CODE TO PREDICT CAR PURCHASING DOLLAR AMOUNT USING ANNs (REGRESSION TASK)

PROBLEM STATEMENT

You are working as a car salesman and you would like to develop a model to predict the total amount in dollars that customers are willing to pay given the following attributes:

- Customer Name
- Customer e-mail
- Country
- Gender
- Age
- Annual Salary
- Credit Card Debt
- Net Worth

The model should predict:

- Car Purchase Amount

STEP #0: LIBRARIES IMPORT

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

STEP #1: IMPORT DATASET

In [2]:
```
car_df = pd.read_csv('Car_Purchasing_Data.csv', encoding='ISO-8859-1')
```

In [3]:
```
car_df
```

Out[3]:

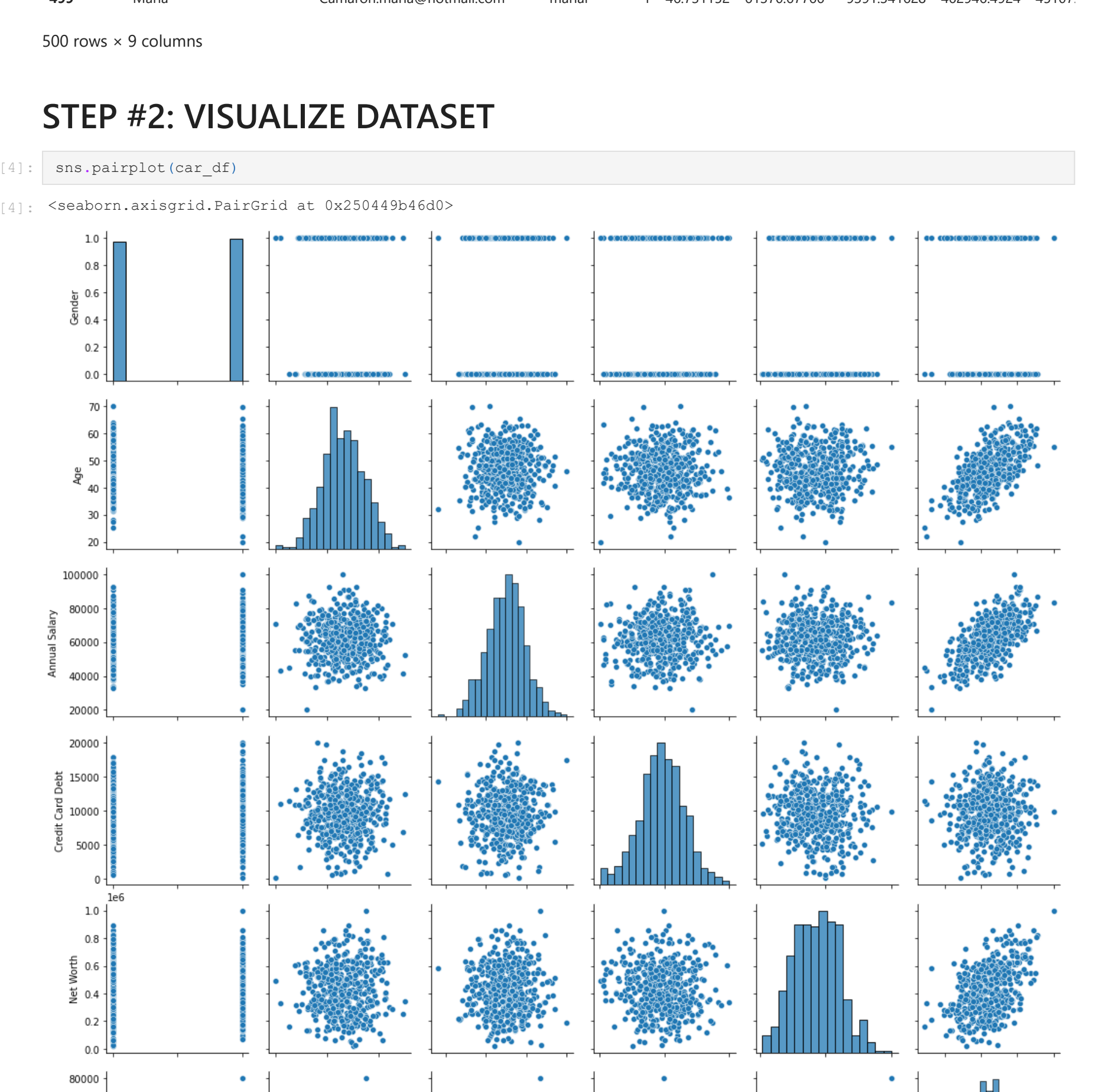
	Customer Name	Customer e-mail	Country	Gender	Age	Annual Salary	Credit Card Debt	Net Worth	Pu Ar
0	Martina Avila	cubilia.Curae.Phasellus@quisaccumsanconvallis.edu	Bulgaria	0	41.851720	62812.09301	11609.380910	238961.2505	35321.
1	Harlan Barnes	eu.dolor@diam.co.uk	Belize	0	40.870623	66646.89292	9572.957136	530973.9078	45115.
2	Naomi Rodriquez	vulputate.mauris.sagittis@ametconsectetueradip...	Algeria	1	43.152897	53798.55112	11160.355060	638467.1773	42925.
3	Jade Cunningham	malesuada@dignissim.com	Cook Islands	1	58.271369	79370.03798	14426.164850	548599.0524	67422.
4	Cedric Leach	felis.ullamcorper.viverra@egetmollislectus.net	Brazil	1	57.313749	59729.15130	5358.712177	560304.0671	55915.
...	...	...	...	...	...	...	...	...	
495	Walter	ligula@Cumsociis.ca	Nepal	0	41.462515	71942.40291	6995.902524	541670.1016	48901.
496	Vanna	Cum.sociis.natoque@Sedmolestie.edu	Zimbabwe	1	37.642000	56039.49793	12301.456790	360419.0988	31491.
497	Pearl	penatibus.et@massanonante.com	Philippines	1	53.943497	68888.77805	10611.606860	764531.3203	64147.
498	Nell	Quisque.varius@arcuVivamussit.net	Botswana	1	59.160509	49811.99062	14013.034510	337826.6382	45442.
499	Marla	Camaron.marla@hotmail.com	marlal	1	46.731152	61370.67766	9391.341628	462946.4924	45107.

