In [1]:
```
# K-Nearest Neighbors (K-NN)

# Importing the libraries
import os
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:
```
os.chdir("D:/My ML Simulations\My_ML_Work/Part 3 - Classification/Section 15 - K-Nearest Neighbors (K-NN)")
```

In [3]:
```
# Importing the dataset
dataset = pd.read_csv('Social_Network_Ads.csv')
X = dataset.iloc[:, [2, 3]].values
y = dataset.iloc[:, 4].values
```

```
In [36]: print(X,'dataset.iloc')
         print(y,'dataset.iloc')
```

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 1 1 0 1 0 1 0 0 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 0 1] dataset.iloc
```

```
In [14]: dataset.head(9)
```

Out[14]:

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
5	15728773	Male	27	58000	0
6	15598044	Female	27	84000	0
7	15694829	Female	32	150000	1
8	15600575	Male	25	33000	0

```
In [15]: # Splitting the dataset into the Training set and Test set
         from sklearn.model_selection import train_test_split
         X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state = 0)
```

```
In [16]: # Feature Scaling
         from sklearn.preprocessing import StandardScaler
         sc = StandardScaler()
         X_train = sc.fit_transform(X_train)
         X_test = sc.transform(X_test)
```

In [33]:
```
print(X_train,'sc.fit_transform')
```

```
[[ 0.58164944 -0.88670699]
 [-0.60673761  1.46173768]
 [-0.01254409 -0.5677824 ]
 [-0.60673761  1.89663484]
 [ 1.37390747 -1.40858358]
 [ 1.47293972  0.99784738]
 [ 0.08648817 -0.79972756]
 [-0.01254409 -0.24885782]
 [-0.21060859 -0.5677824 ]
 [-0.21060859 -0.19087153]
 [-0.30964085 -1.29261101]
 [-0.30964085 -0.5677824 ]
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 [ 0.97777845  1.78066227]
 [ 0.28455268  0.04107362]
 [-0.80480212 -0.21986468]
 [-0.11157634  0.07006676]
 [ 0.28455268 -0.19087153]
 [ 1.96810099 -0.65476184]
 [-0.80480212  1.3457651 ]
 [-1.79512465 -0.59677555]
 [-0.11157634  0.12805305]
 [ 0.28455268 -0.30684411]
 [ 1.07681071  0.56295021]
 [-1.00286662  0.27301877]
 [ 1.47293972  0.35999821]
 [ 0.18552042 -0.3648304 ]
 [ 2.1661655  -1.03167271]
 [-0.30964085  1.11381995]
 [-1.6960924   0.07006676]
 [-0.01254409  0.04107362]
 [ 0.08648817  1.05583366]
 [-0.11157634 -0.3648304 ]
 [-1.20093113  0.07006676]
 [-0.30964085 -1.3505973 ]
 [ 1.57197197  1.11381995]
 [-0.80480212 -1.52455616]
 [ 0.08648817  1.8676417 ]
 [-0.90383437 -0.77073441]
 [-0.50770535 -0.77073441]
 [-0.30964085 -0.91570013]
 [ 0.28455268 -0.71274813]
 [ 0.28455268  0.07006676]
 [ 0.08648817  1.8676417 ]
 [-1.10189888  1.95462113]
 [-1.6960924  -1.5535493 ]
 [-1.20093113 -1.089659  ]
 [-0.70576986 -0.1038921 ]
 [ 0.08648817  0.09905991]
 [ 0.28455268  0.27301877]
 [ 0.8787462  -0.5677824 ]
 [ 0.28455268 -1.14764529]
 [-0.11157634  0.67892279]
```

```
[ 2.1661655  -0.68375498]
[-1.29996338 -1.37959044]
[-1.00286662 -0.94469328]
[-0.01254409 -0.42281668]
[-0.21060859 -0.45180983]
[-1.79512465 -0.97368642]
[ 1.77003648  0.99784738]
[ 0.18552042 -0.3648304 ]
[ 0.38358493  1.11381995]
[-1.79512465 -1.3505973 ]
[ 0.18552042 -0.13288524]
[ 0.8787462  -1.43757673]
[-1.99318916  0.47597078]
[-0.30964085  0.27301877]
[ 1.86906873 -1.06066585]
[-0.4086731   0.07006676]
[ 1.07681071 -0.88670699]
[-1.10189888 -1.11865214]
[-1.89415691  0.01208048]
[ 0.08648817  0.27301877]
[-1.20093113  0.33100506]
[-1.29996338  0.30201192]
[-1.00286662  0.44697764]
[ 1.67100423 -0.88670699]
[ 1.17584296  0.53395707]
[ 1.07681071  0.53395707]
[ 1.37390747  2.331532  ]
[-0.30964085 -0.13288524]
[ 0.38358493 -0.45180983]
[-0.4086731  -0.77073441]
[-0.11157634 -0.50979612]
[ 0.97777845 -1.14764529]
[-0.90383437 -0.77073441]
[-0.21060859 -0.50979612]
[-1.10189888 -0.45180983]
[-1.20093113  1.40375139]] sc.fit_transform
```

