# KSI Project

Group 7

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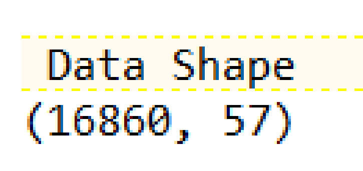
# Objective

- Main objective of this project is to predict the condition which is responsible for a fatal accident
- There are various types of features present in the dataset like the physical and environmental condition of the accident location, geometric coordinate, collision vehicle, driver condition, time of day, and many more which can play an important role in defending the probability of survival

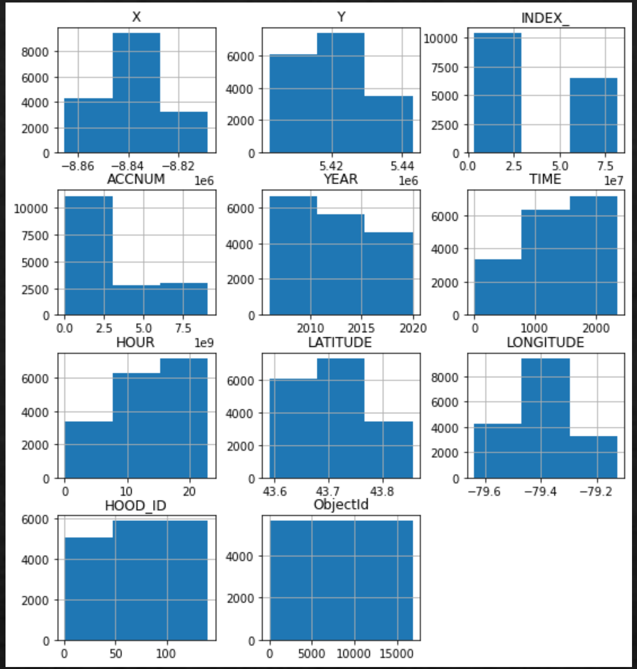
# Data modeling

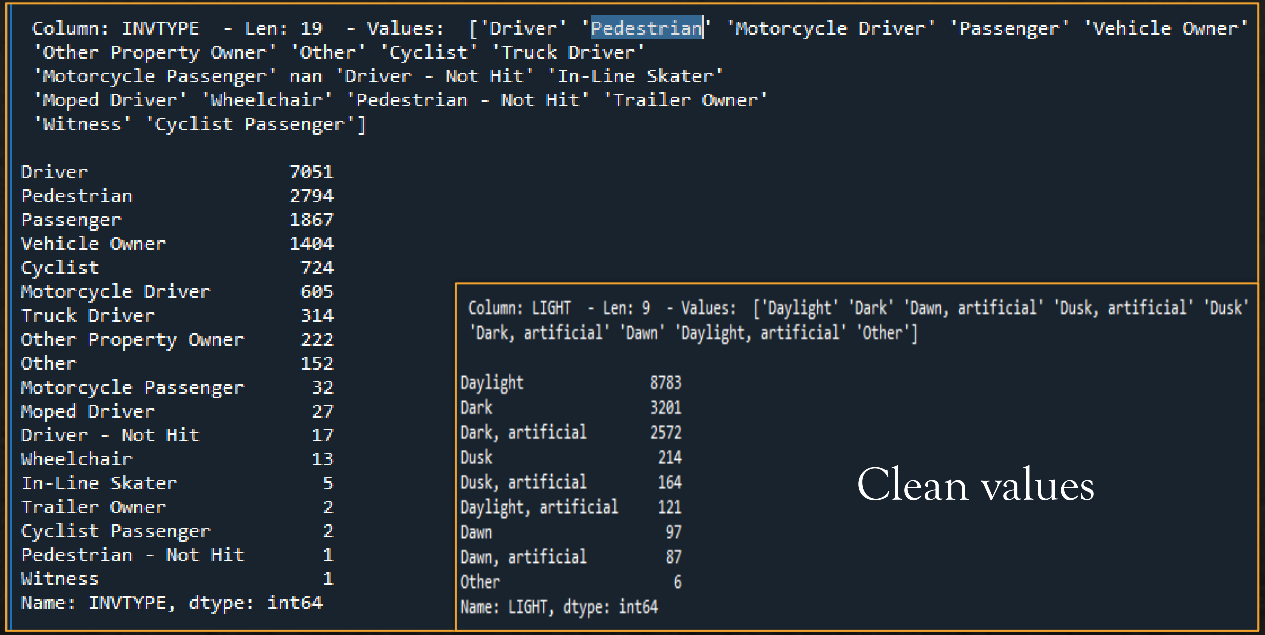
- We check for Null values
- We have checked the data set if it’s balanced and found it to be highly imbalanced
- We’ve extracted the months and years from the date to find seasonal trends
- Removed duplicate columns like neighborhood and Division
- We’ve assumed that columns with very few values will not affect our model much
- They were too many classes in some columns which were grouped to improve performance

