Final Project

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```
install.packages("tidyverse", repos = 'http://cran.us.r-project.org')
```

```
##
## The downloaded binary packages are in
##  /var/folders/0f/mlslmtm962144xtv_vx74m100000gn/T//RtmplhPoiu/downloaded_packages
```

```
library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2 ──
## ✔ ggplot2 3.4.0      ✔ purrr   0.3.4
## ✔ tibble  3.1.8      ✔ dplyr   1.0.10
## ✔ tidyr   1.2.1      ✔ stringr 1.4.1
## ✔ readr   2.1.2      ✔ forcats 0.5.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
```

```
install.packages("ggplot", repos = 'http://cran.us.r-project.org')
```

```
## Warning: package 'ggplot' is not available for this version of R
##
## A version of this package for your version of R might be available elsewhere,
## see the ideas at
## https://cran.r-project.org/doc/manuals/r-patched/R-admin.html#Installing-packages
```

```
library(ggplot2)
install.packages("ggpubr", repos='http://cran.us.r-project.org')
```

```
##
## The downloaded binary packages are in
##  /var/folders/0f/mlslmtm962144xtv_vx74m100000gn/T//RtmplhPoiu/downloaded_packages
```

```
library(ggpubr)
```

```
install.packages("Rtools", repos='http://cran.us.r-project.org')
```

```
## Warning: package 'Rtools' is not available for this version of R
##
## A version of this package for your version of R might be available elsewhere,
## see the ideas at
## https://cran.r-project.org/doc/manuals/r-patched/R-admin.html#Installing-packages
```

```
install.packages("ggplot2", repos = "http://cran.rstudio.org")
```

```
##
## The downloaded binary packages are in
##  /var/folders/0f/mlslmtm962144xtv_vx74m100000gn/T//RtmplhPoiu/downloaded_packages
```

```
library(ggplot2)
```

```
SFtransit <- read.csv("/Users/ellie/Downloads/Muni_Simple_Routes.csv")
str(SFtransit)
```

```
## 'data.frame':    139 obs. of  11 variables:
##  $ PATTERN        : chr  "1    O F00" "1    I F00" "12   I F10" "12   O F10" ...
##  $ PATTERNID      : int  198410 198414 198501 198498 198503 198508 198516 198514 1985
21 198520 ...
##  $ ROUTE_NAME     : chr  "1" "1" "12" "12" ...
##  $ DIRECTION      : chr  "O" "I" "I" "O" ...
##  $ PATTERN_TYPE   : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ SUB_TYPE       : int  0 0 1 1 0 0 1 1 0 0 ...
##  $ PATTERN_VERSION: int  0 0 0 0 0 0 0 0 0 0 ...
##  $ LINEABBR       : chr  "001" "001" "012" "012" ...
##  $ SIGNID         : int  134 134 134 134 134 134 134 134 134 134 ...
##  $ SERVICE_CA     : chr  "Frequent" "Frequent" "" "" ...
##  $ shape          : chr  "MULTILINESTRING ((-122.396965 37.795437, -122.39781 37.7944
37, -122.39898 37.79429, -122.40016 37.79414, -122.4"| __truncated__ "MULTILINESTRING
((-122.49315 37.77971, -122.49346 37.78163, -122.492386 37.78168, -122.49248 37.782917,
-122.49"| __truncated__ "MULTILINESTRING ((-122.4192 37.748158, -122.42029 37.74813, -12
2.420364 37.748913, -122.41979 37.748947, -122.4"| __truncated__ "MULTILINESTRING ((-12
2.42306 37.79394, -122.42324 37.794823, -122.42159 37.795033, -122.419945 37.795242, -12
2."| __truncated__ ...
```

```
SFMuni.stops <- read.csv("/Users/ellie/Downloads/Muni_Stops.csv")
str(SFMuni.stops)
```

```
## 'data.frame':    3249 obs. of  24 variables:
##  $ OBJECTID                   : int  36073 33704 33872 33441 35962 36243 34815 34726
35673 35126 ...
##  $ STOPNAME                   : chr  "Powell St&Francisco St SE-NS/BZ" "Chestnut St&
Laguna St SW-NS/BZ" "Geary Blvd&Fillmore St NW-FS/BZ" "3rd St&Folsom St N-FS/BZ" ...
##  $ TRAPEZESTOPABBR            : chr  "POWLFNC1" "CHESLGN1" "GEARFIL0" ".3STFOL0" ...
##  $ RUCUSSTOPABBR              : chr  "POWLFNCO" "CHESLGNA" "GEARFILL" "3STFOLS" ...
##  $ STOPID                     : int  6056 3948 4295 3124 6098 7624 4878 5404 4481 70
38 ...
##  $ LATITUDE                   : num  37.8 37.8 37.8 37.8 37.8 ...
##  $ LONGITUDE                  : num  -122 -122 -122 -122 -122 ...
##  $ ACCESSIBILITYMASK          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ ATSTREET                   : chr  "FRANCISCO ST" "LAGUNA ST" "AVERY ST" "CLEMENTI
NA ST" ...
##  $ ONSTREET                   : chr  "POWELL ST" "CHESTNUT ST" "GEARY BLVD" "03RD S
T" ...
##  $ POSITION                   : chr  "NS" "NS" "FS" "FS" ...
##  $ ORIENTATION                : chr  "SE" "SW" "NW" "NO" ...
##  $ SERVICEPLANNINGSTOPTYPE    : chr  "BZ" "BZ" "BZ" "BZ" ...
##  $ SHELTER                    : int  1 0 1 1 0 0 0 1 0 0 ...
##  $ INSERT_TIMESTAMP           : num  2.02e+13 2.02e+13 2.02e+13 2.02e+13 2.02e+13
...
##  $ SDE_ID                     : int  14257412 14253217 14253429 14252566 14258040 14
258356 14255435 14254611 14257301 14255518 ...
##  $ SIGNUPID                   : int  134 134 134 134 134 134 134 134 134 134 ...
##  $ SUPERVISOR_DISTRICT        : logi  NA NA NA NA NA NA ...
##  $ shape                      : chr  "POINT (-122.41165 37.80481)" "POINT (-122.4314
04 37.80137)" "POINT (-122.43305 37.78439)" "POINT (-122.39932 37.784203)" ...
##  $ Neighborhoods              : int  106 17 103 32 103 43 45 21 20 99 ...
##  $ SF.Find.Neighborhoods      : int  106 17 103 32 103 43 45 21 20 99 ...
##  $ Current.Police.Districts   : int  6 4 4 1 8 10 7 4 5 6 ...
##  $ Current.Supervisor.Districts: int  3 6 11 10 6 8 8 11 10 3 ...
##  $ Analysis.Neighborhoods     : int  23 13 39 8 31 16 41 39 36 23 ...
```