In [35]:
```
print(X_test,'sc.fit_transform')
```

```
[[-0.80480212  0.50496393]
 [-0.01254409 -0.5677824 ]
 [-0.30964085  0.1570462 ]
 [-0.80480212  0.27301877]
 [-0.30964085 -0.5677824 ]
 [-1.10189888 -1.43757673]
 [-0.70576986 -1.58254245]
 [-0.21060859  2.15757314]
 [-1.99318916 -0.04590581]
 [ 0.8787462  -0.77073441]
 [-0.80480212 -0.59677555]
 [-1.00286662 -0.42281668]
 [-0.11157634 -0.42281668]
 [ 0.08648817  0.21503249]
 [-1.79512465  0.47597078]
 [-0.60673761  1.37475825]
 [-0.11157634  0.21503249]
 [-1.89415691  0.44697764]
 [ 1.67100423  1.75166912]
 [-0.30964085 -1.37959044]
 [-0.30964085 -0.65476184]
 [ 0.8787462   2.15757314]
 [ 0.28455268 -0.53878926]
 [ 0.8787462   1.02684052]
 [-1.49802789 -1.20563157]
 [ 1.07681071  2.07059371]
 [-1.00286662  0.50496393]
 [-0.90383437  0.30201192]
 [-0.11157634 -0.21986468]
 [-0.60673761  0.47597078]
 [-1.6960924   0.53395707]
 [-0.11157634  0.27301877]
 [ 1.86906873 -0.27785096]
 [-0.11157634 -0.48080297]
 [-1.39899564 -0.33583725]
 [-1.99318916 -0.50979612]
 [-1.59706014  0.33100506]
 [-0.4086731  -0.77073441]
 [-0.70576986 -1.03167271]
 [ 1.07681071 -0.97368642]
 [-1.10189888  0.53395707]
 [ 0.28455268 -0.50979612]
 [-1.10189888  0.41798449]
 [-0.30964085 -1.43757673]
 [ 0.48261718  1.22979253]
 [-1.10189888 -0.33583725]
 [-0.11157634  0.30201192]
 [ 1.37390747  0.59194336]
 [-1.20093113 -1.14764529]
 [ 1.07681071  0.47597078]
 [ 1.86906873  1.51972397]
 [-0.4086731  -1.29261101]
 [-0.30964085 -0.3648304 ]
 [-0.4086731   1.31677196]
 [ 2.06713324  0.53395707]
 [ 0.68068169 -1.089659  ]
 [-0.90383437  0.38899135]
 [-1.20093113  0.30201192]
 [ 1.07681071 -1.20563157]
 [-1.49802789 -1.43757673]
 [-0.60673761 -1.49556302]
 [ 2.1661655  -0.79972756]
 [-1.89415691  0.18603934]
 [-0.21060859  0.85288166]
 [-1.89415691 -1.26361786]
 [ 2.1661655   0.38899135]
 [-1.39899564  0.56295021]
 [-1.10189888 -0.33583725]
 [ 0.18552042 -0.65476184]
 [ 0.38358493  0.01208048]
 [-0.60673761  2.331532  ]
 [-0.30964085  0.21503249]
 [-1.59706014 -0.19087153]
 [ 0.68068169 -1.37959044]
 [-1.10189888  0.56295021]
 [-1.99318916  0.35999821]
 [ 0.38358493  0.27301877]
 [ 0.18552042 -0.27785096]
 [ 1.47293972 -1.03167271]
 [ 0.8787462   1.08482681]
 [ 1.96810099  2.15757314]
 [ 2.06713324  0.38899135]
 [-1.39899564 -0.42281668]
 [-1.20093113 -1.00267957]
 [ 1.96810099 -0.91570013]
 [ 0.38358493  0.30201192]
 [ 0.18552042  0.1570462 ]
 [ 2.06713324  1.75166912]
 [ 0.77971394 -0.8287207 ]
 [ 0.28455268 -0.27785096]
 [ 0.38358493 -0.16187839]
 [-0.11157634  2.21555943]
 [-1.49802789 -0.62576869]
 [-1.29996338 -1.06066585]
 [-1.39899564  0.41798449]
 [-1.10189888  0.76590222]
 [-1.49802789 -0.19087153]
 [ 0.97777845 -1.06066585]
 [ 0.97777845  0.59194336]
 [ 0.38358493  0.99784738]] sc.fit_transform
```

In [17]:
```
# Fitting K-NN to the Training set
from sklearn.neighbors import KNeighborsClassifier
classifier = KNeighborsClassifier(n_neighbors = 5, metric = 'minkowski', p = 2)
classifier.fit(X_train, y_train)
```

Out[17]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=None, n_neighbors=5, p=2,
                     weights='uniform')
```

In [18]:
```
# Predicting the Test set results
y_pred = classifier.predict(X_test)
```

In [31]:
```
print(y_pred,'classifier.predict')
```

