: Simple generic “Tract” object.

fig:tr

is always assumed to be (0,0). The `cellSize` argument is also required.

```
R> tr2 = Tract(c(x=20, y=20), cellSize=0.25)
```

Grid Topology...

	x	y
cellcentre.offset	0.125	0.125
cellsize	0.250	0.250
cells.dim	80.000	80.000

```
R> validObject(tr2)
```

```
[1] TRUE
```

2.2.3 Bounding box constructor

The third constructor uses a valid bounding box to set the tract limits. The signature argument is therefore of class “matrix” and must conform to a **bbox** with row names “x” and “y,” and column names “min” and “max.” It must also be a 2×2 matrix with minima less than the maxima. One can set the minima to something other than (0,0) with this constructor.

```
R> bb = bbox(tr2)
R> bb[,1] = c(2,3)
R> bb
```

```
      min max
x      2  20
y      3  20
```

```
R> tr3 = Tract(bb, cellSize=0.5)
```

Grid Topology...

```
              x      y
cellcentre.offset 2.25 3.25
cellsize          0.50 0.50
cells.dim         36.00 34.00
```

2.2.4 RasterLayer constructor

The final “Tract” constructor has signature argument of class “RasterLayer” from the **raster** package. This allows one to directly generate a tract from a given “RasterLayer” object. There are several constructors for such objects that are documented in the **raster** package help files. Suffice it to say that this should add all the flexibility required for making objects of class “Tract”.

```
R> ex = extent(tr3)
R> rl = raster(ex, nrows=34, ncols=36, crs=NA)
R> tr4 = Tract(rl)
R> tr4
```

```
-----
object of class Tract
-----
```

```
Measurement units = metric
Area in square meters = 306 (0.0306 hectares)
```

```
class      : Tract
filename   :
nrow       : 34
ncol       : 36
ncell      : 1224
min value  :
max value  :
projection : NA
xmin       : 2
xmax       : 20
ymin       : 3
ymax       : 20
xres       : 0.5
yres       : 0.5
```

This is the only constructor that does not utilize the first, so it does not echo the “Grid Topology” since the raster object is already created—we simply add to it in this constructor for a valid “Tract” object.

Note that the `raster` constructor will allow one to make rectangular grid cells. This is not allowed in `sampSurf` and will cause an error if tried in the above constructor; only square grid cells are allowed in `sampSurf`.

3 The “bufferedTract” Class

The “bufferedTract” class simply adds a buffer to the tract. The buffer can be thought of most commonly as being internal; that is, it specifies an area within which the log (tree) locations (centers) should fall in order to contain all of the inclusion zones. In other words, we are assuming that we will be placing logs randomly within this buffer so that there is no eventual slopover of the inclusion zones at the boundary. But beyond this, the buffer can be any width, it is up to the user.

Here’s a look at the class structure, class “bufferedTract” is seen to be a subclass of “Tract”...

```
R> getClass('bufferedTract')
```

```
Class "bufferedTract" [package "sampSurf"]
```


Slots:

Name:	bufferRect	spBuffer	description	units
Class:	matrix	SpatialPolygons	character	character
Name:	area	file	data	legend
Class:	numeric	RasterFile	SingleLayerData	RasterLegend
Name:	history	extent	ncols	nrows
Class:	vector	Extent	integer	integer
Name:	crs	layernames	zname	zvalue
Class:	CRS	vector	character	vector
Name:	unit			
Class:	vector			

Extends:

Class "Tract", directly
 Class "RasterLayer", by class "Tract", distance 2
 Class "Raster", by class "Tract", distance 3
 Class "BasicRaster", by class "Tract", distance 4

3.1 Class slots

The following slots are added to the “Tract” class definition...

- *bufferRect*: A matrix holding the buffer rectangle extents in the form of a bounding box that is used by the *sp* package.
- *spBuffer*: The buffer in polygon form as a “SpatialPolygons” object.

3.2 Object creation

The “bufferedTract” can be constructed very simply from a “Tract” object by also specifying a buffer width that is reasonable. In the following we make a buffered tract and add several down logs whose center locations fall within the buffer rectangle...

```
R> tr = setValues(tr, rep(0, ncell(tr)))
R> btr = bufferedTract(10, tr)
```

```
R> dlogs = downLogs(25, btr)
```

```
R> plot(btr, bufferColor='navy', lty='dotted', gridColor='grey90')  
R> plot(dlogs, add=TRUE)
```

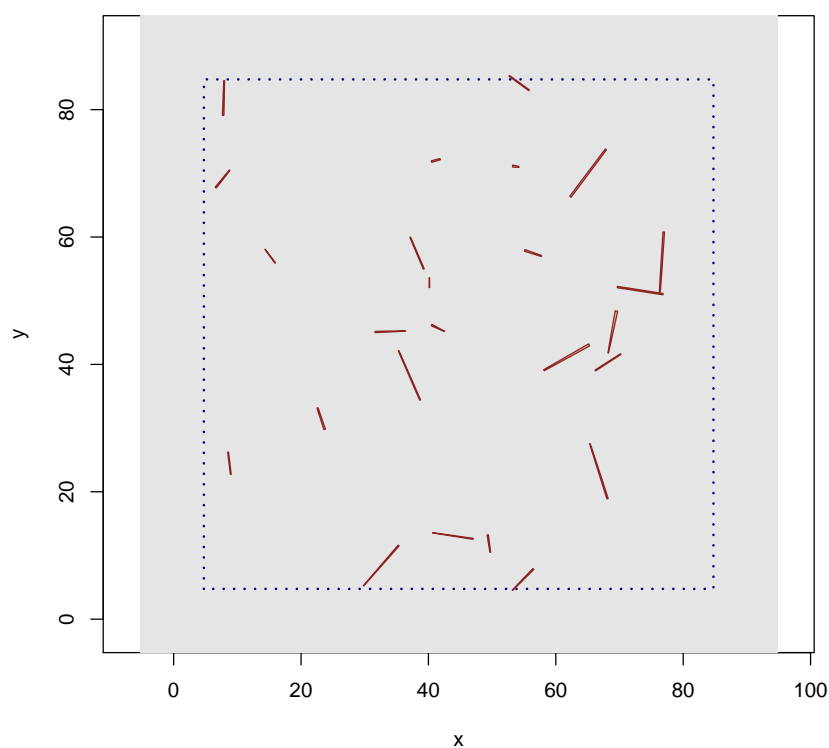


Figure 3: Simple generic “bufferedTract” object with some random logs.

fig:btr

Note in the above that we can make a collection of “downLogs” by simply specifying the number of logs and a “bufferedTract” object, which supplies the bounding box of the buffer area from which to draw the logs.

References

Deusen:2011

J. H. Gove and P. C. Van Deusen. On fixed-area plot sampling for downed coarse woody debris. *Forestry*, 2011. Submitted August 2010.