# Data Exploration Features



```
Data Shape
(16860, 57)
```





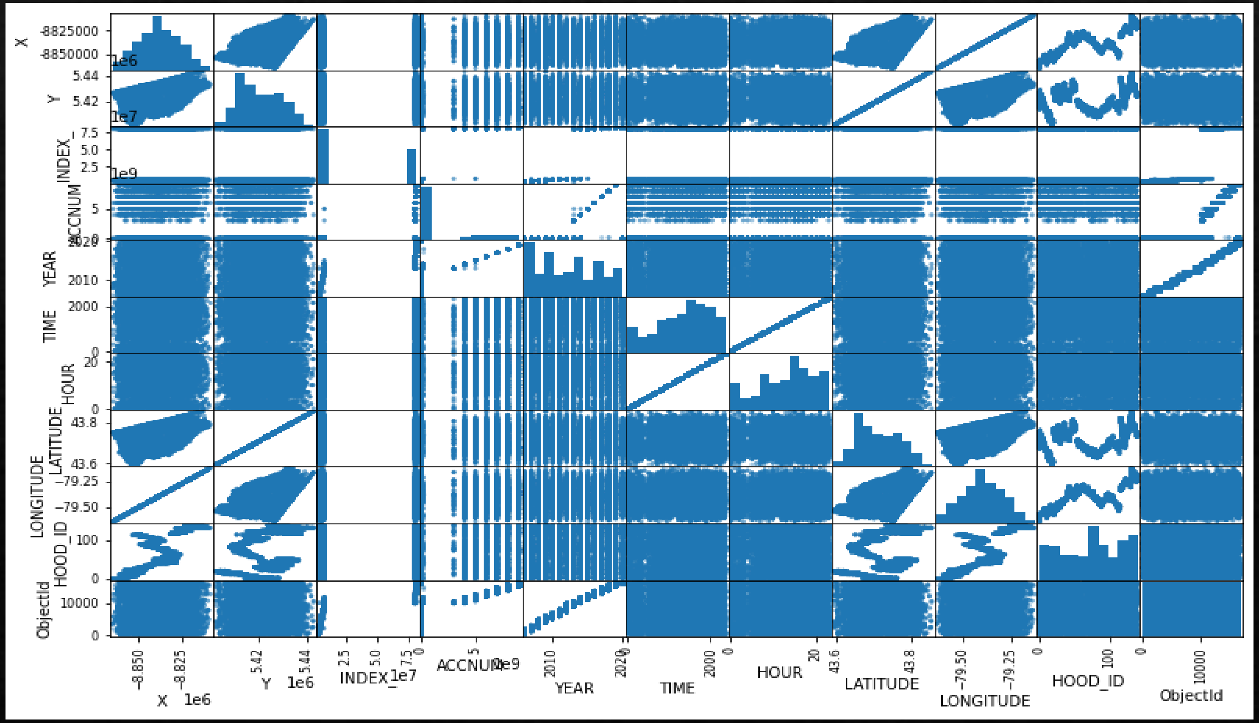
```
Column: INVTYPE  - Len: 19  - Values:  ['Driver' 'Pedestrian' 'Motorcycle Driver' 'Passenger' 'Vehicle Owner'
 'Other Property Owner' 'Other' 'Cyclist' 'Truck Driver'
 'Motorcycle Passenger' nan 'Driver - Not Hit' 'In-Line Skater'
 'Moped Driver' 'Wheelchair' 'Pedestrian - Not Hit' 'Trailer Owner'
 'Witness' 'Cyclist Passenger']

Driver                   7051
Pedestrian               2794
Passenger                1867
Vehicle Owner            1404
Cyclist                   724
Motorcycle Driver         605
Truck Driver              314
Other Property Owner      222
Other                     152
Motorcycle Passenger       32
Moped Driver               27
Driver - Not Hit           17
Wheelchair                 13
In-Line Skater              5
Trailer Owner               2
Cyclist Passenger           2
Pedestrian - Not Hit        1
Witness                     1
Name: INVTYPE, dtype: int64
```

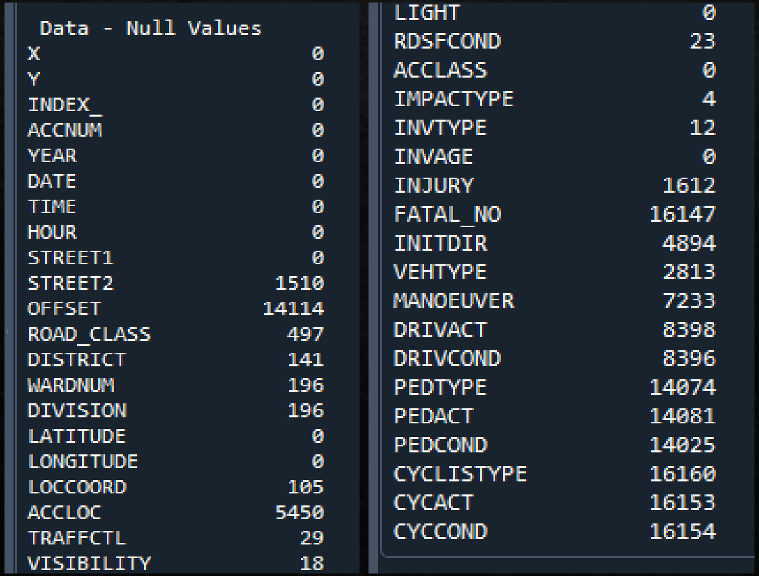
```
Column: LIGHT  - Len: 9  - Values:  ['Daylight' 'Dark' 'Dawn, artificial' 'Dusk, artificial' 'Dusk'
 'Dark, artificial' 'Dawn' 'Daylight, artificial' 'Other']

Daylight                8783
Dark                    3201
Dark, artificial        2572
Dusk                     214
Dusk, artificial         164
Daylight, artificial     121
Dawn                      97
Dawn, artificial          87
Other                      6
Name: LIGHT, dtype: int64
```

Clean values



## Null Values



```
 Data - Null Values
X                   0
Y                   0
INDEX_              0
ACCNUM              0
YEAR                0
DATE                0
TIME                0
HOUR                0
STREET1             0
STREET2          1510
OFFSET          14114
ROAD_CLASS        497
DISTRICT          141
WARDNUM           196
DIVISION          196
LATITUDE            0
LONGITUDE           0
LOCCOORD          105
ACCLOC           5450
TRAFFCTL           29
VISIBILITY         18
```

```
LIGHT               0
RDSFCOND           23
ACCLASS             0
IMPACTYPE           4
INVTYPE            12
INVAGE              0
INJURY           1612
FATAL_NO        16147
INITDIR          4894
VEHTYPE          2813
MANOEUVER        7233
DRIVACT          8398
DRIVCOND         8396
PEDTYPE         14074
PEDACT          14081
PEDCOND         14025
CYCLISTYPE      16160
CYCACT          16153
CYCCOND         16154
```

