Vector spatial data with R : rgeos examples

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PART 1. Distances

Input data

In this 1st example we will use 2 shapefiles as input data :

- **Arbres_align.shp** is a Point shapefile with 553 features. `IDARBRE` column contains unique ID.
- **Parc_Jardin.shp** is a Polygon shapefile with 12 features. `OBJECTID` column contains unique ID.

All the shapefiles are in the RGF93 / Lambert93 coordinate system (EPSG ID = 2154).

```
setwd("D:/bacasable/Rmeeting")
URL <- "http://cartotheque.cefe.cnrs.fr/wp-content/uploads/2016/06/Rmeeting.zip"
download.file(URL,"Rmeeting.zip")
unzip("Rmeeting.zip")

library(sp)
library(rgdal)
library(rgeos)
library(maptools)
```

```
shp_origin <- readOGR(".","Arbres_align")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "Arbres_align"
## with 553 features
## It has 26 fields
```

```
shp_target <- readOGR(".","Parc_Jardin")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "Parc_Jardin"
## with 12 features
## It has 8 fields
```

```
# show unique IDs from IDARBRE & OBJECTID columns
head(shp_origin$IDARBRE)
```

```
## [1] 189.1 189.2 189.3 189.4 189.5 189.6
## 553 Levels: 1240.1 1240.10 1240.11 1240.12 1240.13 1240.14 ... 934.1
```

```
head(shp_target$OBJECTID)
```

```
## [1] 593 595 596 599 601 603
```

The gDistance function : distance matrix between points and polygons

The **gDistance** function with 2 Spatial* objects will return a distance matrix between all features, in meters. Input objects have to be in a metric coordinate system, adn **byid** parameter must be set to TRUE to consider each feature individually.

```
# gDistance will return a 553 x 12 matrix
# (553 points from shp_origin, 12 polygons from shp_target)
dist_mat <- gDistance(shp_target, shp_origin, byid=TRUE)
dim(dist_mat)
```

```
## [1] 553  12
```

Note : if we were working with just 1 layer (to find the closest polygon from the same layer), we would call the gDistance function with just 1 SpatialPolygonsDataFrame. The resulting matrix would have a 0 meter diagonal (distance between each polygon and itself) that we would replace by NA value to find the minimun distance …

```
dist_mat_self <- gDistance(shp_target, byid=TRUE)
is.na(dist_mat_self) <- (dist_mat_self==0)
```

HOWTO find the closest polygons from each points, and its distance

Now we have 553 x 12 matrix with distances. For each 553 points, we want to find the closest polygon.

```
# for each point, find indice of the minimum distance
ind_min <- apply(dist_mat, MARGIN = 1, which.min)
# unique ID of starting point
FROMID <- shp_origin$IDARBRE
# unique ID of closest polygon
TOID <- shp_target$OBJECTID
NEARID <- TOID[ind_min]
# get minimum distance
# mi will be an indices matrix to find the distance to the nearest target
# with 1: row indices(sequence from 1 to N)  and 2:col indices(from which.min)
mi <- cbind(i=seq.int(length(ind_min)), ind_min)
NEARDIST <- dist_mat[mi]
```

We put the result in a new data.frame with 3 columns : FROMID, NEARID, NEARDIST. Then, we join these columns to the original Point shapefile and we save it in a new shapefile.

```
df_result <- data.frame(FROMID, NEARID, NEARDIST, row.names = row.names(shp_origin))

shp_result <- spCbind(shp_origin, df_result)
writeOGR(shp_result,".","result_dist2",driver="ESRI Shapefile")
```

```
## Warning in abbreviate(fld_names, minlength = 7): abbreviate utilisé avec
## des caractères non ASCII

## Warning in writeOGR(shp_result, ".", "result_dist2", driver = "ESRI
## Shapefile"): Field names abbreviated for ESRI Shapefile driver
```

