In [1]:

```
from sklearn.datasets import load_breast_cancer
import pandas as pd
dataset=load_breast_cancer()
df=pd.DataFrame(dataset['data'],columns=dataset['feature_names'])
df['target']=dataset['target']
df.head()
```

Out[1]:

| | mean radius | mean texture | mean perimeter | mean area | mean smoothness | mean compactness | mean concavity | mean concave points | mean symmetry | mean fractal dimension | ... | worst texture | worst perimeter | worst area | worst smoothness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 17.99 | 10.38 | 122.80 | 1001.0 | 0.11840 | 0.27760 | 0.3001 | 0.14710 | 0.2419 | 0.07871 | ... | 17.33 | 184.60 | 2019.0 | 0.1622 |
| **1** | 20.57 | 17.77 | 132.90 | 1326.0 | 0.08474 | 0.07864 | 0.0869 | 0.07017 | 0.1812 | 0.05667 | ... | 23.41 | 158.80 | 1956.0 | 0.1238 |
| **2** | 19.69 | 21.25 | 130.00 | 1203.0 | 0.10960 | 0.15990 | 0.1974 | 0.12790 | 0.2069 | 0.05999 | ... | 25.53 | 152.50 | 1709.0 | 0.1444 |
| **3** | 11.42 | 20.38 | 77.58 | 386.1 | 0.14250 | 0.28390 | 0.2414 | 0.10520 | 0.2597 | 0.09744 | ... | 26.50 | 98.87 | 567.7 | 0.2098 |
| **4** | 20.29 | 14.34 | 135.10 | 1297.0 | 0.10030 | 0.13280 | 0.1980 | 0.10430 | 0.1809 | 0.05883 | ... | 16.67 | 152.20 | 1575.0 | 0.1374 |

5 rows × 31 columns

In [2]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 31 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   mean radius              569 non-null    float64
 1   mean texture             569 non-null    float64
 2   mean perimeter           569 non-null    float64
 3   mean area                569 non-null    float64
 4   mean smoothness          569 non-null    float64
 5   mean compactness         569 non-null    float64
 6   mean concavity           569 non-null    float64
 7   mean concave points      569 non-null    float64
 8   mean symmetry            569 non-null    float64
 9   mean fractal dimension   569 non-null    float64
 10  radius error             569 non-null    float64
 11  texture error            569 non-null    float64
 12  perimeter error          569 non-null    float64
 13  area error               569 non-null    float64
 14  smoothness error         569 non-null    float64
 15  compactness error        569 non-null    float64
 16  concavity error          569 non-null    float64
 17  concave points error     569 non-null    float64
 18  symmetry error           569 non-null    float64
 19  fractal dimension error  569 non-null    float64
 20  worst radius             569 non-null    float64
 21  worst texture            569 non-null    float64
 22  worst perimeter          569 non-null    float64
 23  worst area               569 non-null    float64
 24  worst smoothness         569 non-null    float64
 25  worst compactness        569 non-null    float64
 26  worst concavity          569 non-null    float64
 27  worst concave points     569 non-null    float64
 28  worst symmetry           569 non-null    float64
 29  worst fractal dimension  569 non-null    float64
 30  target                   569 non-null    int32
dtypes: float64(30), int32(1)
memory usage: 135.7 KB
```

In [3]:

```
from sklearn.model_selection import train_test_split
data=df.loc[:, df.columns != 'target']
target=df['target']
x_train,x_test,y_train,y_test=train_test_split(data,target,test_size=0.20,random_state=1)
```

In [4]:

```
print('train data of x_train is: ',x_train.shape)
print('train data of x_test is: ',x_test.shape)
print('train data of y_train is: ',y_train.shape)
print('train data of y_train is: ',y_test.shape)
```

```
train data of x_train is:  (455, 30)
train data of x_test is:  (114, 30)
train data of y_train is:  (455,)
train data of y_train is:  (114,)
```

In [5]:

```
print(y_train.value_counts())
print(y_test.value_counts())
```

```
1    285
0    170
Name: target, dtype: int64
1    72
0    42
Name: target, dtype: int64
```

In [6]:

```
# import the class
from sklearn.linear_model import LogisticRegression
# instantiate the model (using the default parameters)
logreg = LogisticRegression()
# fit the model with data
logreg.fit(x_train,y_train)
#
y_pred=logreg.predict(x_test)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:814: ConvergenceWarning: lbfgs failed to converge (st
atus=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

In [7]:

```
# import the metrics class
from sklearn import metrics
cnf_matrix = metrics.confusion_matrix(y_test, y_pred)
cnf_matrix
```

Out[7]:

```
array([[38,  4],
       [ 2, 70]], dtype=int64)
```

In [8]:

```
print(metrics.classification_report(y_test,y_pred,digits=3))
```

```
              precision    recall  f1-score   support

           0      0.950     0.905     0.927        42
           1      0.946     0.972     0.959        72

    accuracy                          0.947       114
   macro avg      0.948     0.938     0.943       114
weighted avg      0.947     0.947     0.947       114
```

In [9]:

```
import pandas as pd
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.pipeline import Pipeline
from sklearn.model_selection import GridSearchCV, RandomizedSearchCV
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import *
from sklearn.naive_bayes import GaussianNB

import matplotlib.pyplot as plt
```

In [22]:

```
import warnings
warnings.filterwarnings("ignore")
```

In [10]:

```
df.head()
```

Out[10]:

| | mean radius | mean texture | mean perimeter | mean area | mean smoothness | mean compactness | mean concavity | mean concave points | mean symmetry | mean fractal dimension | ... | worst texture | worst perimeter | worst area | worst smoothness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| **2** | 19.69 | 21.25 | 130.00 | 1203.0 | 0.10960 | 0.15990 | 0.1974 | 0.12790 | 0.2069 | 0.05999 | ... | 25.53 | 152.50 | 1709.0 | 0.1444 |
| **3** | 11.42 | 20.38 | 77.58 | 386.1 | 0.14250 | 0.28390 | 0.2414 | 0.10520 | 0.2597 | 0.09744 | ... | 26.50 | 98.87 | 567.7 | 0.2098 |
| **4** | 20.29 | 14.34 | 135.10 | 1297.0 | 0.10030 | 0.13280 | 0.1980 | 0.10430 | 0.1809 | 0.05883 | ... | 16.67 | 152.20 | 1575.0 | 0.1374 |

5 rows × 31 columns

In [11]:

```
clf1 = RandomForestClassifier(random_state=42)
clf2 = SVC(probability=True, random_state=42)
clf3 = LogisticRegression(random_state=42)
clf4 = DecisionTreeClassifier(random_state=42)
clf5 = KNeighborsClassifier()
clf6 = GaussianNB()
clf7 = GradientBoostingClassifier(random_state=42)
```