```
freq <- read.csv("/Users/ellie/Downloads/Bus_Frequency - Sheet1.csv")

str(freq)
```

```
## 'data.frame':    54 obs. of  8 variables:
##  $ Route            : chr  "PH Powell-Hyde Cable Car" "PM Powell-Mason Cable Car" "C
California Street Cable Car" "F Market & Wharves" ...
##  $ Time.span        : chr  "7:00a - 11:00p" "7:00a - 11:00p" "7:00a - 9:00p" "7:00a -
10:00p" ...
##  $ Morning          : chr  "17" "15" "17" "17" ...
##  $ Midday           : chr  "10" "10" "10" "12" ...
##  $ Evening          : chr  "13" "15" "12" "13" ...
##  $ Late.Night       : chr  "17" "17" "20" "17" ...
##  $ Owl              : chr  "-" "-" "-" "-" ...
##  $ Average.Frequency: num  14.2 14.2 14.8 14.8 15 ...
```

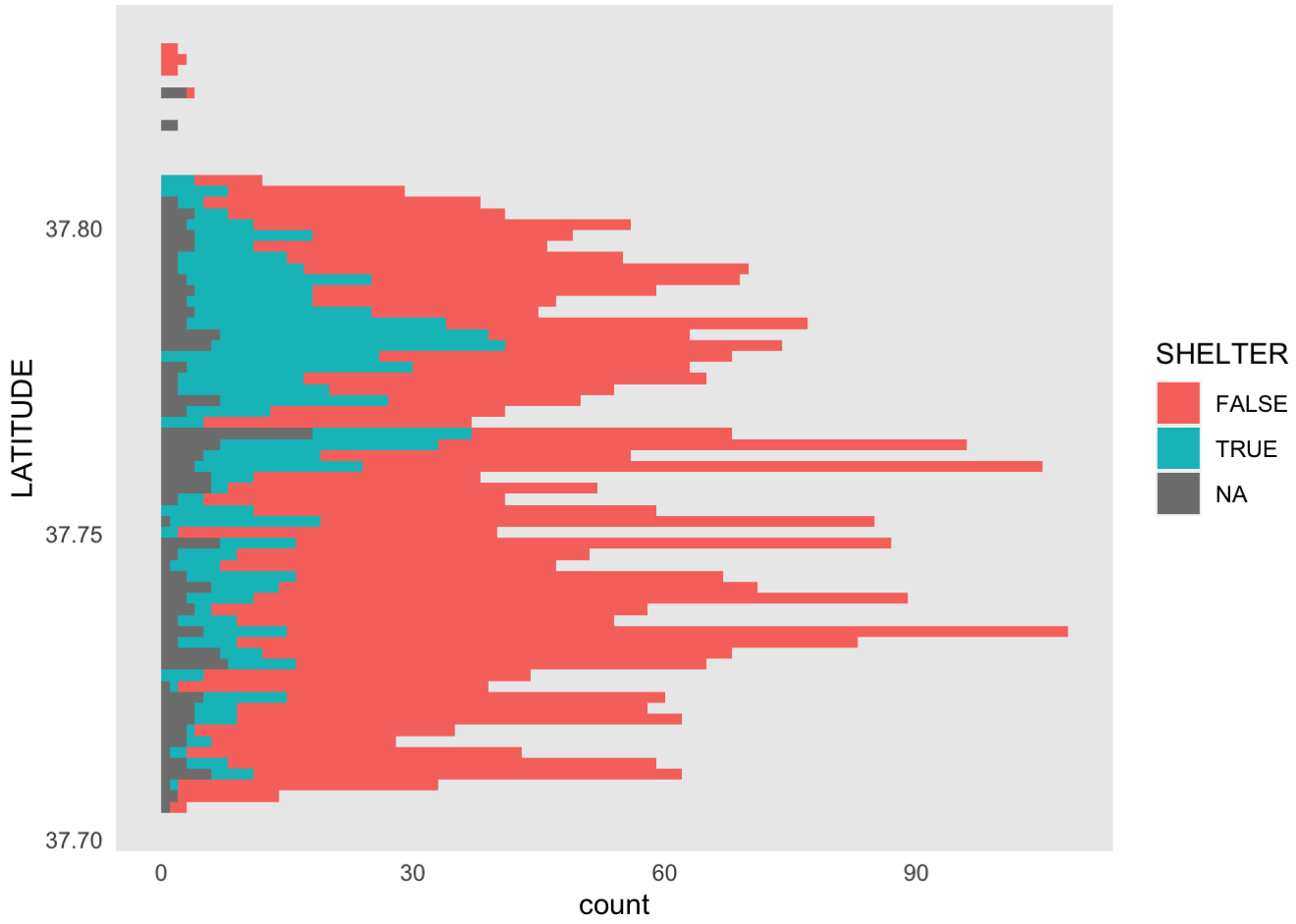
```
SFMuni.stops$POSITION <- as.factor(SFMuni.stops$POSITION)
SFMuni.stops$ORIENTATION <- as.factor((SFMuni.stops$ORIENTATION))
SFMuni.stops$SHELTER <- as.logical(SFMuni.stops$SHELTER)
str(SFMuni.stops)
```

