

Introduction to Spatial Data Programming

Exercise 4

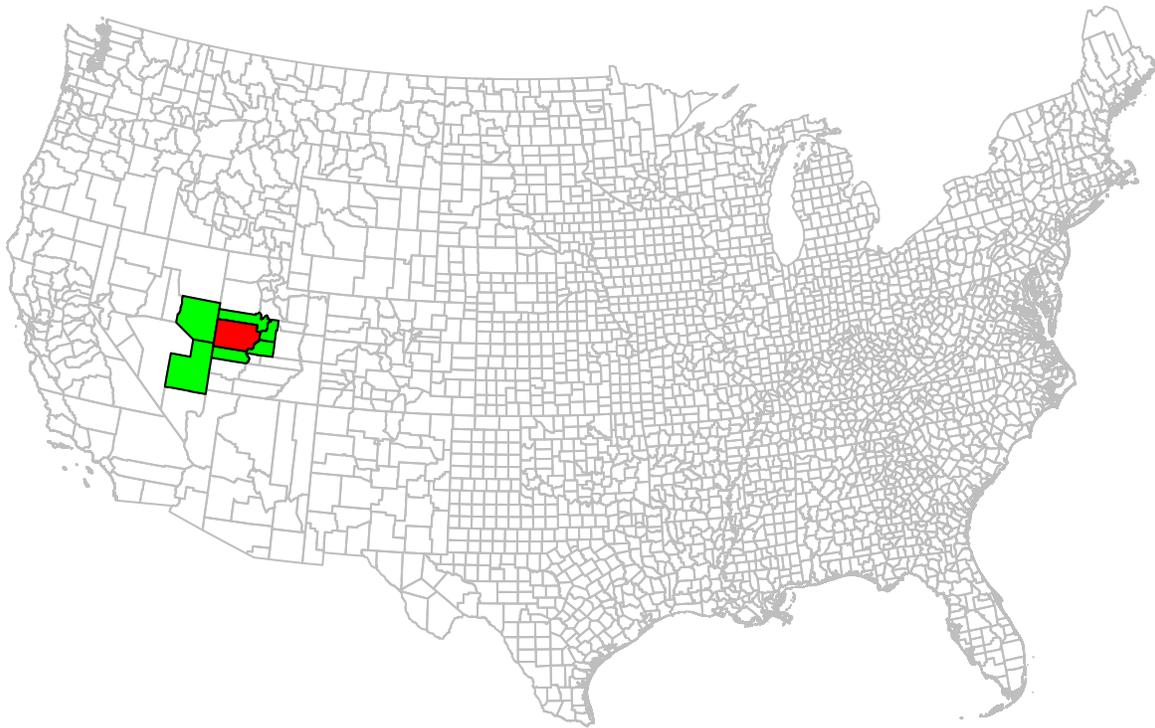
Vector layers & Geometric operations with vector layers

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Question 1

- **Read** the Shapefile of US counties named `USA_2_GADM_fips`
- **Reproject** the layer to the US National Atlas projection (like we did in **Lesson 7**)
- **Choose** a county whose name (`NAME_2` attribute) starts with the same letter as your first name
- Note: there may be more than one county with the same `NAME_2` value in different states (`NAME_1`), in which case you need to choose one state
- **Plot** the US counties (in grey), with the county you chose highlighted (in red), and all bordering counties of the county you chose (in green)
- Note: use a 1 m buffer around the county you chose and subset all counties which intersect with the “buffered” county you chose

```
library(sf)
county = st_read("USA_2_GADM_fips.shp", stringsAsFactors = FALSE, quiet = TRUE)
county = st_transform(county, 2163)
n = county[county$NAME_2 == "Millard" & county$NAME_1 == "Utah", ]
opar = par(mar = rep(0, 4))
plot(st_geometry(county), border = "grey")
plot(st_geometry(county[n, ]), add = TRUE, col = "green")
plot(st_geometry(n), add = TRUE, col = "red")
```



```
par(opar)
```

(50 points)

Question 2

- Write an **expression** that creates the following **data.frame** object with the longitude and latitude of four cities in Israel. You can copy and paste the coordinates given below
- **Replace** the fourth city ("Modiin") with a different city in Israel of your **choice**, whose name starts with the the same letter as your first name. Replace the coordinates accordingly; you can find out the longitude and latitude of the city you chose using maps.google.com or any other web service

```
cities = data.frame(  
  name = c("Tel-Aviv", "Jerusalem", "Beer-Sheva", "Modiin"),  
  lon = c(34.7817676, 35.21371, 34.791462, 35.009699),  
  lat = c(32.0852999, 31.768319, 31.252973, 31.891772)  
)  
cities
```

```
##      name      lon      lat  
## 1  Tel-Aviv 34.78177 32.08530  
## 2  Jerusalem 35.21371 31.76832  
## 3 Beer-Sheva 34.79146 31.25297  
## 4   Modiin 35.00970 31.89177
```

- **Calculate** a pairwise distance matrix between these cities, of class `units` and in kilometers
- Note: the matrix needs to have the appropriate column and row names, as shown below

```
library(units)
cities = st_as_sf(cities, coords = c("lon", "lat"), crs = 4326)
d = st_distance(cities)
d = set_units(d, "km")
colnames(d) = cities$name
rownames(d) = cities$name
d
```

```
## Units: km
##           Tel-Aviv Jerusalem Beer-Sheva  Modiin
## Tel-Aviv   0.00000  53.88850   92.29386  30.40583
## Jerusalem 53.88850   0.00000   69.81292  23.67241
## Beer-Sheva 92.29386  69.81292   0.00000  73.79716
## Modiin    30.40583  23.67241   73.79716  0.00000
```

(50 points)