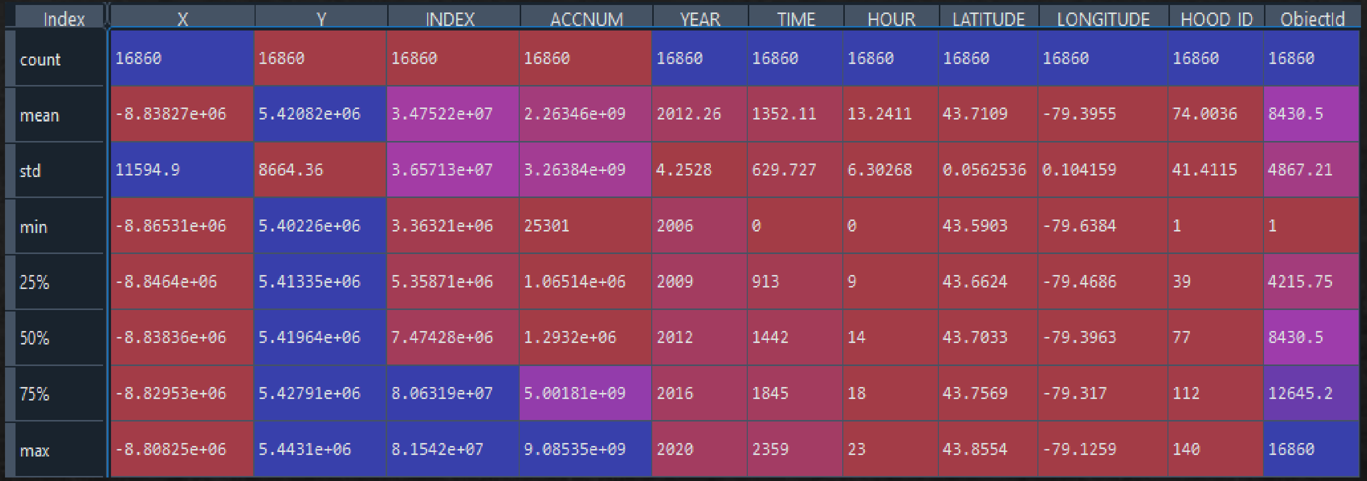
## Plots

Distribution with Histograms

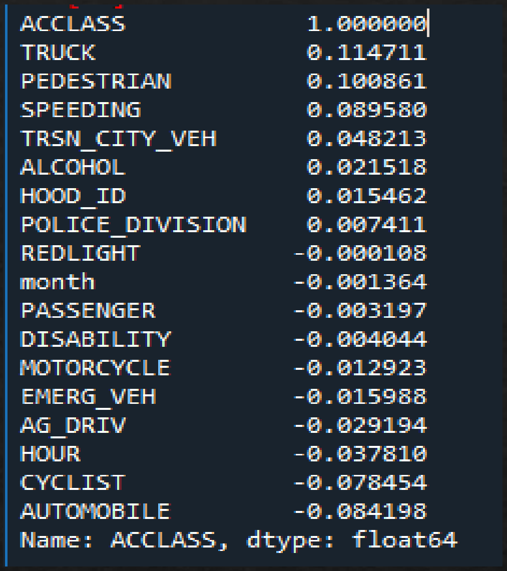
Correlation with Scatter Plot

# Data Exploration Features

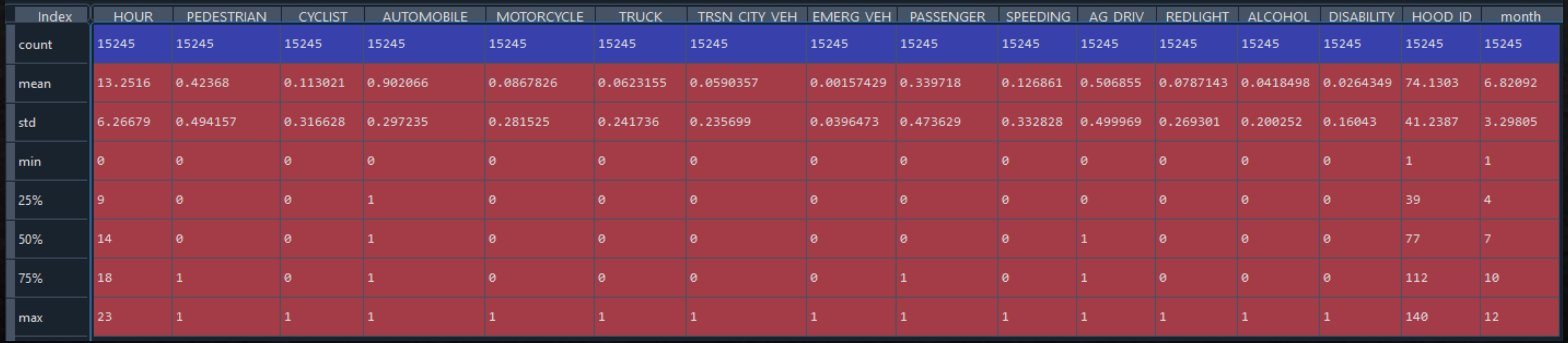
## Stats to analyze mean, standard deviation



| Index | X | Y | INDEX | ACCNUM | YEAR | TIME | HOUR | LATITUDE | LONGITUDE | HOOD ID | ObjectId |
|---|---|---|---|---|---|---|---|---|---|---|---|
| count | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 | 16860 |
| mean | -8.83827e+06 | 5.42082e+06 | 3.47522e+07 | 2.26346e+09 | 2012.26 | 1352.11 | 13.2411 | 43.7109 | -79.3955 | 74.0036 | 8430.5 |
| std | 11594.9 | 8664.36 | 3.65713e+07 | 3.26384e+09 | 4.2528 | 629.727 | 6.30268 | 0.0562536 | 0.104159 | 41.4115 | 4867.21 |
| min | -8.86531e+06 | 5.40226e+06 | 3.36321e+06 | 25301 | 2006 | 0 | 0 | 43.5903 | -79.6384 | 1 | 1 |
| 25% | -8.8464e+06 | 5.41335e+06 | 5.35871e+06 | 1.06514e+06 | 2009 | 913 | 9 | 43.6624 | -79.4686 | 39 | 4215.75 |
| 50% | -8.83836e+06 | 5.41964e+06 | 7.47428e+06 | 1.2932e+06 | 2012 | 1442 | 14 | 43.7033 | -79.3963 | 77 | 8430.5 |
| 75% | -8.82953e+06 | 5.42791e+06 | 8.06319e+07 | 5.00181e+09 | 2016 | 1845 | 18 | 43.7569 | -79.317 | 112 | 12645.2 |
| max | -8.80825e+06 | 5.4431e+06 | 8.1542e+07 | 9.08535e+09 | 2020 | 2359 | 23 | 43.8554 | -79.1259 | 140 | 16860 |

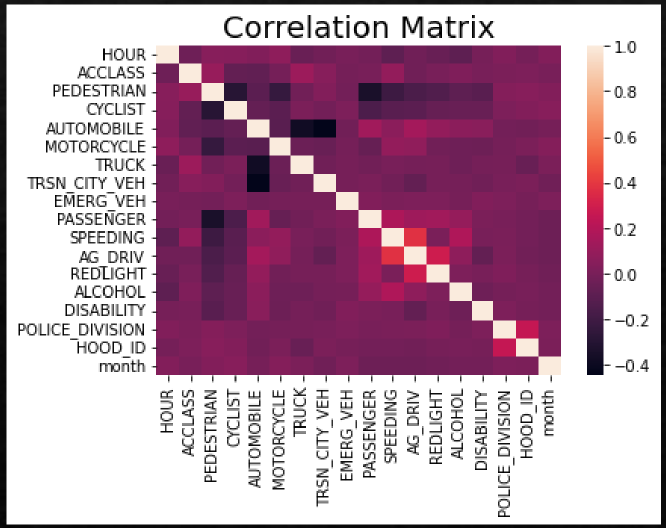


```
ACCLASS               1.000000
TRUCK                 0.114711
PEDESTRIAN            0.100861
SPEEDING              0.089580
TRSN_CITY_VEH         0.048213
ALCOHOL               0.021518
HOOD_ID               0.015462
POLICE_DIVISION       0.007411
REDLIGHT             -0.000108
month                -0.001364
PASSENGER            -0.003197
DISABILITY           -0.004044
MOTORCYCLE           -0.012923
EMERG_VEH            -0.015988
AG_DRIV              -0.029194
HOUR                 -0.037810
CYCLIST              -0.078454
AUTOMOBILE           -0.084198
Name: ACCLASS, dtype: float64
```

