Drawing maps with Leaflet

Making maps in R

- Spatial data comes with locations (perhaps with information about those locations).
- A good way to draw spatial data is on a map.
- The leaflet package is the easiest way to draw maps in R.
- Install these two packages, with two familiar ones:

```
library(tmaptools)
library(leaflet)
library(tidyverse)
library(conflicted)
conflicts_prefer(dplyr::mutate)
conflicts_prefer(dplyr::arrange)
```

Hockey league map

The Ontario hockey divisions (the last example for cluster analysis) came with a very bad map. Can we do better?

- reload the Ontario road distances

```
my_url <-
  "http://ritsokiguess.site/datafiles/ontario-road-distances.csv"
# my_url <- "ontario-road-distances.csv"
ontario <- read_csv(my_url)
```

```
## Rows: 21 Columns: 22
## -- Column specification --------------------------
## Delimiter: ","
## chr  (1): place
## dbl (21): Barrie, Belleville, Brantford, Brockvi...
##
## i Use `spec()` to retrieve the full column specification for thi:
## i Specify the column types or set `show_col_types = FALSE` to qu:
```

Ontario road distances (some)

```
ontario
```

```
## # A tibble: 21 x 22
##    place      Barrie Belle~1 Brant~2 Brock~3 Cornw~4
##    <chr>       <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1 Barrie          0     260     190     405     500
##  2 Belleville    260       0     290     155     250
##  3 Brantford     190     290       0     420     535
##  4 Brockville    405     155     420       0      95
##  5 Cornwall      500     250     535      95       0
##  6 Hamilton      145     255      40     405     500
##  7 Huntsville    125     280     300     405     450
##  8 Kingston      330      75     340      80     180
##  9 Kitchener     180     280      40     425     520
## 10 London        260     360      85     510     605
## # ... with 11 more rows, 16 more variables:
## #   Hamilton <dbl>, Huntsville <dbl>,
```

Grab the places

- and append province ("ON") for reasons shortly to become clear:

```
tibble(place = ontario$place) %>%
  mutate(prov = "ON") %>%
  unite(place1, c(place, prov), sep = " ") -> ontario2
ontario2
```

```
## # A tibble: 21 x 1
##    place1
##    <chr>
##  1 Barrie ON
##  2 Belleville ON
##  3 Brantford ON
##  4 Brockville ON
##  5 Cornwall ON
##  6 Hamilton ON
##  7 Huntsville ON
##  8 Kingston ON
##  9 Kitchener ON
```

Geocode 1/2

- find their latitudes and longitudes ("geocode"; slow).
- Save the geocoded places.

```
ontario2 %>%
  rowwise() %>%
  mutate(ll = list(geocode_OSM(place1))) -> d
```

```
d
```

```
## # A tibble: 21 x 2
##   place1         ll
##   <chr>          <list>
## 1 Barrie ON      <named list [3]>
## 2 Belleville ON  <named list [3]>
## 3 Brantford ON   <named list [3]>
## 4 Brockville ON  <named list [3]>
## 5 Cornwall ON    <named list [3]>
## 6 Hamilton ON    <named list [3]>
## 7 Huntsville ON  <named list [3]>
```

