In [2]:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
dataset = pd.read_csv('Data.csv')
print(dataset)
```

```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0      NaN       Yes
5   France  35.0  58000.0       Yes
6    Spain   NaN  52000.0        No
7   France  48.0  79000.0       Yes
8  Germany  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

In [5]:

```
X = dataset.iloc[:, :-1].values
print(X,"\n")
y = dataset.iloc[:, 3].values
print(y)
```

```
[['France' 44.0 72000.0]
 ['Spain' 27.0 48000.0]
 ['Germany' 30.0 54000.0]
 ['Spain' 38.0 61000.0]
 ['Germany' 40.0 nan]
 ['France' 35.0 58000.0]
 ['Spain' nan 52000.0]
 ['France' 48.0 79000.0]
 ['Germany' 50.0 83000.0]
 ['France' 37.0 67000.0]]

['No' 'Yes' 'No' 'No' 'Yes' 'Yes' 'No' 'Yes' 'No' 'Yes']
```

In [8]:

```
from sklearn.impute import SimpleImputer
imputer = SimpleImputer(missing_values=np.nan, strategy='mean')
imputer.fit(X[:, 1:3])
X[:, 1:3] = imputer.transform(X[:, 1:3])
print(X)
```

```
[['France' 44.0 72000.0]
 ['Spain' 27.0 48000.0]
 ['Germany' 30.0 54000.0]
 ['Spain' 38.0 61000.0]
 ['Germany' 40.0 63777.77777777778]
 ['France' 35.0 58000.0]
 ['Spain' 38.77777777777778 52000.0]
 ['France' 48.0 79000.0]
 ['Germany' 50.0 83000.0]
 ['France' 37.0 67000.0]]
```

In [9]:

```
from sklearn.preprocessing import LabelEncoder
label_encoder_x= LabelEncoder()
X[:, 0]= label_encoder_x.fit_transform(X[:, 0])
print(X)
```

```
[[0 44.0 72000.0]
 [2 27.0 48000.0]
 [1 30.0 54000.0]
 [2 38.0 61000.0]
 [1 40.0 63777.77777777778]
 [0 35.0 58000.0]
 [2 38.77777777777778 52000.0]
 [0 48.0 79000.0]
 [1 50.0 83000.0]
 [0 37.0 67000.0]]
```

In [10]:

```
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct = ColumnTransformer(transformers=[('encoder', OneHotEncoder(), [0])], remainder=
X = np.array(ct.fit_transform(X))
print(X)
```

```
[[1.0 0.0 0.0 44.0 72000.0]
 [0.0 0.0 1.0 27.0 48000.0]
 [0.0 1.0 0.0 30.0 54000.0]
 [0.0 0.0 1.0 38.0 61000.0]
 [0.0 1.0 0.0 40.0 63777.77777777778]
 [1.0 0.0 0.0 35.0 58000.0]
 [0.0 0.0 1.0 38.77777777777778 52000.0]
 [1.0 0.0 0.0 48.0 79000.0]
 [0.0 1.0 0.0 50.0 83000.0]
 [1.0 0.0 0.0 37.0 67000.0]]
```

In [11]:

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
y = le.fit_transform(y)
print(y)
```

```
[0 1 0 0 1 1 0 1 0 1]
```

In [15]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_s
print(X_train,"\n")
print(X_test,"\n")
print(y_train,"\n")
print(y_test,"\n")
```

```
[[0.0 0.0 1.0 38.77777777777778 52000.0]
 [0.0 1.0 0.0 40.0 63777.77777777778]
 [1.0 0.0 0.0 44.0 72000.0]
 [0.0 0.0 1.0 38.0 61000.0]
 [0.0 0.0 1.0 27.0 48000.0]
 [1.0 0.0 0.0 48.0 79000.0]
 [0.0 1.0 0.0 50.0 83000.0]
 [1.0 0.0 0.0 35.0 58000.0]]

[[0.0 1.0 0.0 30.0 54000.0]
 [1.0 0.0 0.0 37.0 67000.0]]

[0 1 0 0 1 1 0 1]

[0 1]
```

In [17]:

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train[:, 3:] = sc.fit_transform(X_train[:, 3:])
X_test[:, 3:] = sc.transform(X_test[:, 3:])
print(X_train,"\n")
print(X_test,"\n")
```

