R Notebook

Analysis Challenge Assignment 2 Author: Guotai Sun

Build a classifier that can predict on or off-task behavior with the aca2_dataset_training.csv data.

My plans: 1.Pick my independent and dependent variables 2.Use linear regression, tree model, bayes prediction and logistic regression with my chosen variables from the training data set 3.Run model evaluation to calculate the accuracy based on the confusion matrix driven from the testing/validating data set 4.Pick my optimal model

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

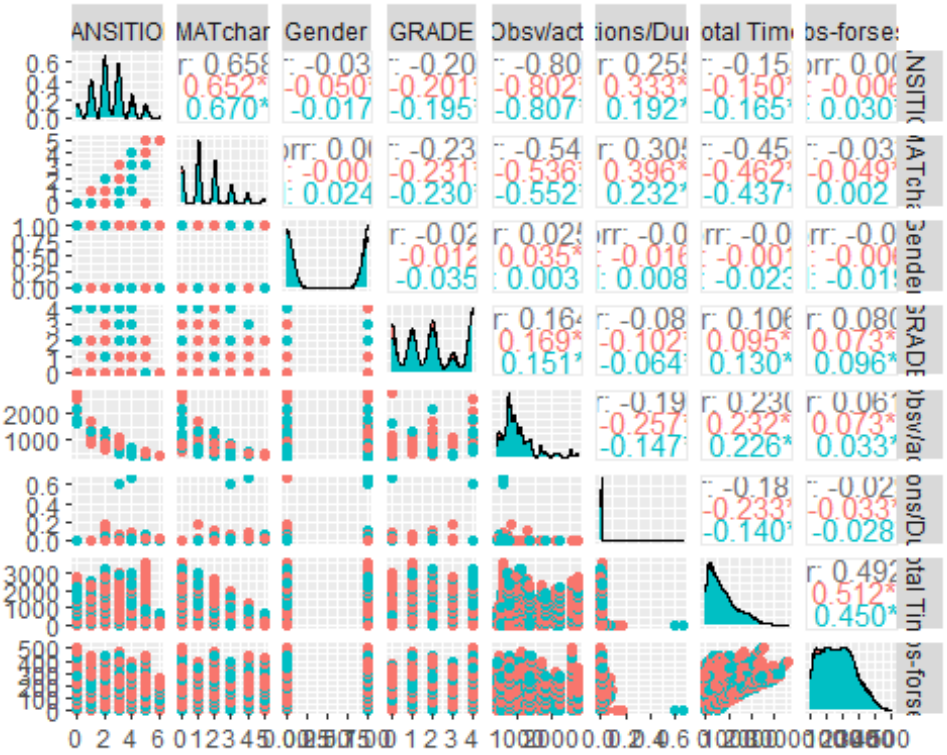
Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

```
library(tidyverse)

## Warning: package 'tidyverse' was built under R version 4.0.5

## -- Attaching packages ---------------------------------------
tidyverse 1.3.1 --

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.4     v dplyr   1.0.7
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1

## Warning: package 'ggplot2' was built under R version 4.0.5

## Warning: package 'tibble' was built under R version 4.0.5

## Warning: package 'tidyr' was built under R version 4.0.5

## Warning: package 'dplyr' was built under R version 4.0.5

## -- Conflicts ------------------------------------------
tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()

train <- read_csv("aca2_dataset_training.csv")

##
## -- Column specification --------------------------------------------
------------
## cols(
```

```
##   UNIQUEID = col_double(),
##   SCHOOL = col_character(),
##   Class = col_character(),
##   GRADE = col_double(),
##   CODER = col_character(),
##   STUDENTID = col_double(),
##   Gender = col_double(),
##   OBSNUM = col_double(),
##   `totalobs-forsession` = col_double(),
##   Activity = col_character(),
##   ONTASK = col_character(),
##   TRANSITIONS = col_double(),
##   NumACTIVITIES = col_double(),
##   FORMATchanges = col_double(),
##   NumFORMATS = col_double(),
##   `Obsv/act` = col_double(),
##   `Transitions/Durations` = col_double(),
##   `Total Time` = col_double()
## )

vali  <- read_csv("aca2_dataset_validation.csv")

##
## -- Column specification ----------------------------------------
------------
## cols(
##   UNIQUEID = col_double(),
##   SCHOOL = col_character(),
##   Class = col_character(),
##   GRADE = col_double(),
##   CODER = col_character(),
##   STUDENTID = col_double(),
##   Gender = col_double(),
##   OBSNUM = col_double(),
##   `totalobs-forsession` = col_double(),
##   Activity = col_character(),
##   ONTASK = col_character(),
##   TRANSITIONS = col_double(),
##   NumACTIVITIES = col_double(),
##   FORMATchanges = col_double(),
##   NumFORMATS = col_double(),
##   `Obsv/act` = col_double(),
##   `Transitions/Durations` = col_double(),
##   `Total Time` = col_double()
## )

train

## # A tibble: 22,184 x 18
##    UNIQUEID SCHOOL Class GRADE CODER STUDENTID Gender OBSNUM
`totalobs-forsessi~
```

```
##       <dbl> <chr>  <chr> <dbl> <chr>     <dbl>  <dbl>  <dbl>
<dbl>
##  1    14400 B      T9Q       0 Z        600865      0      1
1
##  2    14401 B      T9Q       0 Z        596466      0      1
1
##  3    14402 B      T9Q       0 Z        616590      0      1
2
##  4    14403 B      T9Q       0 Z        734358      1      1
3
##  5    14404 B      T9Q       0 Z        826308      1      1
4
##  6    14405 B      T9Q       0 Z        983650      0      1
5
##  7    14406 B      T9Q       0 Z        400753      1      1
6
