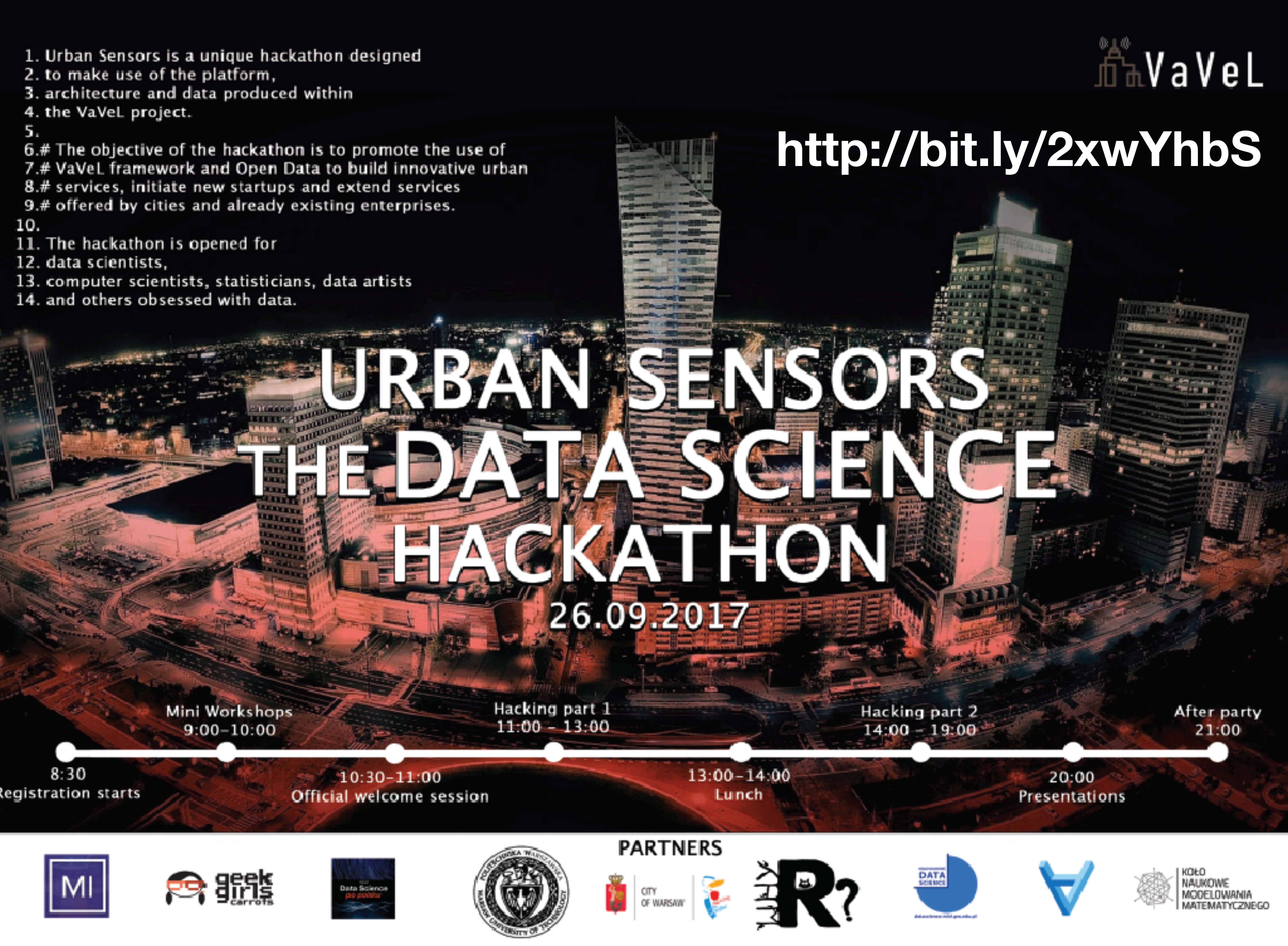


1. Urban Sensors is a unique hackathon designed
2. to make use of the platform,
3. architecture and data produced within
4. the VaVeL project.
5.
6.# The objective of the hackathon is to promote the use of
7.# VaVeL framework and Open Data to build innovative urban
8.# services, initiate new startups and extend services
9.# offered by cities and already existing enterprises.
10.
11. The hackathon is opened for
12. data scientists,
13. computer scientists, statisticians, data artists
14. and others obsessed with data.