500 rows × 9 columns

STEP #2: VISUALIZE DATASET

In [4]:
```
sns.pairplot(car_df)
```

Out[4]: <seaborn.axisgrid.PairGrid at 0x250449b46d0>



STEP #3: CREATE TESTING AND TRAINING DATASET/DATA CLEANING

In [5]:
```
X = car_df.drop(['Customer Name', 'Customer e-mail', 'Country', 'Car Purchase Amount'], axis = 1)
```

In [ ]:

In [6]:
```
X
```

Out[6]:

	Gender	Age	Annual Salary	Credit Card Debt	Net Worth
0	0	41.851720	62812.09301	11609.380910	238961.2505
1	0	40.870623	66646.89292	9572.957136	530973.9078
2	1	43.152897	53798.55112	11160.355060	638467.1773
3	1	58.271369	79370.03798	14426.164850	548599.0524
4	1	57.313749	59729.15130	5358.712177	560304.0671
...	...	...	...	...	...
495	0	41.462515	71942.40291	6995.902524	541670.1016
496	1	37.642000	56039.49793	12301.456790	360419.0988
497	1	53.943497	68888.77805	10611.606860	764531.3203
498	1	59.160509	49811.99062	14013.034510	337826.6382
499	1	46.731152	61370.67766	9391.341628	462946.4924

500 rows × 5 columns

In [7]:
```
y = car_df['Car Purchase Amount']
y.shape
```

Out[7]: (500,)

In [8]:
```
from sklearn.preprocessing import MinMaxScaler

scaler_x = MinMaxScaler()
X_scaled = scaler_x.fit_transform(X)
```

In [9]:
```
scaler_x.data_max_
```

Out[9]: array([1.e+00, 7.e+01, 1.e+05, 2.e+04, 1.e+06])

In [10]:
```
scaler_x.data_min_
```

Out[10]: array([0.,   20., 20000.,   100., 20000.])