##  8    14407 B      T9Q       0 Z        483575      1      1
7
##  9    14408 B      T9Q       0 Z        638337      0      1
8
## 10    14409 B      T9Q       0 Z        744115      1      1
9
## # ... with 22,174 more rows, and 9 more variables: Activity <chr>,
## #   ONTASK <chr>, TRANSITIONS <dbl>, NumACTIVITIES <dbl>,
FORMATchanges <dbl>,
## #   NumFORMATS <dbl>, Obsv/act <dbl>, Transitions/Durations <dbl>,
## #   Total Time <dbl>

table(train$ONTASK)

##
##     N     Y
##  7246 14938

summary(train)

##     UNIQUEID        SCHOOL             Class               GRADE
##  Min.   :14400   Length:22184       Length:22184       Min.   :0.000
##  1st Qu.:21277   Class :character   Class :character   1st Qu.:1.000
##  Median :28264   Mode  :character   Mode  :character   Median :2.000
##  Mean   :28257                                         Mean   :2.056
##  3rd Qu.:35231                                         3rd Qu.:4.000
##  Max.   :42130                                         Max.   :4.000
##     CODER             STUDENTID          Gender           OBSNUM
##  Length:22184       Min.   :  1123   Min.   :0.0000   Min.   : 1.000
##  Class :character   1st Qu.:264220   1st Qu.:0.0000   1st Qu.: 5.000
##  Mode  :character   Median :514301   Median :1.0000   Median : 9.000
##                     Mean   :506966   Mean   :0.5064   Mean   : 9.621
##                     3rd Qu.:743450   3rd Qu.:1.0000   3rd Qu.:14.000
##                     Max.   :999979   Max.   :1.0000   Max.   :32.000
##  totalobs-forsession   Activity            ONTASK
```

```
TRANSITIONS
##  Min.   :  1.0       Length:22184       Length:22184       Min.
:0.000
##  1st Qu.: 82.0       Class :character   Class :character   1st
Qu.:1.000
##  Median :165.0       Mode  :character   Mode  :character   Median
:2.000
##  Mean   :170.7                                             Mean
:2.383
##  3rd Qu.:248.0                                             3rd
Qu.:3.000
##  Max.   :511.0                                             Max.
:6.000
##  NumACTIVITIES   FORMATchanges     NumFORMATS       Obsv/act
##  Min.   :1.000   Min.   :0.000   Min.   :1.000   Min.   : 387.0
##  1st Qu.:2.000   1st Qu.:1.000   1st Qu.:2.000   1st Qu.: 721.2
##  Median :3.000   Median :1.000   Median :2.000   Median : 876.2
##  Mean   :3.383   Mean   :1.534   Mean   :2.534   Mean   : 973.5
##  3rd Qu.:4.000   3rd Qu.:2.000   3rd Qu.:3.000   3rd Qu.:1106.8
##  Max.   :7.000   Max.   :5.000   Max.   :6.000   Max.   :2735.0
##  Transitions/Durations   Total Time
##  Min.   :0.000000      Min.   :   0.0
##  1st Qu.:0.000839      1st Qu.: 252.0
##  Median :0.001513      Median : 586.5
##  Mean   :0.003159      Mean   : 774.6
##  3rd Qu.:0.003268      3rd Qu.:1121.0
##  Max.   :0.666667      Max.   :3554.0

trainD <- train %>% mutate(ONTASK_ON = as_factor(ONTASK))%>%
  select(ONTASK_ON,
TRANSITIONS,FORMATchanges,Gender,GRADE,`Obsv/act`,`Transitions/Duration
s`, `Total Time`,`totalobs-forsession` )

valiD <- vali %>% mutate(ONTASK_ON = as_factor(ONTASK))%>%
  select(ONTASK_ON,
TRANSITIONS,FORMATchanges,Gender,GRADE,`Obsv/act`,`Transitions/Duration
s`, `Total Time`,`totalobs-forsession` )

#install.packages("GGally")
library(GGally)

## Warning: package 'GGally' was built under R version 4.0.5

## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2

ggpairs(trainD, columns = 2:9, ggplot2::aes(colour=ONTASK_ON))
```

