Installation of Packages

First install packages like numpy, scikit-learn, matplotlib

In [ ]:

```
!pip install numpy scikit-learn matplotlib
```

```
Requirement already satisfied: numpy in /home/john/contributions/.venv/lib/pytho
n3.10/site-packages (1.23.2)
Requirement already satisfied: scikit-learn in /home/john/contributions/.venv/li
b/python3.10/site-packages (1.1.2)
Requirement already satisfied: matplotlib in /home/john/contributions/.venv/lib/
python3.10/site-packages (3.6.1)
Requirement already satisfied: scipy>=1.3.2 in /home/john/contributions/.venv/li
b/python3.10/site-packages (from scikit-learn) (1.9.1)
Requirement already satisfied: joblib>=1.0.0 in /home/john/contributions/.venv/l
ib/python3.10/site-packages (from scikit-learn) (1.1.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in /home/john/contribution
s/.venv/lib/python3.10/site-packages (from scikit-learn) (3.1.0)
Requirement already satisfied: packaging>=20.0 in /home/john/contributions/.ven
v/lib/python3.10/site-packages (from matplotlib) (21.3)
Requirement already satisfied: pillow>=6.2.0 in /home/john/contributions/.venv/l
ib/python3.10/site-packages (from matplotlib) (9.2.0)
Requirement already satisfied: python-dateutil>=2.7 in /home/john/contribution
s/.venv/lib/python3.10/site-packages (from matplotlib) (2.8.2)
Requirement already satisfied: kiwisolver>=1.0.1 in /home/john/contributions/.ve
nv/lib/python3.10/site-packages (from matplotlib) (1.4.4)
Requirement already satisfied: fonttools>=4.22.0 in /home/john/contributions/.ve
nv/lib/python3.10/site-packages (from matplotlib) (4.37.4)
Requirement already satisfied: pyparsing>=2.2.1 in /home/john/contributions/.ven
v/lib/python3.10/site-packages (from matplotlib) (3.0.9)
Requirement already satisfied: contourpy>=1.0.1 in /home/john/contributions/.ven
v/lib/python3.10/site-packages (from matplotlib) (1.0.5)
Requirement already satisfied: cycler>=0.10 in /home/john/contributions/.venv/li
b/python3.10/site-packages (from matplotlib) (0.11.0)
Requirement already satisfied: six>=1.5 in /home/john/contributions/.venv/lib/py
thon3.10/site-packages (from python-dateutil>=2.7->matplotlib) (1.16.0)
```

Importation of packages

We import the necessary packages

In [ ]:

```
import numpy as np
from sklearn import svm
from sklearn import datasets, metrics
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plot
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
```

Load Dataset

We load the necessary IRIS dataset.

In [ ]:

```
cancer = datasets.load_breast_cancer()
```

Description of the Dataset

Input features

```
In [ ]: cancer.feature_names
```

```
Out[ ]: array(['mean radius', 'mean texture', 'mean perimeter', 'mean area',
               'mean smoothness', 'mean compactness', 'mean concavity',
               'mean concave points', 'mean symmetry', 'mean fractal dimension',
               'radius error', 'texture error', 'perimeter error', 'area error',
               'smoothness error', 'compactness error', 'concavity error',
               'concave points error', 'symmetry error',
               'fractal dimension error', 'worst radius', 'worst texture',
               'worst perimeter', 'worst area', 'worst smoothness',
               'worst compactness', 'worst concavity', 'worst concave points',
               'worst symmetry', 'worst fractal dimension'], dtype='<U23')
```

Target feature

```
In [ ]: cancer.target_names
```

```
Out[ ]: array(['malignant', 'benign'], dtype='<U9')
```