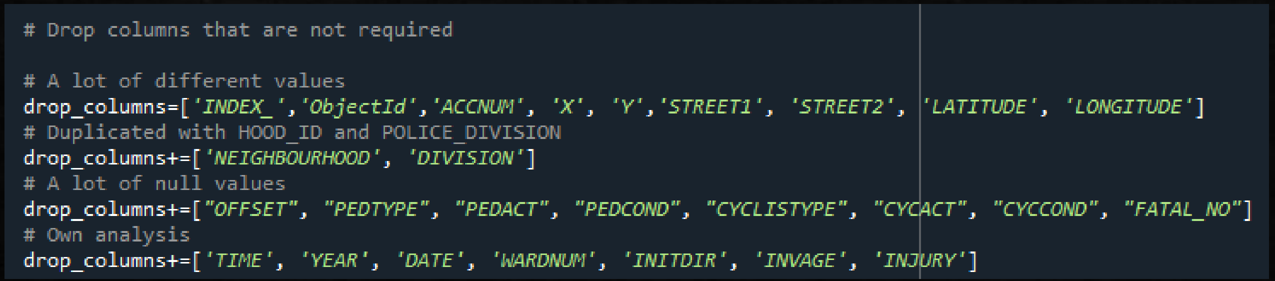


| Index | HOUR | PEDESTRIAN | CYCLIST | AUTOMOBILE | MOTORCYCLE | TRUCK | TRSN CITY VEH | EMERG VEH | PASSENGER | SPEEDING | AG DRIV | REDLIGHT | ALCOHOL | DISABILITY | HOOD ID | month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| count | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 | 15245 |
| mean | 13.2516 | 0.42368 | 0.113021 | 0.902066 | 0.0867826 | 0.0623155 | 0.0590357 | 0.00157429 | 0.339718 | 0.126861 | 0.506855 | 0.0787143 | 0.0418498 | 0.0264349 | 74.1303 | 6.82092 |
| std | 6.26679 | 0.494157 | 0.316628 | 0.297235 | 0.281525 | 0.241736 | 0.235699 | 0.0396473 | 0.473629 | 0.332828 | 0.499969 | 0.269301 | 0.200252 | 0.16043 | 41.2387 | 3.29805 |
| min | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 25% | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 4 |
| 50% | 14 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 77 | 7 |
| 75% | 18 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 112 | 10 |
| max | 23 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 140 | 12 |

## Correlation with ACCLASS



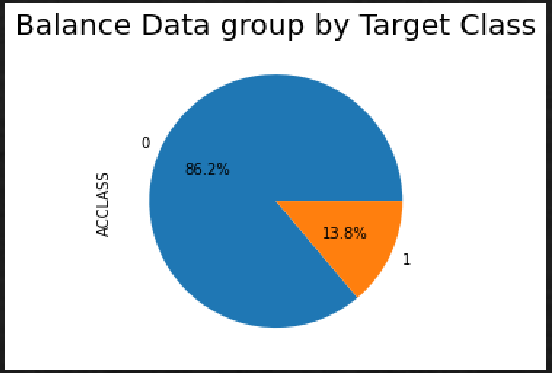
## We drop those columns, and finally we worked with 28 features

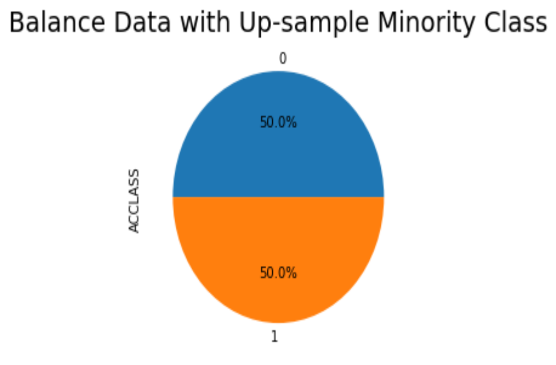


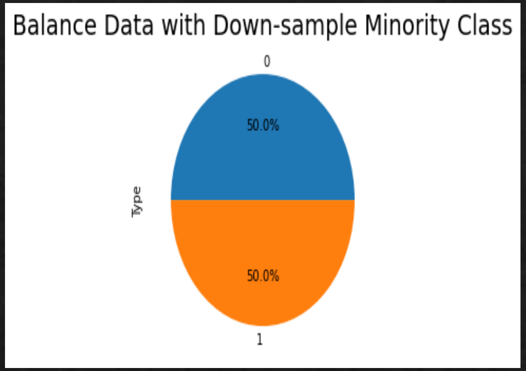
```
# Drop columns that are not required

# A lot of different values
drop_columns=['INDEX_','ObjectId','ACCNUM', 'X', 'Y','STREET1', 'STREET2', 'LATITUDE', 'LONGITUDE']
# Duplicated with HOOD_ID and POLICE_DIVISION
drop_columns+=['NEIGHBOURHOOD', 'DIVISION']
# A lot of null values
drop_columns+=["OFFSET", "PEDTYPE", "PEDACT", "PEDCOND", "CYCLISTYPE", "CYCACT", "CYCCOND", "FATAL_NO"]
# Own analysis
drop_columns+=['TIME', 'YEAR', 'DATE', 'WARDNUM', 'INITDIR', 'INVAGE', 'INJURY']
```