Geocode 2/2

Untangle the lats and longs:

```
d %>%
  unnest_wider(ll) %>%
  unnest_wider(coords) -> ontario3
ontario3
```
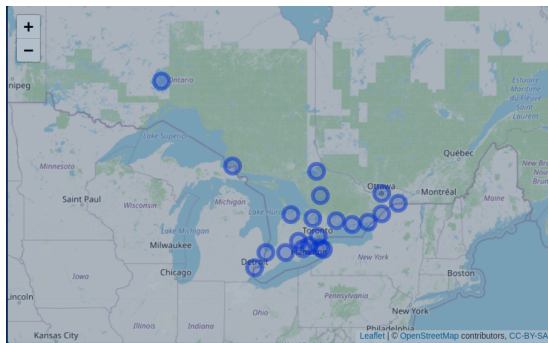
```
## # A tibble: 21 x 5
##     place1        query             x     y bbox
##     <chr>         <chr>         <dbl> <dbl> <list>
##  1 Barrie ON     Barrie ON     -79.7  44.4 <bbox>
##  2 Belleville ON Belleville ON -77.4  44.2 <bbox>
##  3 Brantford ON  Brantford ON  -80.3  43.1 <bbox>
##  4 Brockville ON Brockville ON -75.7  44.6 <bbox>
##  5 Cornwall ON   Cornwall ON   -74.7  45.0 <bbox>
##  6 Hamilton ON   Hamilton ON   -79.9  43.3 <bbox>
##  7 Huntsville ON Huntsville ON -79.2  45.3 <bbox>
```

Make map

- finally:

```
leaflet(data = ontario3) %>%
  addTiles() %>%
  addCircleMarkers(lng = ~x, lat = ~y) -> locs
```
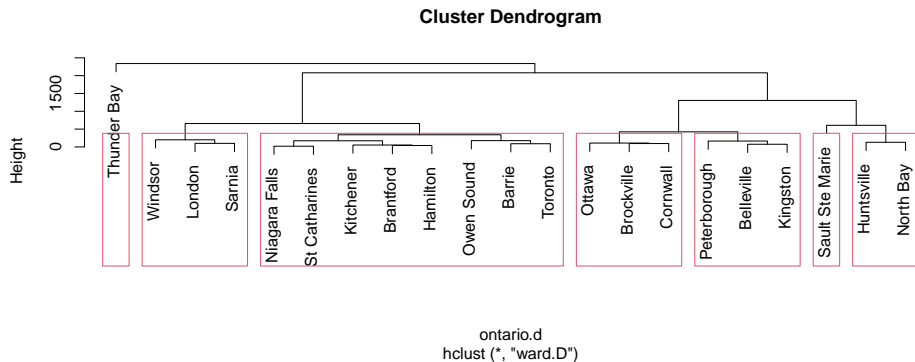
Cluster analysis revisited

```
ontario %>% select(-1) %>% as.dist() -> ontario.d
ontario.hc <- hclust(ontario.d, method = "ward.D")
```

Seven clusters:

```
plot(ontario.hc)
rect.hclust(ontario.hc, 7)
```

Cluster Dendrogram

ontario.d
hclust (*, "ward.D")

Get the clusters

```
tibble(place = ontario$place, cluster = cutree(ontario.hc, 7)) -> clusters
clusters %>% arrange(cluster)

## # A tibble: 21 x 2
##    place          cluster
##    <chr>            <int>
##  1 Barrie               1
##  2 Brantford            1
##  3 Hamilton             1
##  4 Kitchener            1
##  5 Niagara Falls        1
##  6 Owen Sound           1
##  7 St Catharines        1
##  8 Toronto              1
##  9 Belleville           2
## 10 Kingston             2
## # ... with 11 more rows
```

Combine clusters

- combine clusters 6 and 7 with 4 ("north")
- combine clusters 2 and 3 ("east")
- make named divisions

```
clusters %>%
  mutate(division = fct_collapse(factor(cluster),
                                 "north" = c("4", "6", "7"),
                                 "east" = c("2", "3"),
                                 "west" = "5",
                                 "central" = "1")) %>%
  arrange(division) -> divisions
```

The divisions

```
divisions
```

```
## # A tibble: 21 x 3
##    place         cluster division
##    <chr>           <int> <fct>
##  1 Barrie              1 central
##  2 Brantford           1 central
##  3 Hamilton            1 central
##  4 Kitchener           1 central
##  5 Niagara Falls       1 central
##  6 Owen Sound          1 central
##  7 St Catharines       1 central
##  8 Toronto             1 central
##  9 Belleville          2 east
## 10 Brockville          3 east
## # ... with 11 more rows
```