PART 2. Intersection

Input data

We have two polygon layers : the first layer (`Parc_Jardin.shp`) contain woods, the second layer (`grid_500m.shp`) is a grid.

```
# intersection between grid polygons & data polygons (Parc_Jardin)
shp_data <- readOGR(".","Parc_Jardin")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "Parc_Jardin"
## with 12 features
## It has 8 fields
```

```
shp_grid <- readOGR(".", "grid_500m")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "grid_500m"
## with 18 features
## It has 3 fields
```

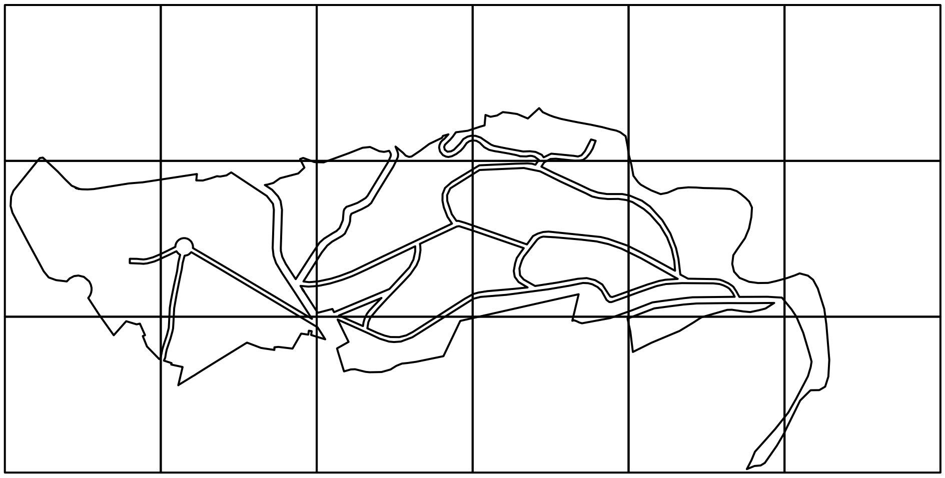
```
names(shp_data@data)
```

```
## [1] "OBJECTID"  "AREA"      "PERIMETER" "DOSSIER"   "SURF"      "LIBEL"
## [7] "CLASS"     "SYMBOLE"
```

```
names(shp_grid@data)
```

```
## [1] "GID"    "XCOORD" "YCOORD"
```

```
plot(shp_grid)
plot(shp_data, add=T)
```



We want to know the total area of woods by grid cell. This can be achieved with 3 steps.

1. Intersecting `shp_data` with `shp_grid` into `result`
2. Calculate area of the geometries from `result`
3. Aggregating `result` by grid cell unique ID

The gIntersection function : intersecting two polygon layers

```
# tip for optimization : keep only grid cells that intersects data
shp_grid_over_data <- shp_grid[shp_data,]

# then, intersect !
result <- gIntersection(shp_data, shp_grid_over_data, byid=TRUE)
class(result)
```

```
## [1] "SpatialPolygons"
## attr(,"package")
## [1] "sp"
```

```
slotNames(result)
```

```
## [1] "polygons"    "plotOrder"   "bbox"        "proj4string"
```

The class of the resulting object is SpatialPolygons … without data frame ! So, how to find original attributes from the intersected polygons ?

HOWTO build a data frame for the resulting SpatialPolygons ?

We will use the polygons ID and the original layers data frames.

```
v_id <- sapply(slot(result,"polygons"), function(plyg) slot(plyg, "ID"))
v_id_data <- sapply(strsplit(v_id, " "), function(id2) id2[1])
v_id_grid <- sapply(strsplit(v_id, " "), function(id2) id2[2])
```

With these IDs, we can get values from original data frames for intersected SpatialPolygons.

```
# get values of shp_data@data corresponding to v_id_data vector
df_data_part <- shp_data@data[v_id_data,]

# get values of shp_grid@data corresponding to v_id_grid vector
df_grid_part <- shp_grid@data[v_id_grid,]
```

We also calculate areas with `gArea` function.

```
SURF_INTER <- gArea(result, byid=TRUE)
df_result <- data.frame(df_data_part, df_grid_part, SURF_INTER, row.names=v_id)
shp_inter <- SpatialPolygonsDataFrame(result, df_result)
writeOGR(shp_inter,".","result_inter",driver="ESRI Shapefile")
```

HOWTO dissolve the resulting layer to get the total area of polygons by grid cell ?