VaVeL

http://bit.ly/2xwYhbS

URBAN SENSORS THE DATA SCIENCE HACKATHON

26.09.2017

8:30
Registration starts

Mini Workshops
9:00-10:00

10:30-11:00
Official welcome session

Hacking part 1
11:00 - 13:00

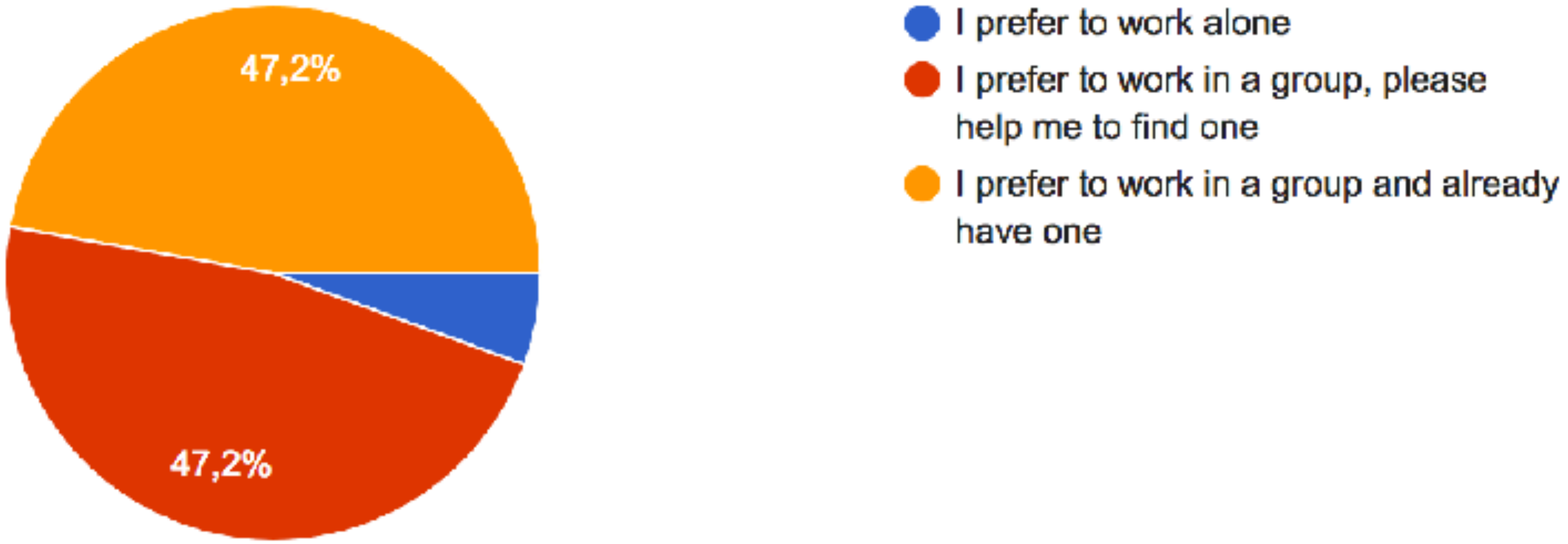
13:00-14:00
Lunch

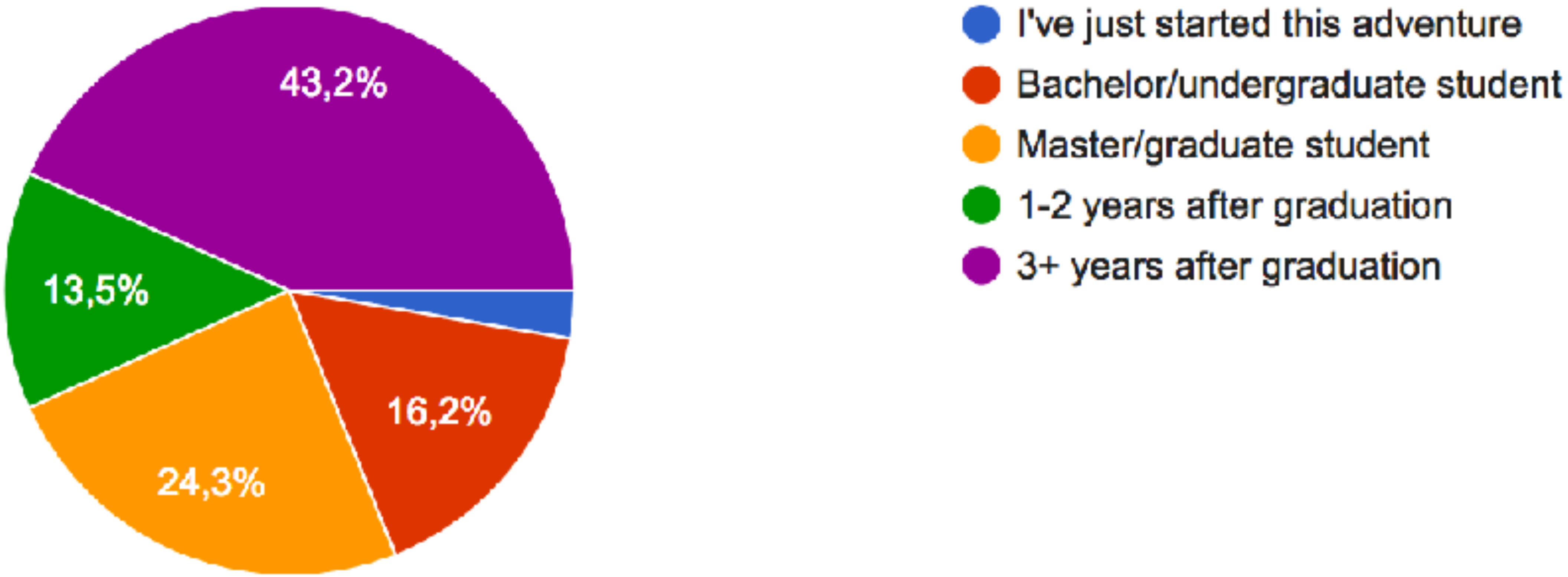
Hacking part 2
14:00 - 19:00

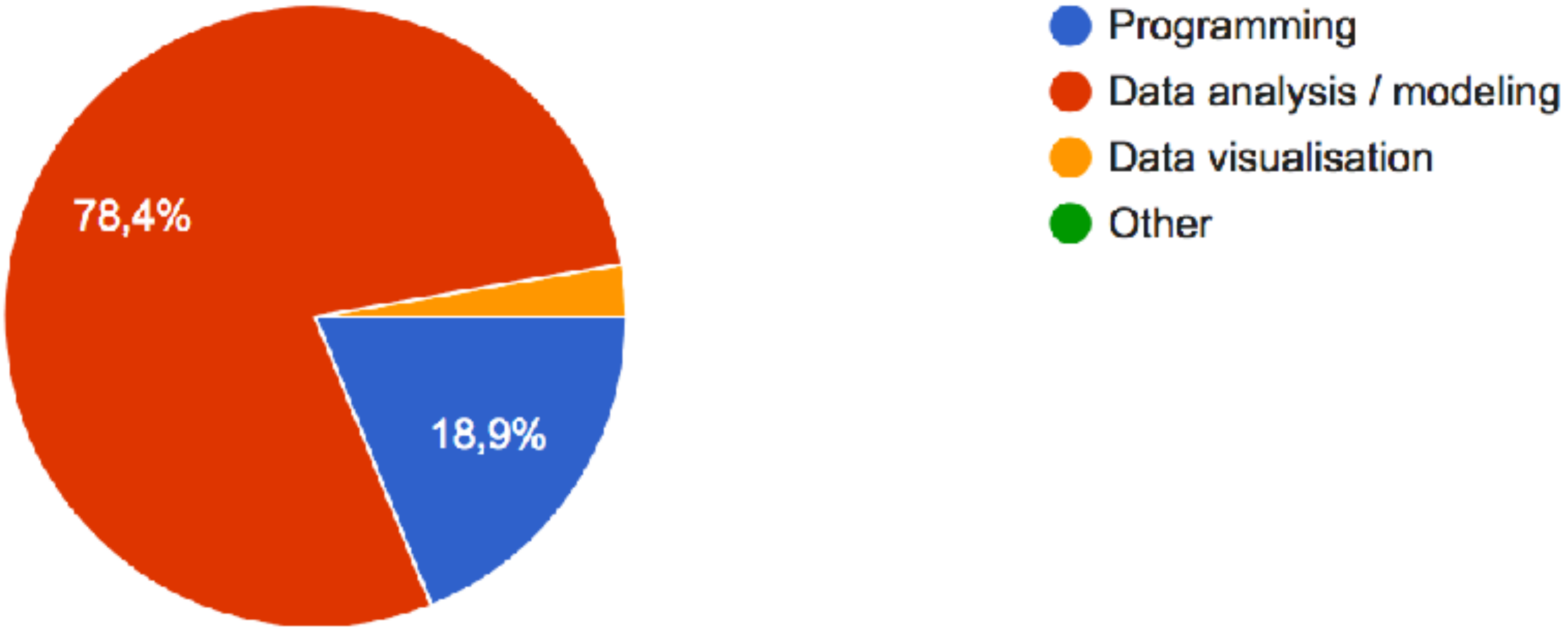
20:00
Presentations

After party
21:00

PARTNERS


47,2%
47,2%
● I prefer to work alone
● I prefer to work in a group, please help me to find one
● I prefer to work in a group and already have one


43,2%
13,5%
24,3%
16,2%
I've just started this adventure
Bachelor/undergraduate student
Master/graduate student
1-2 years after graduation
3+ years after graduation


78,4%
18,9%
Programming
Data analysis / modeling
Data visualisation
Other

VaVeL

VARIETY / VERACITY / VALUE

HANDLING THE MULTIPLICITY OF URBAN SENSORS

The goal of the VaVeL project is to radically advance our ability to use urban data in applications that can **identify and address citizen needs and improve urban life.** This project will develop a general purpose framework for managing and mining multiple heterogeneous urban data streams for cities become more efficient, productive and resilient.

