# Gerry William Nanlohy / 2440018854 / LB01 / Assignment 07

Importing Data from Various Sources

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

Reading Excel Files

In [2]:
```
dataset = pd.read_csv('Social_Network_Ads.csv')
dataset.head()
```

Out[2]:

| | Age | EstimatedSalary | Purchased |
|---|---|---|---|
| **0** | 19 | 19000 | 0 |
| **1** | 35 | 20000 | 0 |
| **2** | 26 | 43000 | 0 |
| **3** | 27 | 57000 | 0 |
| **4** | 19 | 76000 | 0 |

In [3]:
```
dataset.shape
```

Out[3]:
```
(400, 3)
```

Data Reading

In [4]:
```
dataset.describe()
```

Out[4]:

| | Age | EstimatedSalary | Purchased |
|---|---|---|---|
| **count** | 400.000000 | 400.000000 | 400.000000 |
| **mean** | 37.655000 | 69742.500000 | 0.357500 |
| **std** | 10.482877 | 34096.960282 | 0.479864 |
| **min** | 18.000000 | 15000.000000 | 0.000000 |
| **25%** | 29.750000 | 43000.000000 | 0.000000 |
| **50%** | 37.000000 | 70000.000000 | 0.000000 |
| **75%** | 46.000000 | 88000.000000 | 1.000000 |
| **max** | 60.000000 | 150000.000000 | 1.000000 |

In [5]:
```
print(dataset)
```

```
     Age  EstimatedSalary  Purchased
0     19            19000          0
1     35            20000          0
2     26            43000          0
3     27            57000          0
4     19            76000          0
..   ...              ...        ...
395   46            41000          1
396   51            23000          1
397   50            20000          1
398   36            33000          0
399   49            36000          1

[400 rows x 3 columns]
```

In [6]:
```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 3 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   Age              400 non-null    int64
 1   EstimatedSalary  400 non-null    int64
 2   Purchased        400 non-null    int64
dtypes: int64(3)
memory usage: 9.5 KB
```

In [7]:
```
dataset.dtypes
```

Out[7]:
```
Age                int64
EstimatedSalary    int64
Purchased          int64
dtype: object
```

In [8]:
```
dataset.isnull().sum()
```

Out[8]:
```
Age                0
EstimatedSalary    0
Purchased          0
dtype: int64
```

Data Processing

In [9]:
```
x = dataset.iloc[:, :-1]
y = dataset.iloc[:, -1]
```

In [10]:
```
x.head()
```

Out[10]:

| | Age | EstimatedSalary |
|---|---|---|
| **0** | 19 | 19000 |
| **1** | 35 | 20000 |
| **2** | 26 | 43000 |
| **3** | 27 | 57000 |
| **4** | 19 | 76000 |

In [11]:
```
y.head()
```

Out[11]:
```
0    0
1    0
2    0
3    0
4    0
Name: Purchased, dtype: int64
```

In [12]:
```
from sklearn.model_selection import train_test_split
```

In [13]:
```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state=0)
print ('Training set : ', x_train.shape, y_train.shape)
print ('Testing set : ', x_test.shape, y_test.shape)
```

```
Training set :  (320, 2) (320,)
Testing set :  (80, 2) (80,)
```

In [14]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [15]:
```
sc = MinMaxScaler()
x_train_scaled = sc.fit_transform(x_train)
x_test_scaled = sc.fit_transform(x_test)
```

In [16]:
```
x_train_scaled_dataset = pd.DataFrame(x_train_scaled, columns = x_train.columns)
x_test_scaled_dataset = pd.DataFrame(x_test_scaled, columns = x_test.columns)
```

Predict Purchased (1) or Not Purchased (0) using K-NN Classifier with Minkowski Distance Metric.