# Imbalanced Data


Balance Data group by Target Class

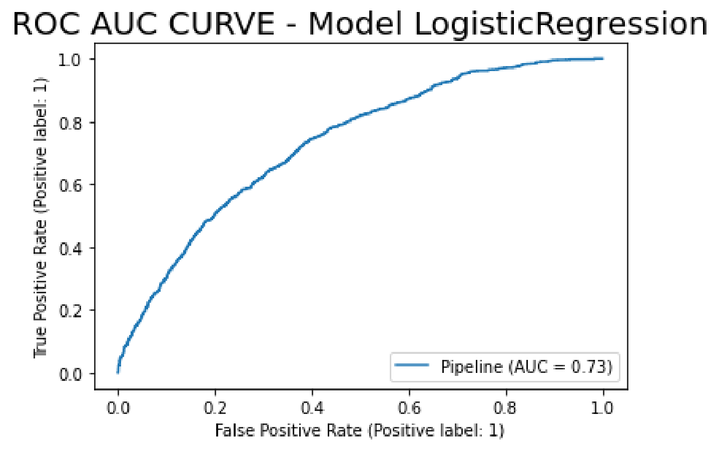

Balance Data with Up-sample Minority Class

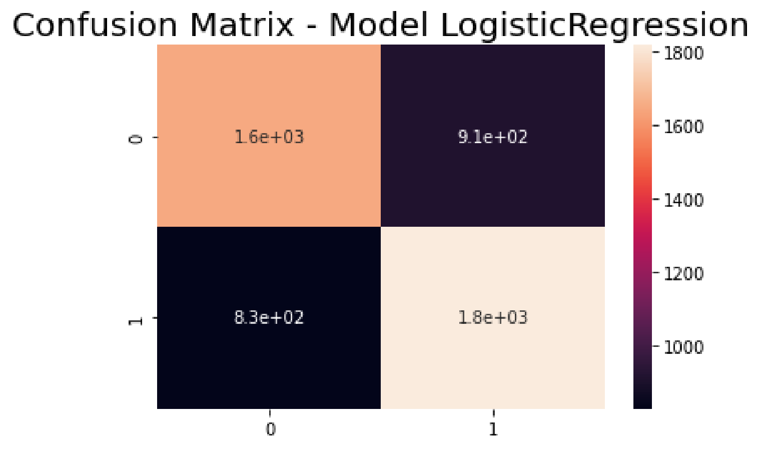

Balance Data with Down-sample Minority Class

| Logistic Regression Model | Imbalanced Data | Balanced with up-sample minority | Balanced with down-sample minority |
|---|---|---|---|
| Accuracy | 0.8646377770426729 | 0.6719781907541085 | 0.6731963688485427 |
| Precision | 0.05207835642618251 | 0.6896022116418369 | 0.6779741997133302 |
| Recall | 0.6374269005847953 | 0.6661226911950152 | 0.6715570279223853 |
| ROC AUC | 0.7523322939754811 | 0.6721921264619507 | 0.6732121849693933 |
| ACCLASS – VALUE 0 | 13022 | 13022 | 2093 |
| ACCLASS – VALUE 1 | 2093 | 13022 | 2093 |

# Logistic regression

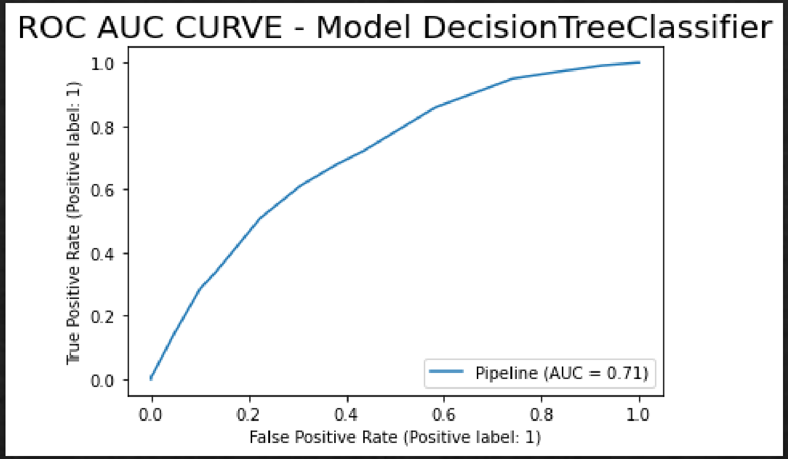
- Test Precision: 0.6658116526200073
- Test Recall: 0.6864374763883642
- Test F1 Score: 0.6759672619047619
- Test ROC AUC Score: 0.6652327897164303
- Test Accuracy Score:  0.6655788059128431

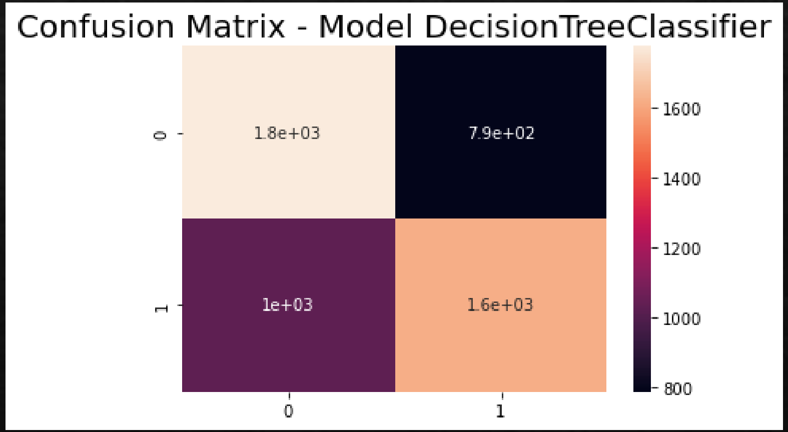




# Decision tree classifier

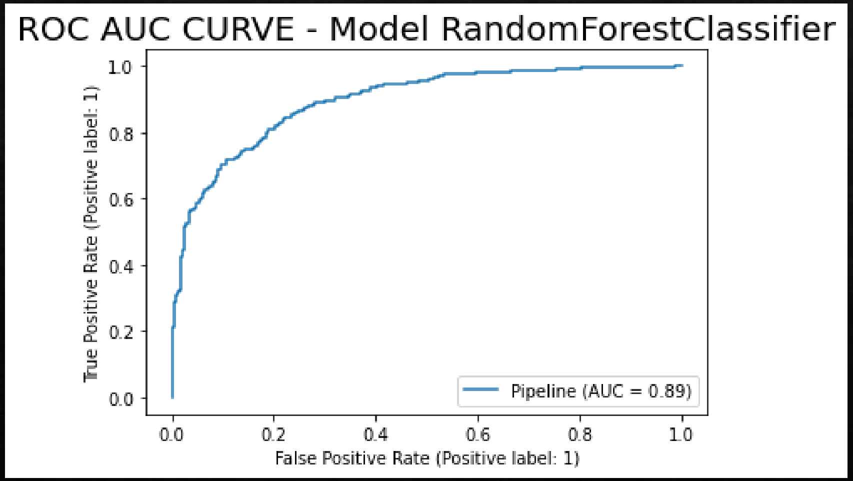
- Test Precision: 0.6730369754881596
- Test Recall: 0.612013600302229
- Test F1 Score: 0.6410763751483973
- Test ROC AUC Score: 0.6524158555765633
- Test Accuracy Score:  0.6517565751583797