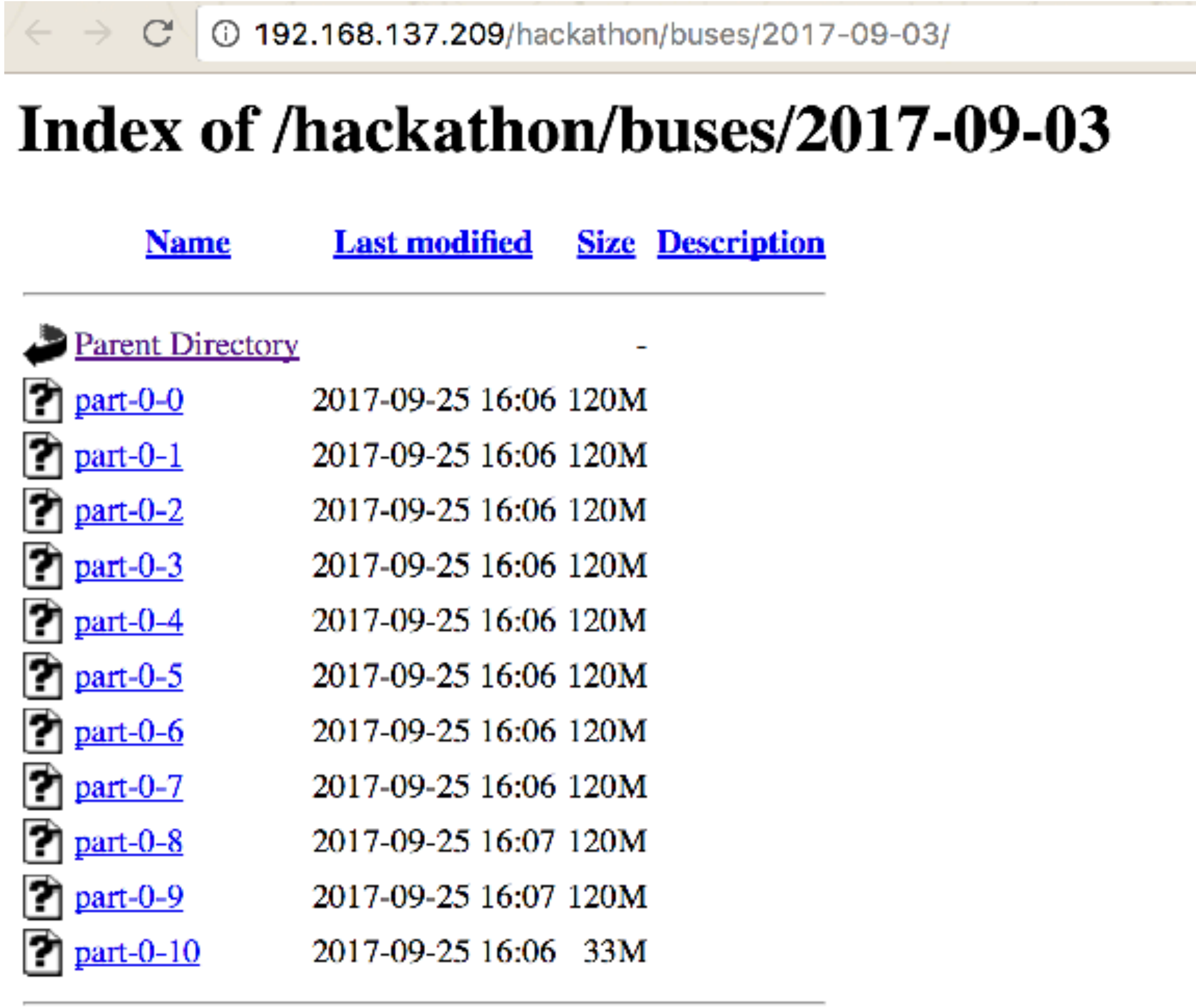
A. Online data for trams and buses

B. Offline data for trams and buses

C. Offline data from cellphones

Offline data for trams and buses

Offline data for trams and buses

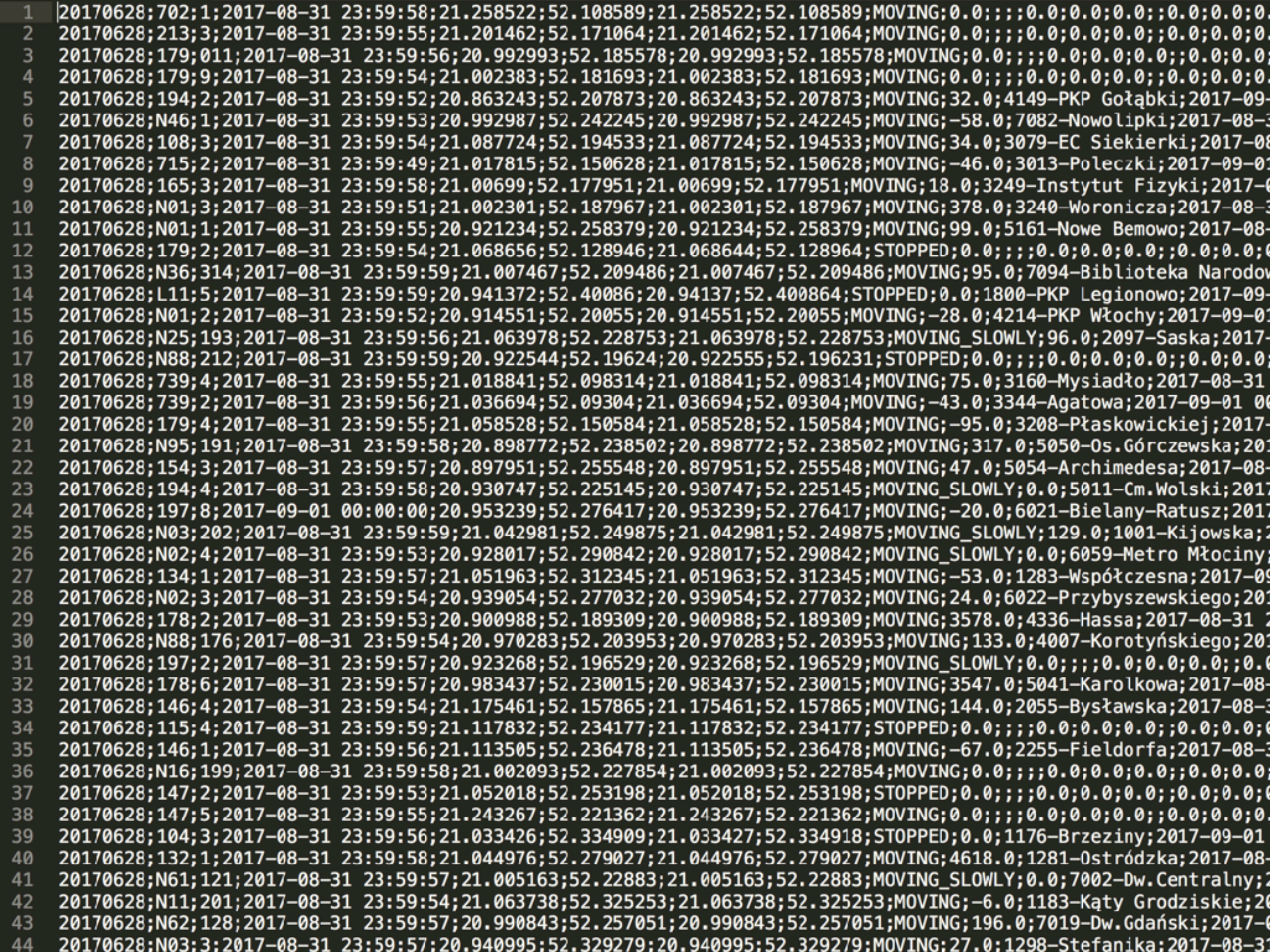


Index of /hackathon/buses/2017-09-03

Name	Last modified	Size	Description
Parent Directory		-	
part-0-0	2017-09-25 16:06	120M	
part-0-1	2017-09-25 16:06	120M	
part-0-2	2017-09-25 16:06	120M	
part-0-3	2017-09-25 16:06	120M	
part-0-4	2017-09-25 16:06	120M	
part-0-5	2017-09-25 16:06	120M	
part-0-6	2017-09-25 16:06	120M	
part-0-7	2017-09-25 16:06	120M	
part-0-8	2017-09-25 16:07	120M	
part-0-9	2017-09-25 16:07	120M	
part-0-10	2017-09-25 16:06	33M	