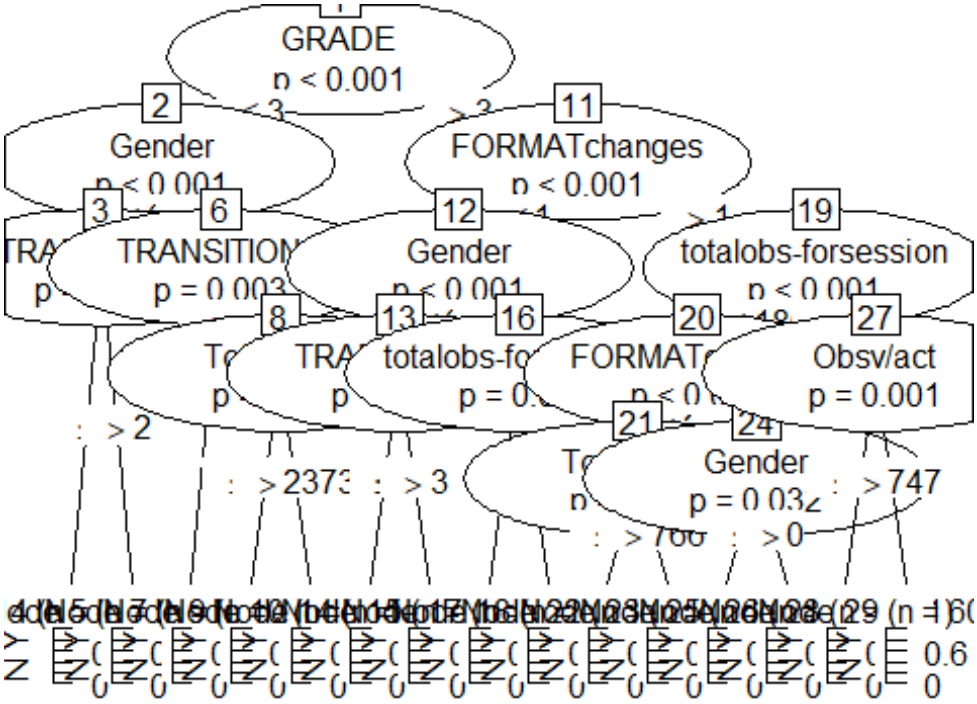



```
#Logistic Regression

logitModel <- glm(ONTASK_ON ~ TRANSITIONS + FORMATchanges + Gender +
GRADE + `Obsv/act`+`Transitions/Durations`+`Total Time`+`totalobs-
forsession` , data = trainD, family = "binomial")

summary(logitModel)

##
## Call:
## glm(formula = ONTASK_ON ~ TRANSITIONS + FORMATchanges + Gender +
##     GRADE + `Obsv/act` + `Transitions/Durations` + `Total Time` +
##     `totalobs-forsession`, family = "binomial", data = trainD)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.4169  -0.9095  -0.8432   1.4233   1.8014
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)               -2.487e-01  9.811e-02  -2.535  0.01125 *
## TRANSITIONS               -1.717e-01  2.201e-02  -7.804 6.00e-15 ***
## FORMATchanges              9.231e-02  1.886e-02   4.896 9.80e-07 ***
## Gender                    -2.026e-01  2.881e-02  -7.033 2.02e-12 ***
## GRADE                      6.936e-02  9.923e-03   6.990 2.75e-12 ***
## `Obsv/act`                -2.793e-04  5.479e-05  -5.098 3.44e-07 ***
## `Transitions/Durations`    1.910e+00  1.429e+00   1.337  0.18128
```

```
## `Total Time`              9.054e-05  3.015e-05   3.003  0.00267 **
## `totalobs-forsession`    -3.367e-04  1.629e-04  -2.067  0.03872 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 28030  on 22183  degrees of freedom
## Residual deviance: 27866  on 22175  degrees of freedom
## AIC: 27884
##
## Number of Fisher Scoring iterations: 4

#Decision Tree
library(party)

## Loading required package: grid

## Loading required package: mvtnorm

## Loading required package: modeltools

## Loading required package: stats4

## Loading required package: strucchange

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

## Loading required package: sandwich

##
## Attaching package: 'strucchange'

## The following object is masked from 'package:stringr':
##
##     boundary

trainTree <- ctree(
  ONTASK_ON ~ TRANSITIONS + FORMATchanges + Gender + GRADE +
`Obsv/act`+`Transitions/Durations`+`Total Time`+`totalobs-forsession`,
  data = trainD)

print(trainTree)

##
##   Conditional inference tree with 15 terminal nodes
```

```
##
## Response:  ONTASK_ON
## Inputs:  TRANSITIONS, FORMATchanges, Gender, GRADE, Obsv/act,
Transitions/Durations, Total Time, totalobs-forsession
