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EY NextWave Data Science Challenge 2019

Local/Regional finalist, ranked top 10 in US, and regional finalist in China over 2936 participants.

Posted by Jiashu Miao on June 12, 2019

The EY NextWave Data Science Challenge 2019 focuses on how data can help the next smart city thrive, and boost the mobility of the future.

> *As a challenge participant, I downloaded a dataset with a vast number of anonymous geolocation records from the US city of Atlanta (Georgia), during October 2018. my task is to produce a model that helps understand the journeys of citizens while they move in the city throughout the day. When digging deep into the challenge, I find the work could inspire solutions that help cities anticipate disruptions, make real-time decisions, design new services, and reshape infrastructures in order to become a city as smart as their citizens.*

I have my team Wendy Huai (https://www.linkedin.com/in/zuxuan-huai-ab59b3101/), who is also from UCLA majoring stats.

Technically speaking, this is a predictive analysis that applied models to determine (binary classification) the response features based on other independent variables.

The evaluation standard is to check the accuracy score when applying the model (developed using training data) to the testing data and how well the model is built based on logic, run-time efficiency, generalization and space of tuning etc.

Here is an overview of the challenge:

- The variables in the dataset are as follows:

Variable Name	Type	Description
hash	String	Represents the unique identifier of a device
trajectory_id	String	Represents the unique identifier of a trajectory associated to a device
time_entry*	Date	Indicates the local time for the starting point of the trajectory (HH:mm:ss)
time_exit*	Date	Indicates the local time for the ending point of the trajectory (HH:mm:ss)
Vmax	Integer	Represents the maximum velocity registered in the course of a trajectory.
Vmin	Integer	Represents the minimum velocity registered in the course of a

		trajectory.
Vmean	Integer	Represents the average velocity registered in the course of a trajectory.
x_entry	Double	Entry x coordinate (cartesian projected position)
y_entry	Double	Entry y coordinate (cartesian projected position)
x_exit	Double	Exit x coordinate (cartesian projected position)
y_exit	Double	Exit y coordinate (cartesian projected position)

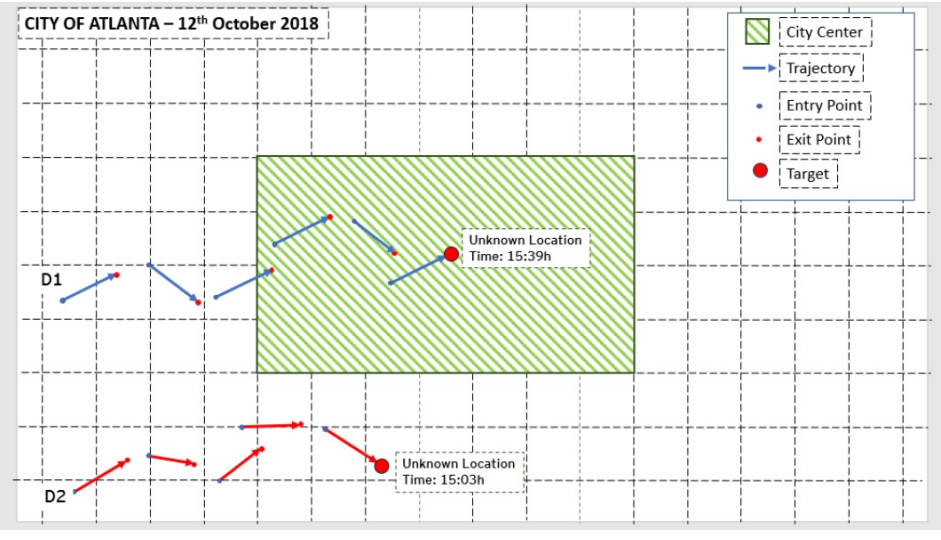
dimemsion: 67065 * 9

The challenge objective

> *I would like to predict how many people are in the city center between 15:00 and 16:00. The test dataset contains a number of devices where the trajectories after 15:00 have been removed. All but one: After 15:00, you will find one last trajectory, with (1) entry location, (2) entry time and an exit time that is between 15:00 and 16:00. But the exit point has been removed.*

My task is to predict the location of this last exit point and whether this device is within the city center or not. The target variable is the latter.

