Loading the Data

BEAM can be configured to output an `events.csv` file for each iteration. For now, I just picked one for testing:

```
eventsCSV = "test/39.events.csv"
```

I then loaded the .csv file, Unfortunately, `read_csv` didn't get all the data types right, so I had to set them manually:

```
coltypes <- paste0("cdcdccdddd",
                   "cddddddddc",
                   "dcccdddddc",
                   "cdcccdldcc",
                   "ccccddcddc",
                   "cccc"
                   )

fullEvents <- read_csv(eventsCSV, col_types = coltypes)
```

Then I selected a few columns of interest, and added a couple more:

```
eventCols <- c("person",
               "time",
               "type",
               "mode",
               "legMode",
               "vehicleType",
               "vehicle",
               "arrivalTime",
               "departureTime",
               "departTime",
               "length",
               "numPassengers",
               "actType",
               "personalVehicleAvailable"
               )
fullEvents %<>% relocate(eventCols)

events <- fullEvents %>% select(eventCols)
events %<>% mutate(
  travelTime = arrivalTime - departureTime,
  avgSpeed = length / travelTime
)
events %<>% arrange(person, time)
```

TODO: I'm working on code to read in various information from the rhFleet file like shift duration, etc., but haven't done that yet. That info can be important for stats like utilization (passengers/hour/vehicle). For now, I just took the actual values:

```
rhHours <- 80000/3600 #add code to read from the file
rhNum <- 12
```

I also loaded some stats from UTA On Demand's monthly reports (the data is available in a pdf, I created the csv):

```
UTAOD <- read_csv("test/UTAODpilotinfo.csv")
UTAOD %>% my_flextable()
```

Month	Avg wkday ridership	Utilization	Avg wait time
DEC	224	1.33	9
JAN	334	2.00	11
FEB	392	2.31	12
MAR	316	1.88	11
APR	275	1.52	10
MAY	105	0.07	8
JUN	162	1.10	9
JUL	155	1.10	9
AUG	193	1.50	12
SEP	214	1.60	12
OCT	200	1.70	13
NOV	169	1.70	13

As a side note, I stored some person IDs that provide useful demonstrations:

```
personRH <- 1067049  #normal ridehail
personRH2 <- 730554   #rh2
personReplan <- 1060618  #rh replanning
personModefail <- 1023248 #mode isn't realised by end of simulation
```

Analysis

##Event Types

A good place to start is with the event types:

```
countEvents <- events %>%
  group_by(type) %>%
  summarize(n = n())
countEvents %>% my_flextable()
```

type	n
actend	80,348
actstart	80,163

type	n
arrival	80,163
departure	86,162
LeavingParkingEvent	68,019
ModeChoice	81,239
ParkingEvent	68,016
PathTraversal	536,014
PersonEntersVehicle	158,062
PersonLeavesVehicle	152,060
Replanning	890
ReserveRideHail	1,224

Many of these are self-explanatory, but here is what I've gathered so far:

- `actstart`/`actend` list the person, time, and type of event
- `arrival`/`departure` list the person, time, and "legmode"
  - `legmode` according to the BEAM documentation is the overall trip mode, either realized (`arrival`) or to be attempted (`departure`)
- `PersonEntersVehicle`/`PersonLeavesVehicle` lists the person, vehicle, and time
- `ReserveRideHail` just lists the person and time
- `ModeChoice` lists the person, time, mode desired, length (distance) of intended trip, and if a personal vehicle was available when the mode choice was made
- `Replanning` just lists the person and time; I believe this is triggered when the original mode choice didn't work for whatever reason, so the agent chooses a different mode (in a subsequent `ModeChoice` event)
- `PathTraversal` is an event for vehicles rather than for agents. It lists time, mode, vehicle type, vehicle, departure time, arrival time, length (distance), and number of passengers. It does not list the person IDs of the passengers, but may be useful for stats like average trip time. However, these events relate to *sub-legs* of the trip, rather than the overall trip.

