AD450 Final Exam

Brandan Owens and Loan Pham

Q.1

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import LogisticRegression
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.metrics import accuracy_score
from sklearn.cluster import KMeans
from sklearn.decomposition import PCA
from sklearn.svm import SVC
from scipy import io
```

In [2]:

```
# q.1.a Read in the dataset “kc_house_data.csv”
df = pd.read_csv("../dataFiles/kc_house_data.csv")
df.head()
```

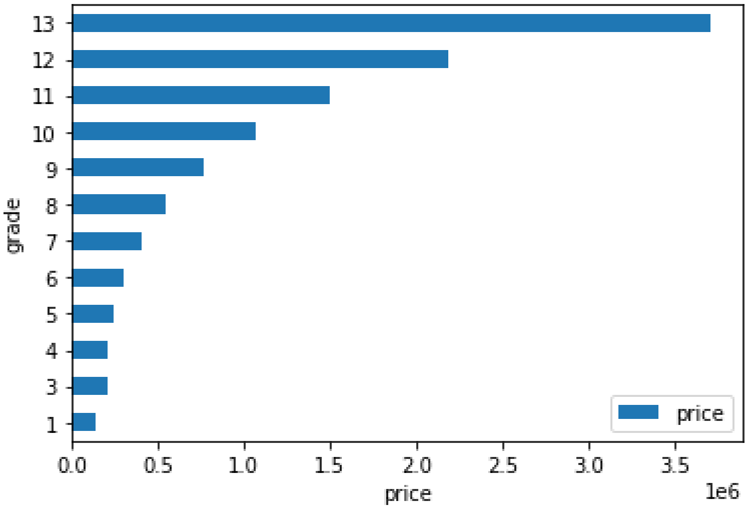
Out[2]:

	price	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	condition	grade	sqft
0	221900	3	1.00	1180	5650	1.0	0	0	3	7	
1	538000	3	2.25	2570	7242	2.0	0	0	3	7	
2	180000	2	1.00	770	10000	1.0	0	0	3	6	
3	604000	4	3.00	1960	5000	1.0	0	0	5	7	
4	510000	3	2.00	1680	8080	1.0	0	0	3	8	

In [3]:

```
# q.1.b First, use groupby to find the average price for each grade of houses. The

grouped_df = df.groupby("grade").mean().reset_index()
new_table = grouped_df[['grade', 'price']].set_index('grade').plot.barh().set_xlab
```



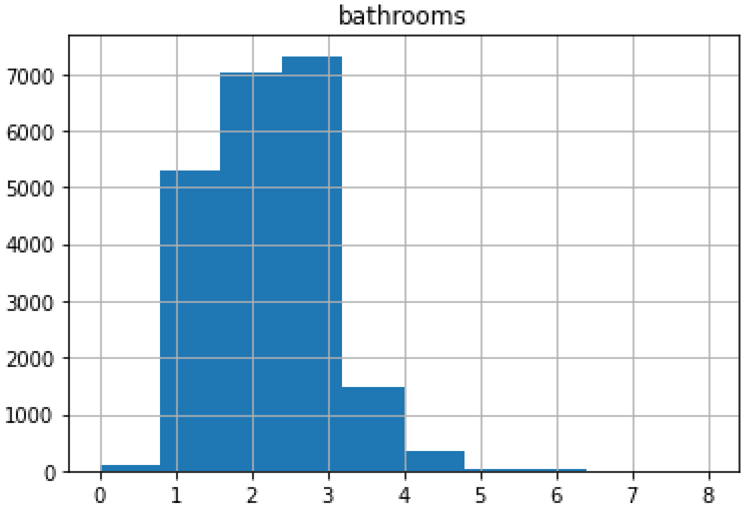
In [4]:

```
# q.1.c Plot a histogram on “bathrooms”

df.hist(column=["bathrooms"])
```

Out[4]:

```
array([[<AxesSubplot:title={'center':'bathrooms'}>]], dtype=object)
```



In [5]:

```
# q.1.d Create a correlation matrix.
corr = df.corr()
corr.head()
```

Out[5]:

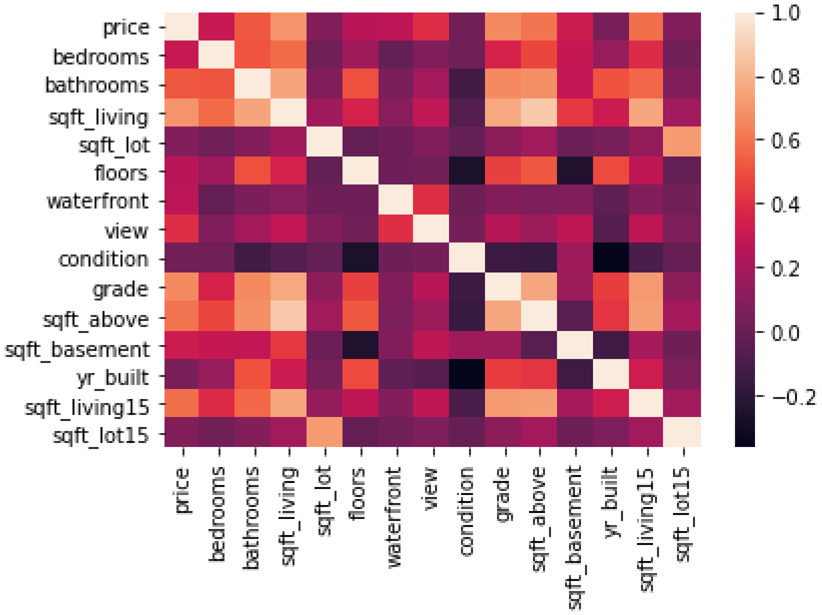
	price	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	con
price	1.000000	0.308350	0.525138	0.702035	0.089661	0.256794	0.266369	0.397293	0.0
bedrooms	0.308350	1.000000	0.515884	0.576671	0.031703	0.175429	-0.006582	0.079532	0.0
bathrooms	0.525138	0.515884	1.000000	0.754665	0.087740	0.500653	0.063744	0.187737	-0.1
sqft_living	0.702035	0.576671	0.754665	1.000000	0.172826	0.353949	0.103818	0.284611	-0.0
sqft_lot	0.089661	0.031703	0.087740	0.172826	1.000000	-0.005201	0.021604	0.074710	-0.0

In [6]:

```
# q.1.d.cont Plot the heatmap from the correltation matrix.
sns.heatmap(corr)
```

Out[6]:

```
<AxesSubplot:>
```



In [7]:

```
# q.1.e Check for any missing values in the dataframe.
df.isnull().any()
```

Out[7]:

```
price            False
bedrooms         False
bathrooms        False
sqft_living      False
sqft_lot         False
floors           False
waterfront       False
view             False
condition        False
grade            False
sqft_above       False
sqft_basement    False
yr_built         False
sqft_living15    False
sqft_lot15       False
dtype: bool
```

In [8]:

```
# q.1.f Set y = price and all other features to be X. Split your data into trainir

y = 'price'
drop_price = df.drop(y, axis=1)
y = df['price']
x = drop_price
Xtrain, Xtest, ytrain, ytest = train_test_split(x,y, test_size=0.2)
```

In [9]:

```
# q.1.g Set up a LinearRegression Model. Train your model with training set.
model = LinearRegression()
model.fit(Xtrain, ytrain)
LinearRegression()
```

```
Out[9]: LinearRegression()
```

```
In [10]:
# q.1.h Show the coefficients on all features using model.coef_.
model.coef_
```

```
Out[10]: array([-3.75921152e+04,  4.83970468e+04,  1.05957354e+02, -6.83741413e-03,
                 2.50731723e+04,  6.12044378e+05,  4.45270574e+04,  1.77175289e+04,
                 1.21486981e+05,  5.11463624e+01,  5.48109917e+01, -3.62309255e+03,
                 2.43499117e+01, -5.40664123e-01])
```

```
In [11]:
# q.1.i Predict housing price using testing data. Compute the root mean squared er
y_pred =  model.predict(Xtest)
mse = mean_squared_error(y_pred, ytest)
error = np.sqrt(mse)
error
```

