UNIVERSITY OF ASIA PACIFIC

Department of Computer Science & Engineering

Artificial Inteligence Lab

Course Code: CSE 404

Project - 2

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Problem Statement :

Multi-variable Linear Regression for predicting the chance of admit of Graduate Admission using Open-Source Dataset.

Dataset: Graduate Admission 2

Introduction :

Multiple linear regression (MLR), also known simply as multiple regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The goal of multiple linear regression is to model the linear relationship between the explanatory (independent) variables and response (dependent) variables. In essence, multiple regression is the extension of ordinary least-squares (OLS) regression because it involves more than one explanatory variable.

Algorithm:

$$\boldsymbol{y = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \ldots + \theta_n x_n + \epsilon}$$

Here,

$\boldsymbol{y}$ = predicted value of the dependent variable

$\boldsymbol{\theta_0}$ = y-intercept or value of y with all parameters set to 0

$\boldsymbol{\theta_1 x_1}$ = regression coefficient of the first independent variable

$\boldsymbol{\theta_n x_n}$ = regression coefficient of the last independent variable

$\boldsymbol{\epsilon}$ = model error or level of variation

Cost Function:

$$J(\theta) = 1/2m \sum_{i=1}^{m} \left(h(\theta)^{(i)} - y^{(i)}\right)^2$$

Gradient Decent:

$$\frac{\partial J(\theta)}{\partial \theta_j} = 1/m \sum_{i=1}^{m} \left(h\left(\theta^{(i)} - y^{(i)}\right).X_j^{(i)}\right.$$

Datasets:

Context:

This dataset is created for prediction of Graduate Admissions from an Indian perspective.

Content:

The dataset contains several parameters which are considered important during the application for Masters Programs.
The parameters included are :

1. GRE Scores (out of 340)
2. TOEFL Scores (out of 120)
3. University Rating (out of 5)
4. Statement of Purpose and Letter of Recommendation Strength (out of 5)
5. Undergraduate GPA (out of 10)
6. Research Experience (either 0 or 1)
7. Chance of Admit (ranging from 0 to 1)

Implementation:

Programming Language: Python

Tools: Jupyter Notebook, Pandas, Matplotlib

1) Without SK-Learn:

Multiple Linear Regression without SK-Learn

Dataset: Graduate Admission 2

Import Necessary Libraries

In [1]:
```
import matplotlib.pyplot as plt # plotting
import numpy as np # linear algebra
import os # accessing directory structure
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
```

In [2]:
```
import warnings
warnings.filterwarnings('ignore')
print(os.listdir('./')) #Check File Directory For Identify DataSets
```

```
['.ipynb_checkpoints', 'Admission_Predict.csv', 'Admission_Predict_Ver1.1.csv', 'archive.zip', 'Multiple Linear Regression with SK-Learn.ipynb', 'Multiple Linear Regression without SK-Learn.ipynb', 'Others']
```

Data Loader & Pre-Processing

In [3]:
```
df = pd.read_csv('Admission_Predict_Ver1.1.csv', delimiter=',', ) #Read From Dataset File
df.dataframeName = 'Admission_Predict_Ver1.1.csv' #Set Dataframe Name
nRow, nCol = df.shape #Extract Row and Column from DataFrame Shape
df=df.drop(columns=['Serial No.']) #Drop 'Serial No.' Column From DataFrame
print(f'There are {nRow} rows and {nCol} columns')
```

```
There are 500 rows and 9 columns
```

In [6]:
```
df.head() #Check Some Rows from Top
```

Out[6]:

	GRE	TOEFL	University_Rating	SOP	LOR	CGPA	Research	Chance_of_Admit
0	337	118	4	4.5	4.5	9.65	1	0.92
1	324	107	4	4.0	4.5	8.87	1	0.76
2	316	104	3	3.0	3.5	8.00	1	0.72
3	322	110	3	3.5	2.5	8.67	1	0.80
4	314	103	2	2.0	3.0	8.21	0	0.65

In [7]:
```
#calculating some statistical data like percentile,
#mean and std of the numerical values of the DataFrame
df.describe()
```

Out[7]:

	GRE	TOEFL	University_Rating	SOP	LOR	CGPA	Research	Chance_of_Admit
count	500.000000	500.000000	500.000000	500.000000	500.00000	500.000000	500.000000	500.00000
mean	316.472000	107.192000	3.114000	3.374000	3.48400	8.576440	0.560000	0.72174
std	11.295148	6.081868	1.143512	0.991004	0.92545	0.604813	0.496884	0.14114
min	290.000000	92.000000	1.000000	1.000000	1.00000	6.800000	0.000000	0.34000
25%	308.000000	103.000000	2.000000	2.500000	3.00000	8.127500	0.000000	0.63000
50%	317.000000	107.000000	3.000000	3.500000	3.50000	8.560000	1.000000	0.72000
75%	325.000000	112.000000	4.000000	4.000000	4.00000	9.040000	1.000000	0.82000
max	340.000000	120.000000	5.000000	5.000000	5.00000	9.920000	1.000000	0.97000