In [17]:
```
from sklearn.neighbors import KNeighborsClassifier
```

In [18]:
```
model = KNeighborsClassifier(n_neighbors = 4, metric = 'minkowski')
model.fit(x_train_scaled, y_train)
y_pred = model.predict(x_test_scaled)
```

In [19]:
```
from sklearn.metrics import accuracy_score
```

In [20]:
```
print('Accuracy Score : ', accuracy_score(y_test, y_pred))
```

```
Accuracy Score :  0.95
```

In [21]:
```
from sklearn import metrics
```

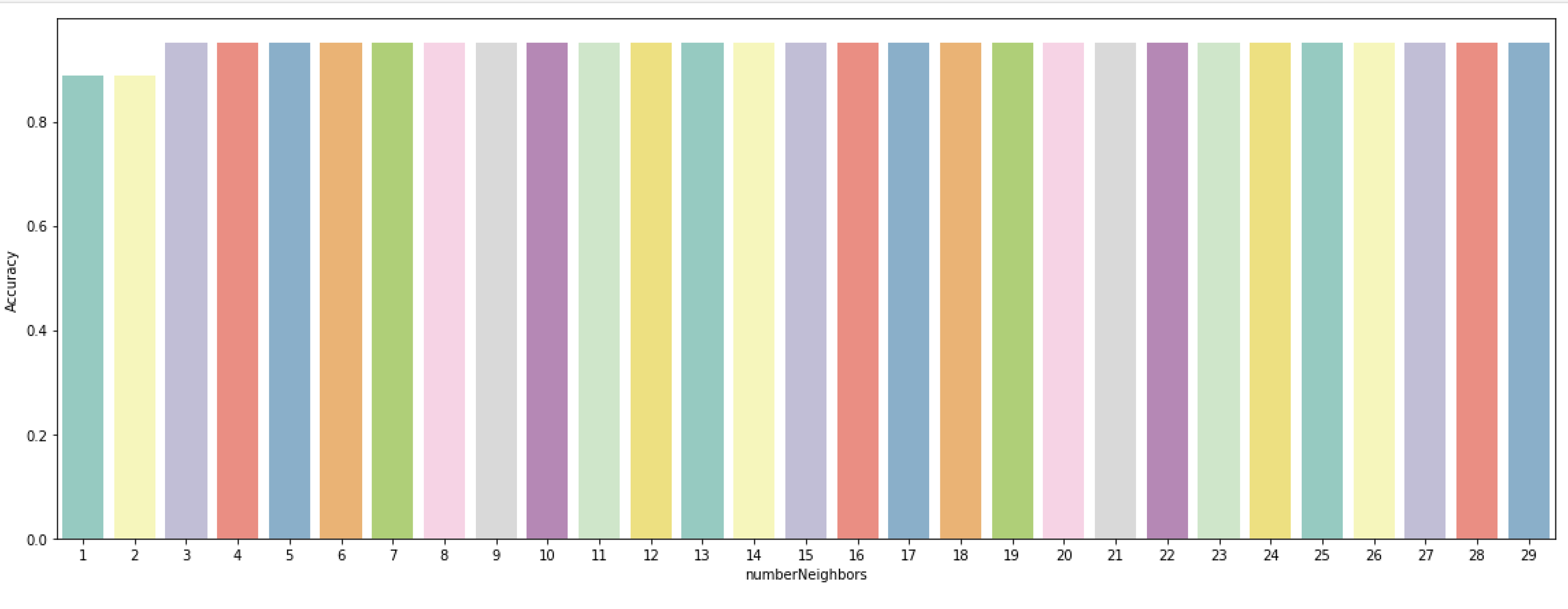
In [22]:
```
Ks = 30
mean_acc = np.zeros((Ks-1))
std_acc = np.zeros((Ks-1))
ConfustionMx = [];
for n in range(1,Ks):

    neigh = KNeighborsClassifier(n_neighbors = n).fit(x_train_scaled, y_train)
    y_pred=neigh.predict(x_test_scaled)
    mean_acc[n-1] = metrics.accuracy_score(y_test, y_pred)
    std_acc[n-1] = np.std(y_pred == y_test)/np.sqrt(y_pred.shape[0])
```

In [23]:
```
print(mean_acc)
```

```
[0.8875 0.8875 0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95
 0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95
 0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95   0.95  ]
```

In [24]:
```
k_accuracy = pd.DataFrame()
k_accuracy['numberNeighbors'] = range(1, Ks)
k_accuracy['Accuracy'] = mean_acc
```

