Diabetes Predictions

Project by Gaurav Kumar Rai

**References**:

[Aditya-Mankar/Diabetes-Prediction: Predict Diabetes using Machine Learning. (github.com)](https://github.com/Aditya-Mankar/Diabetes-Prediction)

**GitHub URL**:

[GauravRai1512/UCDPA\_GauravKumarRai (github.com)](https://github.com/GauravRai1512/UCDPA_GauravKumarRai)

**Abstract**:

This has been very common health issue with age >45 due to our unbalanced unhygienic lifestyle. To predict whether the patient is diabetic or not based on the dataset featured from the **National Institute of Diabetes** and **Digestive and Kidney Disease** becomes very easy through Machine Learning. Dataset has different columns like Glucose, Blood Pressure, Skin Thickness, Insulin, Age & BMI which will help us to predict whether the patient has diabetes or not. Prediction will be done through Machine Learning.

This diabetes problem could be a classic example of binary classification and used KNN model to predict the accuracy. The datasets consist of feature variables and one target variable, **Outcome**.

We have loaded the csv file which we took from **Kaggle** and then started **Exploratory Data Analysis** (EDA) through checking head (), info (), shape () function to get the actual rows and columns details.

Then Data Preparation where Data cleaning process will come into the picture where we must check and clean all possible data which has 0 value NaN and duplicate values.

We build a machine learning model which is **KNN classifier model** of supervised learning to train the data, fit the data, predict the data whether the patients in the dataset have diabetes or not.

**Introduction**:

Diabetes has become very frequent health issue and if not taken care at the right time , high diabetes level can impact majority of the body function and can impact overall health.

Being able to predict the onset of diabetes in patients using Machine Learning Model can help us to determine the high risk patients using data like Glucose, BMI and the model will predict whether you are likely to have diabetes or not thereby giving patients an upper hand on the illness and avoid high costs treatment for diabetes.

The prime objective of this project is to predict diabetes based on data available in the data frame, by identifying which type of algorithm model works best for this prediction.

Use Case:

* A very simple way to identify the diabetes at early stage and better treatment can help to cure from this.
* Prepare the data to be read by ML Model and identify high risk patients based on key Risk Factors.
* Reduce costs for your health care organization by avoiding costly treatments and procedures related to treating diabetes and its complications.

**Dataset**:

Source: [Aditya-Mankar/Diabetes-Prediction: Predict Diabetes using Machine Learning. (github.com)](https://github.com/Aditya-Mankar/Diabetes-Prediction)

Description: This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. The objective of the dataset is to diagnostically predict whether a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. All patients here are females at least 21 years old of Pima Indian heritage.

This source has taken the reference from Kaggle only.

I have chosen this source because the details are very clear and very well explained without any complexity.

**Implementation Process**:

* This process has started from importing all required python dependencies, then loading the csv file which I picked from Kaggle and did some modification like added NaN and 1 duplicate value.

Did data analysis as well to check the info, shape, and head values.

* Then started cleaning data for further processing where removed all NaN value present in the dataset as the occurrence was less than 5% of total data in csv, then converted all 0 to NaN this time we have not removed the data as occurrence was more than 10% so instead of removing this, calculated the mean value and replaced with NaN. Then also deleted duplicate value as well.
* Started data visualization through hist before cleaning the data and then after cleaning the data and checked the state of data through **histogram**.
* Chosen 2 columns Glucose and BMI from the dataset and started plotting through **scatter** and through visualization we can say that when BMI increased Glucose level has also increased and high Glucose level means probability of having diabetes in patient has been increased.
* Then finally started Data Modeling where we have used multiple algorithms to predict the accuracy.
* **K-NN Algorithm Accuracy**: 78.69565217391305
* **SVC Algorithm Accuracy**: 76.08695652173914
* **Linear Regression Accuracy**: 31.660043670199534
* **Logistic Regression Accuracy**: 78.26086956521739
* After applying multiple algo and the accuracy which we have seen except Linear all are almost same with Accuracy but if I must choose best algo accuracy as per data then I would say **K-NN Algorithm** & **Logistic Regression** would be the best Supervised model for Prediction but confusion Matrix and **classification report has best result for K-NN Algorithm so I would choose K-NN Algorithm for our diabetes data to predict correctly.**
* Have used **Train/test split** to measure model performance where we have started to fetch feature(X) and output(y) where feature would be all column except the output and passed as an argument X and y in **train\_test\_split** also we took 30% data as a test data.
* Also have used **iterator** to run the classifier with different K value to check **over/underfitting** also get the accuracy of K neighbor algorithm as it works based on number means K=1,2,3…. can put this as an argument in KNN Model as an KNeighborsClassifier to predict the accuracy. Considering function and all would be same so no need to do this one by one.

Larger k=less complex model=can cause underfitting

Larger k=more complex model=can lead to overfitting

So used for loop with range from 1 to 26 and pass this range value as a variable into this KNN model and the highest accuracy we have achieved with **n\_neighbors=7**

* **Confusion Matrix** has also used to summarize the performance of a classification algorithm. As sometimes accuracy could be misleading if you have an unequal number of observations in each class.so calculating a confusion matrix can give you a better idea of what your classification model is getting right and what types of error its making and based on that you can tell the whether this classification model is the best or not in any circumstances.

Confusion Matrix of **K-Neighbor** classifier as below:

[[[[131 18]

[ 31 50]]

# As per above The Model produced 131 true positive, 50 true negative, 18 false negative, and 31 false positive.

Also calculated **Classification Report** to get the **precision, recall, f1-score**

# The classification report shows a better recall & f1 score for the zero class, which represents individuals who do not have diabetes.

**KNN** precision recall f1-score support

0 0.81 0.88 0.84 149

1 0.74 0.62 0.67 81

accuracy 0.79 230

macro avg 0.77 0.75 0.76 230

weighted avg 0.78 0.79 0.78 230

Confusion Matrix of **Logistic Regression** as below:

[[118 30]

[ 60 22]]

# As per above The Model produced 118 true positive, 22 true negative, 30 false negative, and 60 false positive.

Also calculated **Classification Report** to get the **precision, recall, f1-score**

* # The classification report shows a better recall for the zero class, which represents individuals who do not have diabetes but accuracy is less as comparison to KNN as KNN has 79% accuracy as per classification report

**High Precision: Lower false positive rate**

**High Recall: Lower false negative rate (predicted most fraudulent transaction correctly)**

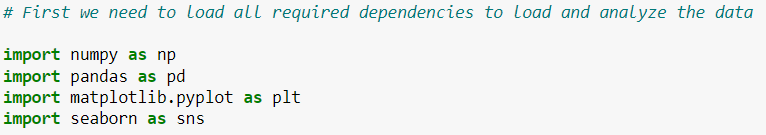
* **Another Analysis:** As per confusion matrix and classification report we can say the best algo would be K-neighbor classifier. But after extending the performance and the analysis we have picked to check the performance based on ROC Curve and AUC and as per this analysis the accuracy has come out on the higher side as below

**Logistic Regression**: ROC AUC **0.8264147816720524** ROC Accuracy **82.64147816720524**

**K-Neighbor classifier: ROC AUC 0.8095534012759963 ROC Accuracy 80.95534012759963**

* The best model came out as Logistic as AUC is greater than K-Neighbor.

