```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.datasets import load_breast_cancer
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.model_selection import GridSearchCV

# Load Breast Cancer Dataset
data = load_breast_cancer()
X = pd.DataFrame(data.data, columns=data.feature_names)
y = pd.Series(data.target, name='target')

# 2. Describe features and setup the dataframe
print(X.head())
print(X.describe())
print(X.isnull().sum())

# 3. Perform exploratory analysis
sns.boxplot(data=X.iloc[:, :10])
plt.show()

# 4. Train and Test Data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# 5. Train the SVC using the Train Dataset
svc = SVC()
svc.fit(X_train, y_train)

# 6. Predict and Analyze the Performance of the SVC Model
y_pred = svc.predict(X_test)
print("Classification Report:")
print(classification_report(y_test, y_pred))
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

# 7. Improve the Accuracy of Model using GridSearchCV Model
```

```
# 7. Improve the Accuracy of Model using GridSearchCV Model
param_grid = {'C': [0.1, 1, 10, 100, 1000], 'gamma': [1, 0.1, 0.01, 0.001, 0.0001], 'kernel': ['rbf']}
grid = GridSearchCV(SVC(), param_grid, refit=True, verbose=3)
grid.fit(X_train, y_train)

# Best parameters found
print("Best Parameters:", grid.best_params_)

# Predict using the best model
y_pred_grid = grid.predict(X_test)

# Analyze the performance
print("Classification Report (GridSearchCV):")
print(classification_report(y_test, y_pred_grid))
print("Confusion Matrix (GridSearchCV):")
print(confusion_matrix(y_test, y_pred_grid))
```

```
   mean radius  mean texture  mean perimeter  mean area  mean smoothness  \
0        17.99         10.38          122.80     1001.0          0.11840
1        20.57         17.77          132.90     1326.0          0.08474
2        19.69         21.25          130.00     1203.0          0.10960
3        11.42         20.38           77.58      386.1          0.14250
4        20.29         14.34          135.10     1297.0          0.10030

   mean compactness  mean concavity  mean concave points  mean symmetry  \
0           0.27760          0.3001              0.14710         0.2419
1           0.07864          0.0869              0.07017         0.1812
2           0.15990          0.1974              0.12790         0.2069
3           0.28390          0.2414              0.10520         0.2597
4           0.13280          0.1980              0.10430         0.1809

   mean fractal dimension  ...  worst radius  worst texture  worst perimeter  \
0                 0.07871  ...         25.38          17.33           184.60
1                 0.05667  ...         24.99          23.41           158.80
2                 0.05999  ...         23.57          25.53           152.50
3                 0.09744  ...         14.91          26.50            98.87
4                 0.05883  ...         22.54          16.67           152.20

   worst area  worst smoothness  worst compactness  worst concavity  \
0      2019.0            0.1622             0.6656           0.7119
1      1956.0            0.1238             0.1866           0.2416
2      1709.0            0.1444             0.4245           0.4504
3       567.7            0.2098             0.8663           0.6869
4      1575.0            0.1374             0.2050           0.4000

   worst concave points  worst symmetry  worst fractal dimension
0                0.2654          0.4601                  0.11890
1                0.1860          0.2750                  0.08902
2                0.2430          0.3613                  0.08758
3                0.2575          0.6638                  0.17300
4                0.1625          0.2364                  0.07678

[5 rows x 30 columns]
       mean radius  mean texture  mean perimeter    mean area  \
count   569.000000    569.000000      569.000000   569.000000
mean     14.127292     19.289649       91.969033   654.889104
std       3.524049      4.301036       24.298981   351.914129
min       6.981000      9.710000       43.790000   143.500000
25%      11.700000     16.170000       75.170000   420.300000
50%      13.370000     18.840000       86.240000   551.100000
75%      15.780000     21.800000      104.100000   782.700000
max      28.110000     39.280000      188.500000  2501.000000
```

```
       mean smoothness  mean compactness  mean concavity  mean concave points  \
count       569.000000        569.000000      569.000000           569.000000
mean          0.096360          0.104341        0.088799             0.048919
std           0.014064          0.052813        0.079720             0.038803
min           0.052630          0.019380        0.000000             0.000000
25%           0.086370          0.064920        0.029560             0.020310
50%           0.095870          0.092630        0.061540             0.033500
