

In [3]: `import numpy as np
import pandas as pd`

In [4]: `df = pd.read_csv("Breast_Cancer_Dataset.csv")
df`

Out[4]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	...	texture_worst	perimeter_worst	area_worst
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.30010	0.14710	...	17.33	184.60	2019.6
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.08690	0.07017	...	23.41	158.80	1959.2
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.19740	0.12790	...	25.53	152.50	1709.1
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.24140	0.10520	...	26.50	98.87	567.3
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.19800	0.10430	...	16.67	152.20	1575.8
...
564	926424	M	21.56	22.39	142.00	1479.0	0.11100	0.11590	0.24390	0.13890	...	26.40	166.10	2027.3
565	926682	M	20.13	28.25	131.20	1261.0	0.09780	0.10340	0.14400	0.09791	...	38.25	155.00	1731.2
566	926954	M	16.60	28.08	108.30	858.1	0.08455	0.10230	0.09251	0.05302	...	34.12	126.70	1125.4
567	927241	M	20.60	29.33	140.10	1265.0	0.11780	0.27700	0.35140	0.15200	...	39.42	184.60	1827.3
568	92751	B	7.76	24.54	47.92	181.0	0.05263	0.04362	0.00000	0.00000	...	30.37	59.16	261.8

569 rows × 33 columns

In [7]: `x = df.drop(["Unnamed: 32", "id", "diagnosis"],axis=1)
y = df.iloc[:,1]
x.head()`

Out[7]:

	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	symmetry_mean	fractal_dimension_mean	...	radius_worst	texture_worst
0	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	0.2419	0.07871	...	25.38	184.60
1	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	0.1812	0.05667	...	24.99	158.80
2	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	0.2069	0.05999	...	23.57	152.50
3	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	0.2597	0.09744	...	14.91	98.87
4	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	0.1809	0.05883	...	22.54	152.20

5 rows × 30 columns

In [8]: `y.head()`

Out[8]:

```
0    M
1    M
2    M
3    M
4    M
Name: diagnosis, dtype: object
```

In [22]: `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)
x_train.shape, x_test.shape`

Out[22]:

```
((455, 30), (114, 30))
```

In [23]: `from sklearn.svm import SVC
model = SVC()`

In [24]: `model.fit(x_train,y_train)
y_pred = model.predict(x_test)
y_pred`

Out[24]:

```
array(['M', 'B', 'B', 'M', 'B', 'B', 'M', 'M', 'M', 'B', 'B', 'M', 'M',
       'M', 'B', 'B', 'M', 'B', 'M', 'B', 'M', 'B', 'B', 'B', 'M', 'M',
       'B', 'B', 'B', 'B', 'B', 'B', 'M', 'M', 'M', 'M', 'M', 'B', 'B',
       'B', 'B', 'B', 'M', 'B', 'M', 'B', 'B', 'B', 'B', 'M', 'B', 'M',
       'M', 'B', 'B', 'M', 'B', 'B', 'B', 'B', 'B', 'M', 'B', 'B', 'B',
       'B', 'B', 'B', 'B', 'B', 'B', 'M', 'M', 'B', 'B', 'M', 'B', 'M',
       'B', 'B', 'B', 'B', 'B', 'B', 'B', 'M', 'B', 'B', 'B', 'B', 'M',
       'B', 'B', 'B', 'B', 'B', 'B', 'B', 'M', 'B', 'B', 'B', 'B', 'M',
       'B', 'B', 'M', 'B', 'B', 'B', 'B', 'M', 'B', 'M', 'B', 'M'], dtype=object)
```

In [25]: `from sklearn.metrics import confusion_matrix, classification_report
confusion_matrix(y_test,y_pred)`

Out[25]:

```
array([[68,  0],
       [10, 36]], dtype=int64)
```

In [26]: `print(classification_report(y_test,y_pred))`

```
              precision    recall  f1-score   support

    B               0.87        1.00        0.93         68
    M               1.00        0.78        0.88         46

 accuracy                   0.91         114
 macro avg                 0.94        0.89        0.90         114
 weighted avg              0.92        0.91        0.91         114
```

In [27]: `from sklearn.model_selection import GridSearchCV
parameters = {"C": [0.1,1,10,100,1000], "gamma": [1,0.1,0.01,0.001,0.0001]}
grid = GridSearchCV(SVC(),parameters, verbose=3)
grid.fit(x_train,y_train)`