We can see the mode choice distribution, as well as the legmode of `arrival` events:

```
modechoice <- events %>%
  filter(type == "ModeChoice") %>%
  group_by(mode) %>%
  summarize(n = n())

legMode <- events %>%
  filter(!is.na(legMode),
         type == "arrival") %>%
  group_by(legMode) %>%
  summarise(n = n())

modeComparison <- left_join(modechoice,
          legMode,
          by = c("mode" = "legMode")
```

```
        ) %>%
  `colnames<-`(c("mode", "modechoice", "legmode")) %>%
  mutate(
    replans = modechoice - legmode,
    replan_pct = replans / modechoice
  )
modeComparison %>% my_flextable(digits = 3)
```

mode	modechoice	legmode	replans	replan_pct
car	67,271	67,197	74	0.001
drive_transit	812	174	638	0.786
ride_hail	580	508	72	0.124
ride_hail_pooled	644	461	183	0.284
walk	10,513	10,404	109	0.010
walk_transit	1,419	1,419	0	0.000

Interestingly, the number of `Replanning` events is lower than the sum of the `replans` column above:

```
events %>%
  filter(type == "Replanning") %>%
  nrow()
```

```
## [1] 890
```

```
modeComparison$replans %>% sum()
```

```
## [1] 1076
```

As it turns out, some people have their day "cut short": they choose a mode but don't arrive at their next event by the end of the simulation:

```
events %>%
  filter(person == personModefail) %>%
  tail(n = 10)
```

```
## # A tibble: 10 x 16
##    person   time type           mode  legMode vehicleType vehicle    arrivalTime
##    <chr>   <dbl> <chr>          <chr> <chr>   <chr>       <chr>            <dbl>
##  1 1023248 80837 PersonEntersV~ <NA>  <NA>    <NA>        body-1023~          NA
##  2 1023248 80837 PersonEntersV~ <NA>  <NA>    <NA>        2587                NA
##  3 1023248 81392 PersonLeavesV~ <NA>  <NA>    <NA>        2587                NA
##  4 1023248 81455 PersonLeavesV~ <NA>  <NA>    <NA>        body-1023~          NA
##  5 1023248 81455 arrival        <NA>  car     <NA>        <NA>                NA
##  6 1023248 81455 actstart       <NA>  <NA>    <NA>        <NA>                NA
##  7 1023248 82218 ModeChoice     car   <NA>    <NA>        <NA>                NA
##  8 1023248 82218 actend         <NA>  <NA>    <NA>        <NA>                NA
```

```
##  9 1023248 82218 departure      <NA>  car     <NA>        <NA>                NA
## 10 1023248 82218 PersonEntersV~ <NA>  <NA>    <NA>        body-1023~          NA
## # ... with 8 more variables: departureTime <dbl>, departTime <dbl>,
## #   length <dbl>, numPassengers <dbl>, actType <chr>,
## #   personalVehicleAvailable <lgl>, travelTime <dbl>, avgSpeed <dbl>
```

##Ridehail Stats

We can look at some of the stats pertaining to ridehail vehicles:

```
rhPassengers <- events %>%
  filter(type == "PathTraversal",
         vehicleType == "micro"
         ) %>%
  select(numPassengers) %>%
  table() %>%
  as_tibble() %>%
  `colnames<-`(c("numPassengers", "n")) %>%
  mutate(pct = n / sum(n))
rhPassengers
```

```
## # A tibble: 3 x 3
##   numPassengers     n    pct
##   <chr>         <int>  <dbl>
## 1 0               918 0.476
## 2 1               972 0.504
## 3 2                39 0.0202
```

```
totRiders <- sum(as.integer(rhPassengers$numPassengers) * rhPassengers$n)
totRiders
```

```
## [1] 1050
```

```
utilization <- totRiders / rhHours / rhNum
utilization
```

```
## [1] 3.9375
```

We can also look at the average time between reserving a ridehail and the next event, whether that's entering the ridehail or replanning and choosing a different mode (note that times are given in minutes):

```
rhTimes <- events %>%
  arrange(person, time) %>%
  mutate(
    rhReserveTime = ifelse(
      type == "ReserveRideHail" & person == lead(person),
      lead(time) - time,
      NA
      ),
    rhReserveOutcome = ifelse(
      type == "ReserveRideHail" & person == lead(person),
      lead(type),
```