Access data from

http://192.168.137.209/hackathon



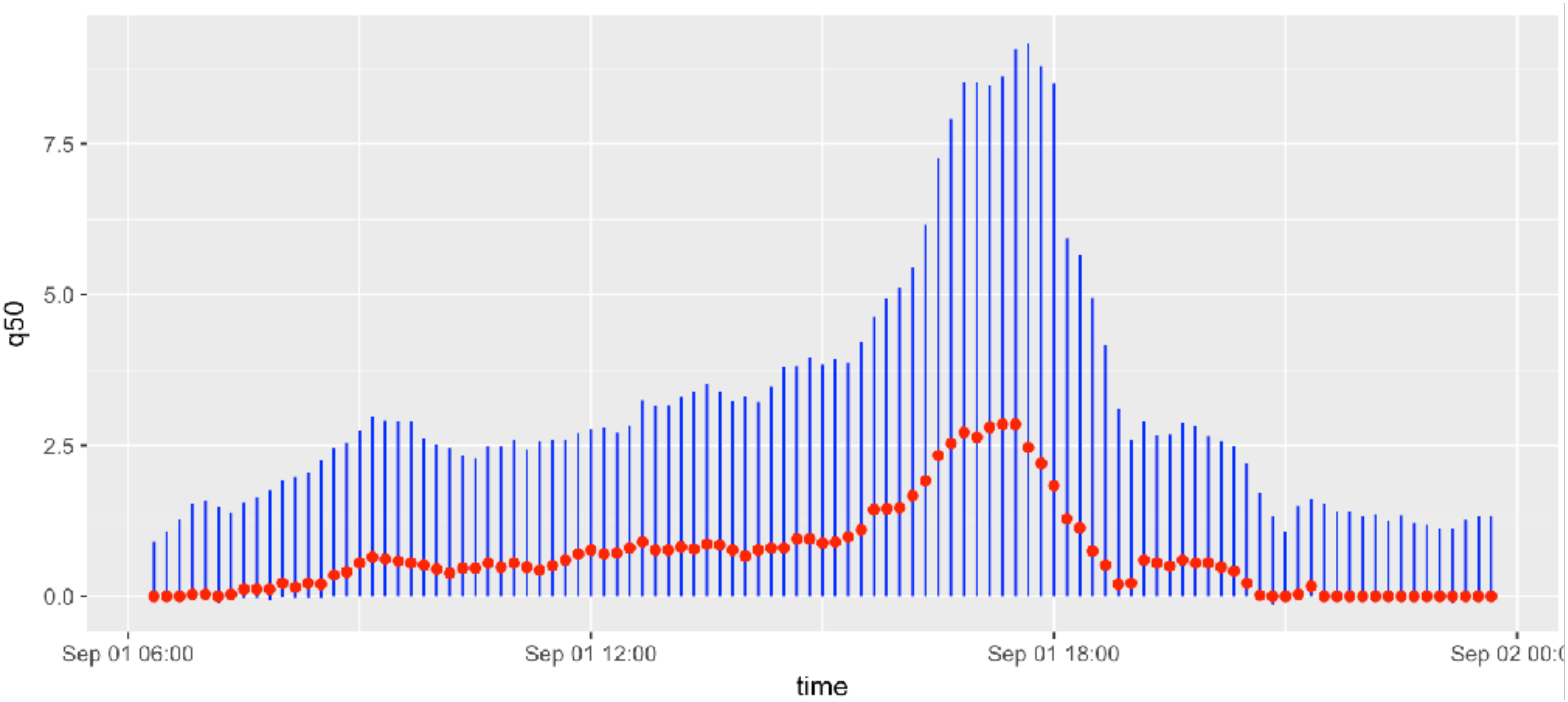
```
20170628;702;1;2017-08-31 23:59:58;21.258522;52.108589;21.258522;52.108589;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;0.
20170628;213;3;2017-08-31 23:59:55;21.201462;52.171064;21.201462;52.171064;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;0.
20170628;179;011;2017-08-31 23:59:56;20.992993;52.185578;20.992993;52.185578;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;179;9;2017-08-31 23:59:54;21.002383;52.181693;21.002383;52.181693;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;0.
20170628;194;2;2017-08-31 23:59:52;20.863243;52.207873;20.863243;52.207873;MOVING;32.0;4149-PKP Gołąbki;2017-09-
20170628;N46;1;2017-08-31 23:59:53;20.992987;52.242245;20.992987;52.242245;MOVING;-58.0;7082-Nowolipki;2017-08-3
20170628;108;3;2017-08-31 23:59:54;21.087724;52.194533;21.087724;52.194533;MOVING;34.0;3079-EC Siekierki;2017-08
20170628;715;2;2017-08-31 23:59:49;21.017815;52.150628;21.017815;52.150628;MOVING;-46.0;3013-Poleczki;2017-09-01
20170628;165;3;2017-08-31 23:59:58;21.00699;52.177951;21.00699;52.177951;MOVING;18.0;3249-Instytut Fizyki;2017-0
20170628;N01;3;2017-08-31 23:59:51;21.002301;52.187967;21.002301;52.187967;MOVING;378.0;3240-Woronicza;2017-08-3
20170628;N01;1;2017-08-31 23:59:55;20.921234;52.258379;20.921234;52.258379;MOVING;99.0;5161-Nowe Bemowo;2017-08-
20170628;179;2;2017-08-31 23:59:54;21.068656;52.128946;21.068644;52.128964;STOPPED;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;N36;314;2017-08-31 23:59:59;21.007467;52.209486;21.007467;52.209486;MOVING;95.0;7094-Biblioteka Narodow
20170628;L11;5;2017-08-31 23:59:59;20.941372;52.40086;20.94137;52.400864;STOPPED;0.0;1800-PKP Legionowo;2017-09-
20170628;N01;2;2017-08-31 23:59:52;20.914551;52.20055;20.914551;52.20055;MOVING;-28.0;4214-PKP Włochy;2017-09-01
20170628;N25;193;2017-08-31 23:59:56;21.063978;52.228753;21.063978;52.228753;MOVING_SLOWLY;96.0;2097-Saska;2017-
20170628;N88;212;2017-08-31 23:59:59;20.922544;52.19624;20.922555;52.196231;STOPPED;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;739;4;2017-08-31 23:59:55;21.018841;52.098314;21.018841;52.098314;MOVING;75.0;3160-Mysiadło;2017-08-31
20170628;739;2;2017-08-31 23:59:56;21.036694;52.09304;21.036694;52.09304;MOVING;-43.0;3344-Agatowa;2017-09-01 00
20170628;179;4;2017-08-31 23:59:55;21.058528;52.150584;21.058528;52.150584;MOVING;-95.0;3208-Płaskowickiej;2017-
20170628;N95;191;2017-08-31 23:59:58;20.898772;52.238502;20.898772;52.238502;MOVING;317.0;5050-Os.Górczewska;20
20170628;154;3;2017-08-31 23:59:57;20.897951;52.255548;20.897951;52.255548;MOVING;47.0;5054-Archimedesa;2017-08-
20170628;194;4;2017-08-31 23:59:58;20.930747;52.225145;20.930747;52.225145;MOVING_SLOWLY;0.0;5011-Cm.Wolski;2017
20170628;197;8;2017-09-01 00:00:00;20.953239;52.276417;20.953239;52.276417;MOVING;-20.0;6021-Bielany-Ratusz;2017
20170628;N03;202;2017-08-31 23:59:59;21.042981;52.249875;21.042981;52.249875;MOVING_SLOWLY;129.0;1001-Kijowska;2
20170628;N02;4;2017-08-31 23:59:53;20.928017;52.290842;20.928017;52.290842;MOVING_SLOWLY;0.0;6059-Metro Młociny;
20170628;134;1;2017-08-31 23:59:57;21.051963;52.312345;21.051963;52.312345;MOVING;-53.0;1283-Współczesna;2017-09
20170628;N02;3;2017-08-31 23:59:54;20.939054;52.277032;20.939054;52.277032;MOVING;24.0;6022-Przybyszewskiego;20
20170628;178;2;2017-08-31 23:59:53;20.900988;52.189309;20.900988;52.189309;MOVING;3578.0;4336-Hassa;2017-08-31 2