In [12]:

```
cost_ls=[]
for step in range(epoch):
    t0,t1,t2,t3,t4,t5,t6,t7=(theta) #Extract Values from List of Theta
    x1,x2,x3,x4,x5,x6,x7=(x) #Extract Values from List of X
    #Hypothesis function
    df['pred']=t0+t1*x1+t2*x2+t3*x3+t4*x4+t5*x5+t6*x6+t7*x7

    #Squared error/difference
    df['diff']=(df.pred-df.Chance_of_Admit)**2

    m = len(y) # Number of datapoints

    cost = (df['diff'].sum())/(2*m) # Cost function
    cost_ls.append(cost) #Append Value of Every Epoch
    print('\n\n')
    print('For step : ', step+1)
    print('Cost is : {}'.format(cost))

    step_size = 0.000001 #initializing learning rate

    # Gradient decent optimization of theta values

    theta[0] = theta[0] - (step_size/m)*(np.sqrt(df['diff']).sum())
    theta[1] = theta[1] - (step_size/m)*((np.sqrt(df['diff'])*x1).sum())
    theta[2] = theta[2] - (step_size/m)*((np.sqrt(df['diff'])*x2).sum())
    theta[3] = theta[3] - (step_size/m)*((np.sqrt(df['diff'])*x3).sum())
    theta[4] = theta[4] - (step_size/m)*((np.sqrt(df['diff'])*x4).sum())
    theta[5] = theta[5] - (step_size/m)*((np.sqrt(df['diff'])*x5).sum())
    theta[6] = theta[6] - (step_size/m)*((np.sqrt(df['diff'])*x6).sum())
    theta[7] = theta[7] - (step_size/m)*((np.sqrt(df['diff'])*x7).sum())

    print('Gradient Decent Optimized Thetas: ', theta)

```

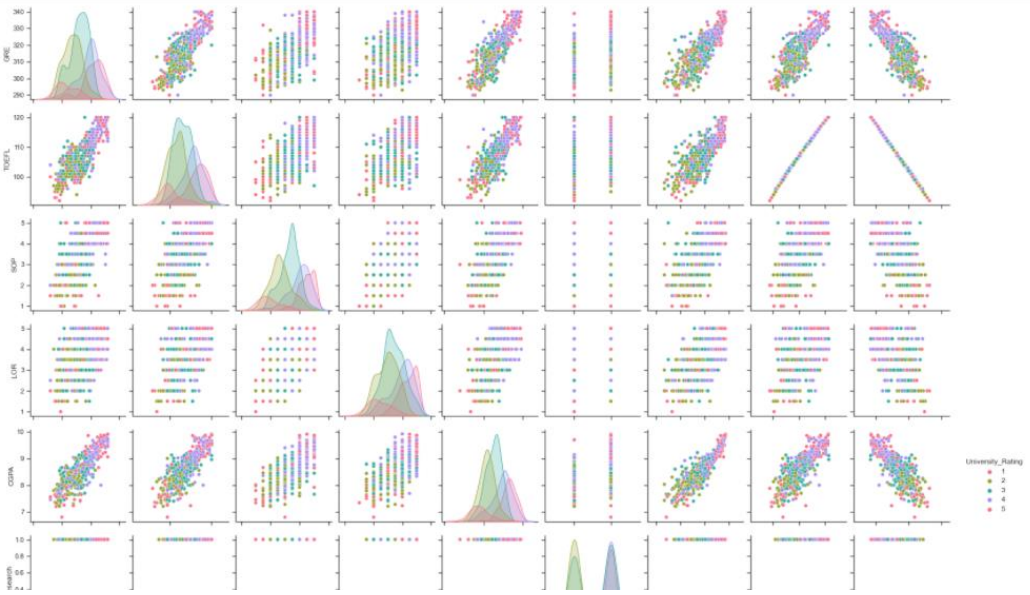
```
For step :  1
Cost is : 600385920.734564
Gradient Decent Optimized Thetas:  [316.43736983827824, 96.21859601954671, -0.6043270709781994, 3.2652565878086803, 3.366399
4358779, 8.455180467867198, 0.26237724954940134, 0.70200125392232]



For step :  2
Cost is : 473532354.80532783
Gradient Decent Optimized Thetas:  [316.4066147826834, 86.47316678619075, -3.906511958023119, 3.16868736679928, 3.2619635078
99899, 8.34749353474166, -0.0019377759525835425, 0.6844725532785806]
```