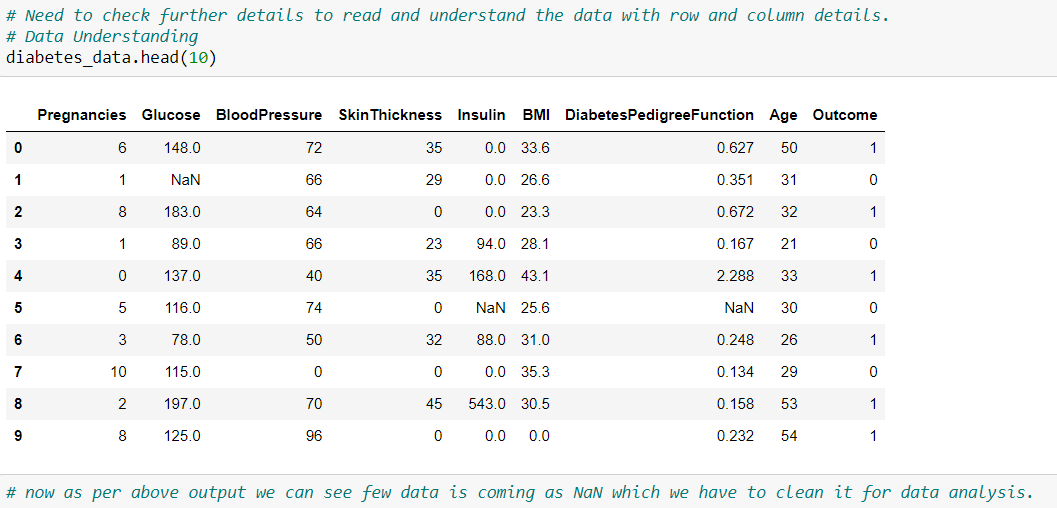
1. Importing Libraries and Dataset

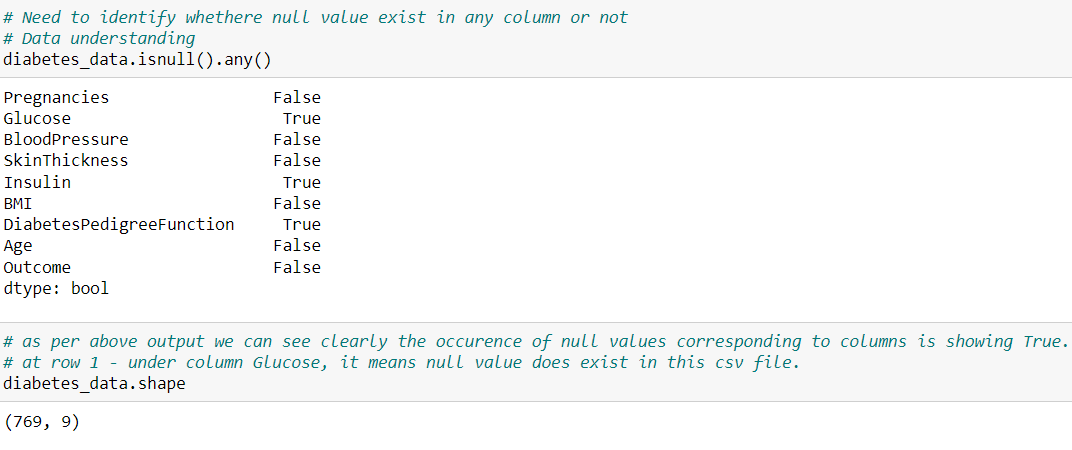


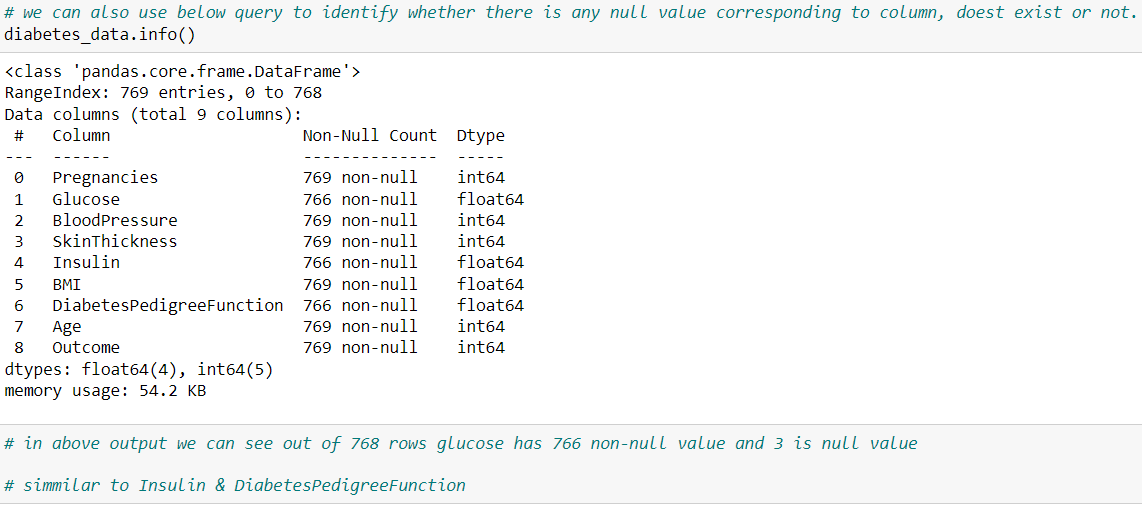
1. Data Loading

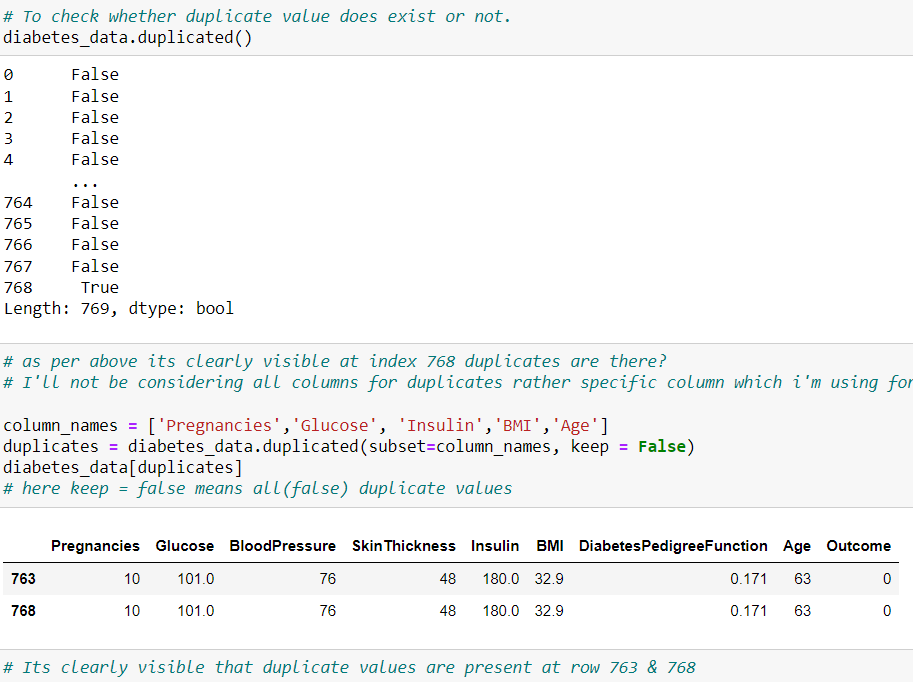


1. Exploratory Data Analysis