Verify number of records

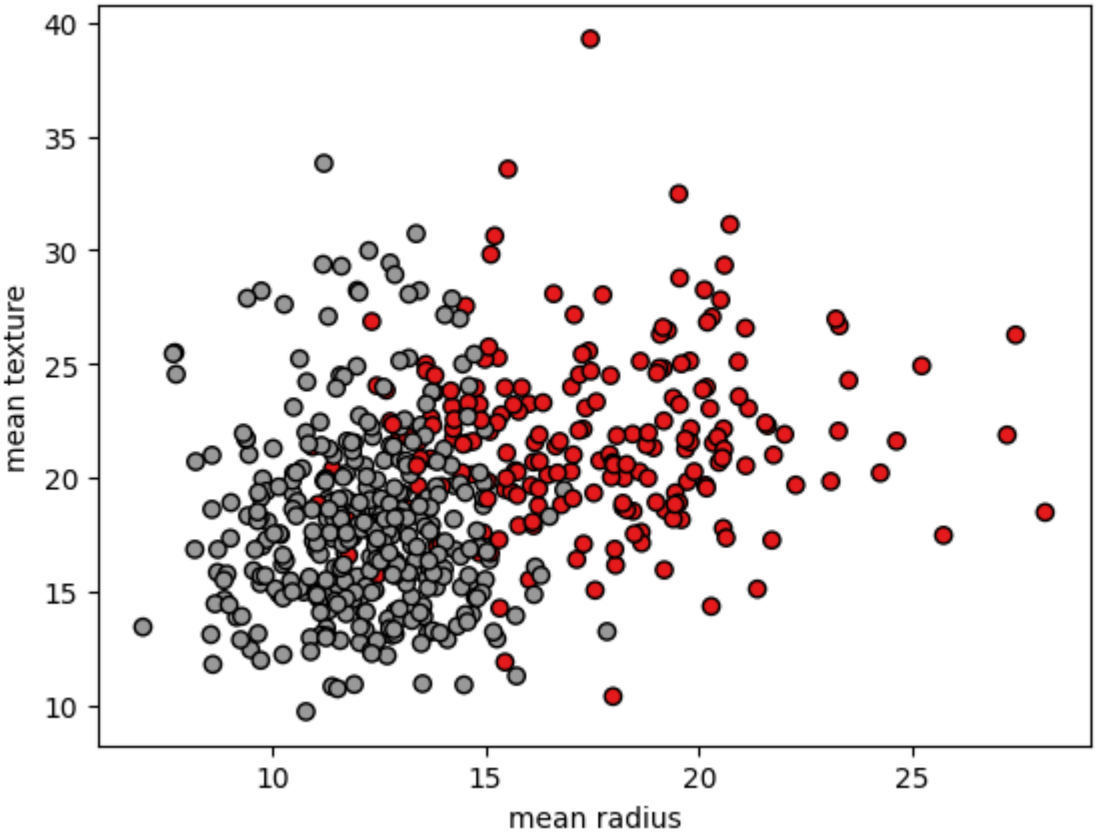
```
In [ ]: print(f"Number of Input Records: {len(cancer.data)}")
        print(f"Number of Target Records: {len(cancer.target)}")
```

```
Number of Input Records: 569
Number of Target Records: 569
```

Visulizing the dataset

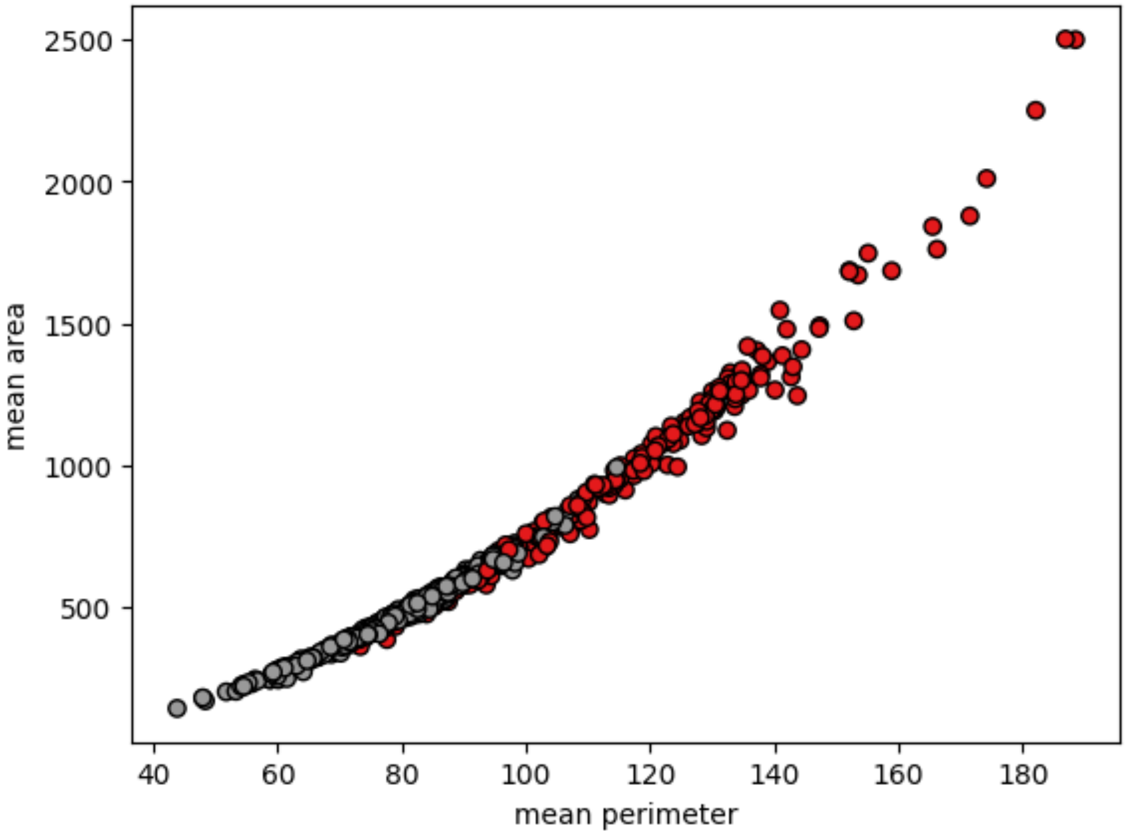
```
In [ ]: x = cancer.data
        y = cancer.target

        plot.scatter(x[:, 0], x[:, 1], c=y, cmap=plot.cm.Set1, edgecolor="k")
        plot.xlabel(cancer.feature_names[0])
        plot.ylabel(cancer.feature_names[1])
        plot.show()
```