```
## 'data.frame':    3249 obs. of  24 variables:
##  $ OBJECTID                   : int  36073 33704 33872 33441 35962 36243 34815 34726
35673 35126 ...
##  $ STOPNAME                   : chr  "Powell St&Francisco St SE-NS/BZ" "Chestnut St&
Laguna St SW-NS/BZ" "Geary Blvd&Fillmore St NW-FS/BZ" "3rd St&Folsom St N-FS/BZ" ...
##  $ TRAPEZESTOPABBR            : chr  "POWLFNC1" "CHESLGN1" "GEARFIL0" ".3STFOL0" ...
##  $ RUCUSSTOPABBR              : chr  "POWLFNCO" "CHESLGNA" "GEARFILL" "3STFOLS" ...
##  $ STOPID                     : int  6056 3948 4295 3124 6098 7624 4878 5404 4481 70
38 ...
##  $ LATITUDE                   : num  37.8 37.8 37.8 37.8 37.8 ...
##  $ LONGITUDE                  : num  -122 -122 -122 -122 -122 ...
##  $ ACCESSIBILITYMASK          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ ATSTREET                   : chr  "FRANCISCO ST" "LAGUNA ST" "AVERY ST" "CLEMENTI
NA ST" ...
##  $ ONSTREET                   : chr  "POWELL ST" "CHESTNUT ST" "GEARY BLVD" "03RD S
T" ...
##  $ POSITION                   : Factor w/ 9 levels "","FS","MB","MD",..: 7 7 2 2 2 3
3 2 2 7 ...
##  $ ORIENTATION                : Factor w/ 12 levels "","EA","MI","NE",..: 8 10 7 5 4
1 4 7 7 8 ...
##  $ SERVICEPLANNINGSTOPTYPE    : chr  "BZ" "BZ" "BZ" "BZ" ...
##  $ SHELTER                    : logi  TRUE FALSE TRUE TRUE FALSE FALSE ...
##  $ INSERT_TIMESTAMP           : num  2.02e+13 2.02e+13 2.02e+13 2.02e+13 2.02e+13
...
##  $ SDE_ID                     : int  14257412 14253217 14253429 14252566 14258040 14
258356 14255435 14254611 14257301 14255518 ...
##  $ SIGNUPID                   : int  134 134 134 134 134 134 134 134 134 134 ...
##  $ SUPERVISOR_DISTRICT        : logi  NA NA NA NA NA NA ...
##  $ shape                      : chr  "POINT (-122.41165 37.80481)" "POINT (-122.4314
04 37.80137)" "POINT (-122.43305 37.78439)" "POINT (-122.39932 37.784203)" ...
##  $ Neighborhoods              : int  106 17 103 32 103 43 45 21 20 99 ...
##  $ SF.Find.Neighborhoods      : int  106 17 103 32 103 43 45 21 20 99 ...
##  $ Current.Police.Districts   : int  6 4 4 1 8 10 7 4 5 6 ...
##  $ Current.Supervisor.Districts: int  3 6 11 10 6 8 8 11 10 3 ...
##  $ Analysis.Neighborhoods     : int  23 13 39 8 31 16 41 39 36 23 ...
```

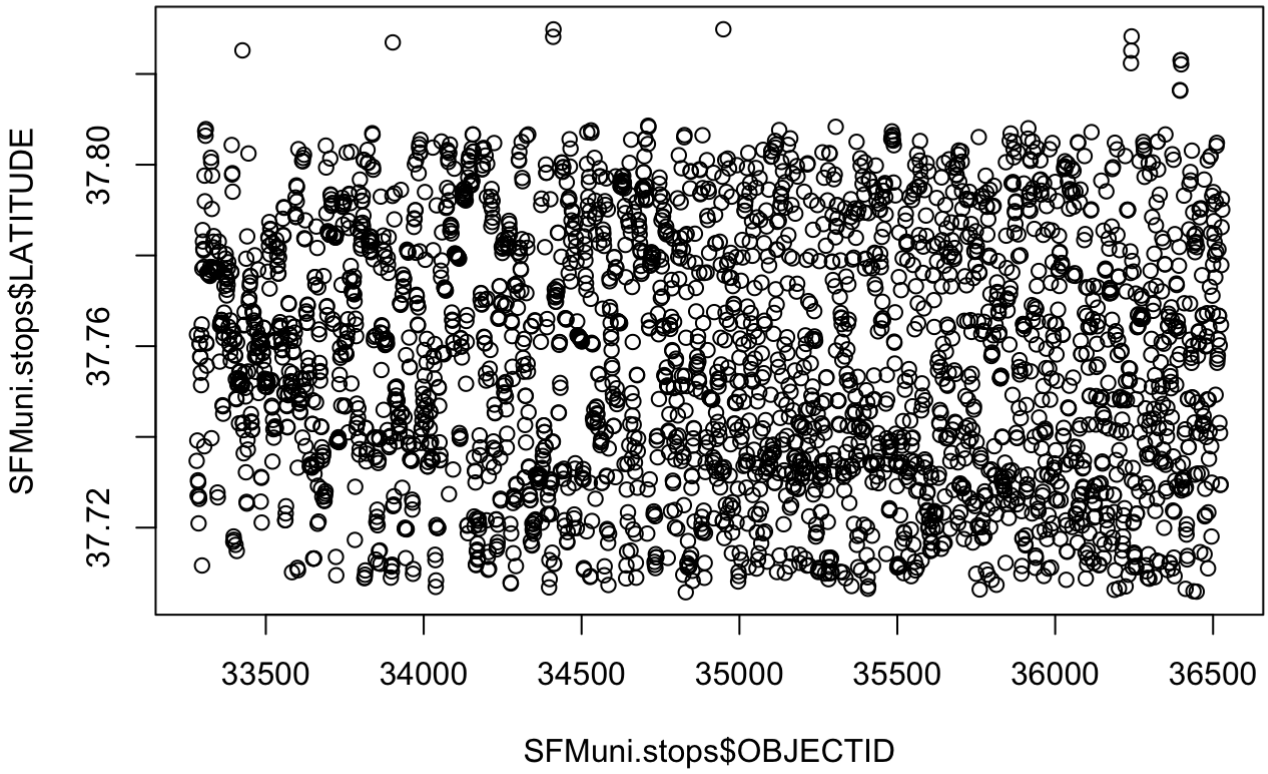
```
#scaled.LATITUDE <- SFMuni.stops$LATITUDE * 120
Sl <- ggplot(SFMuni.stops, aes(LONGITUDE, LATITUDE))