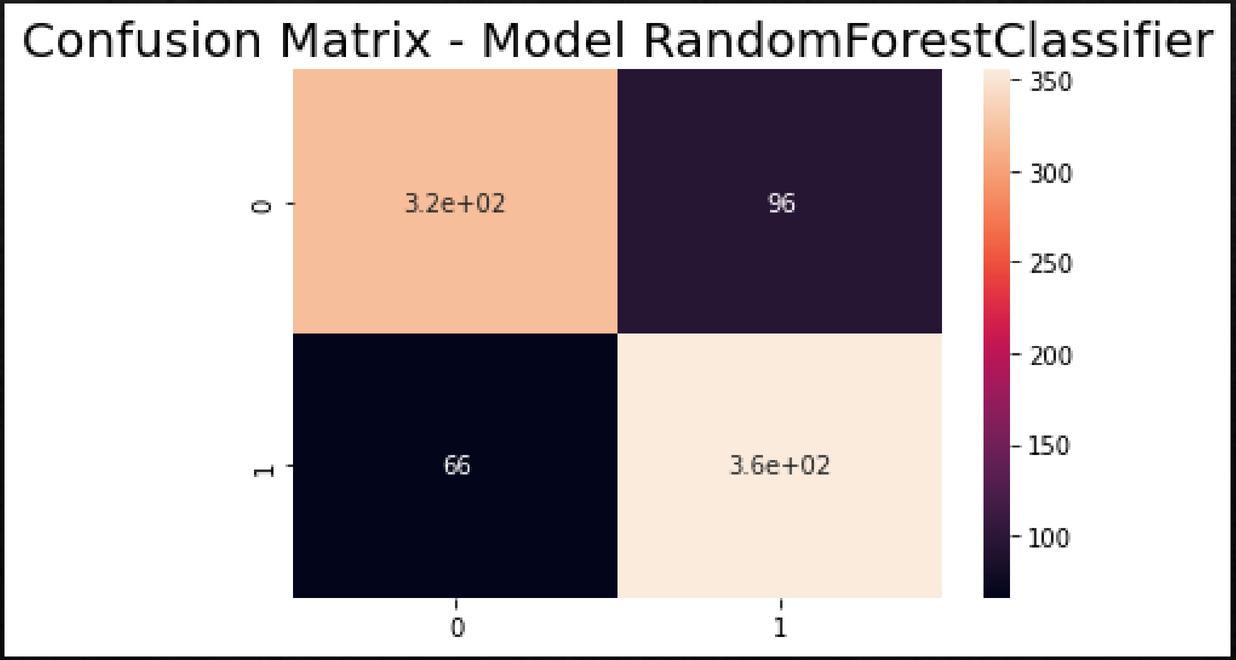




# Random forest classifier

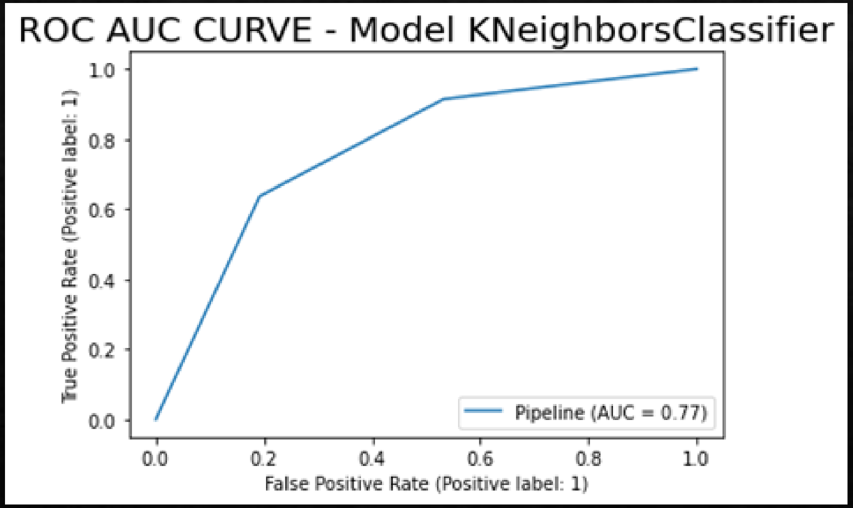
- Test Precision: 0.7871396895787139
- Test Recall: 0.8432304038004751
- Test F1 Score: 0.8142201834862386
- Test ROC AUC Score: 0.8065072882311728
- Test Accuracy Score: 0.8066825775656324