```
[0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 0 1 0 0 1 0 1 0 1 0 0 0 0 0 0 1 0 0 0 0
 0 0 1 0 0 0 0 1 0 0 1 0 1 1 0 0 1 1 1 0 0 1 0 0 1 0 1 0 1 0 0 0 0 1 0 0 1
 0 0 0 0 1 1 1 1 0 0 1 0 0 1 1 0 0 1 0 0 0 0 0 1 1 1] classifier.predict
```

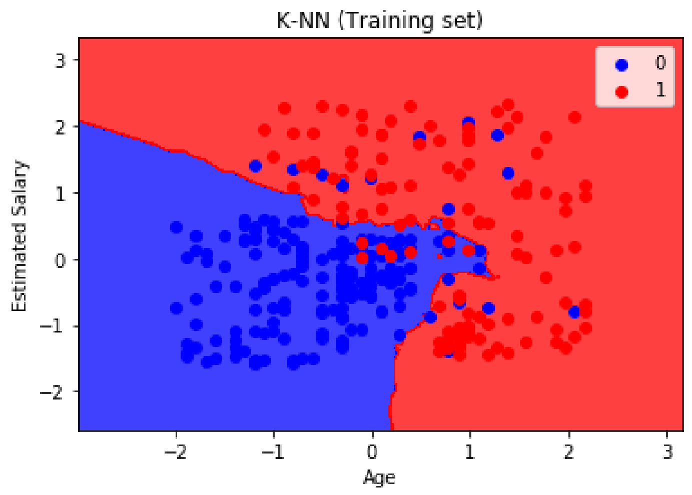
In [19]:
```
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
```

In [42]:
```
print(cm,'confusion_matrix')
```

```
[[64  4]
 [ 3 29]] confusion_matrix
```

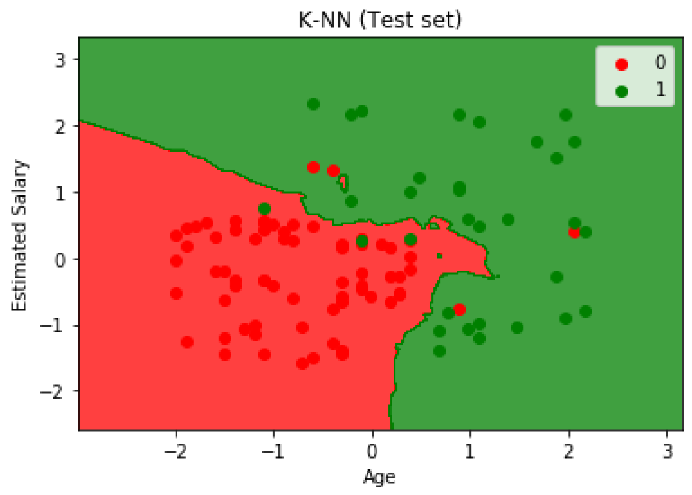
```
In [24]: # Visualising the Training set results
         from matplotlib.colors import ListedColormap
         X_set, y_set = X_train, y_train
         X1, X2 = np.meshgrid(np.arange(start = X_set[:, 0].min() - 1, stop = X_set[:, 0].max() + 1, step = 0.01),
                              np.arange(start = X_set[:, 1].min() - 1, stop = X_set[:, 1].max() + 1, step = 0.01))
         plt.contourf(X1, X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).T).reshape(X1.shape),
                      alpha = 0.75, cmap = ListedColormap(('blue', 'red')))
         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],
                         c = ListedColormap(('blue', 'red'))(i), label = j)
         plt.title('K-NN (Training set)')
         plt.xlabel('Age')
         plt.ylabel('Estimated Salary')
         plt.legend()
         plt.show()
```

```
'c' argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in
case its length matches with 'x' & 'y'.  Please use a 2-D array with a single row if you really want to specify the same RGB or
RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in
case its length matches with 'x' & 'y'.  Please use a 2-D array with a single row if you really want to specify the same RGB or
RGBA value for all points.
```



In [21]:
```python
# Visualising the Test set results
from matplotlib.colors import ListedColormap
X_set, y_set = X_test, y_test
X1, X2 = np.meshgrid(np.arange(start = X_set[:, 0].min() - 1, stop = X_set[:, 0].max() + 1, step = 0.01),
                     np.arange(start = X_set[:, 1].min() - 1, stop = X_set[:, 1].max() + 1, step = 0.01))
plt.contourf(X1, X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).T).reshape(X1.shape),
             alpha = 0.75, 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],
                c = ListedColormap(('red', 'green'))(i), label = j)
plt.title('K-NN (Test set)')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')
plt.legend()
plt.show()
```

```
'c' argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in
case its length matches with 'x' & 'y'.  Please use a 2-D array with a single row if you really want to specify the same RGB or
RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in
case its length matches with 'x' & 'y'.  Please use a 2-D array with a single row if you really want to specify the same RGB or
RGBA value for all points.
```


K-NN (Test set)
Estimated Salary
Age