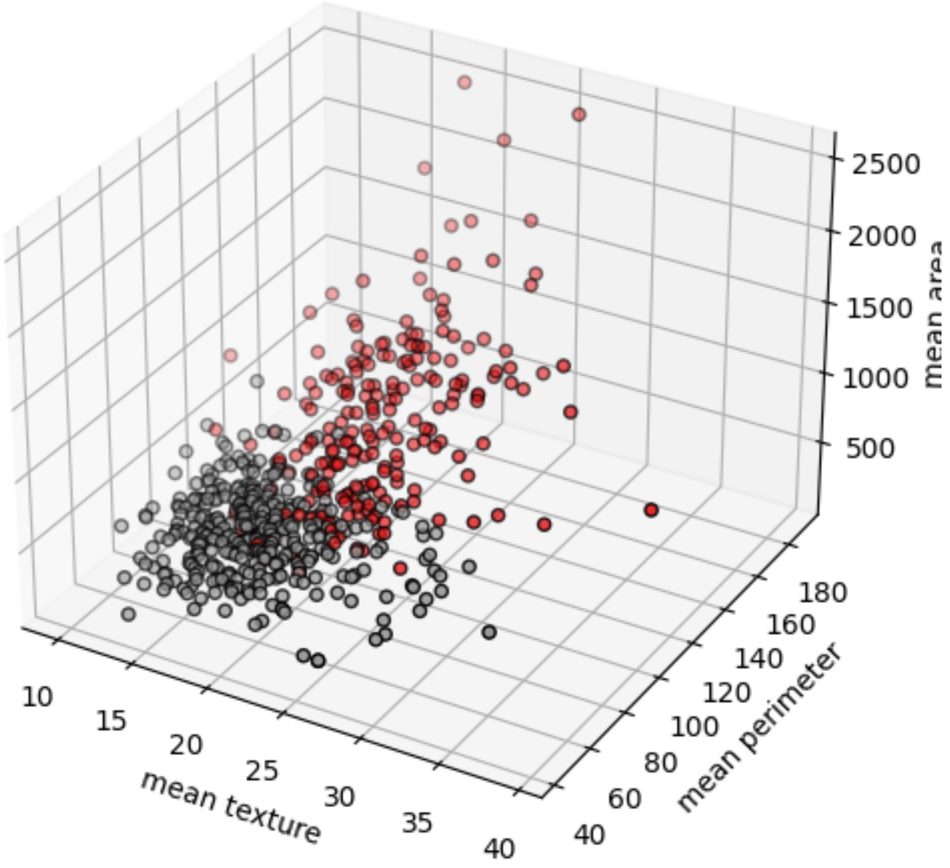
In [ ]:

```
plot.scatter(x[:, 2], x[:, 3], c=y, cmap=plot.cm.Set1, edgecolor="k")
plot.xlabel(cancer.feature_names[2])
plot.ylabel(cancer.feature_names[3])
plot.show()
```