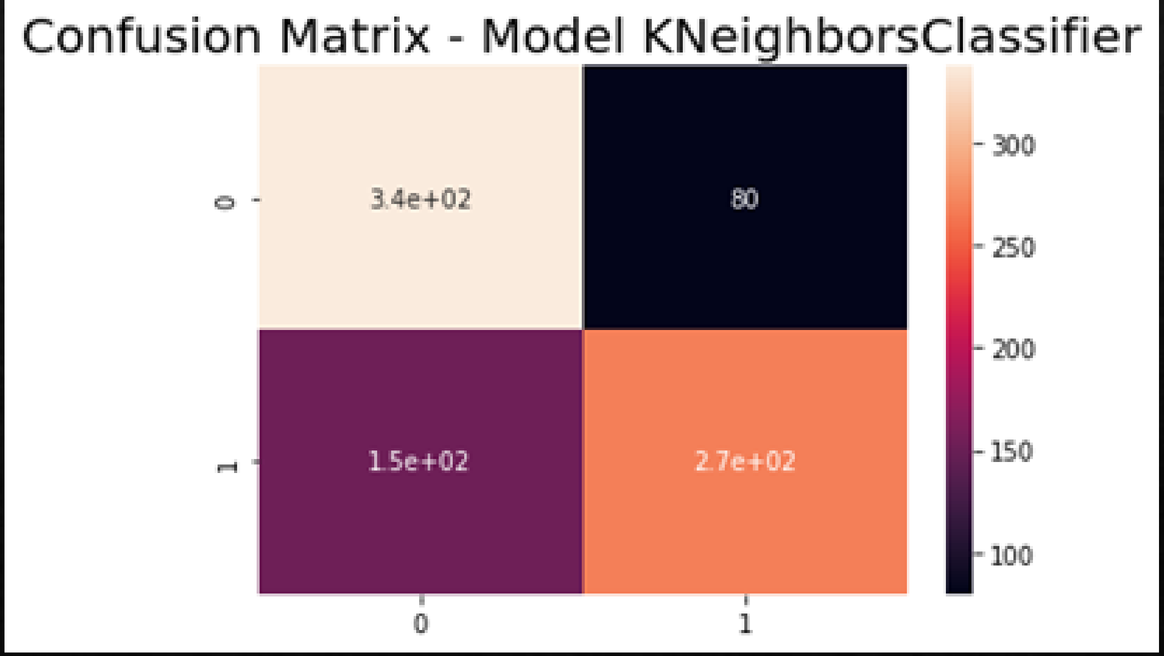




# K Neighbors Classifier

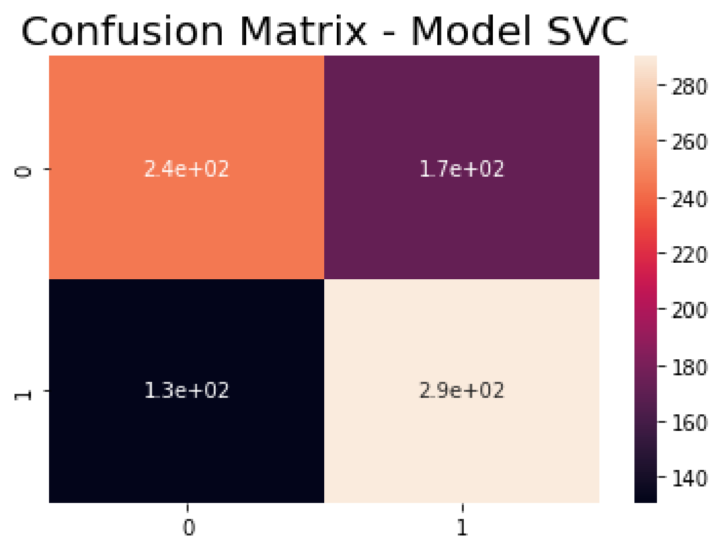
- Test Precision: 0.7701149425287356
- Test Recall: 0.6365795724465558
- Test F1 Score: 0.6970091027308193
- Test ROC AUC Score: 0.7223665248323906
- Test Accuracy Score: 0.7219570405727923

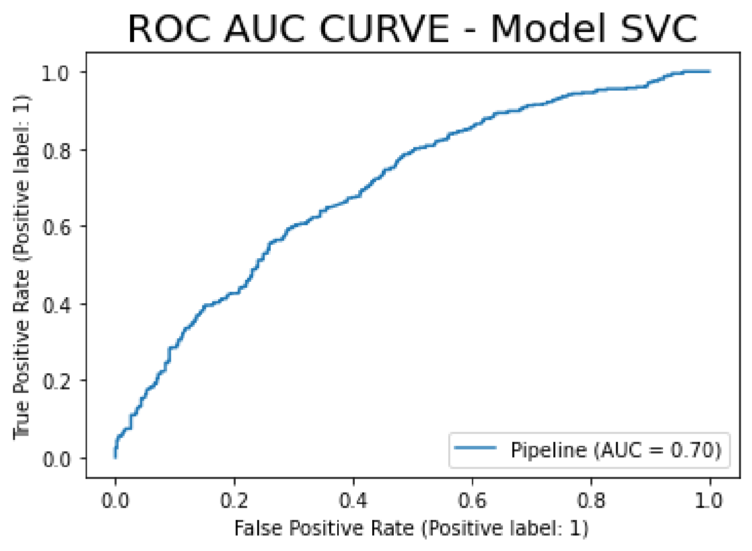




# SVM

- Test Precision: 0.6277056277056277
- Test Recall: 0.6888361045130641
- Test F1 Score: 0.6568516421291052
- Test ROC AUC Score: 0.6381830402661244
- Test Accuracy Score: 0.6384248210023866


Confusion Matrix - Model SVC

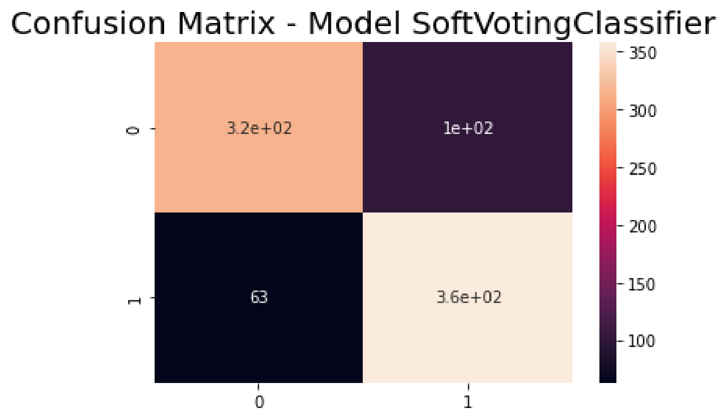

ROC AUC CURVE - Model SVC

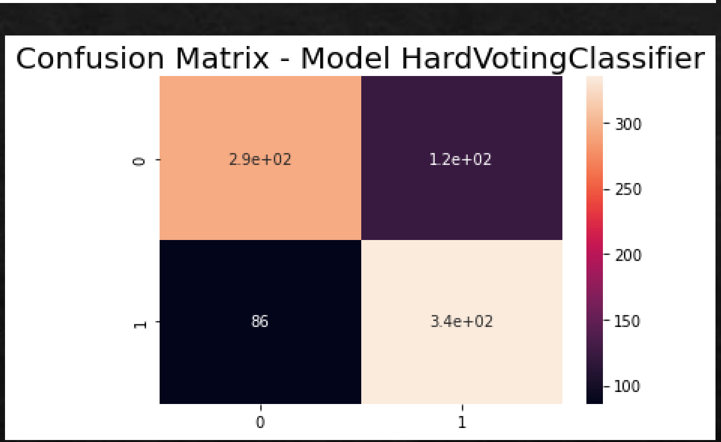
# Hard Voting

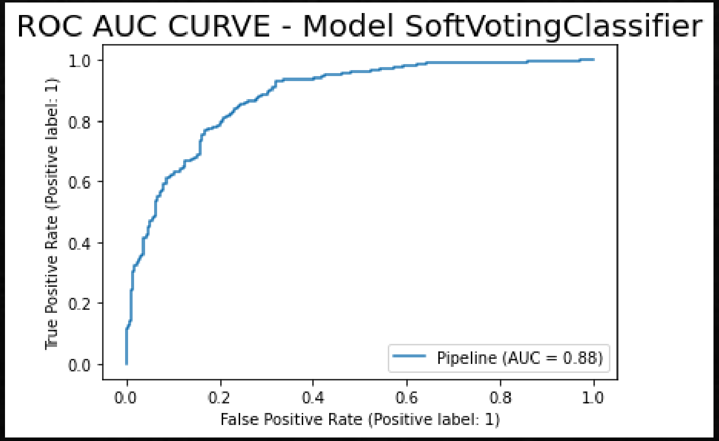
- Test Precision: 0.7314410480349345
- Test Recall: 0.7957244655581948
- Test F1 Score: 0.7622298065984072
- Test ROC AUC Score: 0.7503802183906082
- Test Accuracy Score:  0.7505966587112172

# Soft Voting

- Test Precision: 0.7782608695652173
- Test Recall: 0.850356294536817
- Test F1 Score: 0.8127128263337116
- Test ROC AUC Score: 0.8028759889950272
- Test Accuracy Score:  0.8031026252983293