Sl + geom_point(size = 0.5, aes(color = SHELTER)) + theme(aspect.ratio=3/3, element_blan
k())
```


```
#Sl + geom_point(data = SFMuni.stops %>% filter(SHELTER == T), size = .7, aes(color = OR
IENTATION, shape = SHELTER)) + theme(aspect.ratio=3/3)
#SFMuni.stops$SHELTER

#Sl + geom_point(size = 1, aes(color = Analysis.Neighborhoods, shape = ORIENTATION)) + t
heme(aspect.ratio=3/3)
```

```
sl <- ggplot(SFMuni.stops, aes(x=LONGITUDE))
#sl + geom_histogram(aes(fill = SHELTER), bins = 50)

sl1 <- ggplot(SFMuni.stops, aes(y=LATITUDE))
#pl1 <- sl1 + geom_histogram(aes(fill = SHELTER, alpha = .1), bins = 70)
#pl1

#sl2 <- ggplot(SFMuni.stops, aes(y=LATITUDE))
#pl2 <- sl2 +geom_histogram(aes(fill = SHELTER, alpha = .1), bins = 40)



sl1 + geom_histogram(aes(fill = SHELTER), bins = 70) + theme(element_blank()) #change bi
ns back to 70 # + geom_histogram(aes(fill = SHELTER, alpha = .1), bins = 30) + geom_hist
ogram(aes(fill = SHELTER, alpha = .1), bins = 10) + geom_histogram(aes(fill = SHELTER, a
lpha = .1), bins = 5)
```




```
#IDKplot <- ggplot(SFMuni.stops, x = ORIENTATION, y = POSITION)
#IDKplot + geom_curve()

for(y in 1:ncol(SFMuni.stops)){
  if (is.na(SFMuni.stops[1,y])) SFMuni.stops[1,y] = 0
}

plot(SFMuni.stops$OBJECTID, SFMuni.stops$LATITUDE)
```




```
#for (i in 1:nrow(SFMuni.stops)){
#  for (j in 1:nrow(SFMuni.stops)){
#    if (i == j){
#      cat("skipping", i, "and", j, "\n")
#    }else{
      #l1 = SFMuni.stops$LONGITUDE[i]
      #l2 = SFMuni.stops$LONGITUDE[j]
      #a1 = SFMuni.stops$LATITUDE[i]
      #a2 = SFMuni.stops$LATITUDE[j]
#      d1 = min()
      #cat("we have a longitude of", l1, "and", l2, "\n")
      #cat("we have a latitude of", a1, "and", a2, "\n")
#    }

#  }
#}
```

```
#install.packages("sf")
#install.packages("leaflet")
library(dplyr)
library(sf)
```

```
## Linking to GEOS 3.10.2, GDAL 3.4.2, PROJ 8.2.1; sf_use_s2() is TRUE
```

```
library(leaflet)
#SFtransit$mapShape <- st_as_sfc(SFtransit$shape) # doesn't work for some reason
#plot34 <- ggplot(SFtransit, x = mapShape, y = shape) + geom_line(aes(x=mapShape,y=shap
e))
#plot34


str(SFtransit)
```

```
## 'data.frame':    139 obs. of  11 variables:
##  $ PATTERN        : chr  "1    O F00" "1    I F00" "12   I F10" "12   O F10" ...
##  $ PATTERNID      : int  198410 198414 198501 198498 198503 198508 198516 198514 1985
21 198520 ...
##  $ ROUTE_NAME     : chr  "1" "1" "12" "12" ...
##  $ DIRECTION      : chr  "O" "I" "I" "O" ...
##  $ PATTERN_TYPE   : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ SUB_TYPE       : int  0 0 1 1 0 0 1 1 0 0 ...
##  $ PATTERN_VERSION: int  0 0 0 0 0 0 0 0 0 0 ...
##  $ LINEABBR       : chr  "001" "001" "012" "012" ...
##  $ SIGNID         : int  134 134 134 134 134 134 134 134 134 134 ...
##  $ SERVICE_CA     : chr  "Frequent" "Frequent" "" "" ...
##  $ shape          : chr  "MULTILINESTRING ((-122.396965 37.795437, -122.39781 37.7944
37, -122.39898 37.79429, -122.40016 37.79414, -122.4"| __truncated__ "MULTILINESTRING
((-122.49315 37.77971, -122.49346 37.78163, -122.492386 37.78168, -122.49248 37.782917,
-122.49"| __truncated__ "MULTILINESTRING ((-122.4192 37.748158, -122.42029 37.74813, -12
2.420364 37.748913, -122.41979 37.748947, -122.4"| __truncated__ "MULTILINESTRING ((-12
2.42306 37.79394, -122.42324 37.794823, -122.42159 37.795033, -122.419945 37.795242, -12
2."| __truncated__ ...
```