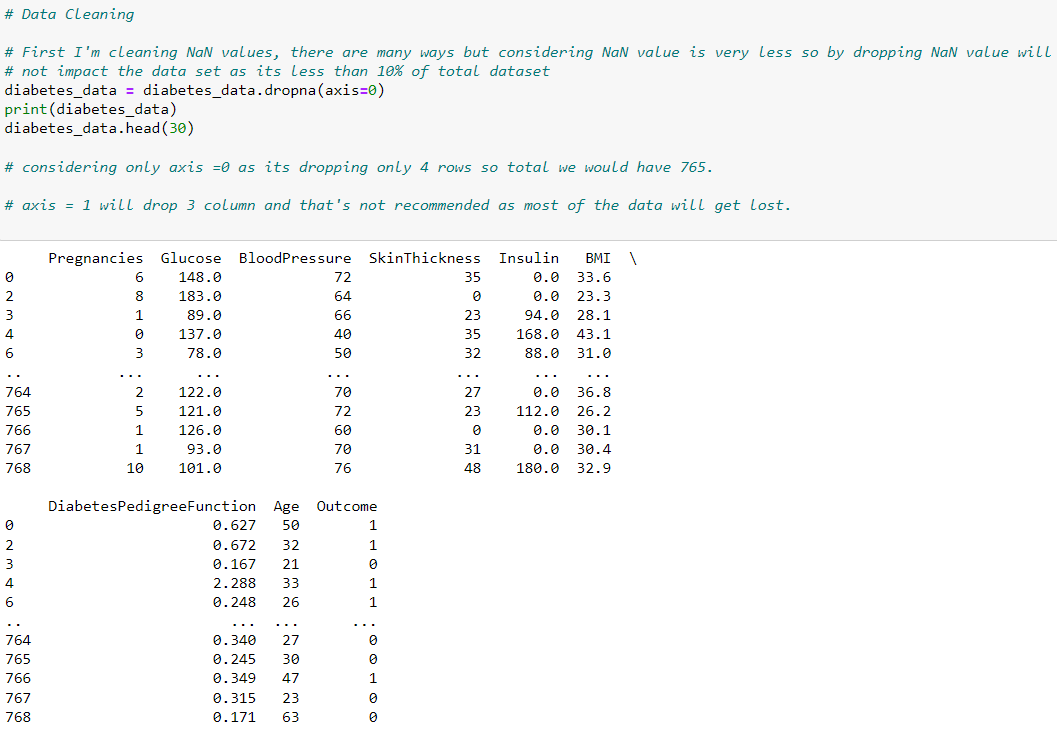


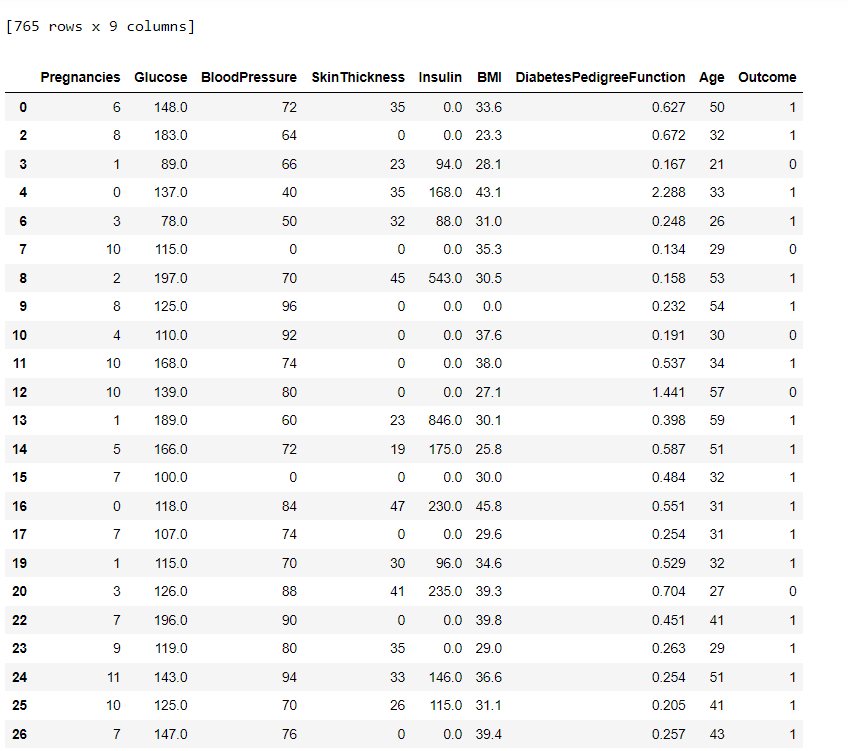


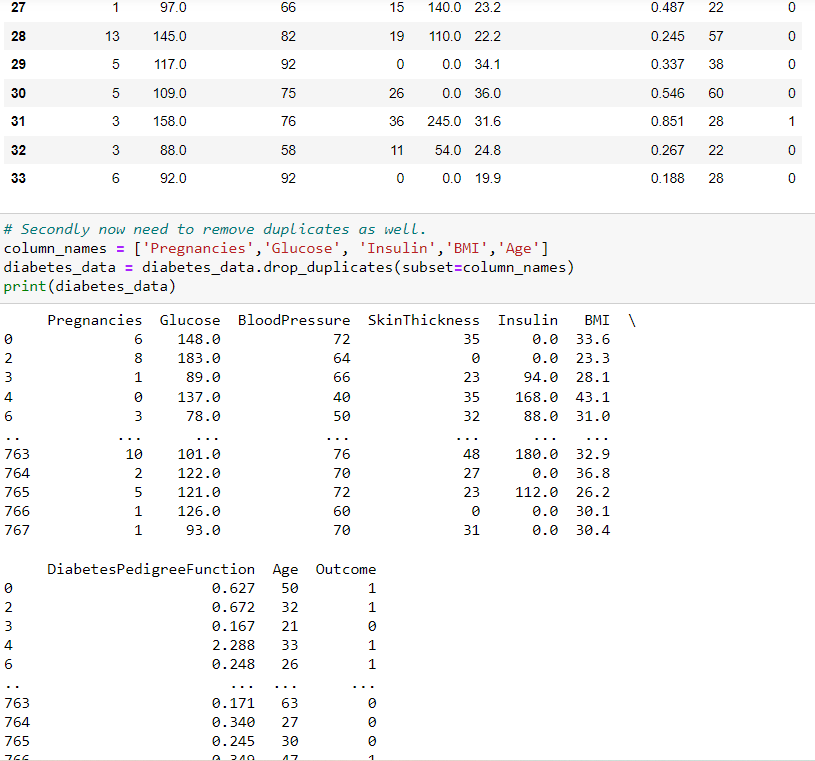


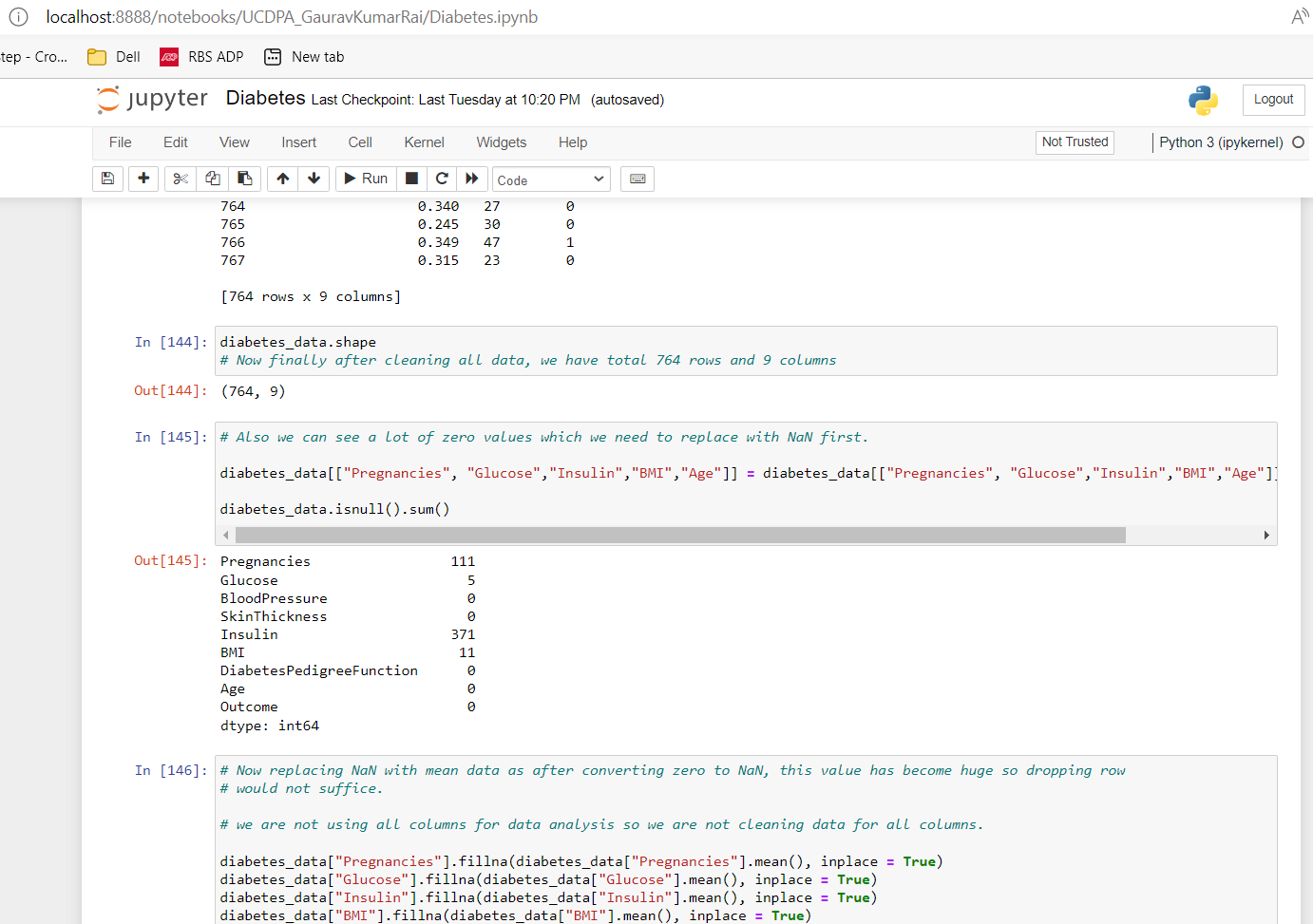


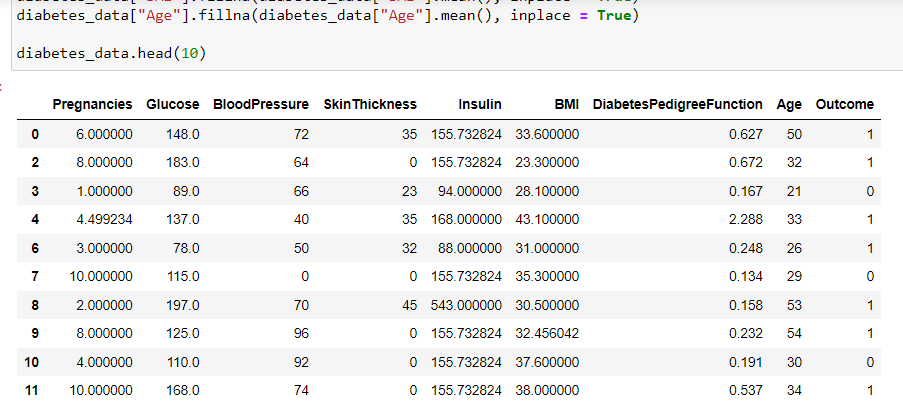
1. Data Cleaning



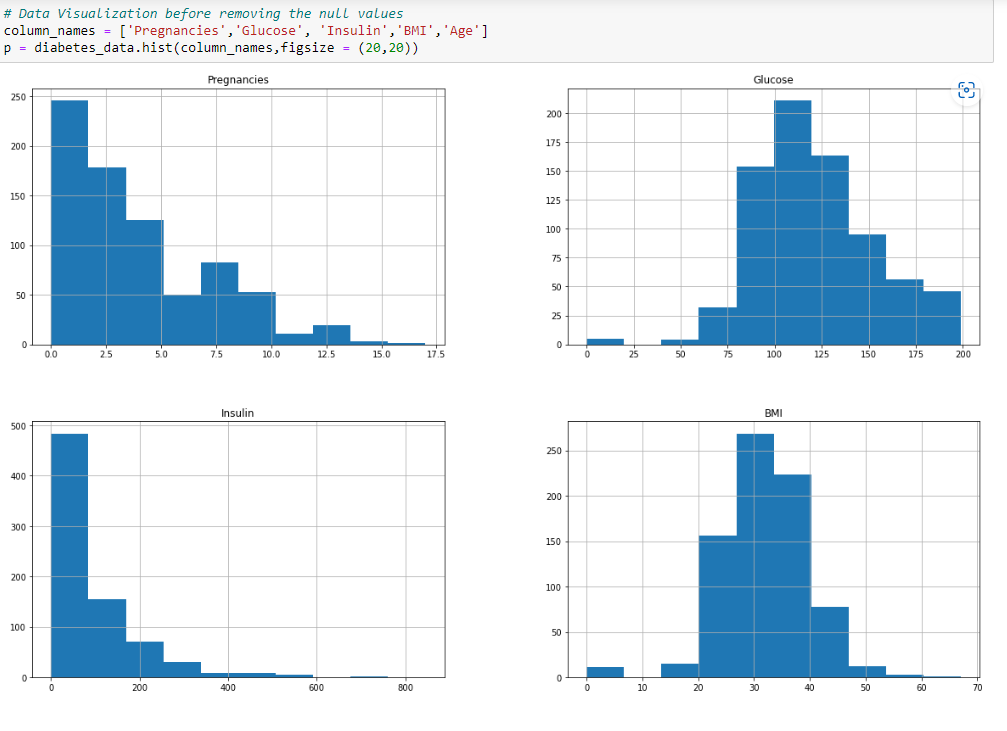