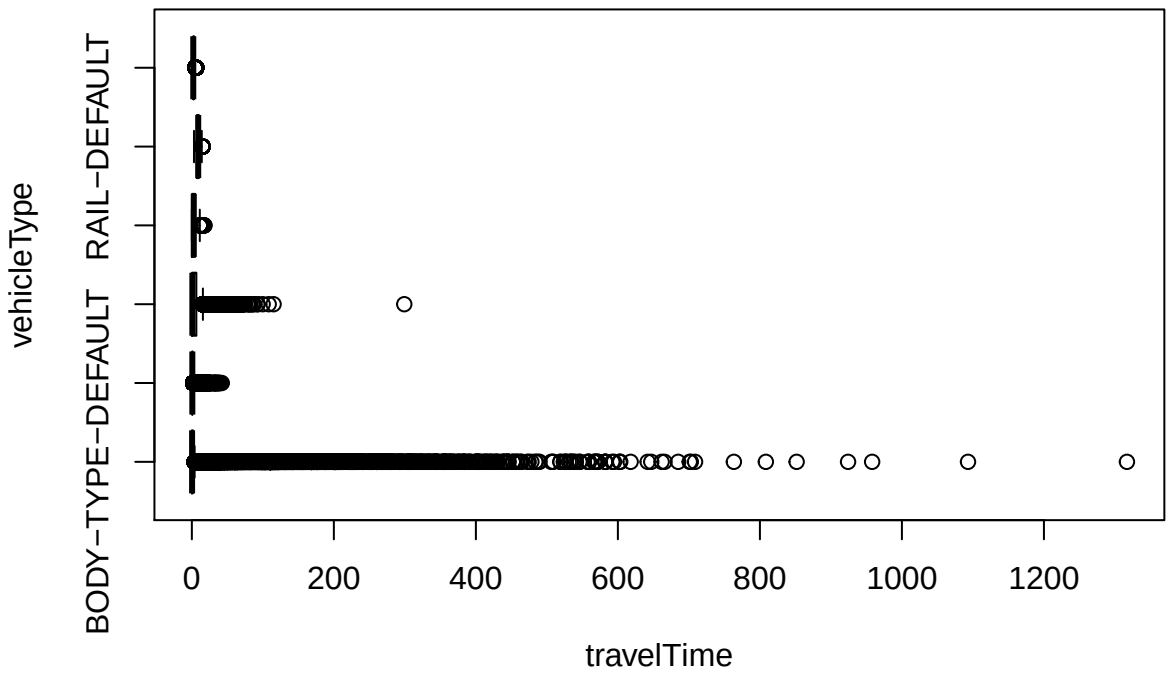
```
      NA
      )
  ) %>%
  filter(!is.na(rhReserveTime))

rhTimes %>%
  group_by(rhReserveOutcome) %>%
  summarise(
    mean = mean(rhReserveTime) / 60,
    median = median(rhReserveTime) /60,
    min = min(rhReserveTime) / 60,
    max = max(rhReserveTime) / 60
    ) %>%
  my_flextable()
```

rhReserveOutcome	mean	median	min	max
PersonEntersVehicle	5.78	5.60	0.25	16.98
Replanning	2.14	2.27	0.08	3.50

##Travel Times

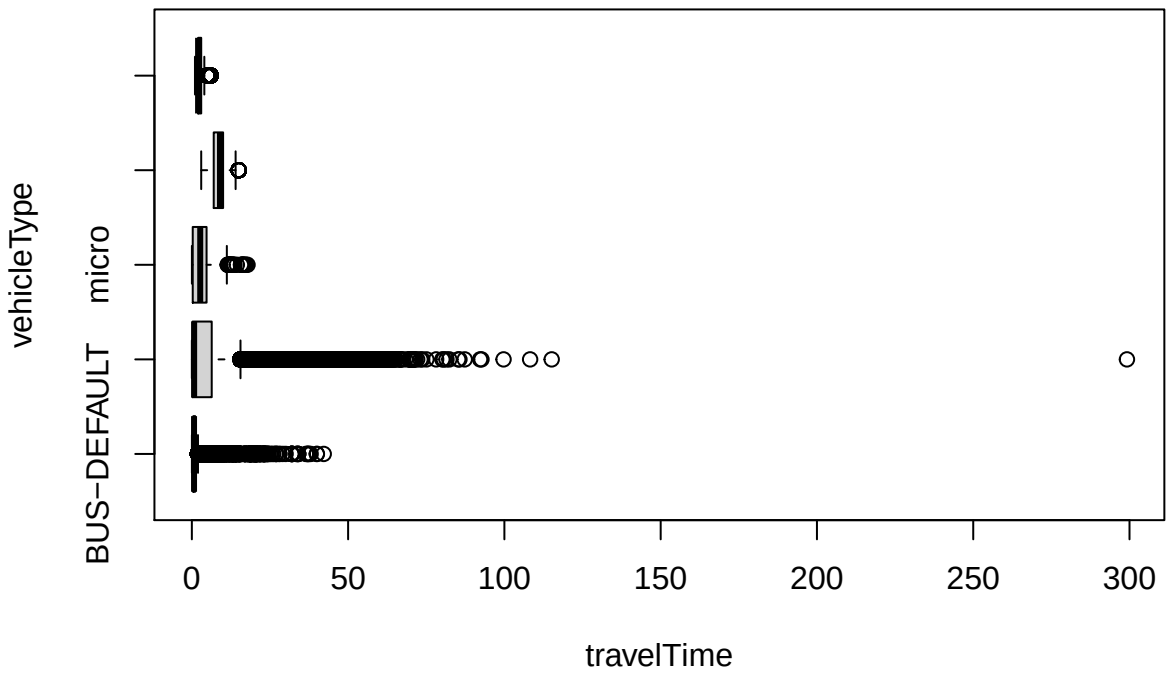
We can also look at travel times (again in minutes):

```
events %>%
  filter(!is.na(travelTime)) %>%
  mutate(travelTime = travelTime / 60) %>%
  group_by(vehicleType) %>%
  boxplot(travelTime ~ vehicleType,
          data = .,
          horizontal = T)
```

