Algorithm

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Importing necessary packages/Libraries

```
invisible(library(dplyr))
invisible(library(lubridate))
invisible(library(caTools))
invisible(library(data.table))
invisible(library(rpart))
invisible(library(rpart.plot))
invisible(library(C50))
```

Generating the dataset

Data description:

- speed: Real-time speed of the bus in commute .
- dist_prev: The distance between the current bus and the previous bus on the same route.
- dist_next: The distance between the current bus and the next bus on the same route.
- crowd_curr: The number of passengers currently in the bus.
- crowd_next: The number of passengers in the next bus on the same route.
- schd_time: The scheduled arrival time specified for bus at previous stop on their route.
- arr_time: The actual arrival time of the bus at the previous stop on their route.
- on_time: Whether the bus arrived on time or not at the previous stop on their route.
- time_delay: The difference between the actual arrival time and the scheduled arrival time.

```
set.seed(1)
speed = round(rnorm(1000,50,15),2)
dist_prev = abs(round(rnorm(1000,2,1),2))
dist_next = abs(round(rnorm(1000,2,1),2))
crowd_curr = rpois(1000,25)
crowd_next = rpois(1000,25)
schd_time = sample(seq(strptime(’01/01/2018’,format = "%d/%m/%Y"),
                       strptime(’01/01/2019’,format = "%d/%m/%Y"),
                       by="hour"), 1000, replace = T)
arr_time = schd_time+(rnorm(1000,300,350)*-1)
on_time = ifelse(difftime(arr_time,schd_time)<=0,1,0)
time_delay = difftime(arr_time,schd_time)
data = data.frame(crowd_curr,crowd_next,
                  dist_prev, dist_next,speed,
                  schd_time,arr_time,on_time,time_delay)
head(select(data,crowd_curr,crowd_next,on_time))
```

```
##   crowd_curr crowd_next on_time
## 1         28         27       0
## 2         26         24       1
## 3         31         21       1
## 4         20         28       1
## 5         27         21       0
## 6         23         21       0
```

Generating an algorithm to label the datasets

Each record is considered as a bus and the label is the indication given to the bus driver whether to maintain speed, decrease speed, or to increase represented by 0,1,2 respectively

```
data = data %>% mutate(.,indicate = with(.,case_when(
  (dist_next<1.8 & dist_prev<1.8 & crowd_next<25 & crowd_curr<28) ~ 0,
  (dist_next<1.8 & dist_prev<1.8 & crowd_next<25 & crowd_curr>28) ~ 0,
  (dist_next<1.8 & dist_prev<1.8 & crowd_next>25 & crowd_curr<28) ~ 2,
  (dist_next<1.8 & dist_prev<1.8 & crowd_next>25 & crowd_curr>28) ~ 0,
  (dist_next<1.8 & dist_prev>1.8 & crowd_next<25 & crowd_curr<28) ~ 1,
  (dist_next<1.8 & dist_prev>1.8 & crowd_next<25 & crowd_curr>28) ~ 1,
  (dist_next<1.8 & dist_prev>1.8 & crowd_next>25 & crowd_curr<28) ~ 2,
  (dist_next<1.8 & dist_prev>1.8 & crowd_next>25 & crowd_curr>28) ~ 1,
  (dist_next>1.8 & dist_prev<1.8 & crowd_next<25 & crowd_curr<28) ~ 2,
  (dist_next>1.8 & dist_prev<1.8 & crowd_next<25 & crowd_curr>28) ~ 0,
  (dist_next>1.8 & dist_prev<1.8 & crowd_next>25 & crowd_curr<28) ~ 2,
  (dist_next>1.8 & dist_prev<1.8 & crowd_next>25 & crowd_curr>28) ~ 2,
  (dist_next>1.8 & dist_prev>1.8 & crowd_next<25 & crowd_curr<28) ~ 0,
  (dist_next>1.8 & dist_prev>1.8 & crowd_next<25 & crowd_curr>28) ~ 0,
  (dist_next>1.8 & dist_prev>1.8 & crowd_next>25 & crowd_curr<28) ~ 2,
  (dist_next>1.8 & dist_prev>1.8 & crowd_next>25 & crowd_curr>28) ~ 0,
)))

head(select(data,crowd_curr,on_time,indicate))
```

```
##   crowd_curr on_time indicate
## 1         28       0       NA
## 2         26       1        1
## 3         31       1        0
## 4         20       1        2
## 5         27       0        0
## 6         23       0        2
```

The table below indicates the indications that each of the bus instances receive

```
data$indicate = factor(data$indicate,levels=c(0,1,2),labels = c("Maintain Speed","Slow Down","Speed Up"
table(data$indicate)
```

```
##
## Maintain Speed      Slow Down       Speed Up
##            314            124            412
```