After I estimate the position of each target, I have to classify that point based on whether it is located inside the city center or not: See the graphic example below



The procedure

Overview – Exloration – Questioning – Data Inspection – Preprocessing (cleaning, imputation, manipulation, balancing, normalization, transformation ...) – Stratified Data Spliting – Feature Engineering – Modeling – Tuning – Validation (CV,kV, LOOCV ...) – Testing – Evaluation (AUC/ROC, ConfusionMatrix ...) – Re-tuning – Submission

There are 37 models I have built and featured using R and Python based on the running time and hands-on application during this competition, and they are (not limited to):

Model Name	-	-
Logistirc Regression	Naive Bayesian	Regression Trees & Baggings
kNN	SVM	Random Forest
Gradient Boosting	Ensembled Model	LDA/QDA

Sample submission

The submissions are csv files containing the information of trajectory_id with classfiation result 1/0 representing if the person is in city center or not.

Rankings

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- Top 10 in US with quite less intense amount of submissions:  ![](https://raw.githubuser
-  Ranking 11 in China region under name DEEDEE as local finalist ![](https://raw.githubu
```

Improvement

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 - we could improve the model with more advanced algorithms such as Generalized RF.
 - Imputate the missing values better
 - Balance the data distribution for some of the models
 - Create more variables given the 6* 67065 dimension, we can create more training featur
 - Conduct more cross validations.
```

Reference files:

EY DATA CHALLENGE (https://github.com/michaelmiaomiao/EYDATA)

Sample R code

```
 set.seed(16)
# n=use
new=n[sample(1:nrow(n),104268,replace = F),]
 # new=use
 train.index <- createDataPartition(new$target,p = .75, list = FALSE)
 new_train <- new[train.index,]
 new_test <- new[-train.index,]
set.seed(16)
ranger3 <- ranger(
    formula   = target ~ .,
    data      = new_train[,c(4,5,8,9,11,12,13,14,15,16,17)],
    num.trees = 500,
    mtry      = 8,
    sample.fraction = .55,
    min.node.size=5,
    importance = "impurity"
  )
rangepre3 <- predict(ranger3,new_test[,c(4,5,8,9,11,12,13,14,15,16,17)],type = "response"
pre3 <- ifelse(rangepre3$predictions>0.5,1,0)
errorrange3 <- mean(pre3!=new_test$target)
cat(1-errorrange3,"\n")

last <- read.csv("reallyuseuse.csv")
n=NULL
n=last
```

```
set.seed(71)

train.indexkk <- createDataPartition(new$target, p = .75, list = FALSE)
new_train <- new[train.indexkk, ]
new_test <- new[-train.indexkk, ]
features_train <- as.matrix(new_train[,c(3,4,5,6,22:33)])
response_train <- as.matrix(new_train[,9])
# names(new)
features_test <- as.matrix(new_test[,c(3,4,5,6,22:33)])
response_test <- as.matrix(new_test[,9])
# parameter list
params <- list(
  eta = .1,
    max_depth = 5,
    min_child_weight = 2,
    subsample = .8,
    colsample_bytree = .9
)
 set.seed(31)
# train final model
xgb.fit.final2 <- xgboost(
  params = params,
  data = features_train,
  label = response_train,
  nrounds = 410,
  objective = "reg:linear",
  verbose = 0
)
gbpre <- predict(xgb.fit.final2,features_test)
 gbpre <- ifelse(gbpre>0.5,1,0)
table(gbpre)
ggerror <- mean(gbpre!=response_test)
cat(1-ggerror)
```

> *Jiashu Miao June 18th 2019 :)*

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