20170628;N88;176;2017-08-31 23:59:54;20.970283;52.203953;20.970283;52.203953;MOVING;133.0;4007-Korotyńskiego;20
20170628;197;2;2017-08-31 23:59:57;20.923268;52.196529;20.923268;52.196529;MOVING_SLOWLY;0.0;;;;0.0;0.0;0.0;;0.0
20170628;178;6;2017-08-31 23:59:57;20.983437;52.230015;20.983437;52.230015;MOVING;3547.0;5041-Karolkowa;2017-08-
20170628;146;4;2017-08-31 23:59:54;21.175461;52.157865;21.175461;52.157865;MOVING;144.0;2055-Bysławska;2017-08-3
20170628;115;4;2017-08-31 23:59:59;21.117832;52.234177;21.117832;52.234177;STOPPED;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;146;1;2017-08-31 23:59:56;21.113505;52.236478;21.113505;52.236478;MOVING;-67.0;2255-Fieldorfa;2017-08-3
20170628;N16;199;2017-08-31 23:59:58;21.002093;52.227854;21.002093;52.227854;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;147;2;2017-08-31 23:59:53;21.052018;52.253198;21.052018;52.253198;STOPPED;0.0;;;;0.0;0.0;0.0;;0.0;0.0;
20170628;147;5;2017-08-31 23:59:55;21.243267;52.221362;21.243267;52.221362;MOVING;0.0;;;;0.0;0.0;0.0;;0.0;0.0;0.
20170628;104;3;2017-08-31 23:59:56;21.033426;52.334909;21.033427;52.334918;STOPPED;0.0;1176-Brzeziny;2017-09-01
20170628;132;1;2017-08-31 23:59:58;21.044976;52.279027;21.044976;52.279027;MOVING;4618.0;1281-Ostródzka;2017-08-
20170628;N61;121;2017-08-31 23:59:57;21.005163;52.22883;21.005163;52.22883;MOVING_SLOWLY;0.0;7002-Dw.Centralny;
20170628;N11;201;2017-08-31 23:59:54;21.063738;52.325253;21.063738;52.325253;MOVING;-6.0;1183-Kąty Grodziskie;2
20170628;N62;128;2017-08-31 23:59:57;20.990843;52.257051;20.990843;52.257051;MOVING;196.0;7019-Dw.Gdański;2017-
20170628;N03;3;2017-08-31 23:59:57;20.940995;52.329279;20.940995;52.329279;MOVING;27.0;1298-Stefanika;2017-08-3
```

```
"versionID", #String
"line",#String,
"brigade", #String
"time",#String,
"lon",#Double,
"lat",#Double,
"rawLon",#Double,
"rawLat",#Double,
"status",#String,
"delay",#String,
"delayAtStop",#String,
"plannedLeaveTime",#String,
"nearestStop",#String,
"nearestStopDistance",#Double,
"nearestStopLon",#Double,
"nearestStopLat",#Double,
"previousStop",#String,
"previousStopLon",#Double,
"previousStopLat",#Double,
"previousStopDistance",#Double,
"previousStopArrivalTime",#String,
"previousStopLeaveTime",#String,
"nextStop",#String,
"nextStopLon",#Double,
"nextStopLat",#Double,
"nextStopDistance",#Double,
"nextStopTimetableVisitTime",#String,
"courseIdentifier",#String,
"courseDirection",#String,
"timetableIdentifier",#String,
"timetableStatus",#String,
"receivedTime",#String,
"processingFinishedTime",#String
"onWayToDepot" ,#String
"overlapsWithNextBrigade",#String
"atStop",#String
"overlapsWithNextBrigadeStopLineBrigade",#String
"speed"
```

```
library("dplyr")
library("lubridate")
library("ggplot2")

# read all files
files <- list.files(pattern = "part")
parts <- lapply(files, read_csv2, col_names = FALSE)
one_day <- do.call(rbind, parts)

# enrich raw data
colnames(one_day) <- c( "versionID",  ……………….)
one_day$time16 <- substr(one_day$time, 1, 15)
one_day$delay <- as.numeric(as.character(one_day$delay))

# calculate aggregates
quant <- one_day[,-39]  %>%
  filter(time16 > "2017-09-01 06:1",
         time16 < "2017-09-01 23:5") %>%
  mutate(delay=delay/60) %>%
  group_by(time16) %>%
  summarise(q05 = quantile(delay, 0.5, na.rm=TRUE),
            q25 = quantile(delay, 0.25, na.rm=TRUE),
            q50 = quantile(delay, 0.50, na.rm=TRUE),
            q75 = quantile(delay, 0.75, na.rm=TRUE),
            q95 = quantile(delay, 0.95, na.rm=TRUE)) %>%
  mutate(time = ymd_hm(paste0(time16,"0")))
```