In [25]:
```
plt.figure(figsize=(16, 6))
plt.xlabel('Number of Neighbors')
plt.ylabel('Accuracy Score')
sns.barplot(x=k_accuracy['numberNeighbors'], y=k_accuracy['Accuracy'], data=k_accuracy, palette='Set3')
plt.tight_layout()
plt.show()
```




In [26]:
```
final_model = KNeighborsClassifier(n_neighbors = 4, metric ='minkowski')
final_model.fit(x_train_scaled, y_train)
y_pred = final_model.predict(x_test_scaled)
```

In [27]:
```
print('Final Accuracy Score : ', accuracy_score(y_test, y_pred))
```

```
Final Accuracy Score :  0.95
```

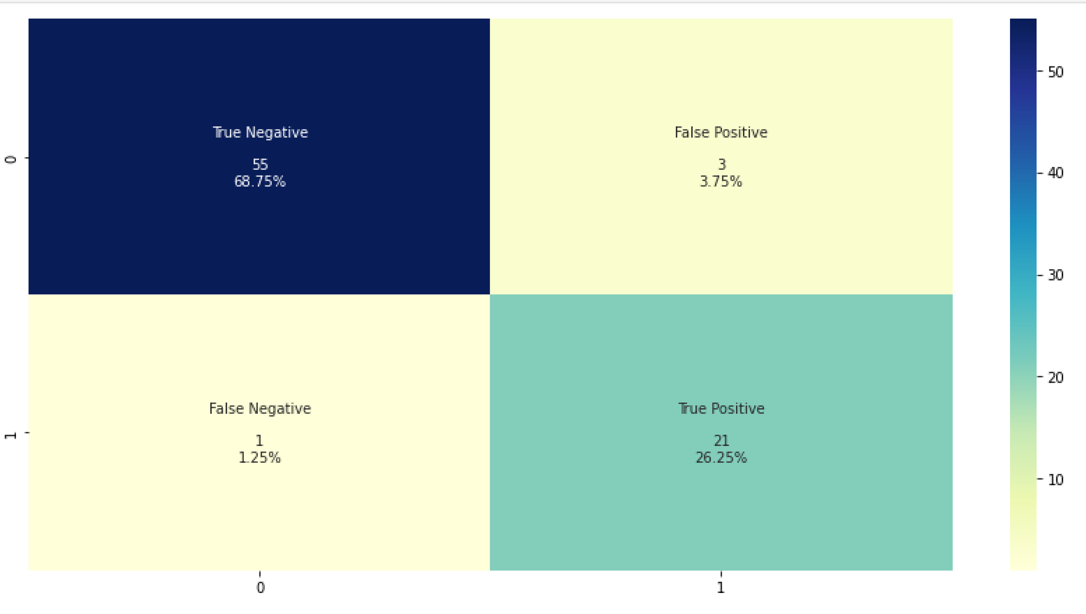
Calculated Accuracy Score using Confusion Matrix

In [28]:
```
from sklearn.metrics import confusion_matrix
```

In [29]:
```
cf_matrix = confusion_matrix(y_test, y_pred)
print(cf_matrix)
```

```
[[55  3]
 [ 1 21]]
```

In [30]:
```
plt.figure(figsize=(12, 6))
group_names = ['True Negative\n','False Positive\n','False Negative\n','True Positive\n']
group_counts = ['{0:0.0f}'.format(value) for value in
                cf_matrix.flatten()]
group_percentages = ['{0:.2%}'.format(value) for value in
                     cf_matrix.flatten()/np.sum(cf_matrix)]
labels = [f'{v1}\n{v2}\n{v3}' for v1, v2, v3 in
          zip(group_names, group_counts, group_percentages)]
labels = np.asarray(labels).reshape(2, 2)
sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='YlGnBu')
plt.tight_layout()
plt.show()
```




In [31]:
```
TN = 55
FP = 3
FN = 1
TP = 21
def calculateAccuracy(trueNeg, falsePos, falseNeg, truePos):
  return (trueNeg + truePos) / (trueNeg + falsePos + truePos + falseNeg)
cf_accuracy = calculateAccuracy(TN, FP, FN, TP)
```