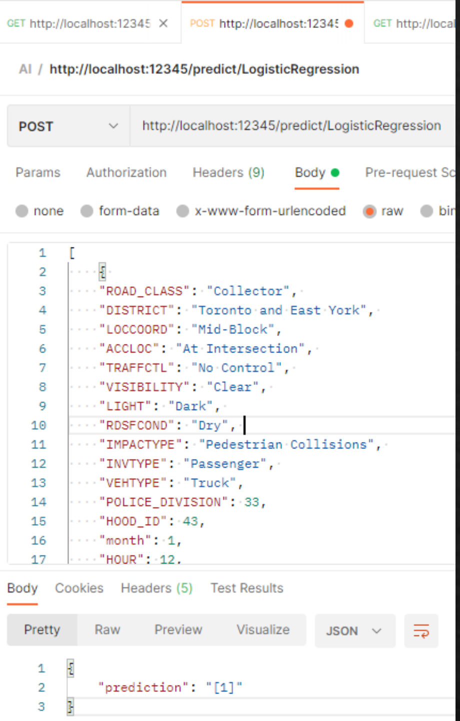


# Model Stats

| | Logistic Regression | Random Forest | Decision Tree | K Neighbors | SVC | Hard Voting | Soft Voting |
|---|---|---|---|---|---|---|---|
| **Accuracy** | 66.55% | **80.67%** | 65.18% | 72.20% | 63.84% | 75.06% | **80.31%** |
| **Precision** | 66.58% | **78.71%** | 67.30% | 77.01% | 62.77% | 73.14% | **77.83%** |
| **Recall** | 68.64% | 84.32% | 61.20% | 63.66% | 68.88% | 79.57% | 85.04% |
| **F1** | 67.60% | 81.42% | 64.11% | 69.70% | 65.69% | 76.22% | 81.27% |
| **ROC AUC** | 66.52% | 80.65% | 65.24% | 72.24% | 63.82% | 75.04% | 80.29% |

# DEMO

- API
  - Flask
  - Python
- Website
  - HTML, JavaScript, jQuery, CSS

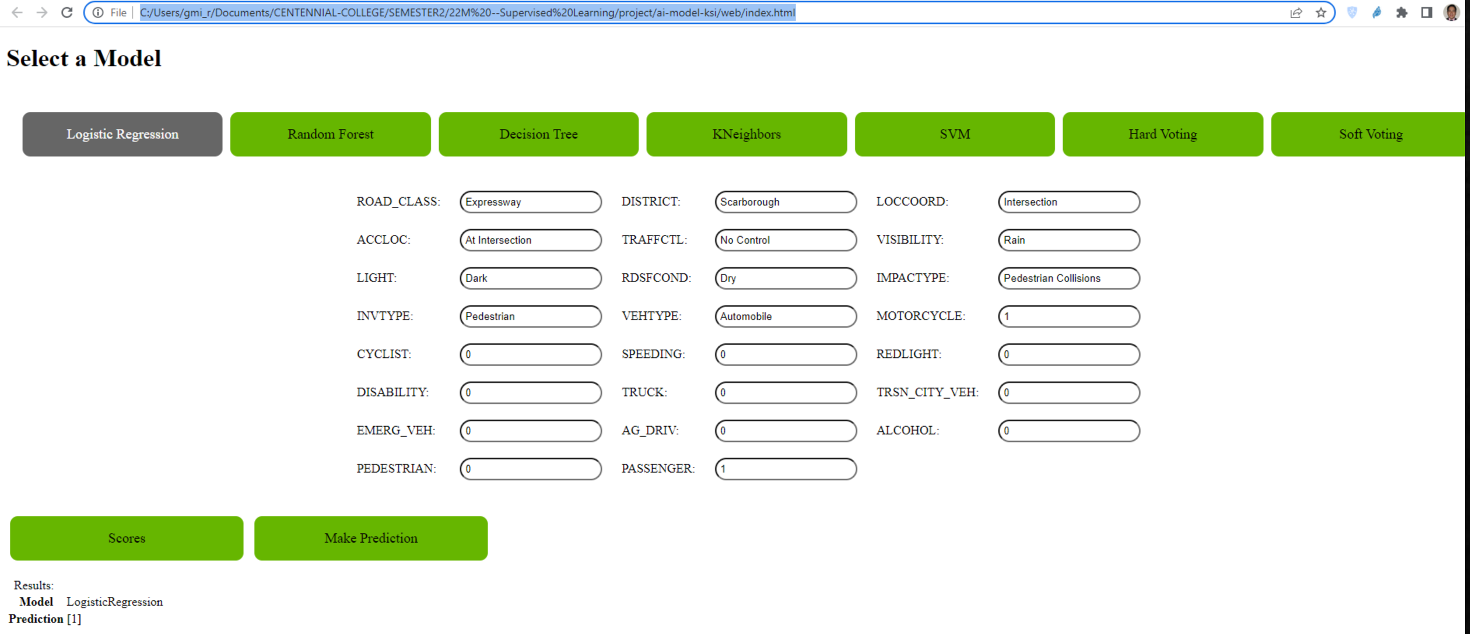


AI / http://localhost:12345/predict/LogisticRegression

POST http://localhost:12345/predict/LogisticRegression

```
[
    {
    "ROAD_CLASS": "Collector",
    "DISTRICT": "Toronto and East York",
    "LOCCOORD": "Mid-Block",
    "ACCLOC": "At Intersection",
    "TRAFFCTL": "No Control",
    "VISIBILITY": "Clear",
    "LIGHT": "Dark",
    "RDSFCOND": "Dry",
    "IMPACTYPE": "Pedestrian Collisions",
    "INVTYPE": "Passenger",
    "VEHTYPE": "Truck",
    "POLICE_DIVISION": 33,
    "HOOD_ID": 43,
    "month": 1,
    "HOUR": 12,
```

```
{
    "prediction": "[1]"
}
```



C:/Users/gmi_r/Documents/CENTENNIAL-COLLEGE/SEMESTER2/22M%20--Supervised%20Learning/project/ai-model-ksi/web/index.html

## Select a Model

| | | | | | |
|---|---|---|---|---|---|
| ROAD_CLASS: | Expressway | DISTRICT: | Scarborough | LOCCOORD: | Intersection |
| ACCLOC: | At Intersection | TRAFFCTL: | No Control | VISIBILITY: | Rain |
| LIGHT: | Dark | RDSFCOND: | Dry | IMPACTYPE: | Pedestrian Collisions |
| INVTYPE: | Pedestrian | VEHTYPE: | Automobile | MOTORCYCLE: | 1 |
| CYCLIST: | 0 | SPEEDING: | 0 | REDLIGHT: | 0 |
| DISABILITY: | 0 | TRUCK: | 0 | TRSN_CITY_VEH: | 0 |
| EMERG_VEH: | 0 | AG_DRIV: | 0 | ALCOHOL: | 0 |
| PEDESTRIAN: | 0 | PASSENGER: | 1 | | |

Results:
**Model** LogisticRegression
**Prediction** [1]