Offline data for trams and buses

```
ggplot(quant, aes(time, q50)) +
     geom_linerange(aes(ymin=q25, ymax=q75), color=“blue") +
     geom_point(color="red")
```



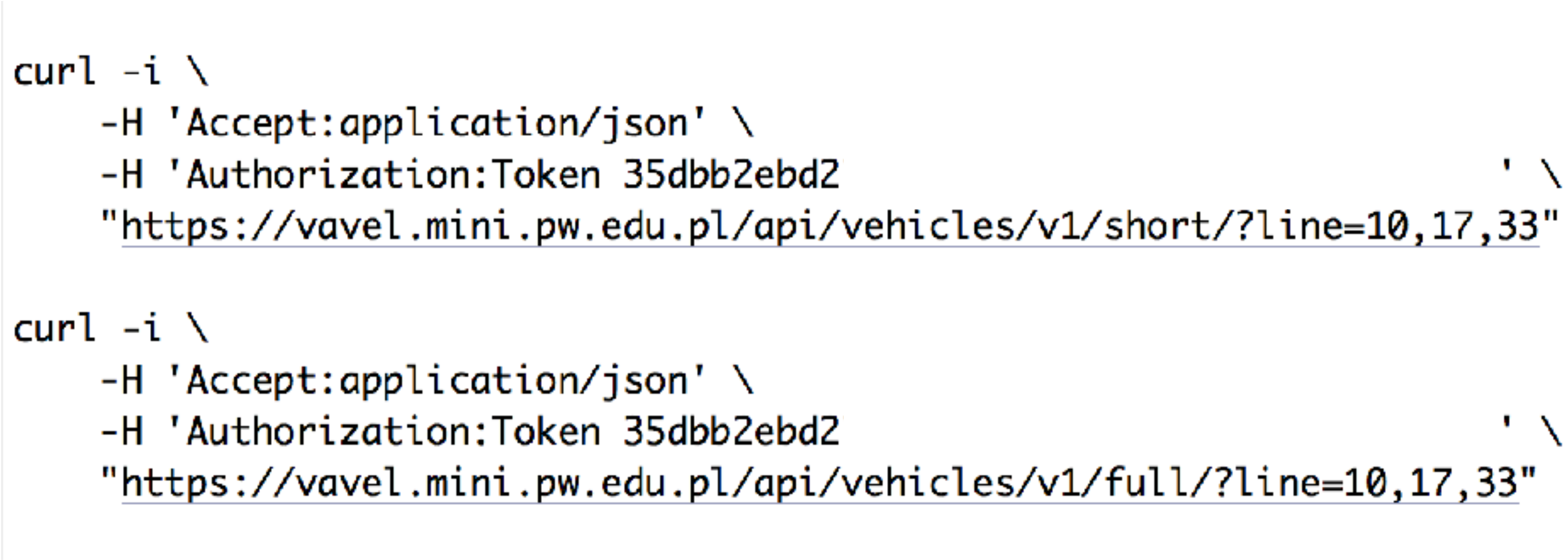
Online data for trams and buses

Online data for trams and buses

Read current positions and characteristics of trams and buses with our REST service.

You will need a token (should have one already).

Use the short/full hooks for smaller / longer list of characteristics.



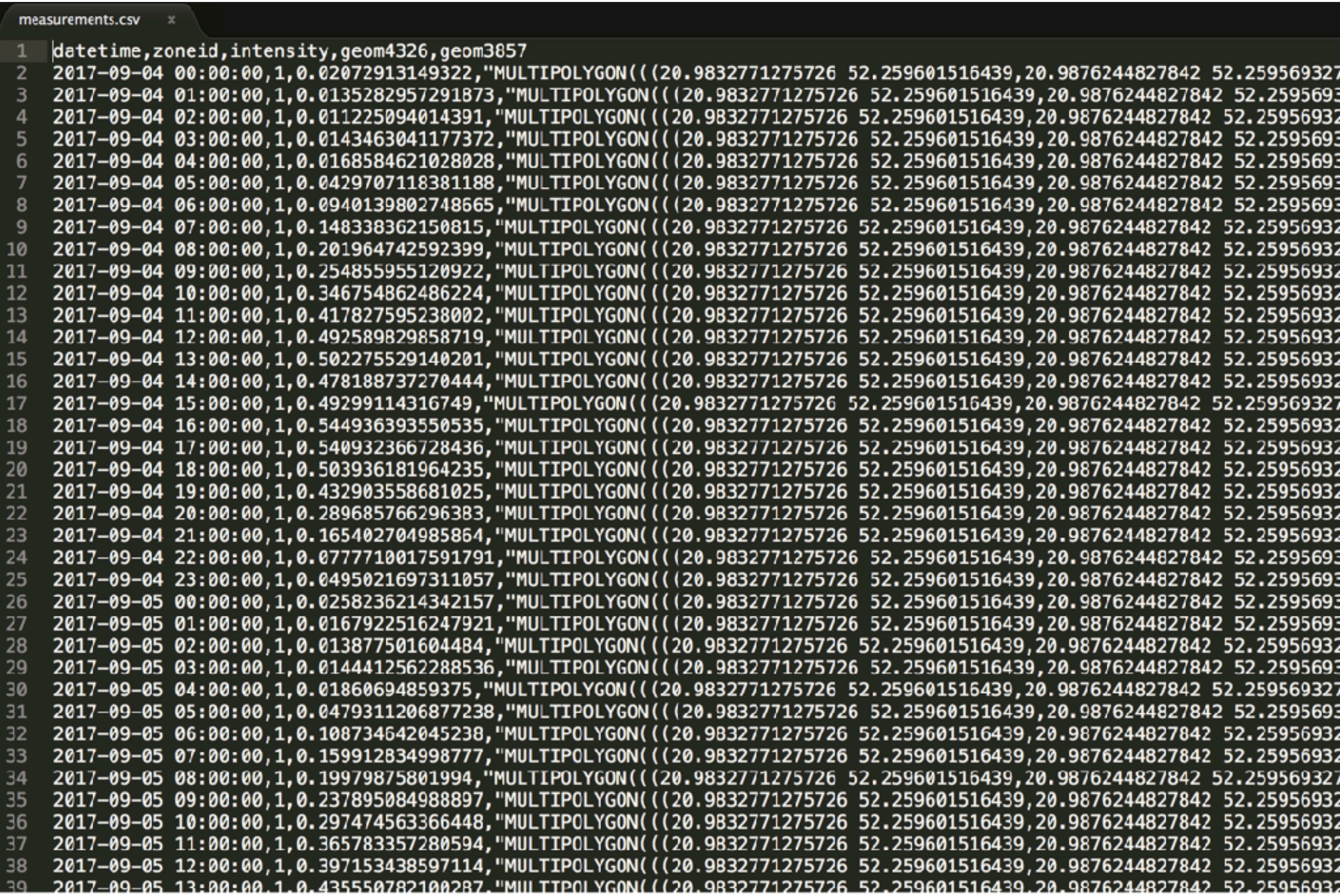
```
curl -i \
    -H 'Accept:application/json' \
    -H 'Authorization:Token 35dbb2ebd2                             ' \
    "https://vavel.mini.pw.edu.pl/api/vehicles/v1/short/?line=10,17,33"

curl -i \
    -H 'Accept:application/json' \
    -H 'Authorization:Token 35dbb2ebd2                             ' \
    "https://vavel.mini.pw.edu.pl/api/vehicles/v1/full/?line=10,17,33"
```