## Number of observations:  22184
##
## 1) GRADE <= 3; criterion = 1, statistic = 53.869
##   2) Gender <= 0; criterion = 1, statistic = 25.407
##     3) TRANSITIONS <= 2; criterion = 0.994, statistic = 11.41
##       4)*  weights = 4166
##     3) TRANSITIONS > 2
##       5)*  weights = 3539
##   2) Gender > 0
##     6) TRANSITIONS <= 2; criterion = 0.997, statistic = 12.397
##       7)*  weights = 4304
##     6) TRANSITIONS > 2
##       8) Total Time <= 2373; criterion = 0.961, statistic = 7.917
##         9)*  weights = 3589
##       8) Total Time > 2373
##         10)*  weights = 129
## 1) GRADE > 3
##   11) FORMATchanges <= 1; criterion = 1, statistic = 38.192
##     12) Gender <= 0; criterion = 1, statistic = 33.411
##       13) TRANSITIONS <= 3; criterion = 1, statistic = 22.713
##         14)*  weights = 2023
##       13) TRANSITIONS > 3
##         15)*  weights = 377
##     12) Gender > 0
##       16) totalobs-forsession <= 59; criterion = 0.96, statistic =
7.847
##         17)*  weights = 359
##       16) totalobs-forsession > 59
##         18)*  weights = 1781
##   11) FORMATchanges > 1
##     19) totalobs-forsession <= 186; criterion = 1, statistic =
21.884
##       20) FORMATchanges <= 2; criterion = 1, statistic = 17.186
##         21) Total Time <= 766; criterion = 0.998, statistic = 13.426
##           22)*  weights = 604
##         21) Total Time > 766
##           23)*  weights = 151
##       20) FORMATchanges > 2
##         24) Gender <= 0; criterion = 0.968, statistic = 8.234
##           25)*  weights = 111
##         24) Gender > 0
##           26)*  weights = 187
##     19) totalobs-forsession > 186
##       27) Obsv/act <= 747; criterion = 0.999, statistic = 14.63
##         28)*  weights = 261
```

```
##       27) Obsv/act > 747
##         29)*  weights = 603

plot(trainTree)
```




```
ONTASK_pred_tree <- predict(trainTree, valiD[2:9])

treeCM <- table(valiD$ONTASK_ON,ONTASK_pred_tree)
treeCM

##    ONTASK_pred_tree
##        Y    N
##   Y 3613   85
##   N 1752   97

library(caret)

## Loading required package: lattice

##
## Attaching package: 'caret'

## The following object is masked from 'package:purrr':
##
##     lift

treeAccuracy <- confusionMatrix(treeCM)$overall["Accuracy"]
```

```
cat('The accuracy for the tree regression model is', treeAccuracy*100,
'%')

## The accuracy for the tree regression model is 66.883 %

#Naive Bayes
library(e1071)

trainNB <- naiveBayes(
  ONTASK_ON ~ TRANSITIONS + FORMATchanges + Gender + GRADE +
`Obsv/act`+`Transitions/Durations`+`Total Time`+`totalobs-forsession`,
  data = trainD)

ONTASK_pred_NB <- predict(trainNB, trainD[2:9])

performance = trainD$ ONTASK_ON == ONTASK_pred_NB
cat('The accuracy is', sum(performance)/length(performance)*100, '%')

## The accuracy is 66.43076 %
```

Add a new chunk by clicking the *Insert Chunk* button on the toolbar or by pressing *Ctrl+Alt+I*.

When you save the notebook, an HTML file containing the code and output will be saved alongside it (click the *Preview* button or press *Ctrl+Shift+K* to preview the HTML file).

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