Let us aggregate the result of intersection by grid cell

```
df_agg <- aggregate(SURF_INTER~GID, df_result, sum)
```

We join original `shp_grid` and aggregated areas from `df_agg` using **GID** column. Then we save the result in a new shapefile.

```
v_agg_id <- df_agg$GID
v_agg_surf <- df_agg$SURF_INTER

v_grid_id <- shp_grid$GID
o <- match(v_agg_id, v_grid_id)

SURFGRID <- rep(0,length(v_grid_id))
SURFGRID[o] <- v_agg_surf

shp_grid2 <- spCbind(shp_grid, SURFGRID)
head(shp_grid2@data)
```

```
##   GID XCOORD  YCOORD    SURFGRID
## 0  g1 769700 6283500   185.29271
## 1  g2 770200 6283500   189.05079
## 2  g3 770700 6283500 17019.19555
## 3  g4 771200 6283500 57441.46698
## 4  g5 771700 6283500    64.37117
## 5  g6 772200 6283500     0.00000
```

```
writeOGR(shp_grid2,".","result_grid_aggr",driver="ESRI Shapefile")
```

We obtain a new shapefile from which we can easily calculate the percentage of wood areas in each cell grid.

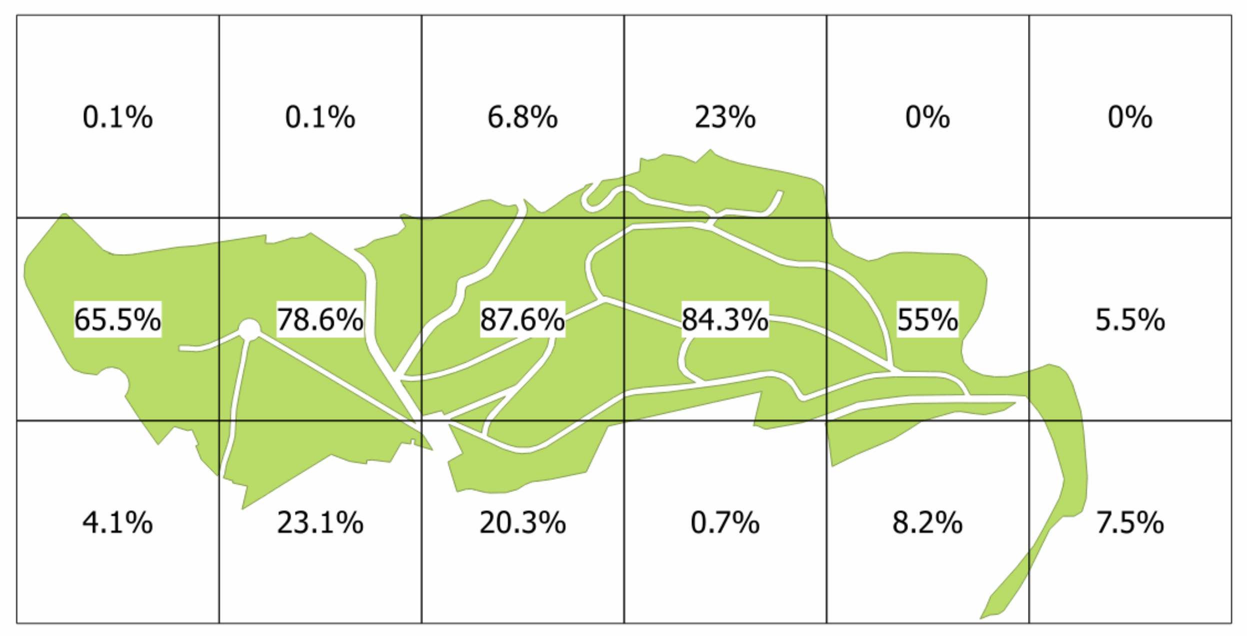


Figure 1: Wood percentage per cell in QGIS