```
#SFtransit$shape



l1shape <- as.numeric(SFtransit$shape[1])
```

```
## Warning: NAs introduced by coercion
```

```
l1shape
```

```
## [1] NA
```

```
SFtransit$shape <- gsub("MULTILINESTRING \\(\\(", "", SFtransit$shape)
SFtransit$shape <- gsub("\\)\\)", "", SFtransit$shape)

mapshape <- SFtransit$shape
longlang <- list()
lists <- list()
for(x in 1:length(mapshape[])){

  longlang <- strsplit(mapshape[x], " ,")
  longlang <- strsplit(mapshape[x], " +")
  sfshape <- longlang[[1]]
  sfshape <- gsub(",", "", sfshape)
  as.numeric(sfshape)

  x <- list()
  y <- list()
  for(i in 1:length(sfshape)){
    if(i%%2!=0){
      x <- append(x, sfshape[i])
    }else{
      y <- append(y, sfshape[i])
    }
  }
  xs <- vector()
  ys <- vector()
  for(i in 1:length(x[])){
    xs[i] <- x[[i]]
    ys[i] <- y[[i]]
  }
  df <- data.frame()
  df <-data.frame(x=c(xs),
                  y=c(ys))
  lists[[length(lists)+1]] <- df

}
```

```
#for (i in 1:length(lists)){
#  lists[[i]] <- as.numeric(lists[[i]])
#}


######################

#lists[[1]]$x

#str(lists)


mySPECIALdf <- as.data.frame(lists[[1]])
mySPECIALdf$x <- as.numeric(mySPECIALdf$x)
mySPECIALdf$y <- as.numeric(mySPECIALdf$y)
#str(mySPECIALdf)

for (i in 1:length(lists)){
  #print(i)
  lists[[i]]$x <- as.numeric(lists[[i]]$x)
  lists[[i]]$y <- as.numeric(lists[[i]]$y)
}

str(lists)
```

```
## List of 139
##  $ :'data.frame':    98 obs. of  2 variables:
##   ..$ x: num [1:98] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:98] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    99 obs. of  2 variables:
##   ..$ x: num [1:99] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:99] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    114 obs. of  2 variables:
##   ..$ x: num [1:114] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:114] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    112 obs. of  2 variables:
##   ..$ x: num [1:112] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:112] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    147 obs. of  2 variables:
##   ..$ x: num [1:147] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:147] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    149 obs. of  2 variables:
##   ..$ x: num [1:149] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:149] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    168 obs. of  2 variables:
##   ..$ x: num [1:168] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:168] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    162 obs. of  2 variables:
##   ..$ x: num [1:162] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:162] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    156 obs. of  2 variables:
##   ..$ x: num [1:156] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:156] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    180 obs. of  2 variables:
##   ..$ x: num [1:180] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:180] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    149 obs. of  2 variables:
##   ..$ x: num [1:149] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:149] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    152 obs. of  2 variables:
##   ..$ x: num [1:152] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:152] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    123 obs. of  2 variables:
##   ..$ x: num [1:123] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:123] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    151 obs. of  2 variables:
##   ..$ x: num [1:151] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:151] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    99 obs. of  2 variables:
##   ..$ x: num [1:99] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:99] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    110 obs. of  2 variables:
##   ..$ x: num [1:110] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:110] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    214 obs. of  2 variables:
##   ..$ x: num [1:214] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:214] 37.7 37.7 37.7 37.7 37.7 ...
```

```
##  $ :'data.frame':    191 obs. of  2 variables:
##   ..$ x: num [1:191] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:191] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    139 obs. of  2 variables:
##   ..$ x: num [1:139] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:139] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    147 obs. of  2 variables:
##   ..$ x: num [1:147] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:147] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    96 obs. of  2 variables:
##   ..$ x: num [1:96] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:96] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    107 obs. of  2 variables:
##   ..$ x: num [1:107] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:107] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    100 obs. of  2 variables:
##   ..$ x: num [1:100] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:100] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    88 obs. of  2 variables:
##   ..$ x: num [1:88] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:88] 37.8 37.8 37.8 37.8 37.7 ...
##  $ :'data.frame':    235 obs. of  2 variables:
##   ..$ x: num [1:235] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:235] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    223 obs. of  2 variables:
##   ..$ x: num [1:223] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:223] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    234 obs. of  2 variables:
##   ..$ x: num [1:234] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:234] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    248 obs. of  2 variables:
##   ..$ x: num [1:248] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:248] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    274 obs. of  2 variables:
##   ..$ x: num [1:274] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:274] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    286 obs. of  2 variables:
##   ..$ x: num [1:286] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:286] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    71 obs. of  2 variables:
##   ..$ x: num [1:71] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:71] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    102 obs. of  2 variables:
##   ..$ x: num [1:102] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:102] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    97 obs. of  2 variables:
##   ..$ x: num [1:97] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:97] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    86 obs. of  2 variables:
##   ..$ x: num [1:86] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:86] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    114 obs. of  2 variables:
```