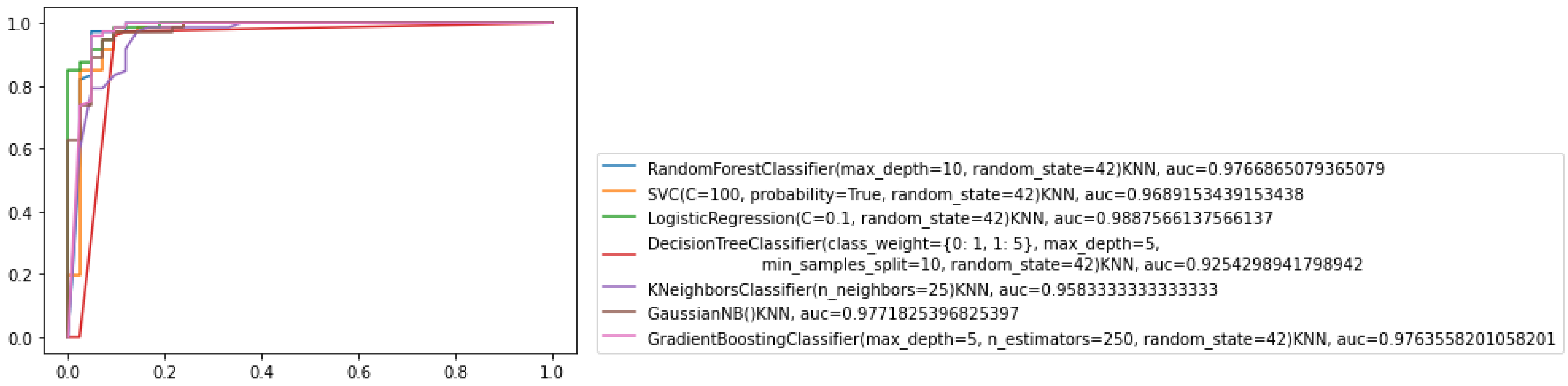
In [12]:

```
param1 = {}
param1['classifier__n_estimators'] = [10, 50, 100, 250]
param1['classifier__max_depth'] = [5, 10, 20]
param1['classifier__class_weight'] = [None, {0:1,1:5}, {0:1,1:10}, {0:1,1:25}]
param1['classifier'] = [clf1]
param2 = {}
param2['classifier__C'] = [10**-2, 10**-1, 10**0, 10**1, 10**2]
param2['classifier__class_weight'] = [None, {0:1,1:5}, {0:1,1:10}, {0:1,1:25}]
param2['classifier'] = [clf2]
param3 = {}
param3['classifier__C'] = [10**-2, 10**-1, 10**0, 10**1, 10**2]
param3['classifier__penalty'] = ['l1', 'l2']
param3['classifier__class_weight'] = [None, {0:1,1:5}, {0:1,1:10}, {0:1,1:25}]
param3['classifier'] = [clf3]
param4 = {}
param4['classifier__max_depth'] = [5,10,25,None]
param4['classifier__min_samples_split'] = [2,5,10]
param4['classifier__class_weight'] = [None, {0:1,1:5}, {0:1,1:10}, {0:1,1:25}]
param4['classifier'] = [clf4]
param5 = {}
param5['classifier__n_neighbors'] = [2,5,10,25,50]
param5['classifier'] = [clf5]
param6 = {}
# param6['var_smoothing'] = np.logspace(0,-9, num=100)
param6['classifier'] = [clf6]
param7 = {}
param7['classifier__n_estimators'] = [10, 50, 100, 250]
param7['classifier__max_depth'] = [5, 10, 20]
param7['classifier'] = [clf7]
```

In [35]:

```
import matplotlib.pyplot as plt

c=0
for i in(clf1,clf2,clf3,clf4,clf5,clf6,clf7):

    pipeline = Pipeline([('classifier', i)])
    params = [param1, param2, param3, param4, param5, param6, param7]
    gs = GridSearchCV(pipeline, params[c], cv=3, n_jobs=-1, scoring='roc_auc').fit(x_train, y_train)
    # print(gs.best_params_)
    print(i)
    # print(pipeline, params[c])
    c=c+1
    if(i==i):
        y_pred_proba = gs.predict_proba(x_test)[::,1]
        fpr_k, tpr_k, _k = metrics.roc_curve(y_test, y_pred_proba)
        auc = metrics.roc_auc_score(y_test, y_pred_proba)
        plt.plot(fpr_k,tpr_k,label=str(i).partition("!")[0]+"KNN, auc="+str(auc))
        plt.legend()
        plt.legend(loc=(1.04,0))

    print("Test ROC AUC Score:",roc_auc_score(gs.predict(x_test), y_test))



print("\n")
```

```
RandomForestClassifier(max_depth=10, random_state=42)
Test ROC AUC Score: 0.9675324675324675
SVC(C=100, probability=True, random_state=42)
Test ROC AUC Score: 0.9342105263157896
LogisticRegression(C=0.1, random_state=42)
Test ROC AUC Score: 0.9605128205128205
DecisionTreeClassifier(class_weight={0: 1, 1: 5}, max_depth=5,
                       min_samples_split=10, random_state=42)
Test ROC AUC Score: 0.941025641025641
KNeighborsClassifier(n_neighbors=25)
Test ROC AUC Score: 0.9231200897867564
GaussianNB()
Test ROC AUC Score: 0.947972972972973
GradientBoostingClassifier(max_depth=5, n_estimators=250, random_state=42)
Test ROC AUC Score: 0.947972972972973
```



In [ ]:

```
print("Best AUC: Logistic Regression 0.98")
```