In [ ]:
```
fig = plot.figure(figsize=(6, 6))
ax = fig.add_subplot(projection="3d")

ax.scatter(x[:, 1], x[:, 2], x[:, 3], c=y, cmap=plot.cm.Set1, edgecolor="k")
ax.set_xlabel(cancer.feature_names[1])
ax.set_ylabel(cancer.feature_names[2])
ax.set_zlabel(cancer.feature_names[3])
plot.show()
```



In [ ]:
```
fig = plot.figure(figsize=(6, 6))
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ax.set_xlabel(cancer.feature_names[0])
ax.set_ylabel(cancer.feature_names[2])
ax.set_zlabel(cancer.feature_names[3])
plot.show()
```
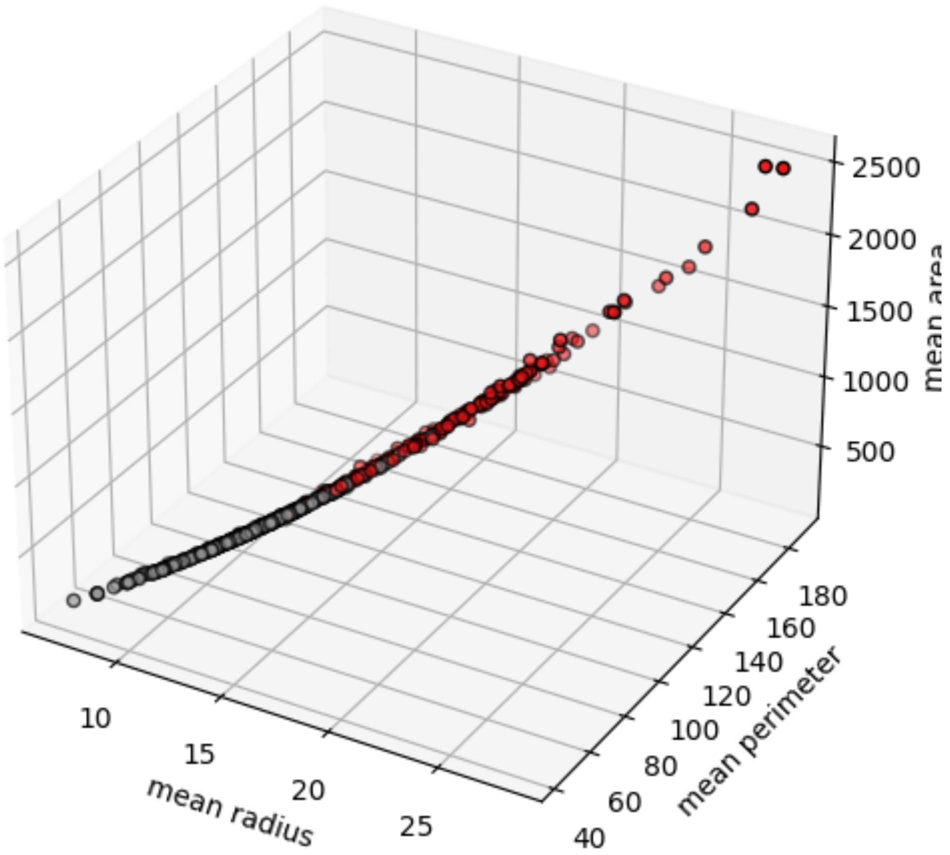



Training

In [ ]:

```
x = cancer.data
y = cancer.target

x_train, x_test, y_train, y_test = train_test_split(
    x, y, train_size=0.7, random_state=12, stratify=y
)
```

In [ ]:

```
print(f"Number of Training Records (input): {len(x_train)}")
print(f"Number of Training Records (target): {len(y_train)}")

print(f"Number of Test Records (input): {len(x_test)}")
print(f"Number of Test Records (input): {len(x_test)}")
```

```
Number of Training Records (input): 398
Number of Training Records (target): 398
Number of Test Records (input): 171
Number of Test Records (input): 171
```