```
[[0.0 0.0 1.0 -0.1915918438457856 -1.0781259408412427]
 [0.0 1.0 0.0 -0.014117293757057902 -0.07013167641635401]
 [1.0 0.0 0.0 0.5667085065333239 0.6335624327104546]
 [0.0 0.0 1.0 -0.3045301939022488 -0.30786617274297895]
 [0.0 0.0 1.0 -1.901801144700799 -1.4204636155515822]
 [1.0 0.0 0.0 1.1475343068237056 1.2326533634535488]
 [0.0 1.0 0.0 1.4379472069688966 1.5749910381638883]
 [1.0 0.0 0.0 -0.7401495441200352 -0.5646194287757336]]

[[0.0 1.0 0.0 -1.4661817944830127 -0.9069571034860731]
 [1.0 0.0 0.0 -0.44973664397484425 0.20564033932253029]]
```

In [18]:

```
import numpy as np
import pandas as pd
!pip install scikit-learn
```

```
Requirement already satisfied: scikit-learn in /home/student/anaconda
3/lib/python3.9/site-packages (0.24.2)
Requirement already satisfied: numpy>=1.13.3 in /home/student/anaconda
3/lib/python3.9/site-packages (from scikit-learn) (1.20.3)
Requirement already satisfied: scipy>=0.19.1 in /home/student/anaconda
3/lib/python3.9/site-packages (from scikit-learn) (1.7.1)
Requirement already satisfied: joblib>=0.11 in /home/student/anaconda
3/lib/python3.9/site-packages (from scikit-learn) (1.1.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in /home/student/a
naconda3/lib/python3.9/site-packages (from scikit-learn) (2.2.0)
```

In [90]:

```
import pandas as pd
df = pd.read_csv('BreastCancer.csv')
df.shape
cols=df.columns
print(df)
df.value_counts('diagnosis')
```

```
           id diagnosis  radius_mean  texture_mean  perimeter_mean  ar
ea_mean  \
0      842302         M        17.99         10.38          122.80
1001.0
1      842517         M        20.57         17.77          132.90
1326.0
2    84300903         M        19.69         21.25          130.00
1203.0
3    84348301         M        11.42         20.38           77.58
386.1
4    84358402         M        20.29         14.34          135.10
1297.0
..        ...       ...          ...           ...             ...
...
564    926424         M        21.56         22.39          142.00
1479.0
565    926682         M        20.13         28.25          131.20
1261.0
566    926954         M        16.60         28.08          108.30
858.1
567    927241         M        20.60         29.33          140.10
1265.0
568     92751         B         7.76         24.54           47.92
181.0

     smoothness_mean  compactness_mean  concavity_mean  concave points
_mean  \
0            0.11840           0.27760         0.30010              0.
14710
1            0.08474           0.07864         0.08690              0.
07017
2            0.10960           0.15990         0.19740              0.
12790
3            0.14250           0.28390         0.24140              0.
10520
4            0.10030           0.13280         0.19800              0.
10430
..               ...               ...             ...
...
564          0.11100           0.11590         0.24390              0.
13890
565          0.09780           0.10340         0.14400              0.
09791
566          0.08455           0.10230         0.09251              0.
05302
567          0.11780           0.27700         0.35140              0.
15200
568          0.05263           0.04362         0.00000              0.
00000

     ...  texture_worst  perimeter_worst  area_worst  smoothness_worst
\
```

```
0    ...          17.33           184.60      2019.0           0.16220
1    ...          23.41           158.80      1956.0           0.12380
2    ...          25.53           152.50      1709.0           0.14440
3    ...          26.50            98.87       567.7           0.20980
4    ...          16.67           152.20      1575.0           0.13740
..   ...            ...              ...         ...              ...
564  ...          26.40           166.10      2027.0           0.14100
565  ...          38.25           155.00      1731.0           0.11660
566  ...          34.12           126.70      1124.0           0.11390
567  ...          39.42           184.60      1821.0           0.16500
568  ...          30.37            59.16       268.6           0.08996