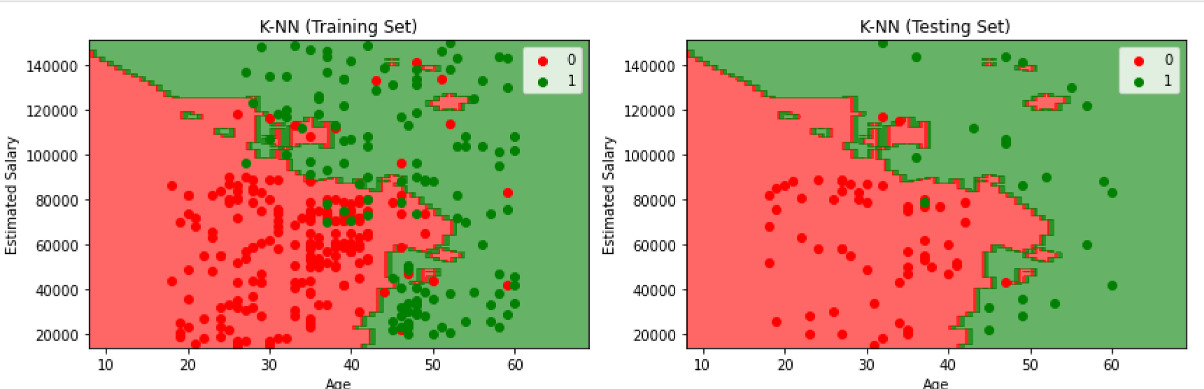
In [32]:
```
print('Confussion Matrix Accuracy Score : ', cf_accuracy)
```

```
Confussion Matrix Accuracy Score :  0.95
```

Visualising the Training and Test set results

In [33]:
```
import warnings
from matplotlib.colors import ListedColormap
```

In [34]:
```
with warnings.catch_warnings():
    warnings.simplefilter("ignore")
    plt.figure(figsize = (12,4))

    plt.subplot(1,2,1)
    x_set, y_set = sc.inverse_transform(x_train_scaled), y_train
    x1, x2 = np.meshgrid(np.arange(start = x_set[:, 0].min() - 10, stop = x_set[:, 0].max() + 10, step = 1),
                         np.arange(start = x_set[:, 1].min() - 1000, stop = x_set[:, 1].max() + 1000, step = 1))
    plt.contourf(x1, x2, final_model.predict(sc.transform(np.array([x1.ravel(), x2.ravel()]).T)).reshape(x1.shape),
                alpha = 0.6, cmap = ListedColormap(('red', 'green')))
    plt.xlim(x1.min(), x1.max())
    plt.ylim(x2.min(), x2.max())
    for i, j in enumerate(np.unique(y_set)):
      plt.scatter (x_set[y_set == j, 0], x_set[y_set == j, 1], color = ListedColormap(('red', 'green'))(i), label = j)

    plt.title('K-NN (Training Set)')
    plt.xlabel('Age')
    plt.ylabel('Estimated Salary')
    plt.legend()

    plt.subplot(1,2,2)
    x_set, y_set = sc.inverse_transform(x_test_scaled), y_test
    x1, x2 = np.meshgrid(np.arange(start = x_set[:, 0]. min() - 10, stop = x_set[:, 0].max() + 10, step = 1),
                         np.arange(start = x_set[:, 1].min() - 1000, stop = x_set[:, 1].max() + 1000, step = 1))
    plt.contourf(x1, x2, final_model.predict(sc.transform(np.array([x1.ravel(), x2.ravel()]).T)).reshape(x1.shape),
                alpha = 0.6, cmap = ListedColormap(('red', 'green')))
    plt.xlim(x1.min(), x1.max())
    plt.ylim(x2.min(), x2.max())
    for i, j in enumerate(np.unique(y_set)):
      plt.scatter(x_set[y_set == j, 0], x_set[y_set == j, 1], color = ListedColormap(('red', 'green'))(i), label = j)

    plt.title('K-NN (Testing Set)')
    plt.xlabel('Age')
    plt.ylabel('Estimated Salary')
    plt.legend()
    plt.tight_layout()
    plt.show()
```




End of Code