Thus we obtain the following observations from above table: Number of buses instructed to “Maintain Speed” : 314 Number of buses instructed to “Slow Down” : 123 Number of buses instructed to “Speed Up” : 412

Modelling a decision tree algorithm to make future scheduling

Splitting the data into train and test

```
set.seed(1)
split = sample.split(data$indicate, SplitRatio = 0.75)
train = data[split,]
test = data[!split,]
```

Creating a penalty matrix to avoid miscalculation

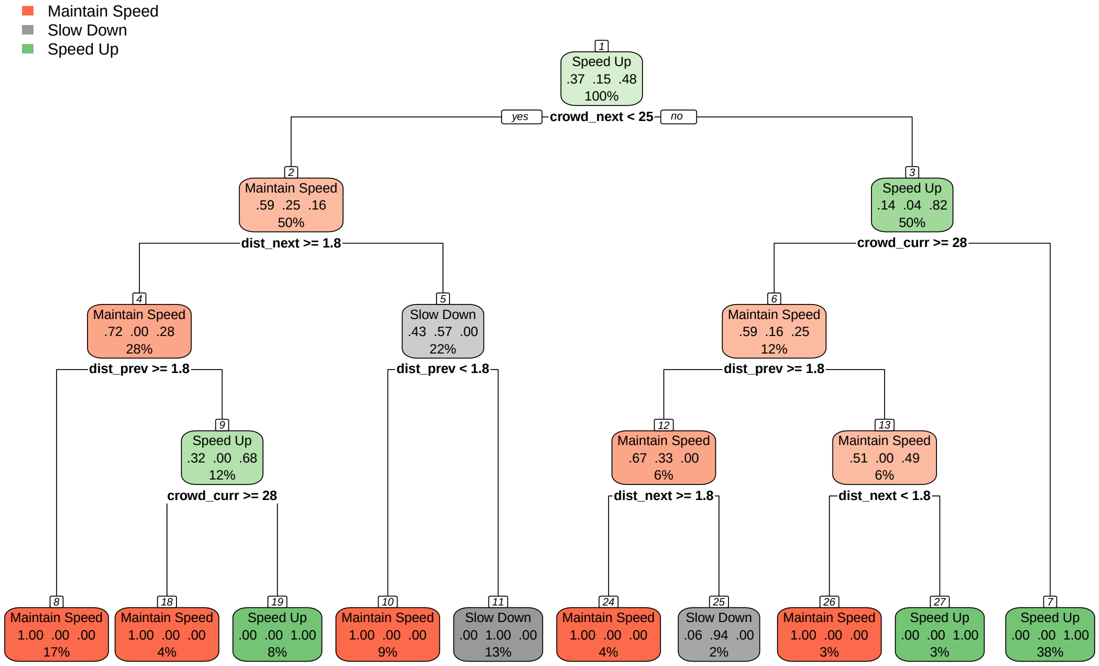
```
penalty.matrix <- matrix(c(1,1,0,10,0,10,0,0,0), byrow=TRUE, nrow=3)
```

Building the decision tree model with rpart

```
dtree <- rpart(indicate~.,data=data,method = "class")
```

Visualizing the decision tree

```
rpart.plot(dtree, nn=TRUE)
```



Maintain Speed
Slow Down
Speed Up
1
Speed Up
.37 .15 .48
100%
yes
crowd_next < 25
no
2
Maintain Speed
.59 .25 .16
50%
dist_next >= 1.8
3
Speed Up
.14 .04 .82
50%
crowd_curr >= 28
4
Maintain Speed
.72 .00 .28
28%
dist_prev >= 1.8
5
Slow Down
.43 .57 .00
22%
dist_prev < 1.8
6
Maintain Speed
.59 .16 .25
12%
dist_prev >= 1.8
9
Speed Up
.32 .00 .68
12%
crowd_curr >= 28
12
Maintain Speed
.67 .33 .00
6%
dist_next >= 1.8
13
Maintain Speed
.51 .00 .49
6%
dist_next < 1.8
8
Maintain Speed
1.00 .00 .00
17%
18
Maintain Speed
1.00 .00 .00
4%
19
Speed Up
.00 .00 1.00
8%
10
Maintain Speed
1.00 .00 .00
9%
11
Slow Down
.00 1.00 .00
13%
24
Maintain Speed
1.00 .00 .00
4%
25
Slow Down
.06 .94 .00
2%
26
Maintain Speed
1.00 .00 .00
3%
27
Speed Up
.00 .00 1.00
3%
7
Speed Up
.00 .00 1.00
38%