In [11]:
```
print(X_scaled)
```

```
[[0.         0.4370344  0.53515116 0.57836085 0.22342985]
 [0.         0.41741247 0.58308616 0.476028   0.52140195]
 [1.         0.46305795 0.42248189 0.55579674 0.63108896]
 ...
 [1.         0.67886994 0.61110973 0.52822145 0.75972584]
 [1.         0.78321017 0.37264988 0.69914746 0.3243129 ]
 [1.         0.53462305 0.51713347 0.46690159 0.45198622]]
```

In [12]:
```
X_scaled.shape
```

Out[12]: (500, 5)

In [13]:
```
y.shape
```

Out[13]: (500,)

In [14]:
```
y = y.values.reshape(-1,1)
```

In [15]:
```
y.shape
```

Out[15]: (500, 1)

In [16]:
```
y
```

Out[16]:
```
array([[35321.45877],
       [45115.52566],
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```

In [17]:
```
scaler_y = MinMaxScaler()

y_scaled = scaler_y.fit_transform(y)
```

In [18]:
```
y_scaled
```

```
Out[18]: array([[0.37072477],
       [0.50866938],
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```

STEP#4: TRAINING THE MODEL

```
In [19]: from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y_scaled, test_size = 0.25)
```

```
In [20]: import tensorflow.keras
from keras.models import Sequential
from keras.layers import Dense
from sklearn.preprocessing import MinMaxScaler

model = Sequential()
model.add(Dense(25, input_dim=5, activation='relu'))
model.add(Dense(25, activation='relu'))
model.add(Dense(1, activation='linear'))
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 25)                150
_________________________________________________________________
dense_1 (Dense)              (None, 25)                650
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 26
=================================================================
Total params: 826
Trainable params: 826
Non-trainable params: 0
_________________________________________________________________
```

```
In [21]: model.compile(optimizer='adam', loss='mean_squared_error')
```

```
In [22]: epochs_hist = model.fit(X_train, y_train, epochs=20, batch_size=25,  verbose=1, validation_split=0.2)
```

```
Epoch 1/20
12/12 [==============================] - 1s 16ms/step - loss: 0.1013 - val_loss: 0.0337
Epoch 2/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0253 - val_loss: 0.0158
Epoch 3/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0189 - val_loss: 0.0167
Epoch 4/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0162 - val_loss: 0.0117
Epoch 5/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0136 - val_loss: 0.0098
Epoch 6/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0118 - val_loss: 0.0080
Epoch 7/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0094 - val_loss: 0.0064
Epoch 8/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0075 - val_loss: 0.0048
Epoch 9/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0063 - val_loss: 0.0039
Epoch 10/20
12/12 [==============================] - 0s 5ms/step - loss: 0.0052 - val_loss: 0.0033
Epoch 11/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0043 - val_loss: 0.0029
Epoch 12/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0037 - val_loss: 0.0025
Epoch 13/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0032 - val_loss: 0.0022
Epoch 14/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0028 - val_loss: 0.0020
Epoch 15/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0026 - val_loss: 0.0019
Epoch 16/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0023 - val_loss: 0.0018
Epoch 17/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0021 - val_loss: 0.0016
Epoch 18/20
12/12 [==============================] - 0s 3ms/step - loss: 0.0019 - val_loss: 0.0015
Epoch 19/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0018 - val_loss: 0.0015
Epoch 20/20
12/12 [==============================] - 0s 4ms/step - loss: 0.0016 - val_loss: 0.0014
```