Online data for trams and buses

```
library("rvest")
library("jsonlite")

# set token and list of lines
linie <- "10,17,33"
token2 <- “35dbb2ebd27b23cfbec359dbd560adf2………..”

# get data
res <- GET(url = paste0("https://vavel.mini.pw.edu.pl/api/vehicles/v1/short/?line=", linie),
          add_headers(Authorization = paste("Token", token2)))
jsonlite::fromJSON(as.character(res))

# brigade line delay       status              time      lon      lat
#521.18877 025   10      0      STOPPED 2017-09-25T23:47:39Z 21.00311
#522.24342   8   17     90       MOVING 2017-09-26T00:04:51Z 20.99225
#523.18883  17   17      0      STOPPED 2017-09-25T21:43:11Z 21.00261
#524.18885   9   10      0       MOVING 2017-09-25T21:19:04Z 21.00261
#525.23154  11   10      0       MOVING 2017-09-25T21:22:37Z 20.96954
#526.29925 036   17      0       MOVING 2017-09-25T20:52:11Z 20.93416
```

Offline data from cellphones

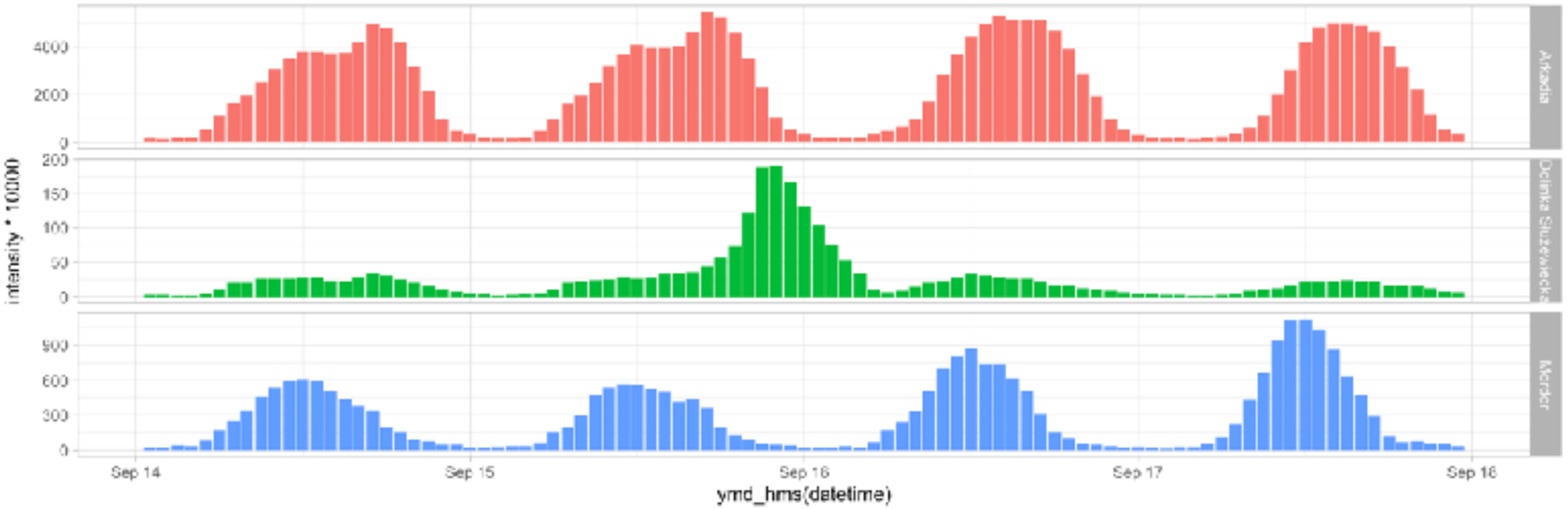
Offline data from cellphones



measurements.csv

```
datetime,zoneid,intensity,geom4326,geom3857
2017-09-04 00:00:00,1,0.02072913149322,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.259569327
2017-09-04 01:00:00,1,0.0135282957291873,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 02:00:00,1,0.011225094014391,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 03:00:00,1,0.0143463041177372,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 04:00:00,1,0.0168584621028028,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 05:00:00,1,0.0429707118381188,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 06:00:00,1,0.0940139802748665,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 07:00:00,1,0.148338362150815,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 08:00:00,1,0.201964742592399,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 09:00:00,1,0.254855955120922,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 10:00:00,1,0.346754862486224,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 11:00:00,1,0.417827595238002,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 12:00:00,1,0.492589829858719,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 13:00:00,1,0.502275529140201,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 14:00:00,1,0.478188737270444,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 15:00:00,1,0.49299114316749,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.259569327
2017-09-04 16:00:00,1,0.544936393550535,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 17:00:00,1,0.540932366728436,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 18:00:00,1,0.503936181964235,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 19:00:00,1,0.432903558681025,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 20:00:00,1,0.289685766296383,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 21:00:00,1,0.165402704985864,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-04 22:00:00,1,0.0777710017591791,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-04 23:00:00,1,0.0495021697311057,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-05 00:00:00,1,0.0258236214342157,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-05 01:00:00,1,0.0167922516247921,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-05 02:00:00,1,0.013877501604484,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 03:00:00,1,0.0144412562288536,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-05 04:00:00,1,0.01860694859375,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.259569327
2017-09-05 05:00:00,1,0.0479311206877238,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.2595693
2017-09-05 06:00:00,1,0.108734642045238,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 07:00:00,1,0.159912834998777,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 08:00:00,1,0.19979875801994,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.259569327
2017-09-05 09:00:00,1,0.237895084988897,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 10:00:00,1,0.297474563366448,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 11:00:00,1,0.365783357280594,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 12:00:00,1,0.397153438597114,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
2017-09-05 13:00:00,1,0.435550782100287,"MULTIPOLYGON(((20.9832771275726 52.259601516439,20.9876244827842 52.25956932
```