```
Out[11]: 216185.47760654907
```

Q.2

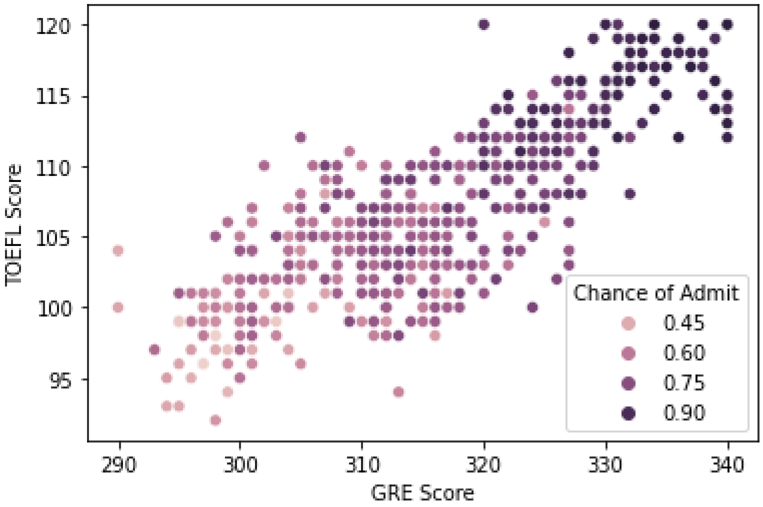
```
In [12]:
# q.2 Read in the dataset 'Admission_Predict.csv' and name it 'df'.
df = pd.read_csv("../dataFiles/Admission_Predict.csv")
df.head(10)
```

Out[12]:

	GRE Score	TOEFL Score	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
5	330	115	5	4.5	3.0	9.34	1	0.90
6	321	109	3	3.0	4.0	8.20	1	0.75
7	308	101	2	3.0	4.0	7.90	0	0.68
8	302	102	1	2.0	1.5	8.00	0	0.50
9	323	108	3	3.5	3.0	8.60	0	0.45

```
In [13]:
# q.2.a Recreate the following scatter plot where x = “GRE score”, y = “TOEFL scor
sns.scatterplot(data=df, x='GRE Score', y='TOEFL Score', hue='Chance of Admit')
```

```
Out[13]: <AxesSubplot:xlabel='GRE Score', ylabel='TOEFL Score'>
```

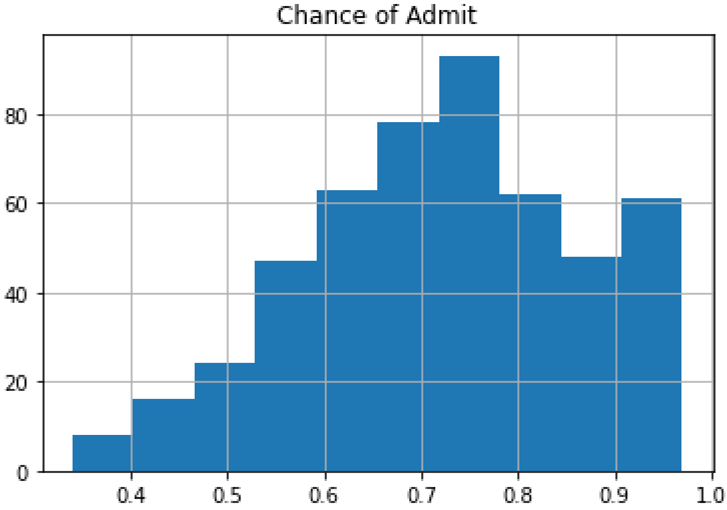


In [14]:

```
# q.2.b Recreate the following histogram for 'Chance of Admit'
df.hist(column='Chance of Admit')
```

Out[14]:

```
array([[<AxesSubplot:title={'center':'Chance of Admit'}>]], dtype=object)
```

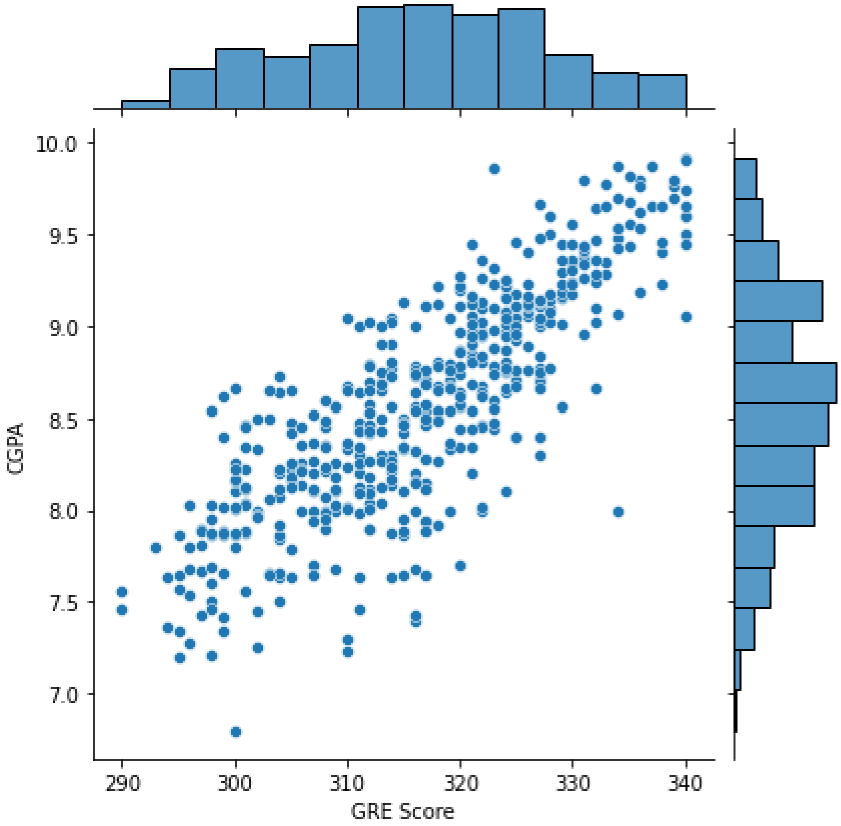


In [15]:

```
# q.2.c Recreate the following jointplot between x='GRE Score' and y='CGPA'.
sns.jointplot(data=df, x='GRE Score', y='CGPA')
```

Out[15]:

```
<seaborn.axisgrid.JointGrid at 0x23d80aa36d0>
```

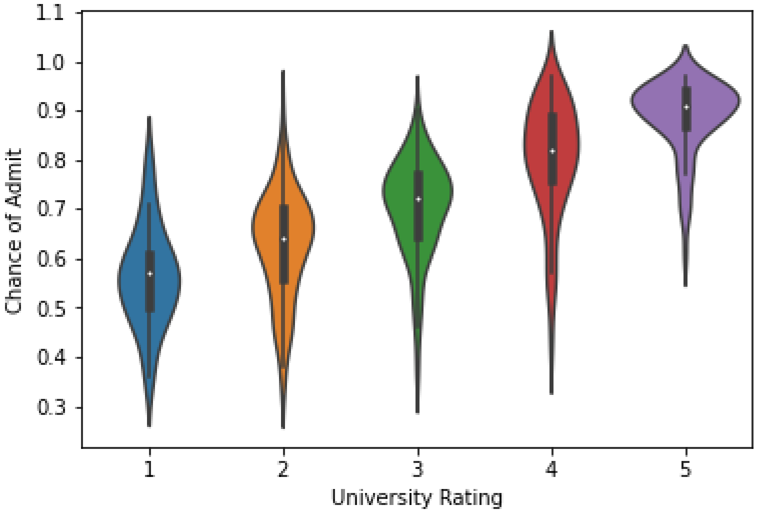


In [16]:

```python
# q.2.d Create a violin plot on 'Chance of Admit' for each group of 'University Ra
sns.violinplot(data=df, x='University Rating', y='Chance of Admit')
```

Out[16]:

```
<AxesSubplot:xlabel='University Rating', ylabel='Chance of Admit'>
```



In [17]:

```python
# q.2.e Create a new datafram, df2, by dropping the 'Chance of Admit' column.
df2 = df.drop('Chance of Admit', axis=1)
df2.head(10)
```

Out[17]:

	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research
0	337	118	4	4.5	4.5	9.65	1
1	324	107	4	4.0	4.5	8.87	1

	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research
2	316	104	3	3.0	3.5	8.00	1
3	322	110	3	3.5	2.5	8.67	1
4	314	103	2	2.0	3.0	8.21	0
5	330	115	5	4.5	3.0	9.34	1
6	321	109	3	3.0	4.0	8.20	1
7	308	101	2	3.0	4.0	7.90	0
8	302	102	1	2.0	1.5	8.00	0
9	323	108	3	3.5	3.0	8.60	0

In [18]:

```
# q.2.f In df2, group the data into 3 clusters. Use K-Means clustering.
kmeans = KMeans(n_clusters=3)
```

In [19]:

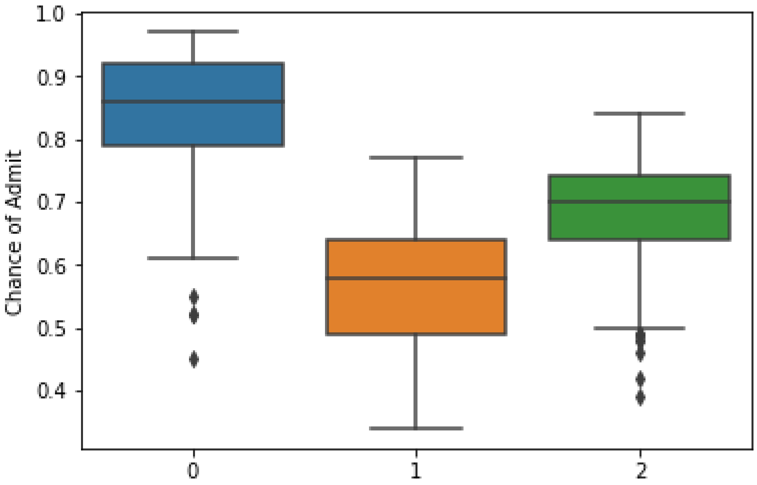
```
# q.2.g In df2, create a new column 'cluster' by predicting the cluster for each r
kmeans.fit(df2)
cluster = kmeans.predict(df2)
```

In [20]:

```
# q.2.h Put the column 'cluster' in the original dataframe, df. Create a boxplot c
df['cluster'] = cluster
sns.boxplot(data=df,x=cluster,y='Chance of Admit')
```

Out[20]:

```
<AxesSubplot:ylabel='Chance of Admit'>
```



Q.3

In this question, you will train a random forest classifier to recognize a digit in an image.

In [21]:

```
#q.3.a Save the file 'train_32x32.mat' in your working directory. Then, use the fo
train_data = io.loadmat('../dataFiles/train_32x32.mat')
```

```
X = train_data['X']
y = train_data['y']
```

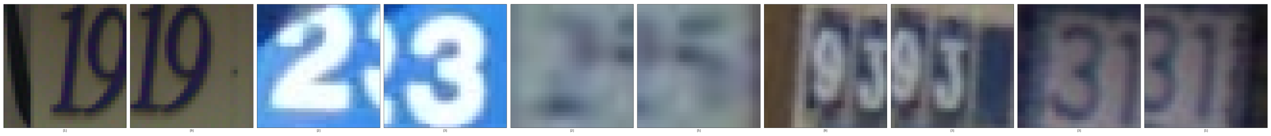
In [22]:

```
# q.3.b Show the first 10 images. Also, put the corresponding target as the xlabel
# Hint:
#To display image, use
#       ax[i].imshow(X[:,:,:,i])
#To set the xlabel, use
#       ax[i].set(xlabel=y[i])
fig, ax = plt.subplots(1, 10, figsize=(64, 64))

for i, axi in enumerate(ax.flat):
    axi.imshow(X[:, :, :, i])
    axi.set(xlabel=y[i])
    axi.set(xticks=[], yticks=[])

plt.tight_layout()
```

```
C:\Users\jeric\miniconda3\lib\site-packages\matplotlib\text.py:1165: FutureWarnin
g: elementwise comparison failed; returning scalar instead, but in the future will
perform elementwise comparison
  if s != self._text:
```



In [23]:

```
# q.3.c Reshape X and y using the following codes
X = X.reshape(X.shape[0]*X.shape[1]*X.shape[2], X.shape[3]).T
y = y.reshape(y.shape[0], )
```

In [24]:

```
# q.3.d Split the data into training set and testing set.
X_train, X_test, y_train, y_test = train_test_split(X,y)
```

In [25]:

```
# q.3.e Set up a RandomForestClassifier model and train the model with the trainir
model = RandomForestClassifier(n_estimators=100)
model.fit(X_train, y_train)
```

Out[25]:

```
RandomForestClassifier()
```

In [26]:

```
# q.3.f Making predictions with the testing data. Find the accuracy score.
y_pred = model.predict(X_test)
accuracy_score(y_test, y_pred)
```

Out[26]:

```
0.7007917007917008
```