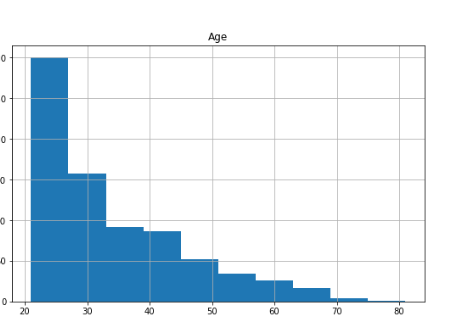


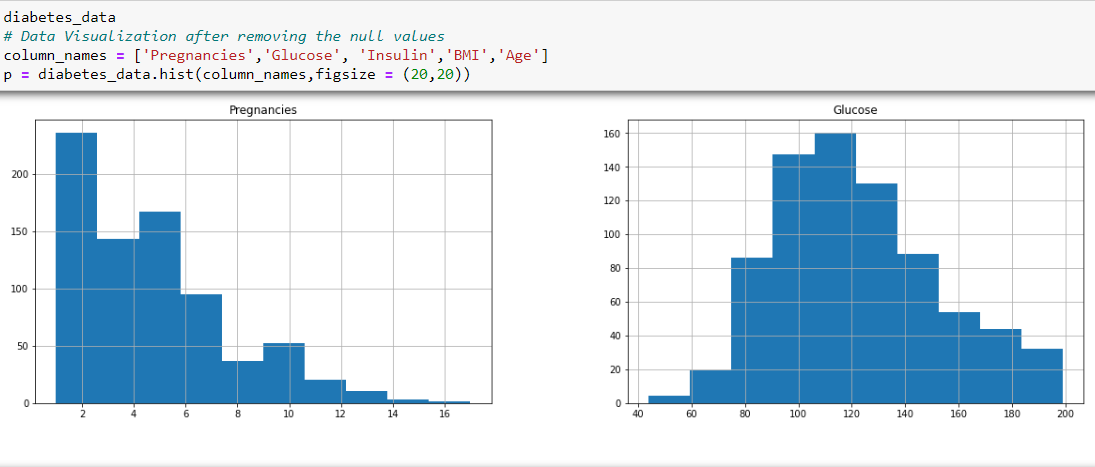


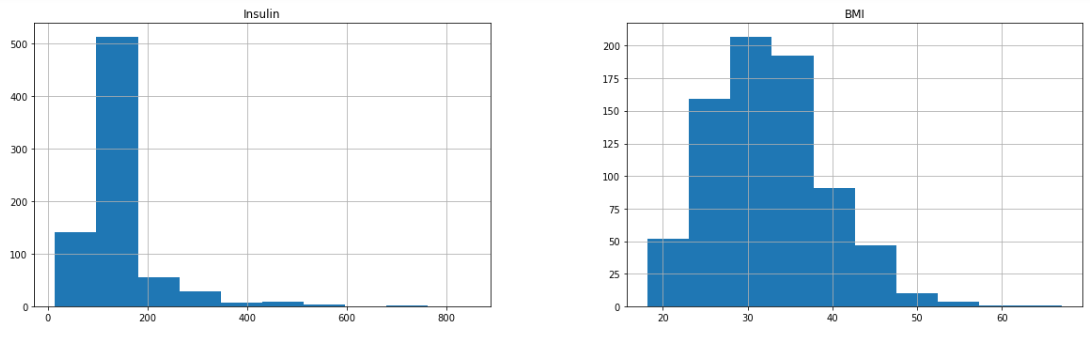


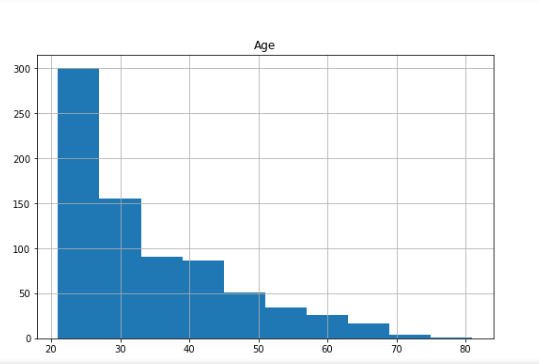
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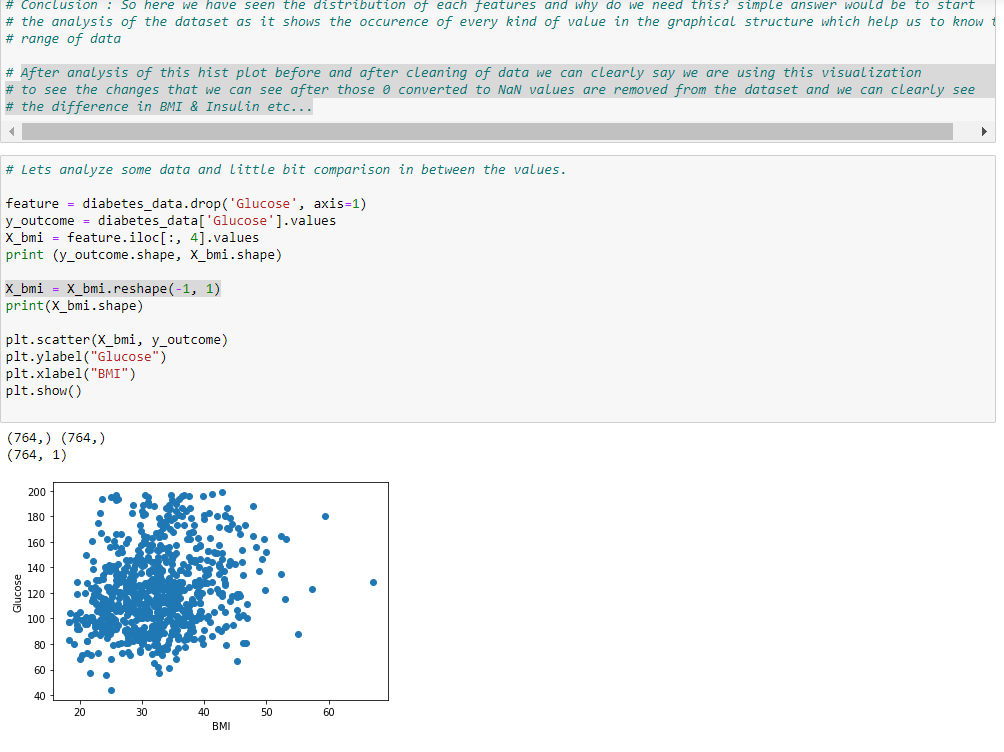