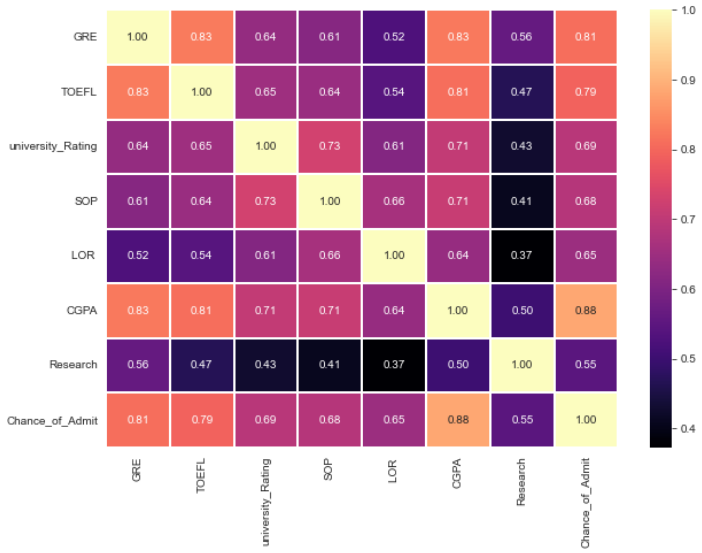
In [18]:

```
sns.set(style="ticks", color_codes=True)
sns.pairplot(df, hue="University_Rating", palette="husl")
plt.show()
```



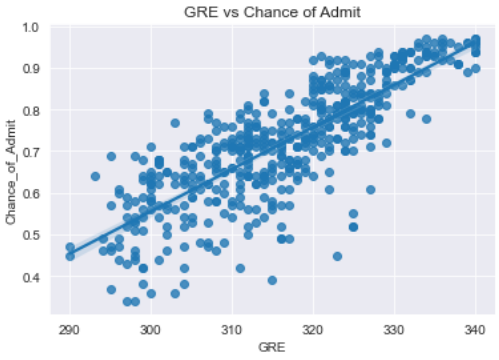
2) With SK-Learn:

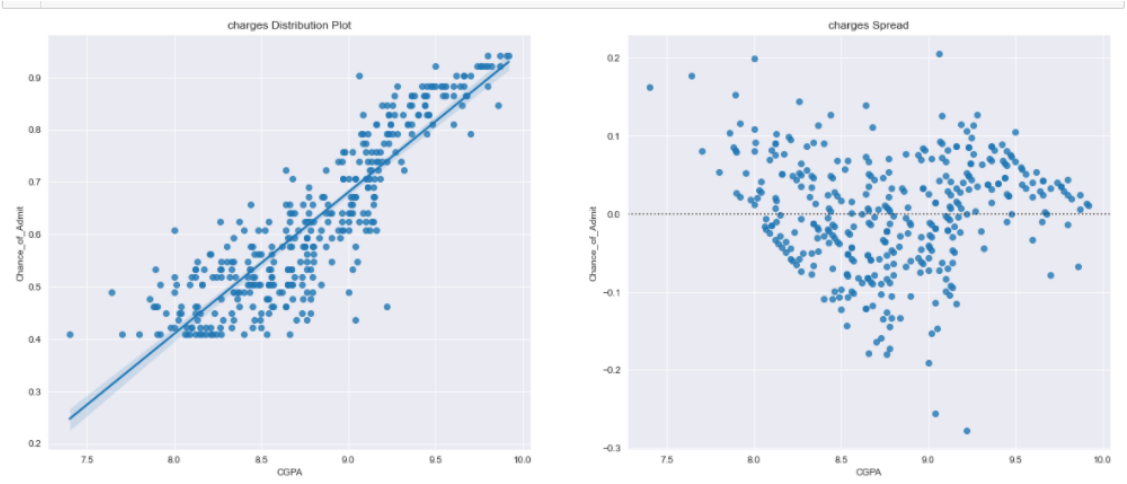
In [12]:
```
#Heat-Map For Compute pairwise correlation of columns
plt.figure(figsize=(10,7))
cr = data.corr()
sb.heatmap(cr, annot=True, linewidths=0.1, fmt= '.2f',cmap="magma")
plt.show()
```



In [13]:
```
#RegPlot for GRE & Chance_Of_Admit

fig = sb.regplot(data.GRE,data.Chance_of_Admit)
plt.title("GRE vs Chance of Admit")
plt.show()
```





Result Analysis:

```
plt.ylabel('Predicted')
plt.title('Visualizing the model performance')
plt.grid()
```

Test Linear Regression Model

In [32]:
```
# our model is ready to predict y.
y_predict = Lin_regressor.predict(X_test)
```

In [33]:
```
# our model prediction
y_predict[:10]
```

Out[33]:
```
array([0.5545905 , 0.45969253, 0.5398055 , 0.67006317, 0.31890853,
       0.58834413, 0.44172199, 0.45338511, 0.86326694, 0.52002521])
```

In [34]:
```
# y test
y_test[:10]
```

Out[34]:
```
array([0.5476, 0.4624, 0.5184, 0.6241, 0.4761, 0.6724, 0.4096, 0.4096,
       0.8836, 0.5776])
```

In [35]:
```
from sklearn import metrics
#Check the Accuracy of the Model
metrics.mean_absolute_error(y_test,y_predict)
```

Out[35]:
```
0.05313501697385051
```

5% Error Means our Model is 95% correct

Conclusion:

By doing this project I gained knowledge about Multi-variable Linear Regression and also learned the way to apply this on any real-life dataset.