KNN Classifier

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Importing all the needed modules :

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sb
from sklearn import preprocessing, neighbors, model_selection, metrics
```

Data Reading

In [3]:
```
df = pd.read_csv("/Users/devmarwah/Downloads/UniversalBank.csv")
```

Printing head and shape of the data to have a look at it :

In [4]:
```
df.head()
```

Out[4]:

	ID	Age	Experience	Income	ZIP Code	Family	CCAvg	Education	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard
0	1	25	1	49	91107	4	1.6	1	0	0	1	0	0	0
1	2	45	19	34	90089	3	1.5	1	0	0	1	0	0	0
2	3	39	15	11	94720	1	1.0	1	0	0	0	0	0	0
3	4	35	9	100	94112	1	2.7	2	0	0	0	0	0	0
4	5	35	8	45	91330	4	1.0	2	0	0	0	0	0	1

In [5]:
```
df.shape
```

Out[5]:
```
(5000, 14)
```

Data Preparation

We will be dropping ID and ZIP code since they are irrelavent to the target variable **Personal Loan**

In [6]:
```
df.drop(["ID","ZIP Code"], axis=1,inplace = True)
```

In [7]:
```
df.head()
```

Out[7]:

	Age	Experience	Income	Family	CCAvg	Education	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard
0	25	1	49	4	1.6	1	0	0	1	0	0	0
1	45	19	34	3	1.5	1	0	0	1	0	0	0
2	39	15	11	1	1.0	1	0	0	0	0	0	0
3	35	9	100	1	2.7	2	0	0	0	0	0	0
4	35	8	45	4	1.0	2	0	0	0	0	0	1

Here, the factor education has more than 2 categories (3). Therefore, we need to convert it into dummy variables for Knn algorithm to be able to work the right way.

In [8]:
```
df.dtypes
```

Out[8]:
```
Age                    int64
Experience             int64
Income                 int64
Family                 int64
CCAvg                float64
Education              int64
Mortgage               int64
Personal Loan          int64
Securities Account     int64
CD Account             int64
Online                 int64
CreditCard             int64
dtype: object
```

We need to be converting Education to a cateorical variable to convert it into dummy variables.

In [10]:
```
df["Education"] = df["Education"].astype("category")
df["Education"].dtype
```

Out[10]:
```
CategoricalDtype(categories=[1, 2, 3], ordered=False)
```

In [15]:
```
df.dtypes
```

Out[15]:
```
Age                    int64
Experience             int64
Income                 int64
Family                 int64
CCAvg                  int64
Mortgage               int64
Personal Loan          int64
Securities Account     int64
CD Account             int64
Online                 int64
CreditCard             int64
Education_1            int64
Education_2            int64
Education_3            int64
dtype: object
```

In [11]:
```
df=pd.get_dummies(df,"Education").astype("int")
```

Verifying dummies by displaying head of the dataframe :

In [12]:
```
df.head()
```

Out[12]:

	Age	Experience	Income	Family	CCAvg	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard	Education_1	Education_2	Education_3
0	25	1	49	4	1	0	0	1	0	0	0	1	0	0
1	45	19	34	3	1	0	0	1	0	0	0	1	0	0
2	39	15	11	1	1	0	0	0	0	0	0	1	0	0
3	35	9	100	1	2	0	0	0	0	0	0	0	1	0
4	35	8	45	4	1	0	0	0	0	0	1	0	1	0

We can observe above that the factor "Education" has been converted to three dummy variables.

Normalizing Data

In [17]:
```
df_norm = pd.DataFrame(preprocessing.StandardScaler().fit_transform(df.iloc[:,np.r_[0:6,7:11]]))
```

In [19]:
```
df.iloc[:,np.r_[0:6,7:11]] = df_norm
```

In [20]:
```
df.head()
```

Out[20]:

	Age	Experience	Income	Family	CCAvg	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard	Education_1	Education_2	Education_3
0	-1.774417	-1.666078	-0.538229	1.397414	-0.295024	-0.555524	0	2.928915	-0.25354	-1.216618	-0.645314	1	0	0
1	-0.029524	-0.096330	-0.864109	0.525991	-0.295024	-0.555524	0	2.928915	-0.25354	-1.216618	-0.645314	1	0	0
2	-0.552992	-0.445163	-1.363793	-1.216855	-0.295024	-0.555524	0	-0.341423	-0.25354	-1.216618	-0.645314	1	0	0
3	-0.901970	-0.968413	0.569765	-1.216855	0.279176	-0.555524	0	-0.341423	-0.25354	-1.216618	-0.645314	0	1	0
4	-0.901970	-1.055621	-0.625130	1.397414	-0.295024	-0.555524	0	-0.341423	-0.25354	-1.216618	1.549632	0	1	0

Model Construction

Splitting data into training and testing data :

In [23]:
```
x = np.array(df.drop("Personal Loan",axis=1))
y = np.array(df["Personal Loan"])
t=model_selection.train_test_split
x_train,x_test, y_train ,y_test = t(x,y,test_size=0.2,random_state=2)
```

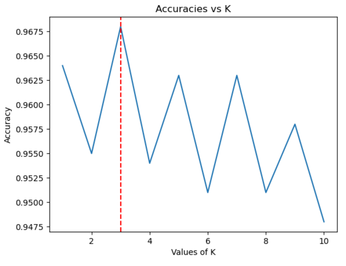
Training model for a range of k to find the optimal value of k

In [28]:
```
# Setting a range of values for k
k_values = range(1,11)
# Making empty list for accuracies
accuracies = []
# Training the model
for k in k_values:
    clf=neighbors.KNeighborsClassifier(n_neighbors = k)
    clf.fit(x_train,y_train)
    accuracy = clf.score(x_test,y_test)
    accuracies.append(accuracy)
```

Plotting accuracies vs k values to get the optimal value of k

In [30]:
```
plt.plot(k_values,accuracies)
plt.title("Accuracies vs K")
plt.xlabel("Values of K")
plt.ylabel("Accuracy")
plt.axvline(x=3,color="r",linestyle="--")
```

Out[30]:
```
<matplotlib.lines.Line2D at 0x16752e690>
```



Highest accuracy is for the value of k so we will train our model for k=3

In [31]:
```
clf=neighbors.KNeighborsClassifier(n_neighbors=3)
clf.fit(x_train,y_train)
```

Out[31]:
```
KNeighborsClassifier(n_neighbors=3)
```

Finding accuracy of the model

In [33]:
```
print("Accuracy :",clf.score(x_test,y_test))
```

```
Accuracy : 0.968
```

Hence, our model is 96.8% accurate

Making predictions using this model

In [34]:
```
p = clf.predict(x_test)
```

Making confusion matrix of final results :

In [37]:
```
cm = metrics.confusion_matrix(y_test,p)
plt.figure()
sb.heatmap(cm,cmap="Blues",xticklabels=["0","1"],yticklabels=["0","1"],annot=True)
plt.xlabel("Actual Values")
plt.ylabel("Predicted Values")
```

Out[37]:
```
Text(50.722222222222214, 0.5, 'Predicted Values')
```