STEP#5: EVALUATING THE MODEL

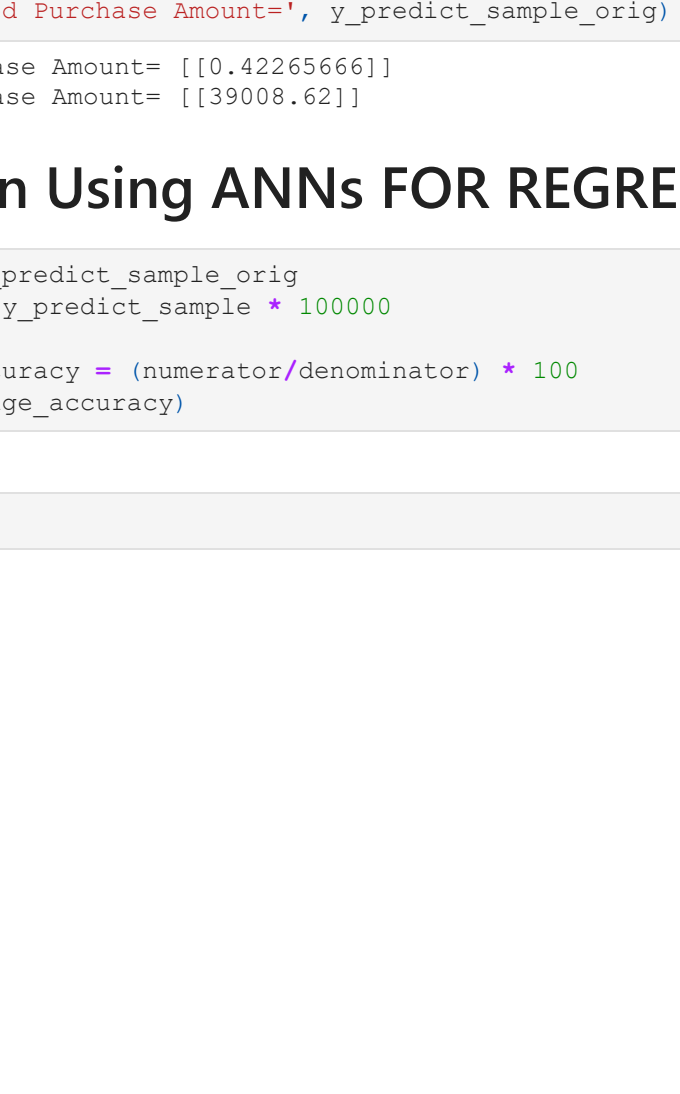
```
In [23]: print(epochs_hist.history.keys())
```

```
dict_keys(['loss', 'val_loss'])
```

```
In [24]: plt.plot(epochs_hist.history['loss'])
plt.plot(epochs_hist.history['val_loss'])

plt.title('Model Loss Progression During Training/Validation')
plt.ylabel('Training and Validation Losses')
plt.xlabel('Epoch Number')
plt.legend(['Training Loss', 'Validation Loss'])
```

```
Out[24]: <matplotlib.legend.Legend at 0x25050d00280>
```




```
In [25]: # Gender, Age, Annual Salary, Credit Card Debt, Net Worth

# ***(Note that input data must be normalized)***

X_test_sample = np.array([[0, 0.4370344,  0.53515116, 0.57836085, 0.22342985]])
#X_test_sample = np.array([[1, 0.53462305, 0.51713347, 0.46690159, 0.45198622]])

y_predict_sample = model.predict(X_test_sample)

print('Expected Purchase Amount=', y_predict_sample)
y_predict_sample_orig = scaler_y.inverse_transform(y_predict_sample)
print('Expected Purchase Amount=', y_predict_sample_orig)
```

```
Expected Purchase Amount= [[0.42265666]]
Expected Purchase Amount= [[39008.62]]
```

Prediction Using ANNs FOR REGRESSION TASKS!

```
In [26]: numerator = y_predict_sample_orig
denominator = y_predict_sample * 100000

percentage_accuracy = (numerator/denominator) * 100
print(percentage_accuracy)
```

```
[[92.29387637]]
```

```
In [ ]:
```