75%           0.105300          0.130400        0.130700             0.074000
max           0.163400          0.345400        0.426800             0.201200

       mean symmetry  mean fractal dimension  ...  worst radius  \
count     569.000000              569.000000  ...    569.000000
mean        0.181162                0.062798  ...     16.269190
std         0.027414                0.007060  ...      4.833242
min         0.106000                0.049960  ...      7.930000
25%         0.161900                0.057700  ...     13.010000
50%         0.179200                0.061540  ...     14.970000
75%         0.195700                0.066120  ...     18.790000
max         0.304000                0.097440  ...     36.040000

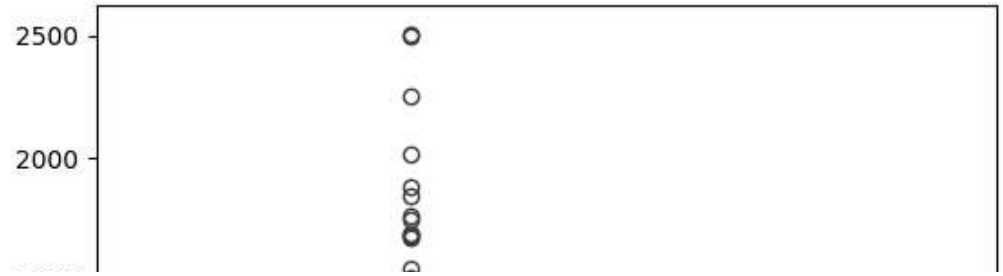
       worst texture  worst perimeter   worst area  worst smoothness  \
count     569.000000       569.000000   569.000000        569.000000
mean       25.677223       107.261213   880.583128          0.132369
std         6.146258        33.602542   569.356993          0.022832
min        12.020000        50.410000   185.200000          0.071170
25%        21.080000        84.110000   515.300000          0.116600
50%        25.410000        97.660000   686.500000          0.131300
75%        29.720000       125.400000  1084.000000          0.146000
max        49.540000       251.200000  4254.000000          0.222600

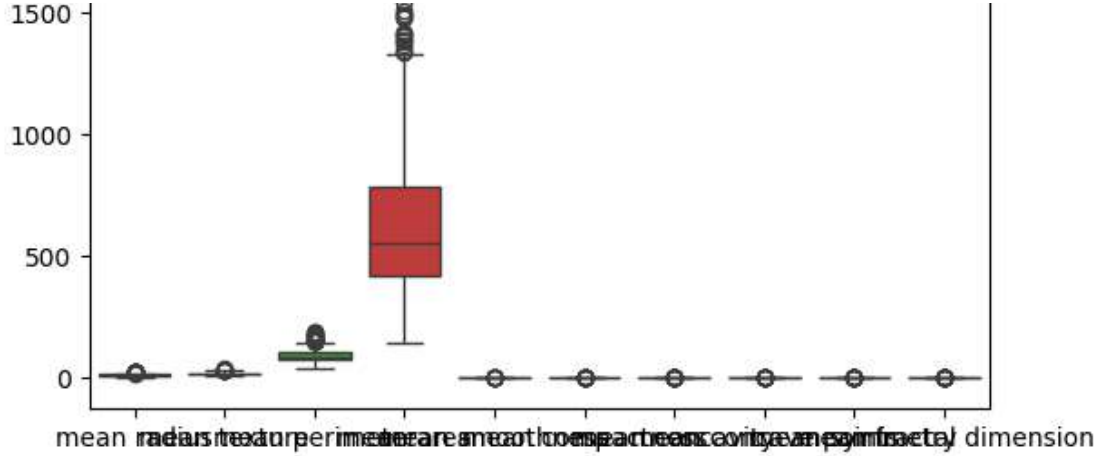
       worst compactness  worst concavity  worst concave points  \
count         569.000000       569.000000            569.000000
mean            0.254265         0.272188              0.114606
std             0.157336         0.208624              0.065732
min             0.027290         0.000000              0.000000
25%             0.147200         0.114500              0.064930
50%             0.211900         0.226700              0.099930
75%             0.339100         0.382900              0.161400
max             1.058000         1.252000              0.291000

       worst symmetry  worst fractal dimension
count      569.000000               569.000000
mean         0.290076                 0.083946
std          0.061867                 0.018061
min          0.156500                 0.055040
```

```
25%          0.250400                0.071460
50%          0.282200                0.080040
75%          0.317900                0.092080
max          0.663800                0.207500

[8 rows x 30 columns]
mean radius                0
mean texture               0
mean perimeter             0
mean area                  0
mean smoothness            0
mean compactness           0
mean concavity             0
mean concave points        0
mean symmetry              0
mean fractal dimension     0
radius error               0
texture error              0
perimeter error            0
area error                 0
smoothness error           0
compactness error          0
concavity error            0
concave points error       0
symmetry error             0
fractal dimension error    0
worst radius               0
worst texture              0
worst perimeter            0
worst area                 0
worst smoothness           0
worst compactness          0
worst concavity            0
worst concave points       0
worst symmetry             0
worst fractal dimension    0
dtype: int64
```






```
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.86      0.92        43
           1       0.92      1.00      0.96        71

    accuracy                           0.95       114
   macro avg       0.96      0.93      0.94       114
weighted avg       0.95      0.95      0.95       114

Confusion Matrix:
[[37  6]
 [ 0 71]]
Fitting 5 folds for each of 25 candidates, totalling 125 fits
[CV 1/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 3/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.1s
[CV 5/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.626 total time=   0.0s
```

```
[CV 3/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.978 total time=   0.0s
[CV 2/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.890 total time=   0.0s
[CV 3/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.945 total time=   0.0s
[CV 4/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.879 total time=   0.0s
[CV 5/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.901 total time=   0.0s
[CV 1/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.637 total time=   0.1s
[CV 2/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 3/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.923 total time=   0.1s
[CV 2/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.1s
[CV 3/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 4/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.868 total time=   0.1s
[CV 5/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 1/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.978 total time=   0.0s