Standardization of features

In [ ]:

```
sc = StandardScaler()
sc.fit(x_train)
print(f"Mean: {sc.mean_} \nVariance={sc.var_}")
```

```
Mean: [1.41116357e+01 1.93185176e+01 9.19045980e+01 6.52341960e+02
 9.66789196e-02 1.05407538e-01 8.93099095e-02 4.90316307e-02
 1.81254271e-01 6.30428141e-02 4.05524874e-01 1.23957437e+00
 2.88369472e+00 4.00465050e+01 6.94425879e-03 2.58227136e-02
 3.20159445e-02 1.17238518e-02 2.03908492e-02 3.83992337e-03
 1.62950075e+01 2.58059548e+01 1.07512337e+02 8.83543467e+02
 1.32253090e-01 2.59834422e-01 2.75337379e-01 1.14728872e-01
 2.90603769e-01 8.47426382e-02]
Variance=[1.21148968e+01 1.93139543e+01 5.81708590e+02 1.19210235e+05
 2.02861211e-04 2.94862617e-03 6.59054875e-03 1.54361157e-03
 7.37663889e-04 4.76459835e-05 7.02566544e-02 3.48667141e-01
 3.79566539e+00 1.83372480e+03 9.32635828e-06 3.50145290e-04
 9.40691912e-04 4.01944541e-05 6.53382860e-05 7.41031383e-06
 2.36127072e+01 3.98101703e+01 1.15402630e+03 3.30127345e+05
 5.23850716e-04 2.76004641e-02 4.53267425e-02 4.53968643e-03
 3.70242936e-03 3.34704998e-04]
```

In [ ]:

```
x_train_std = sc.transform(x_train)
x_test_std = sc.transform(x_test)
```

In [ ]:

```
classifier = svm.SVC()

# training
classifier.fit(x_train_std, y_train)
```

Out[ ]:

```
▾ SVC

SVC()
```

Classification report

In [ ]:

```
predicted_target = classifier.predict(x_test_std)

# classification report
print(metrics.classification_report(y_test, predicted_target))
```

```
              precision    recall  f1-score   support

           0       0.94      0.95      0.95        64
           1       0.97      0.96      0.97       107

    accuracy                           0.96       171
   macro avg       0.96      0.96      0.96       171
weighted avg       0.96      0.96      0.96       171
```