Take "ON" off of `ontario3`

```
ontario3 %>%
  mutate(place = str_replace(place1, " ON$", "")) -> ontario3
ontario3
```

```
## # A tibble: 21 x 6
##    place1        query         x     y bbox   place
##    <chr>         <chr>     <dbl> <dbl> <list> <chr>
##  1 Barrie ON     Barrie ON -79.7  44.4 <bbox> Barr~
##  2 Belleville ON Bellevill~ -77.4  44.2 <bbox> Bell~
##  3 Brantford ON  Brantford~ -80.3  43.1 <bbox> Bran~
##  4 Brockville ON Brockvill~ -75.7  44.6 <bbox> Broc~
##  5 Cornwall ON   Cornwall ~ -74.7  45.0 <bbox> Corn~
##  6 Hamilton ON   Hamilton ~ -79.9  43.3 <bbox> Hami~
##  7 Huntsville ON Huntsvill~ -79.2  45.3 <bbox> Hunt~
##  8 Kingston ON   Kingston ~ -76.5  44.2 <bbox> King~
##  9 Kitchener ON  Kitchener~ -80.5  43.5 <bbox> Kitc~
## 10 London ON     London ON -81.2  43.0 <bbox> Lond~
## # ... with 11 more rows
```

Add the divisions, matching by place

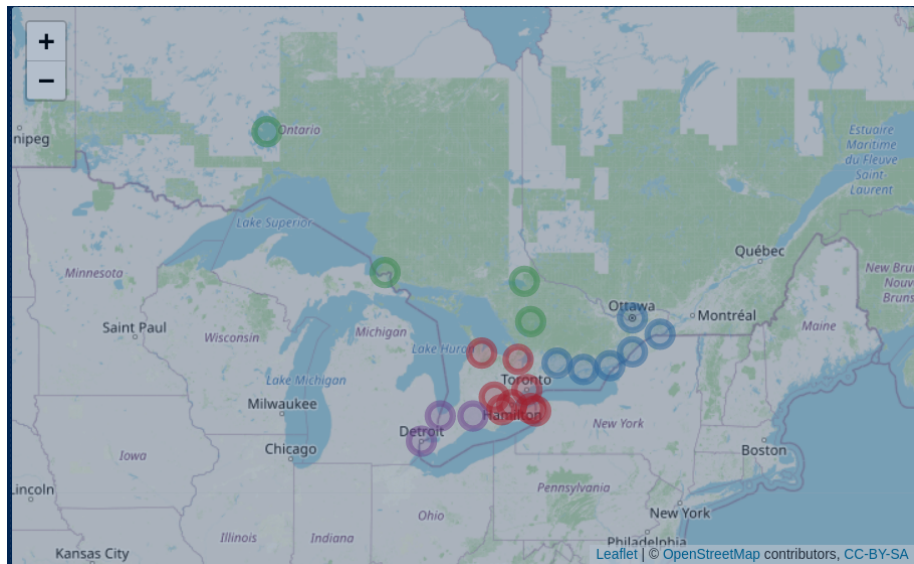- and draw map

```
pal <- colorFactor("Set1", divisions$division)

ontario3 %>% left_join(divisions) %>%
  select(place, x, y, division) %>%
  leaflet() %>%
  addTiles() %>%
  addCircleMarkers(lng = ~x, lat = ~y,
                   color = ~pal(division)) -> divmap

## Joining with `by = join_by(place)`
```

The map with divisions

Original seven clusters

The same idea gets a map of the original seven clusters:

```
pal <- colorFactor("Set1", divisions$cluster)
ontario3 %>% left_join(divisions) %>%
  select(place, x, y, cluster) %>%
  leaflet() %>%
  addTiles() %>%
  addCircleMarkers(lng = ~x, lat = ~y,
                   color = ~pal(cluster)) -> divmap

## Joining with `by = join_by(place)`
```

Map with seven clusters