[CV 2/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 3/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.945 total time=   0.0s
[CV 4/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 5/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 1/5] END .........C=10, gamma=1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .........C=10, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 3/5] END .........C=10, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END .........C=10, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 5/5] END .........C=10, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 1/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.637 total time=   0.1s
[CV 2/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 3/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.1s
[CV 2/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.1s
[CV 3/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
```

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[CV 4/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 5/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 1/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 2/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.1s
[CV 3/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.934 total time=   0.1s
[CV 4/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.879 total time=   0.1s
[CV 5/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.890 total time=   0.1s
[CV 1/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.989 total time=   0.0s
[CV 2/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 3/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.967 total time=   0.0s
[CV 4/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 5/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.945 total time=   0.0s
[CV 1/5] END ........C=100, gamma=1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ........C=100, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END ........C=100, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END ........C=100, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ........C=100, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 5/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 1/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 2/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 3/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 4/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.879 total time=   0.1s
[CV 5/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.890 total time=   0.0s
[CV 1/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.956 total time=   0.0s
[CV 2/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.956 total time=   0.0s
[CV 3/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.945 total time=   0.0s
[CV 4/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.912 total time=   0.0s
[CV 5/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 1/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 4/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 1/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
```

```
[CV 4/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.0s
[CV 5/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.626 total time=   0.1s
[CV 1/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 2/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 3/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.626 total time=   0.0s
[CV 4/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 5/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.637 total time=   0.0s
[CV 1/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.1s
[CV 2/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.912 total time=   0.1s
[CV 3/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 4/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.879 total time=   0.0s
[CV 5/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.890 total time=   0.1s
[CV 1/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.945 total time=   0.0s
[CV 2/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.923 total time=   0.0s
[CV 3/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.934 total time=   0.0s
[CV 4/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.868 total time=   0.0s
[CV 5/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.934 total time=   0.0s
Best Parameters: {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
Classification Report (GridSearchCV):
              precision    recall  f1-score   support

           0       0.95      0.91      0.93        43
           1       0.95      0.97      0.96        71

    accuracy                           0.95       114
   macro avg       0.95      0.94      0.94       114
weighted avg       0.95      0.95      0.95       114
```