```
##   ..$ x: num [1:114] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:114] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    100 obs. of  2 variables:
##   ..$ x: num [1:100] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:100] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    116 obs. of  2 variables:
##   ..$ x: num [1:116] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:116] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    97 obs. of  2 variables:
##   ..$ x: num [1:97] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:97] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    132 obs. of  2 variables:
##   ..$ x: num [1:132] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:132] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    127 obs. of  2 variables:
##   ..$ x: num [1:127] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:127] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    74 obs. of  2 variables:
##   ..$ x: num [1:74] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:74] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    86 obs. of  2 variables:
##   ..$ x: num [1:86] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:86] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    173 obs. of  2 variables:
##   ..$ x: num [1:173] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:173] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    302 obs. of  2 variables:
##   ..$ x: num [1:302] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:302] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    199 obs. of  2 variables:
##   ..$ x: num [1:199] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:199] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    180 obs. of  2 variables:
##   ..$ x: num [1:180] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:180] 37.8 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    110 obs. of  2 variables:
##   ..$ x: num [1:110] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:110] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    111 obs. of  2 variables:
##   ..$ x: num [1:111] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:111] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    155 obs. of  2 variables:
##   ..$ x: num [1:155] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:155] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    151 obs. of  2 variables:
##   ..$ x: num [1:151] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:151] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    149 obs. of  2 variables:
##   ..$ x: num [1:149] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:149] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    117 obs. of  2 variables:
##   ..$ x: num [1:117] -123 -123 -123 -123 -123 ...
```

```
##   ..$ y: num [1:117] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    117 obs. of  2 variables:
##   ..$ x: num [1:117] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:117] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    111 obs. of  2 variables:
##   ..$ x: num [1:111] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:111] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    70 obs. of  2 variables:
##   ..$ x: num [1:70] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:70] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    77 obs. of  2 variables:
##   ..$ x: num [1:77] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:77] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    334 obs. of  2 variables:
##   ..$ x: num [1:334] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:334] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    336 obs. of  2 variables:
##   ..$ x: num [1:336] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:336] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    299 obs. of  2 variables:
##   ..$ x: num [1:299] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:299] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    301 obs. of  2 variables:
##   ..$ x: num [1:301] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:301] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    72 obs. of  2 variables:
##   ..$ x: num [1:72] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:72] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    80 obs. of  2 variables:
##   ..$ x: num [1:80] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:80] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    181 obs. of  2 variables:
##   ..$ x: num [1:181] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:181] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    184 obs. of  2 variables:
##   ..$ x: num [1:184] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:184] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    141 obs. of  2 variables:
##   ..$ x: num [1:141] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:141] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    136 obs. of  2 variables:
##   ..$ x: num [1:136] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:136] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    108 obs. of  2 variables:
##   ..$ x: num [1:108] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:108] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    107 obs. of  2 variables:
##   ..$ x: num [1:107] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:107] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    127 obs. of  2 variables:
##   ..$ x: num [1:127] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:127] 37.7 37.7 37.7 37.7 37.7 ...
```

```
##  $ :'data.frame':    139 obs. of  2 variables:
##   ..$ x: num [1:139] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:139] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    292 obs. of  2 variables:
##   ..$ x: num [1:292] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:292] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    120 obs. of  2 variables:
##   ..$ x: num [1:120] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:120] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    165 obs. of  2 variables:
##   ..$ x: num [1:165] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:165] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    247 obs. of  2 variables:
##   ..$ x: num [1:247] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:247] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    52 obs. of  2 variables:
##   ..$ x: num [1:52] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:52] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    39 obs. of  2 variables:
##   ..$ x: num [1:39] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:39] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    86 obs. of  2 variables:
##   ..$ x: num [1:86] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:86] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    75 obs. of  2 variables:
##   ..$ x: num [1:75] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:75] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    131 obs. of  2 variables:
##   ..$ x: num [1:131] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:131] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    112 obs. of  2 variables:
##   ..$ x: num [1:112] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:112] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    173 obs. of  2 variables:
##   ..$ x: num [1:173] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:173] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    154 obs. of  2 variables:
##   ..$ x: num [1:154] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:154] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    106 obs. of  2 variables:
##   ..$ x: num [1:106] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:106] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    107 obs. of  2 variables:
##   ..$ x: num [1:107] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:107] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    107 obs. of  2 variables:
##   ..$ x: num [1:107] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:107] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    58 obs. of  2 variables:
##   ..$ x: num [1:58] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:58] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    54 obs. of  2 variables:
```

```
##   ..$ x: num [1:54] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:54] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    54 obs. of  2 variables:
##   ..$ x: num [1:54] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:54] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    81 obs. of  2 variables:
##   ..$ x: num [1:81] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:81] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    124 obs. of  2 variables:
##   ..$ x: num [1:124] -123 -123 -123 -123 -123 ...
##   ..$ y: num [1:124] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    125 obs. of  2 variables:
##   ..$ x: num [1:125] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:125] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    161 obs. of  2 variables:
##   ..$ x: num [1:161] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:161] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    160 obs. of  2 variables:
##   ..$ x: num [1:160] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:160] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    265 obs. of  2 variables:
##   ..$ x: num [1:265] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:265] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    258 obs. of  2 variables:
##   ..$ x: num [1:258] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:258] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    178 obs. of  2 variables:
##   ..$ x: num [1:178] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:178] 37.8 37.8 37.8 37.8 37.8 ...
##  $ :'data.frame':    186 obs. of  2 variables:
##   ..$ x: num [1:186] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:186] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    222 obs. of  2 variables:
##   ..$ x: num [1:222] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:222] 37.7 37.7 37.7 37.7 37.7 ...
##  $ :'data.frame':    254 obs. of  2 variables:
##   ..$ x: num [1:254] -122 -122 -122 -122 -122 ...
##   ..$ y: num [1:254] 37.8 37.8 37.8 37.8 37.8 ...
##   [list output truncated]
```

```
max(SFMuni.stops$LATITUDE)
```

```
## [1] 37.82985
```

```
min(SFMuni.stops$LATITUDE)
```

```
## [1] 37.70576
```

```
max(SFMuni.stops$LONGITUDE)
```

```
## [1] -122.3656
```

```
min(SFMuni.stops$LONGITUDE)
```

```
## [1] -122.5108
```

```
first <- as.data.frame(lists[[2]])
pl <- ggplot(first, aes(x,y))
pl1 <- pl + geom_path(size = .3) + xlim(-122.5108,-122.3656) + ylim(37.70576,37.82985) +
theme(aspect.ratio = 1/1)
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## ℹ Please use `linewidth` instead.
```