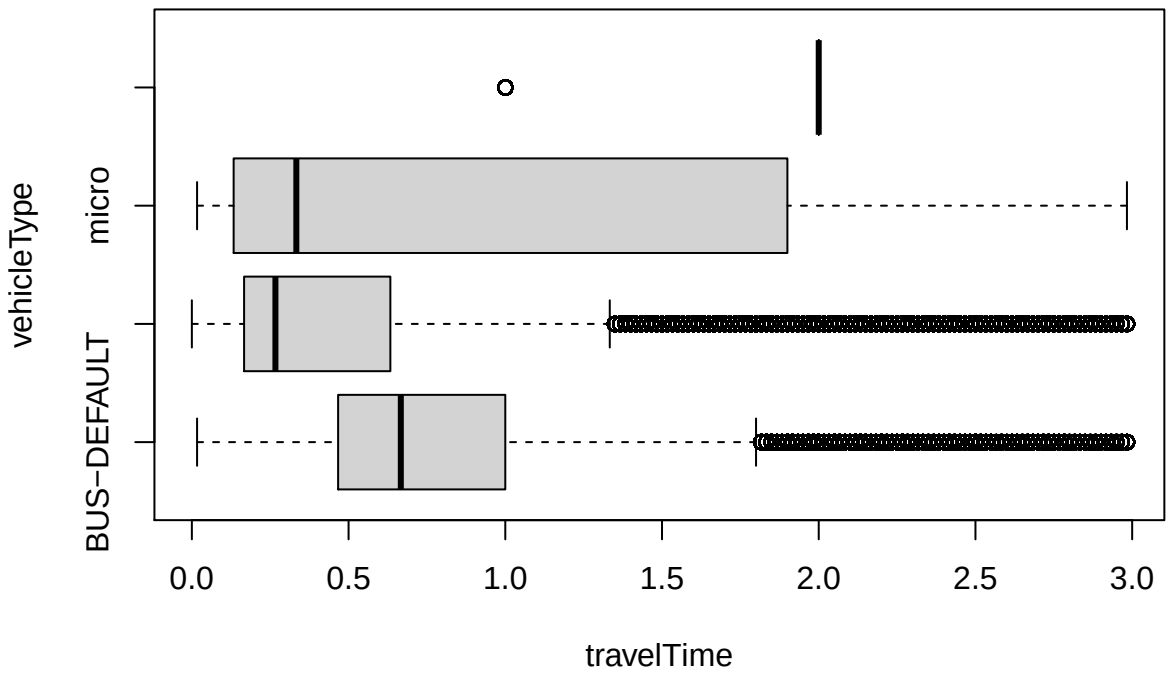


We may have some routing issues since it seems people are willing to walk upwards of 20 hours. However, we can still look at subsets of the data:

```
events %>%
  filter(!is.na(travelTime),
         !grepl("BODY", vehicleType)
         ) %>%
  mutate(travelTime = travelTime / 60) %>%
  group_by(vehicleType) %>%
  boxplot(travelTime ~ vehicleType,
          data = .,
          horizontal = T)
```




```
events %>%
  filter(!is.na(travelTime),
         !grepl("BODY", vehicleType),
         travelTime < 180
         ) %>%
  mutate(travelTime = travelTime / 60) %>%
  group_by(vehicleType) %>%
  boxplot(travelTime ~ vehicleType,
          data = .,
          horizontal = T)
```


vehicleType
micro
BUS−DEFAULT
0.0
0.5
1.0
1.5
2.0
2.5
3.0
travelTime