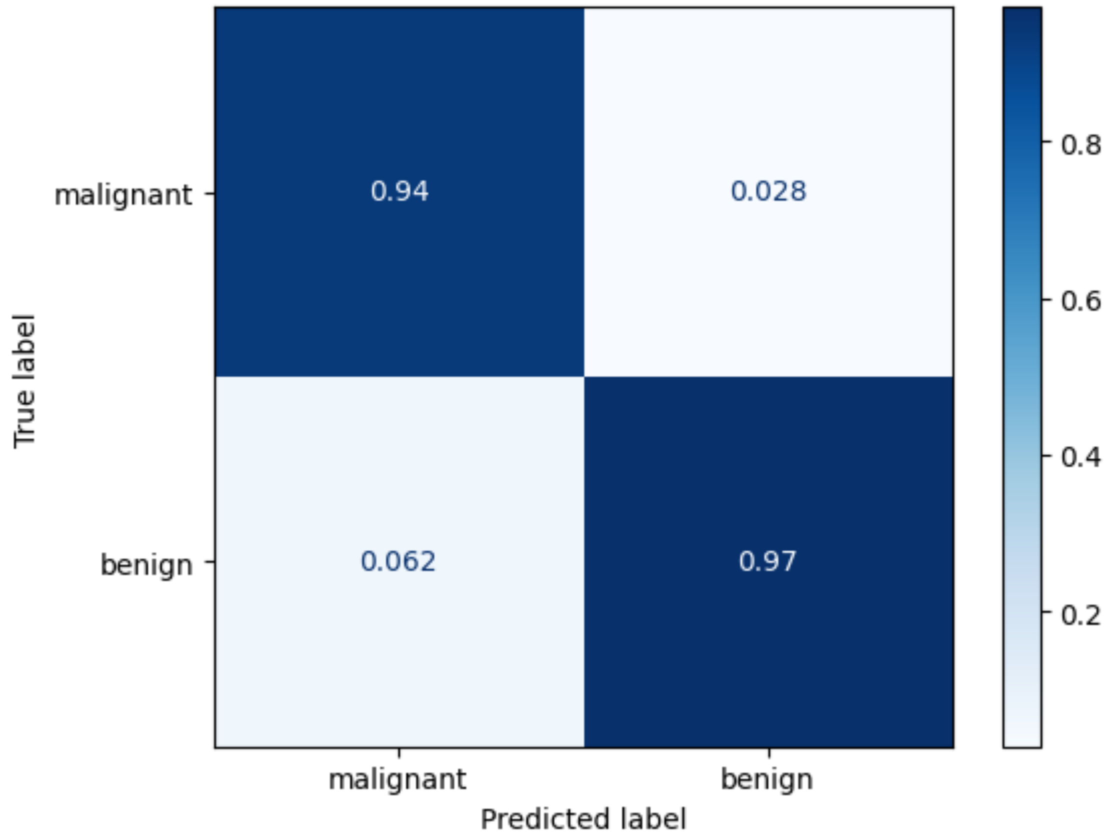
Confusion matrix

In [ ]:

```
cm = confusion_matrix(y_test, predicted_target, normalize="pred")
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=cancer.target_
disp.plot(cmap=plot.cm.Blues)
```

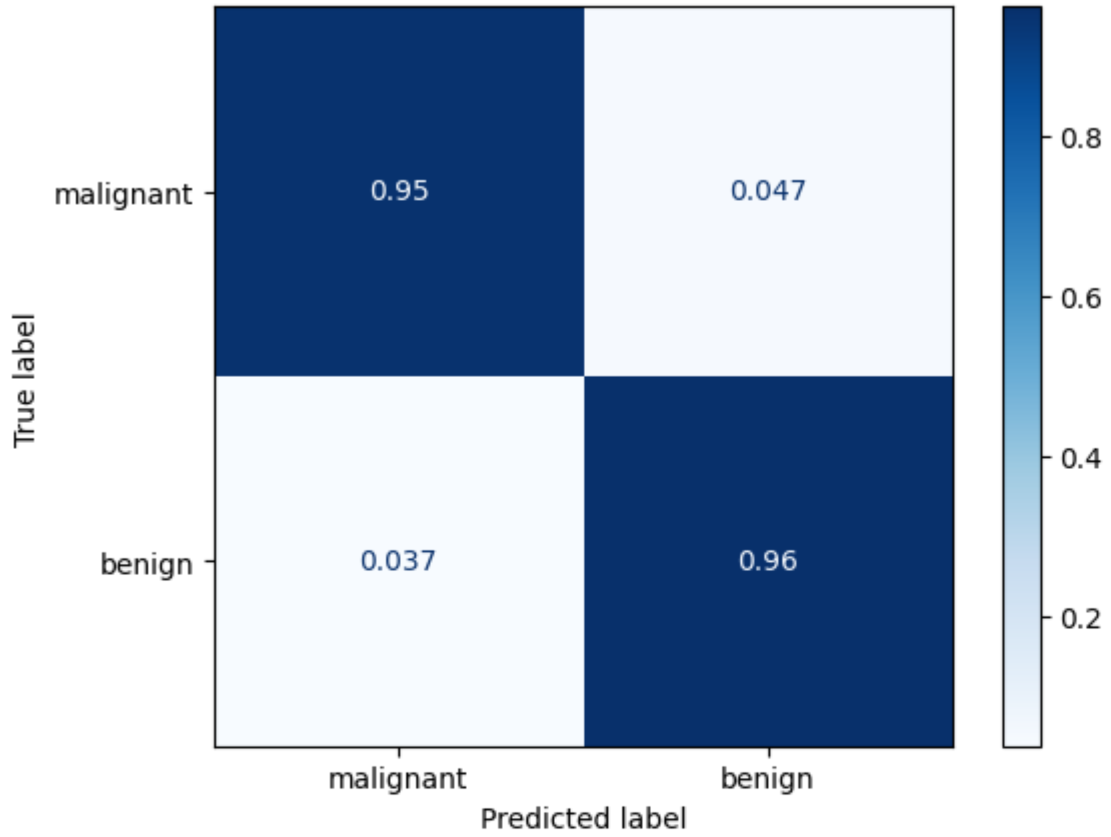
Out[ ]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f59a55f7070
>
```



In [ ]:
```
cm = confusion_matrix(y_test, predicted_target, normalize="true")
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=cancer.target_
disp.plot(cmap=plot.cm.Blues)
```

Out[ ]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f59a54ea440
>
```



References

- The Iris Dataset
- 3D scatterplot
- sklearn.preprocessing.StandardScaler
- sklearn.model_selection.train_test_split
- Iris classification with sklearn perceptron
- Support Vector Machines
- plot_confusion_matrix without estimator