Fitting 5 folds for each of 25 candidates, totalling 125 fits

```
[CV 1/5] END .....C=0.1, gamma=1,, score=0.637 total time= 0.1s
[CV 2/5] END .....C=0.1, gamma=1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=0.1, gamma=1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=0.1, gamma=1,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=0.1, gamma=1,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=0.1, gamma=0.1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=0.1, gamma=0.1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=0.1, gamma=0.1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=0.1, gamma=0.1,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=0.1, gamma=0.1,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=0.1, gamma=0.001,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=0.1, gamma=0.001,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=0.1, gamma=0.001,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=0.1, gamma=0.001,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=0.1, gamma=0.001,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=0.1, gamma=0.0001,, score=0.890 total time= 0.0s
[CV 2/5] END .....C=0.1, gamma=0.0001,, score=0.901 total time= 0.0s
[CV 3/5] END .....C=0.1, gamma=0.0001,, score=0.923 total time= 0.0s
[CV 4/5] END .....C=0.1, gamma=0.0001,, score=0.945 total time= 0.0s
[CV 5/5] END .....C=0.1, gamma=0.0001,, score=0.934 total time= 0.0s
[CV 1/5] END .....C=1, gamma=1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=1, gamma=1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=1, gamma=1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=1, gamma=1,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=1, gamma=1,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=1, gamma=0.01,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=1, gamma=0.01,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=1, gamma=0.01,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=1, gamma=0.01,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=1, gamma=0.01,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=1, gamma=0.001,, score=0.901 total time= 0.0s
[CV 2/5] END .....C=1, gamma=0.001,, score=0.901 total time= 0.0s
[CV 3/5] END .....C=1, gamma=0.001,, score=0.879 total time= 0.0s
[CV 4/5] END .....C=1, gamma=0.001,, score=0.956 total time= 0.0s
[CV 5/5] END .....C=1, gamma=0.001,, score=0.923 total time= 0.0s
[CV 1/5] END .....C=1, gamma=0.0001,, score=0.890 total time= 0.0s
[CV 2/5] END .....C=1, gamma=0.0001,, score=0.923 total time= 0.0s
[CV 3/5] END .....C=1, gamma=0.0001,, score=0.934 total time= 0.0s
[CV 4/5] END .....C=1, gamma=0.0001,, score=0.945 total time= 0.0s
[CV 5/5] END .....C=1, gamma=0.0001,, score=0.956 total time= 0.0s
[CV 1/5] END .....C=10, gamma=1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=10, gamma=1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=10, gamma=1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=10, gamma=1,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=10, gamma=1,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=10, gamma=0.1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=10, gamma=0.1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=10, gamma=0.1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=10, gamma=0.1,, score=0.637 total time= 0.0s
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[CV 1/5] END .....C=10, gamma=0.01,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=10, gamma=0.01,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=10, gamma=0.01,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=10, gamma=0.01,, score=0.637 total time= 0.0s
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[CV 3/5] END .....C=10, gamma=0.001,, score=0.934 total time= 0.0s
[CV 4/5] END .....C=10, gamma=0.001,, score=0.956 total time= 0.0s
[CV 5/5] END .....C=10, gamma=0.001,, score=0.956 total time= 0.0s
[CV 1/5] END .....C=100, gamma=1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=100, gamma=1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=100, gamma=1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=100, gamma=1,, score=0.637 total time= 0.0s
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[CV 1/5] END .....C=100, gamma=0.1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=100, gamma=0.1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=100, gamma=0.1,, score=0.637 total time= 0.0s
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[CV 2/5] END .....C=100, gamma=0.01,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=100, gamma=0.01,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=100, gamma=0.01,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=100, gamma=0.01,, score=0.626 total time= 0.0s
[CV 1/5] END .....C=1000, gamma=1,, score=0.637 total time= 0.0s
[CV 2/5] END .....C=1000, gamma=1,, score=0.637 total time= 0.0s
[CV 3/5] END .....C=1000, gamma=1,, score=0.637 total time= 0.0s
[CV 4/5] END .....C=1000, gamma=1,, score=0.637 total time= 0.0s
[CV 5/5] END .....C=1000, gamma=1,, score=0.626 total time= 0.0s
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[CV 2/5] END .....C=1000, gamma=0.1,, score=0.637 total time= 0.0s
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[CV 1/5] END .....C=1000, gamma=0.01,, score=0.637 total time= 0.0s
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[CV 3/5] END .....C=1000, gamma=0.001,, score=0.901 total time= 0.0s
[CV 4/5] END .....C=1000, gamma=0.001,, score=0.934 total time= 0.0s
[CV 5/5] END .....C=1000, gamma=0.001,, score=0.934 total time= 0.0s
```

Out[27]:

```
GridSearchCV(estimator=SVC(),
              param_grid={'C': [0.1, 1, 10, 100, 1000],
                           'gamma': [1, 0.1, 0.01, 0.001, 0.0001]},
              verbose=3)
```

In [28]: `grid.best_params_`

Out[28]:

```
{'C': 10, 'gamma': 0.0001}
```

In [29]: `grid_pred = grid.predict(x_test)
confusion_matrix(y_test,grid_pred)`

Out[29]:

```
array([[67,  1],
       [ 7, 39]], dtype=int64)
```

In [31]: `print(classification_report(y_test,grid_pred))`

```
              precision    recall  f1-score   support

    B               0.91        0.99        0.94         68
    M               0.97        0.85        0.91         46

 accuracy                   0.93         114
 macro avg                 0.94        0.92        0.93         114
 weighted avg              0.93        0.93        0.93         114
```

We can see that the accuracy increased from 91% to 93%