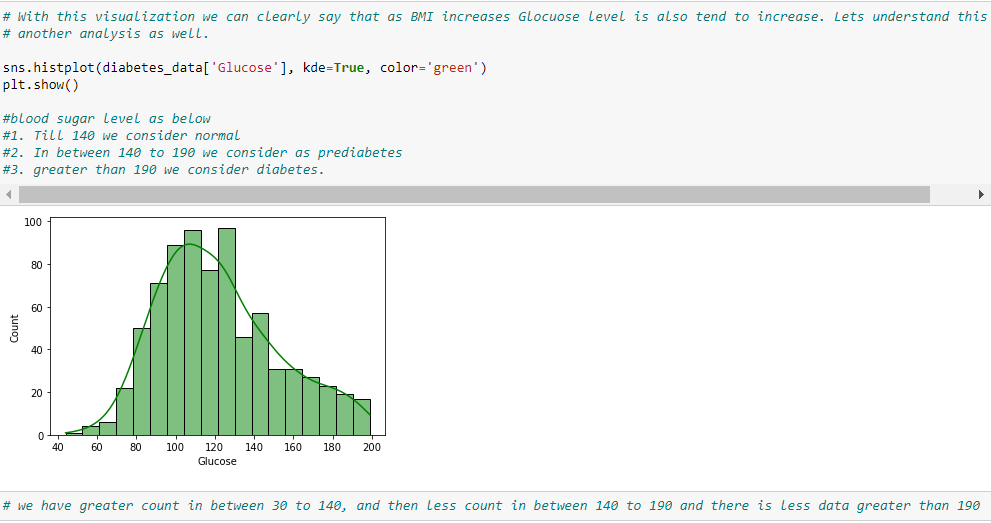




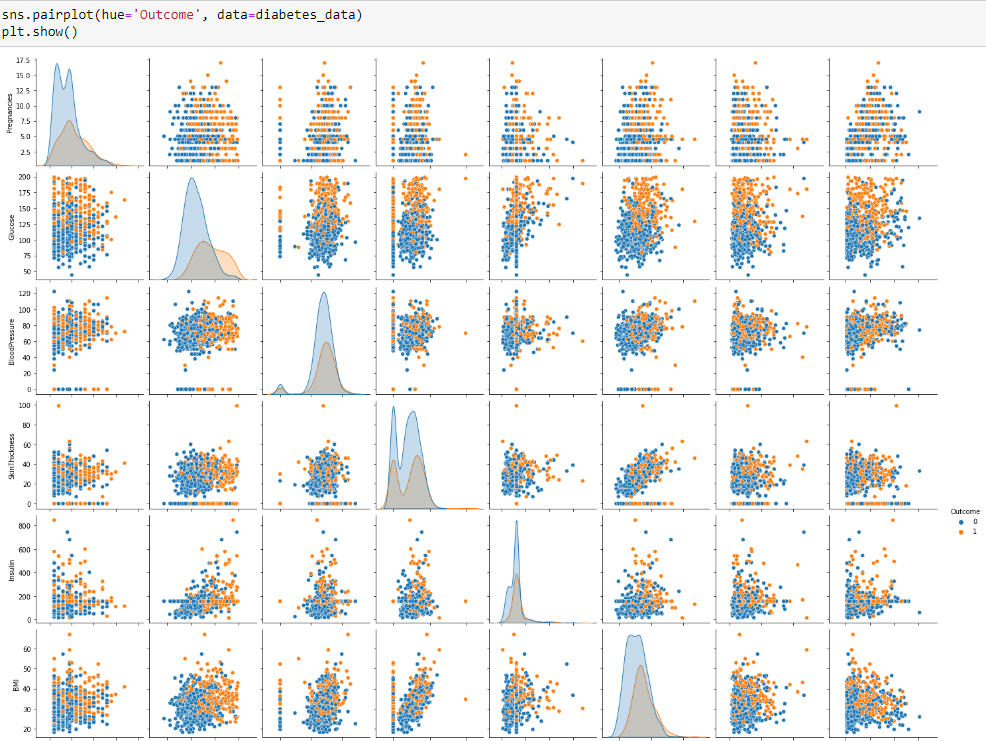


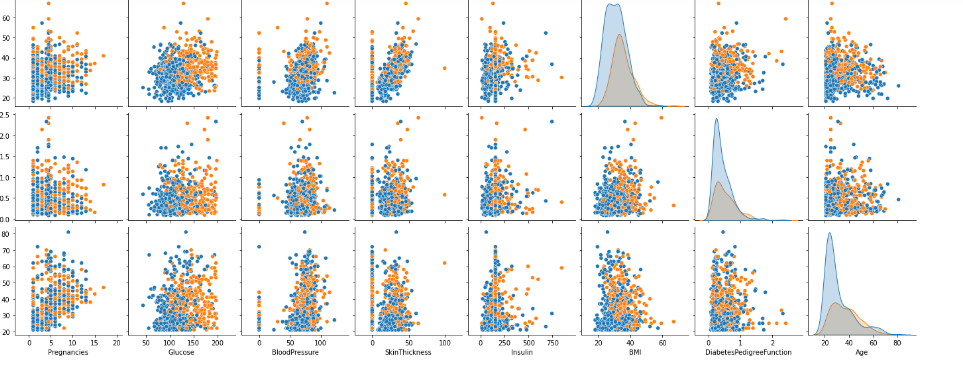


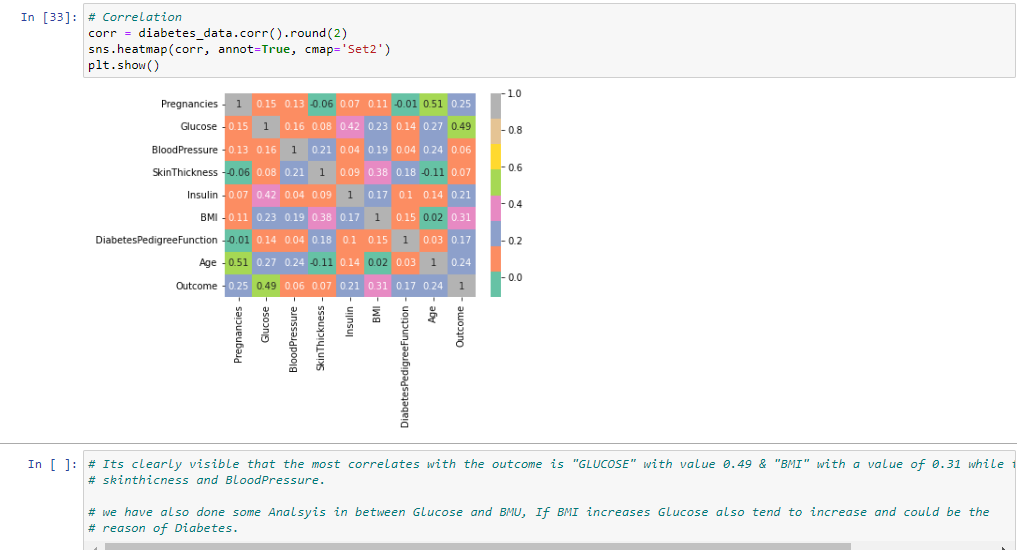




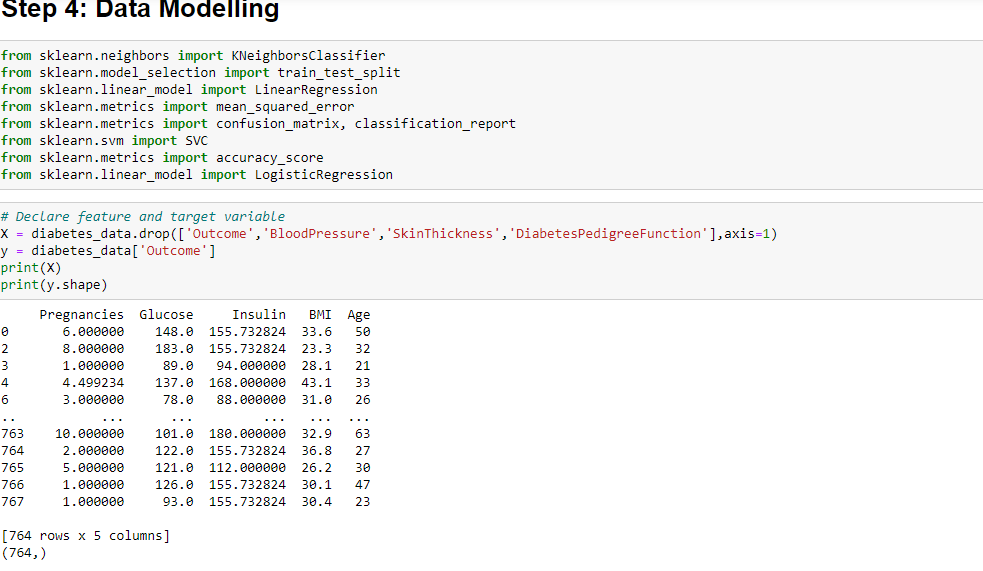


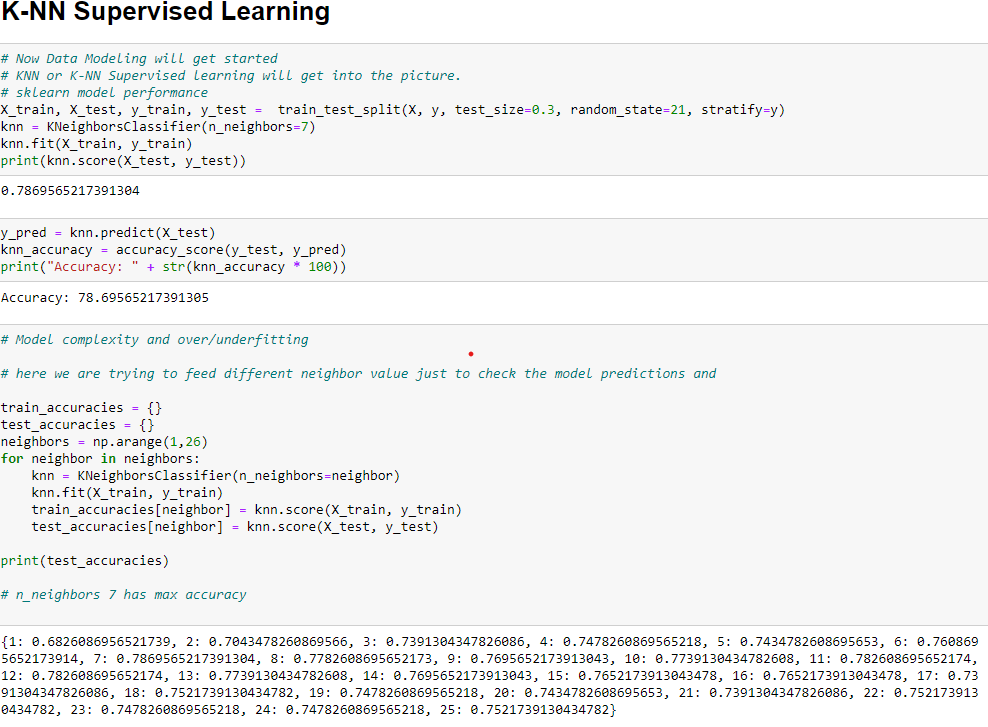




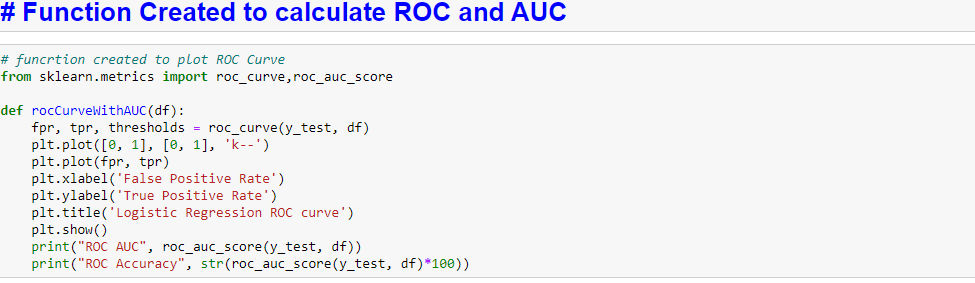


1. Data Modelling:

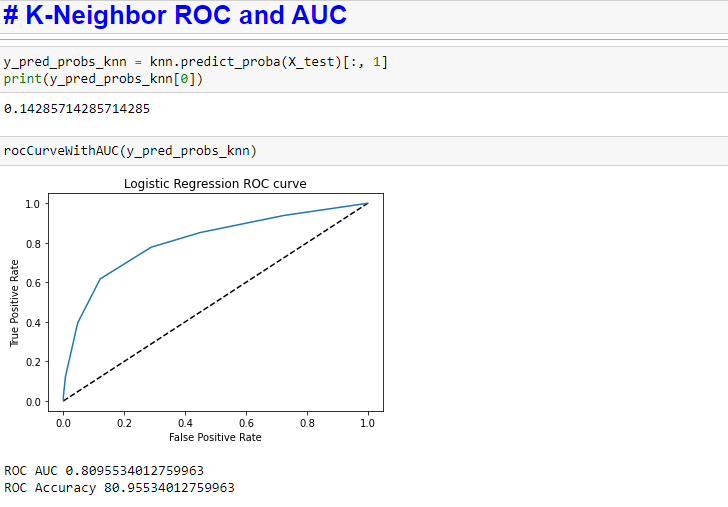


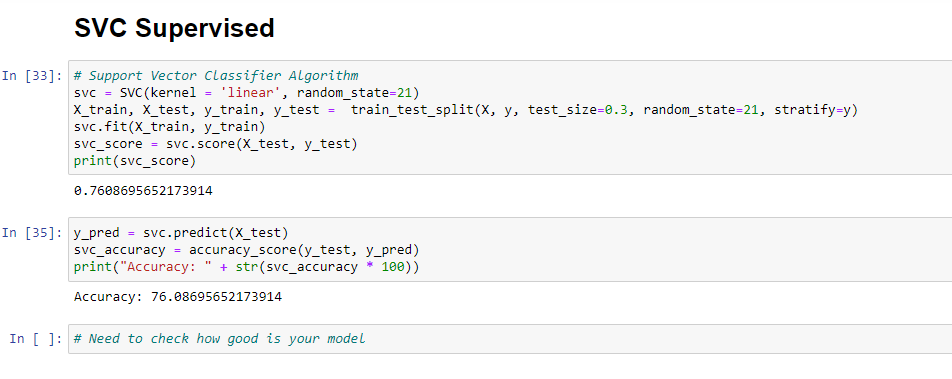


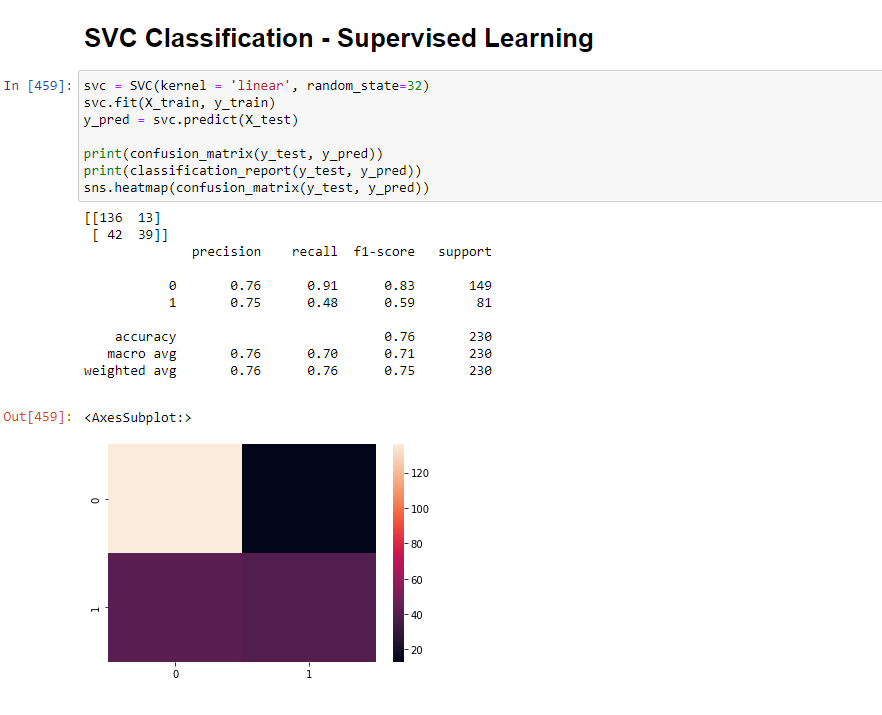


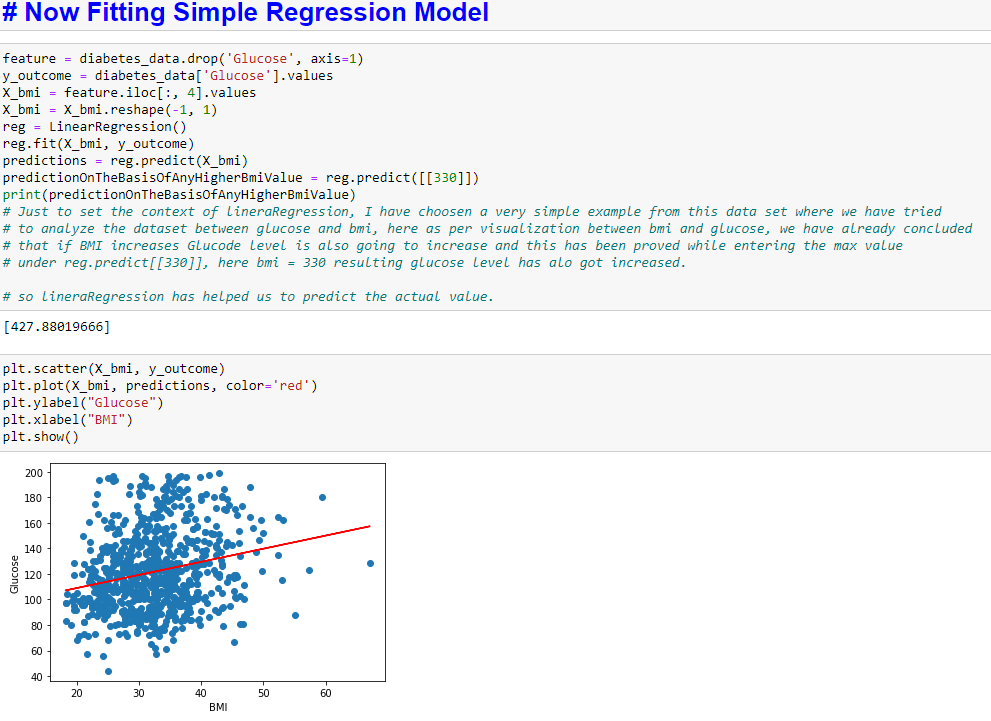




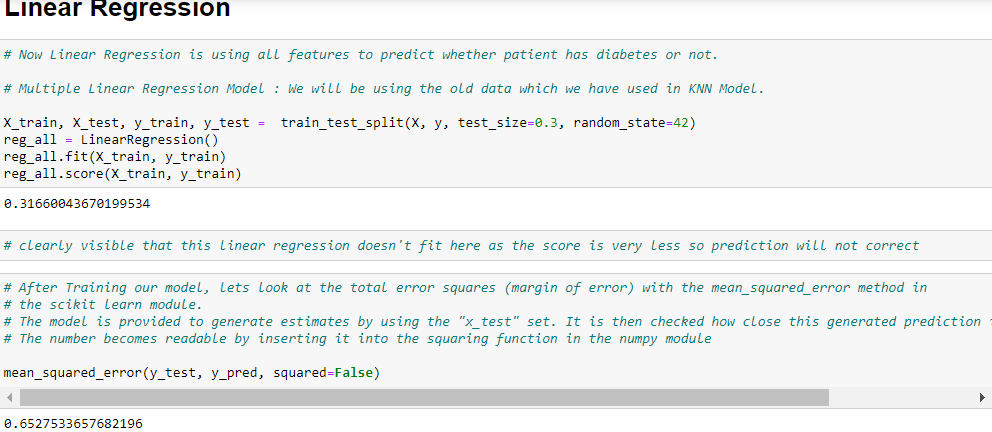


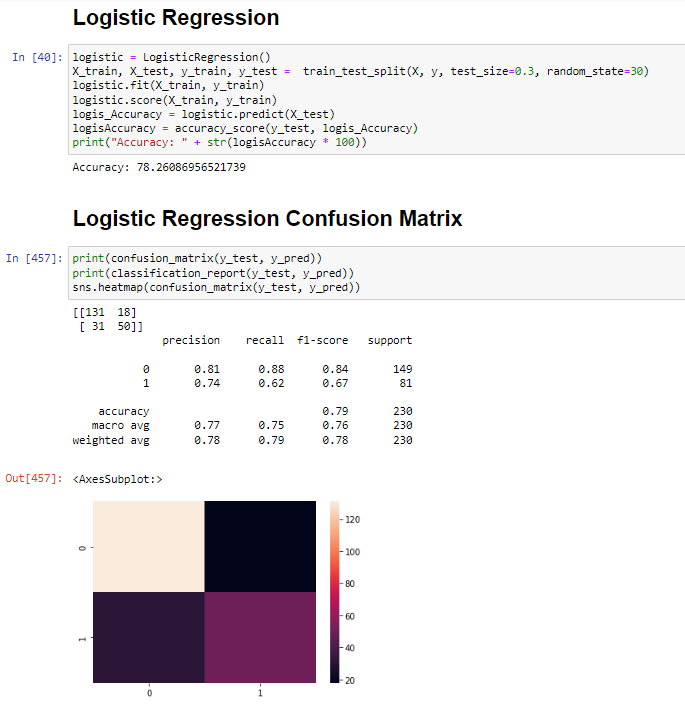


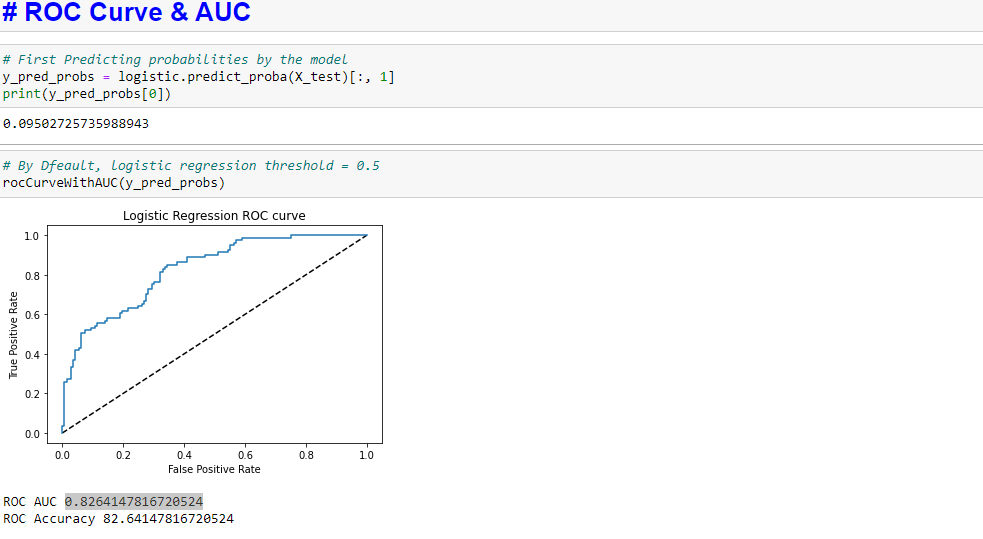


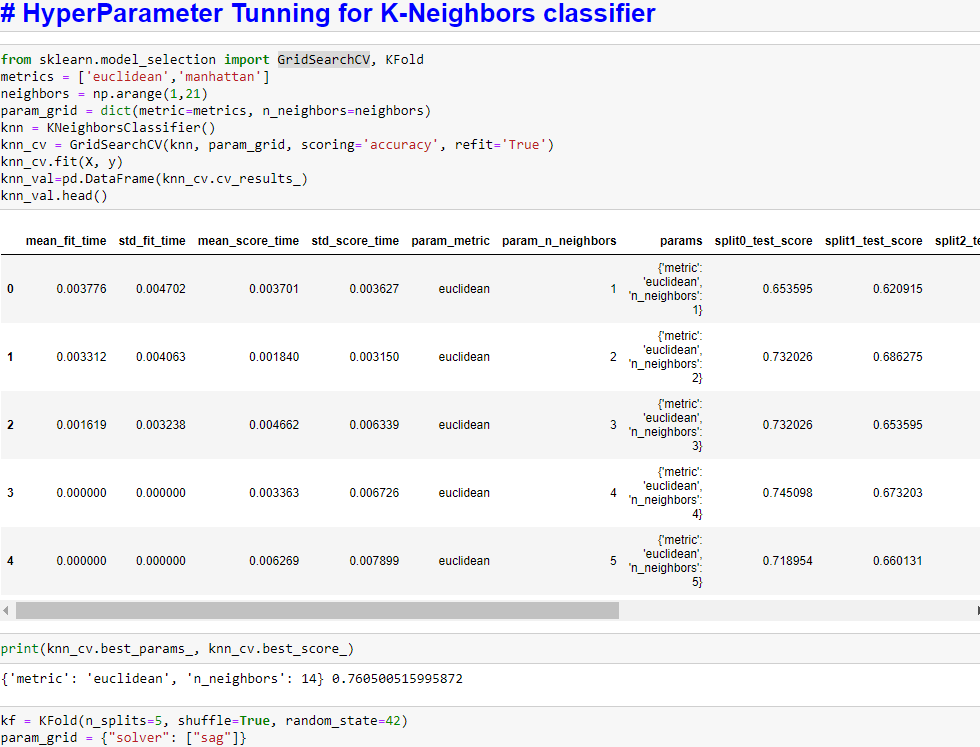


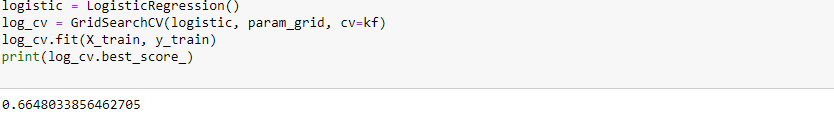


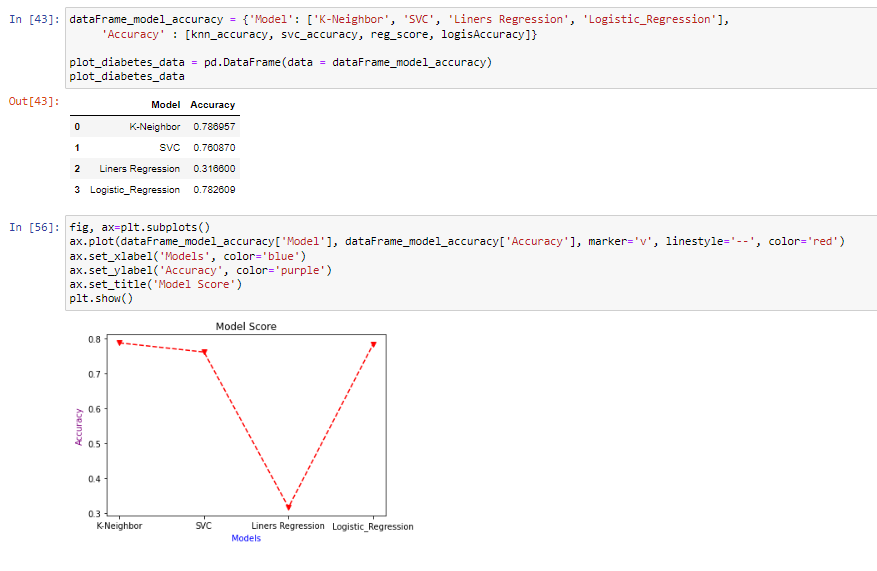


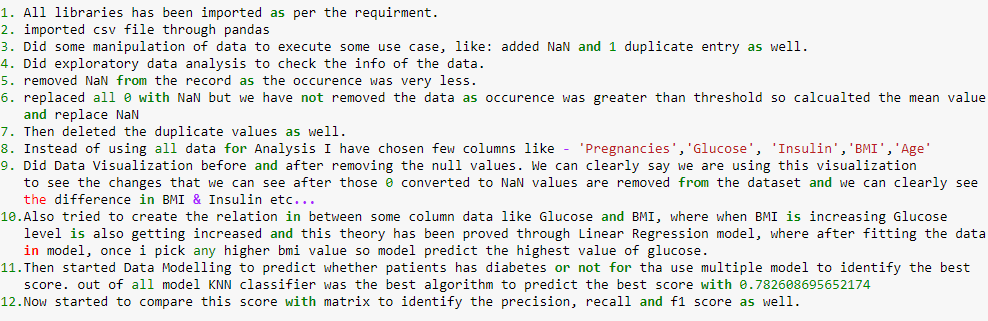












**Results**:

Analysis 1:

* **K-NN Algorithm Accuracy**: 78.69565217391305
* **SVC Algorithm Accuracy**: 76.08695652173914
* **Linear Regression Accuracy**: 31.660043670199534
* **Logistic Regression Accuracy**: 78.26086956521739

After implementing multiple Algorithm along with the confusion matrix and classification report, we can clearly say K-NN Algo has better accuracy.

As per above data K-NN Algo has better accuracy and better precision, recall & f1-score in comparison to Logistic Regression Model.