Offline data from cellphones

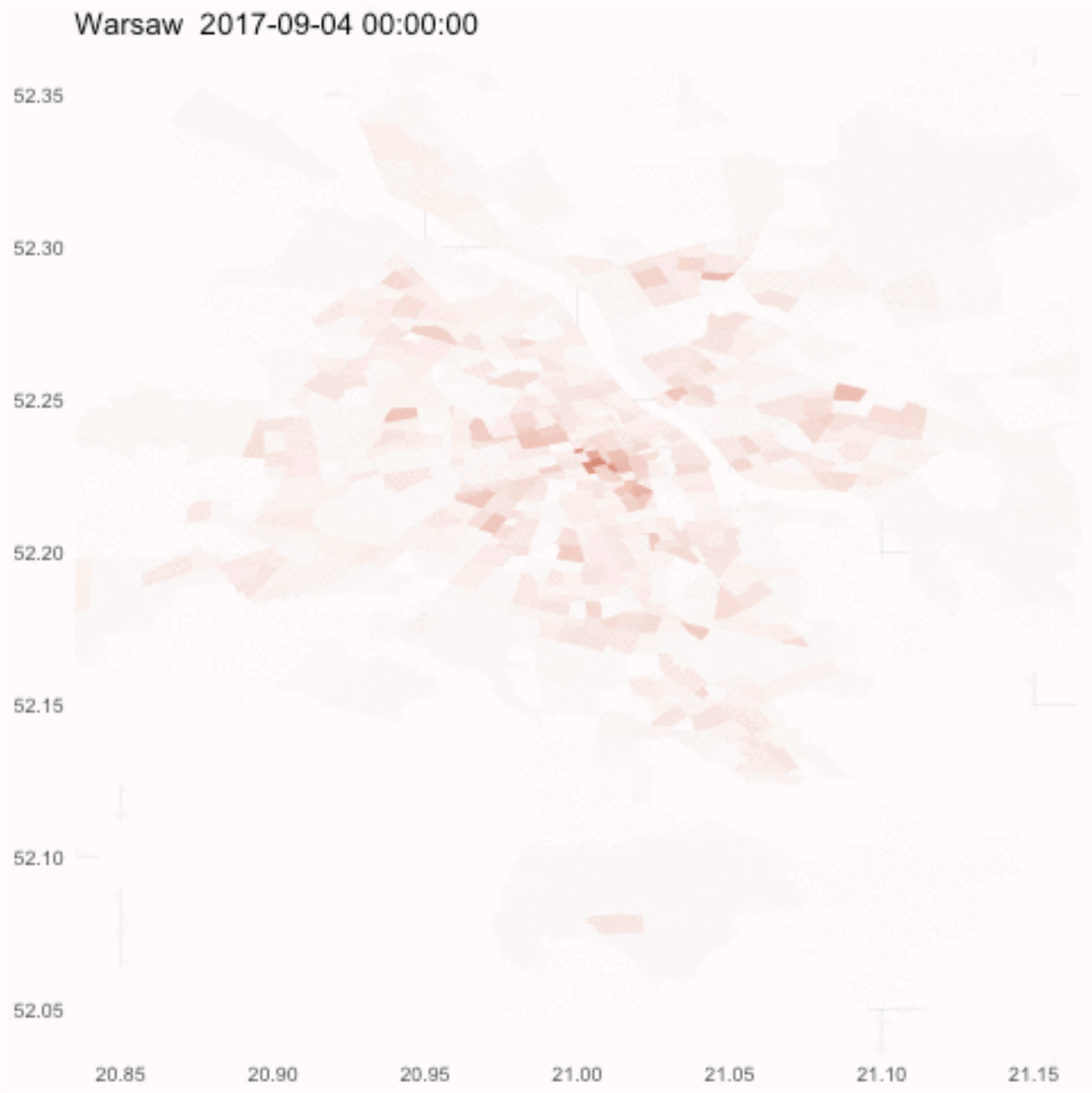


```
library("curl")
library("httr")
library("dplyr")
library("lubridate")
library("tidyr")
library("ggplot2")

# read measurements from phones
dane <- read.csv("measurements.csv", stringsAsFactors = FALSE)

selected <- filter(dane,
                   zoneid %in% c(1, 553, 751),
                   datetime > "2017-09-14 00:00:00")

selected$zoneid <- factor(selected$zoneid,
                      labels=c("Arkadia", "Dolinka Służewiecka", "Mordor"))

# plot data for 3 zones
ggplot(selected, aes(ymd_hms(datetime), intensity*10000, fill=factor(zoneid))) +
  geom_col() + facet_grid(zoneid~., scales = "free_y") +
  theme_light()
```

Offline data from cellphones

```
library(“sf”)
library(“animation”)

saveGIF({
  for (czas in czasy[1:24]) {
    daneGodzina <- filter(dane, datetime == czas)

    tmp <- gsub(daneGodzina[,4], pattern = "[^0-9 \\.,]", replacement = "")
    tmp2 <- strsplit(tmp, split=",")
    tmp3 <- lapply(tmp2, strsplit, split = " ")
    tmp4 <- lapply(tmp3, function(x) {
      tt <- sapply(x, as.numeric)
      tt <- cbind(tt, tt[,1])
      st_polygon(list(t(tt)))
    })

    geometry <- do.call(st_sfc, tmp4)
    areas <- 100/(st_area(geometry) + 5*10^-6) # scaling factor
    ss <- st_sf(intensity = pmin(daneGodzina$intensity * 10000 * areas/2649104, 2000), geometry )

    pl <- ggplot(ss) +
      geom_sf(aes(fill = intensity, color=intensity)) +
      theme_minimal() +
      scale_fill_gradient(limits = c(0, 2000), low = "#ffffff", high = "#990000") +
      scale_color_gradient(limits = c(0, 2000), low = "#ffffff", high = "#990000") +
      ggtitle(paste("Warsaw ", czas)) +
      theme(legend.position = "none") +
      coord_sf(xlim=c(20.85,21.15), ylim = c(52.05,52.35))
   print(pl)
  }
}, clean = FALSE, interval=0.2)
```

Offline data from cellphones



Your turn

How to start? Propositions

Programming

Mobile app that will show closest trams / buses

Webapp that will compare two alternative routes

App that will estimate number of people during an event

Analysis

Detect or predict future delays

Report current level of traffic ‘*korkometr*’

Compare a single event to a baseline

Data vis

Show distribution of delays per time / line / place

Show where are closes trams / buses

Show how single event (marathon) affected data