     compactness_worst  concavity_worst  concave points_worst  symmetr
y_worst  \
0              0.66560           0.7119                0.2654
0.4601
1              0.18660           0.2416                0.1860
0.2750
2              0.42450           0.4504                0.2430
0.3613
3              0.86630           0.6869                0.2575
0.6638
4              0.20500           0.4000                0.1625
0.2364
..                 ...              ...                   ...
...
564            0.21130           0.4107                0.2216
0.2060
565            0.19220           0.3215                0.1628
0.2572
566            0.30940           0.3403                0.1418
0.2218
567            0.86810           0.9387                0.2650
0.4087
568            0.06444           0.0000                0.0000
0.2871

     fractal_dimension_worst  Unnamed: 32
0                    0.11890          NaN
1                    0.08902          NaN
2                    0.08758          NaN
3                    0.17300          NaN
4                    0.07678          NaN
..                       ...          ...
564                  0.07115          NaN
565                  0.06637          NaN
566                  0.07820          NaN
567                  0.12400          NaN
568                  0.07039          NaN

[569 rows x 33 columns]
```

Out[90]:

```
diagnosis
B    357
M    212
dtype: int64
```

In [93]:

```
####Data Preprocessing
# Step 2.Separating the dependent and independent variable
y = df['diagnosis'] ##DEpendent variable
df.drop('diagnosis', axis = 1,inplace = True)
#Step 3. REmoving Unimportant features and features with most of the values are nul
df.drop('Unnamed: 32', axis = 1,inplace=True)
df.drop('id', axis = 1,inplace=True)
cols=df.columns
print(cols)
x = df ##Independent Variables
```

```
Index(['radius_mean', 'texture_mean', 'perimeter_mean', 'area_mean',
       'smoothness_mean', 'compactness_mean', 'concavity_mean',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mea
n',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothne
ss_se',
       'compactness_se', 'concavity_se', 'concave points_se', 'symmetr
y_se',
       'fractal_dimension_se', 'radius_worst', 'texture_worst',
       'perimeter_worst', 'area_worst', 'smoothness_worst',
       'compactness_worst', 'concavity_worst', 'concave points_worst',
       'symmetry_worst', 'fractal_dimension_worst'],
      dtype='object')
```

In [92]:

```
df.describe() ###Finding spread and central tendency of data
```

Out[92]:

	id	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_m
count	5.690000e+02	569.000000	569.000000	569.000000	569.000000	569.000
mean	3.037183e+07	14.127292	19.289649	91.969033	654.889104	0.096
std	1.250206e+08	3.524049	4.301036	24.298981	351.914129	0.014
min	8.670000e+03	6.981000	9.710000	43.790000	143.500000	0.052
25%	8.692180e+05	11.700000	16.170000	75.170000	420.300000	0.086
50%	9.060240e+05	13.370000	18.840000	86.240000	551.100000	0.095
75%	8.813129e+06	15.780000	21.800000	104.100000	782.700000	0.105
max	9.113205e+08	28.110000	39.280000	188.500000	2501.000000	0.163

8 rows × 32 columns

In [29]:

```
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_st
```

In [30]:

```
##Step 5:Feature Scaling(MinMaxScaler)
from sklearn.preprocessing import MinMaxScaler
st_x= MinMaxScaler()
x_train= st_x.fit_transform(x_train)
x_test=st_x.fit_transform(x_test)
print(x_train)
```

```
[[0.23044157 0.32157676 0.21940433 ... 0.31484671 0.30277942 0.0985832
3]
 [0.20062473 0.42116183 0.19452699 ... 0.06965208 0.34042973 0.0667716
1]
 [0.62232003 0.76929461 0.60403566 ... 0.56079917 0.19850187 0.0743145
7]
 ...
 [0.11619102 0.35726141 0.11077327 ... 0.17402687 0.17524147 0.1726354
5]
 [0.12963226 0.35311203 0.11706171 ... 0.         0.06780997 0.0691984
8]
 [0.21434995 0.59004149 0.21235575 ... 0.33251808 0.10782574 0.2117276
7]]
```

In [31]:

```
from sklearn.neighbors import KNeighborsClassifier
Classifier = KNeighborsClassifier(n_neighbors = 5)
Classifier.fit(x_train,y_train)
```

Out[31]:

```
KNeighborsClassifier()
```

In [32]:

```
y_pred = Classifier.predict(x_test)
print(y_pred)
```

```
['M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B'
'M'
 'M' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'B' 'M' 'B' 'M' 'B' 'M' 'B'
'M'
 'B' 'M' 'B' 'M' 'M' 'B' 'M' 'B' 'B' 'M' 'B' 'B' 'B' 'M' 'M' 'M' 'M'
'B'
 'B' 'B' 'B' 'B' 'B' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'M' 'M' 'M' 'B' 'M'
'M'
 'B' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B' 'M' 'B' 'B' 'B' 'M'
'M'
 'B' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'M'
'B'
 'M' 'M' 'B' 'M' 'M' 'M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'M'
'M'
 'M' 'B' 'B' 'B' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B' 'B' 'B' 'M']
```

In [43]:

```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test,y_pred,labels=Classifier.classes_)
print(cm)
```

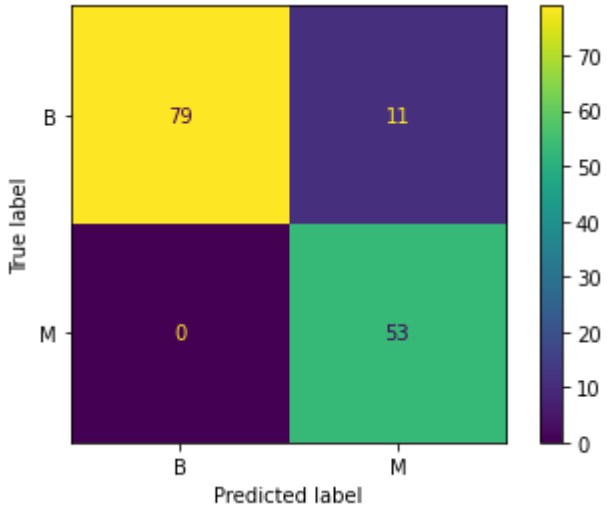
```
[[79 11]
 [ 0 53]]
```

In [46]:

```
from sklearn.metrics import ConfusionMatrixDisplay
disp = ConfusionMatrixDisplay(confusion_matrix = cm,display_labels = Classifier.cla
disp.plot()
```

Out[46]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f
37513548e0>
```



In [48]:

```
##Classifier Accuracy
training_score = lassifier.score(x_train, y_train)
test_score = Classifier.score(x_test, y_test)
print(training_score)
print(test_score)
```

```
0.9765258215962441
0.9230769230769231
```

In [52]:

```
## Now we can try it with different values of k.
K = []
training = []
test = []
scores = {}
for k in range(2, 22):
    clf = KNeighborsClassifier(n_neighbors = k)
    clf.fit(x_train, y_train)
    training_score = clf.score(x_train, y_train)
    test_score = clf.score(x_test, y_test)
    K.append(k)
    training.append(training_score)
    test.append(test_score)
    scores[k] = [training_score, test_score]
##Evaluating the model
for keys, values in scores.items():
    print(keys, ':', values)
```

```
2 : [0.9765258215962441, 0.9230769230769231]
3 : [0.9812206572769953, 0.8951048951048951]
4 : [0.9835680751173709, 0.916083916083916]
5 : [0.9765258215962441, 0.9230769230769231]
6 : [0.9788732394366197, 0.9090909090909091]
7 : [0.9788732394366197, 0.916083916083916]
8 : [0.9812206572769953, 0.951048951048951]
9 : [0.9765258215962441, 0.9230769230769231]
10 : [0.9741784037558685, 0.9370629370629371]
11 : [0.9765258215962441, 0.9230769230769231]
12 : [0.9694835680751174, 0.9300699300699301]
13 : [0.9741784037558685, 0.9300699300699301]
14 : [0.9694835680751174, 0.9370629370629371]
15 : [0.9694835680751174, 0.9370629370629371]
16 : [0.9647887323943662, 0.9440559440559441]
17 : [0.9694835680751174, 0.9370629370629371]
18 : [0.9671361502347418, 0.9440559440559441]
19 : [0.971830985915493, 0.9440559440559441]
20 : [0.9624413145539906, 0.9440559440559441]
21 : [0.9647887323943662, 0.9440559440559441]
```

In [53]:

```
###Visualization
import matplotlib.pyplot as plt
plt.scatter(K, training, color ='k')
plt.scatter(K, test, color ='g')
plt.show()
```