```
pl1 + geom_point(data = SFMuni.stops, size = 0.5, aes(LONGITUDE, LATITUDE, color = SHELT
ER)) + theme(aspect.ratio=3/3, element_blank())
```

```
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```

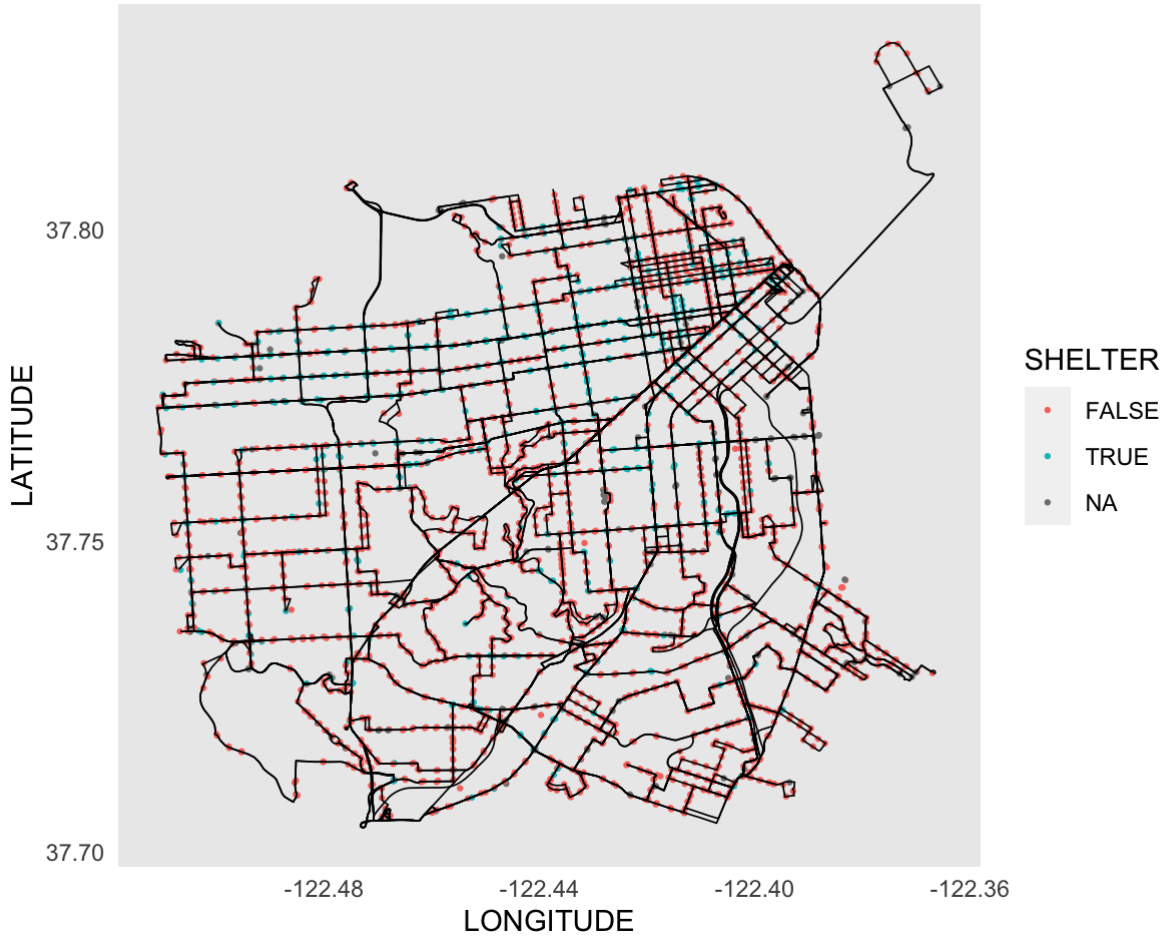
```
lists[[23]]
```

```
##             x        y
## 1   -122.4233 37.79396
## 2   -122.4249 37.79462
## 3   -122.4232 37.79483
## 4   -122.4232 37.79482
## 5   -122.4216 37.79503
## 6   -122.4214 37.79415
## 7   -122.4212 37.79326
## 8   -122.4196 37.79347
## 9   -122.4179 37.79369
## 10  -122.4178 37.79281
## 11  -122.4177 37.79234
## 12  -122.4176 37.79193
## 13  -122.4174 37.79098
## 14  -122.4172 37.79005
## 15  -122.4170 37.78912
## 16  -122.4154 37.78933
## 17  -122.4137 37.78954
## 18  -122.4136 37.78860
## 19  -122.4134 37.78796
## 20  -122.4134 37.78767
## 21  -122.4133 37.78739
## 22  -122.4132 37.78674
## 23  -122.4130 37.78579
## 24  -122.4129 37.78536
## 25  -122.4129 37.78531
## 26  -122.4128 37.78487
## 27  -122.4126 37.78394
## 28  -122.4124 37.78301
## 29  -122.4122 37.78208
## 30  -122.4120 37.78114
## 31  -122.4132 37.78100
## 32  -122.4137 37.78093
## 33  -122.4153 37.78072
## 34  -122.4151 37.77979
## 35  -122.4150 37.77889
## 36  -122.4148 37.77873
## 37  -122.4142 37.77824
## 38  -122.4132 37.77746
## 39  -122.4126 37.77703
## 40  -122.4122 37.77667
## 41  -122.4116 37.77623
## 42  -122.4111 37.77580
## 43  -122.4106 37.77543
## 44  -122.4101 37.77500
## 45  -122.4095 37.77455
## 46  -122.4091 37.77420
## 47  -122.4085 37.77377
## 48  -122.4097 37.77284
## 49  -122.4101 37.77253
## 50  -122.4107 37.77206
## 51  -122.4113 37.77158
```

```
## 52  -122.4125 37.77063
## 53  -122.4140 37.77187
## 54  -122.4145 37.77141
## 55  -122.4150 37.77090
## 56  -122.4153 37.77036
## 57  -122.4156 37.76960
## 58  -122.4156 37.76937
## 59  -122.4156 37.76854
## 60  -122.4155 37.76694
## 61  -122.4153 37.76532
## 62  -122.4131 37.76545
## 63  -122.4124 37.76550
## 64  -122.4115 37.76555
## 65  -122.4105 37.76561
## 66  -122.4104 37.76432
## 67  -122.4103 37.76304
## 68  -122.4101 37.76176
## 69  -122.4100 37.76049
## 70  -122.4099 37.75957
## 71  -122.4098 37.75920
## 72  -122.4097 37.75911
## 73  -122.4097 37.75845
## 74  -122.4096 37.75773
## 75  -122.4096 37.75760
## 76  -122.4095 37.75609
## 77  -122.4095 37.75600
## 78  -122.4094 37.75497
## 79  -122.4093 37.75440
## 80  -122.4093 37.75426
## 81  -122.4093 37.75423
## 82  -122.4091 37.75280
## 83  -122.4090 37.75120
## 84  -122.4088 37.74960
## 85  -122.4087 37.74836
## 86  -122.4097 37.74834
## 87  -122.4106 37.74832
## 88  -122.4115 37.74830
## 89  -122.4126 37.74828
## 90  -122.4137 37.74826
## 91  -122.4149 37.74823
## 92  -122.4159 37.74822
## 93  -122.4160 37.74918
## 94  -122.4161 37.75077
## 95  -122.4163 37.75238
## 96  -122.4168 37.75234
## 97  -122.4174 37.75231
## 98  -122.4179 37.75228
## 99  -122.4185 37.75224
## 100 -122.4186 37.75229
```

```
#first <- as.data.frame(lists[[2]])
Sl <- ggplot(SFMuni.stops, aes(LONGITUDE, LATITUDE))
psl <- sl + geom_point(size = 0.45, aes(LONGITUDE, LATITUDE, color = SHELTER)) + theme(a
spect.ratio=3/3, element_blank())
#psl
#psl + geom_path(data = lists[[2]], size = 0.3, aes(x,y)) + theme(aspect.ratio=3/3, elem
ent_blank())
```

```
#str(lists)
for (i in 1:length(lists)){
  newRoute = paste("geom_path(data = lists[[",i,"]], size = 0.3, aes(x,y, size = 12))",
sep = "")
  psl <- psl + eval(parse(text = newRoute))

  #print(newRoute)
}
psl
```




```
?leaflet
?sf
```