K-Neighbor classifier would be the best diabetes prediction for patients with this analysis.

Analysis 2:

**ROC Curve & AUC** used to check how good the K-neighbor and Logistic Regression model in correctly predicting positive and negative outcomes. The larger the AUC, the better the model.

K-Neighbor AUC: 0.8095534012759963

Logistic Regression: 0.8264147816720524

As per above data we can clearly say the prediction of logistic regression is better than K-Neighbor Model.

Analysis 3:

We have also explored **Hyperparameter Tunning** for K-neighbor and Logistic Regression and the stats which we have clearly say K-Neighbor classifier model is the best model in comparison to Logistic Regression

**Conclusion**: K-Neighbor Model and Logistic both are the best model for this use case. But if I have to choose only one then I would go for K-Neighbor as the prediction of this model is better than logistic.

**Insights:**

* Downloaded Diabetes CSV file from Kaggle and did some modification to cover all possible scenarios where NaN, 0 and duplicate values are present.

1. : Removed NaN value as the occurrence was very less
2. : First converted 0 into NaN and then calculated mean value to replace NaN
3. : Identify duplicate and removed it from the data

* Data Visualization has also been performed to check the distribution of each feature in a form of graphical structure which helps us to know the range of data before and after cleaning it.

(1): We can clearly see that there is a spike in BMI at the range of 0-30 after cleaning the data.

(2): We can clearly see that there is a spike in insulin at the range of 400-600

* Did Data Visualization in between 2 columns [Glucose, BMI] of diabetes data set to get the sense of how they are interlinked through scatter from library matplotlib. Have used this visualization to predict Glucose level through Linear Regression Model.

**Analysis**: BMI Increases Glucose level is also tended to increase.

reg = LinearRegression()

reg.fit(X\_bmi, y\_outcome)

predictions = reg.predict(X\_bmi)

predictionOnTheBasisOfAnyHigherBmiValue = reg.predict([[330]]) gives output 427.88019666, to conclude this after this regression model if I’m predicting higher value then glucose level is also getting high.

* Data Modelling has started to find the best predictions with the help of different algorithm. So first we must create feature(X) and output(Y) and then test train and split data to check the model performance.
* Model Complexity and over/underfitting with different neighbor values to check the train and test accuracies with the help of KNN algo, also plotted the graph in between Accuracy and number of neighbors and neighbor=7 have given the best prediction.
* I have used 4 Algo. After applying all important algorithm, we have seen 2 algo predictions has reached to the level where we can say below 2 algorithms would help us to predict diabetes correctly in patients.

(1): K-Neighbors Classifier: Given the accuracy of 78.69565217391305

(2): Logistic Regression: Given the accuracy of 78.26086956521739

Still need to Analyse some data to identify the best one.

* Confusion Matrix and classification report has helped us to identify the best model and that is K-Neighbor classifier Model as their precision, recall, f1score and accuracy is best in comparison to logistic Regression Model.
* ROC Curve and AUC analysis clearly says Logistic Regression has better performance to predict the diabetes in patients.
* Hyper Parameter Tunning says K-neighbor has the best score and accuracy in comparison to Logistic
* **To conclude all these, I would select K-Neighbor for diabetes prediction as it has better accuracy, precision, recall, f1 score, hyperparameter tunning as well**.