Components of the write-up and presentation

Statement of question/topic that you want to answer and what motivated you to study the question/topic

The topic we studied was public transit in San Francisco. Specifically, we were interested in how the population density in the city relates to the MUNI routes. We all ride MUNI almost every day and were excited to learn more about the system and think through how potential improvements could be made.

If applicable, what data will you analyze? Identify at least one data source (can be from Kaggle, etc.)

We used two data sets. We downloaded both from sf.gov as `.csv` files. The first, “MUNI Stops”, lists all 3428 MUNI bus stops in the city, including their cross sections, stop ID numbers, and latitudinal and longitudinal information. The second, “MUNI Routes” lists all of the bus lines and their information regarding their direction and frequency.

What challenges do you face in analyzing this data?

There were many challenges we faced in this process. First, it was very difficult to figure out how to get the data to a place where it could be plotted. We wanted to be able to plot the actual bus routes by graphing each stop onto a map of the city. The latitude/longitude data regarding each stop was not in a format that this was possible, so we had to first figure out how to list it in an accessible way. Second, despite our best efforts, we could not find a data set with information regarding the population density within the city. Our solution to this was to use a photo of a map of the city with the density information represented by different colors. We used this image to overlay our routes onto. This solution had its own problems associated with it, including scaling our map of the stops to the scale of the map used online since we did not have the ability to manipulate that map.

What packages were needed for this case study?

1. `dpylr` : Is used to organize data and make manipulation easier, allows one to call row/column data easily
2. `sf` : Is used to plot spatial data, experimented with this method to plot routes using polygon geometry
3. `leaflet` : Creates a map widget using the leaflet package, easily renders spatial objects from the sp or sf packages, or data frames with latitude/longitude columns
4. `ggplot` : Can be used to declare the input data frame for a graphic and to specify the set of plot aesthetics intended to be common throughout all layers
5. `ggpubr` : Simpler version of ggplot, creates plots with less code

Discussion: What did you learn from this experience? What more could you do with this project in the future?

One of the biggest lessons we learned is that data cleaning and organizing can be the most time consuming part of analysis projects. Although it took us a while to find the data we wanted to work with, develop questions to explore, and eventually to discuss the results, the most challenging part for us was to get the data into a format that we could work with. Part of the reason this was so time consuming was because of how important it was for us to set the data aside and come back to it multiple times with fresh(ish) eys. On that note, another key part of our project was the teamwork. It took all of us sharing ideas, explaining our problems, and working together to get the assignment done. We were all happy to work in a collaborative and patient team and now have a much better understanding as to the value of teams in data analysis. Finally, there was so much more we wanted to do with this data if we had more time and more data to work with. Our ideas for additional analyses included examining the frequency information in relation to which stops had shelters and which did not, and looking at where car crashes occur most frequently in order to provide recommendations for better traffic signals and alternative MUNI routes. These analyses along with the analyses we completed in this project could be used to recommend changes to the frequency of bus routes, or even to provide recommendations for how to expand the underground transit options in the city.