JADAVPUR UNIVERSITY

MACHINE LEARNING LABORATORY

ASSIGNMENT #2 - B) WINE DATASET

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DEPARTMENT - INFORMATION TECHNOLOGY

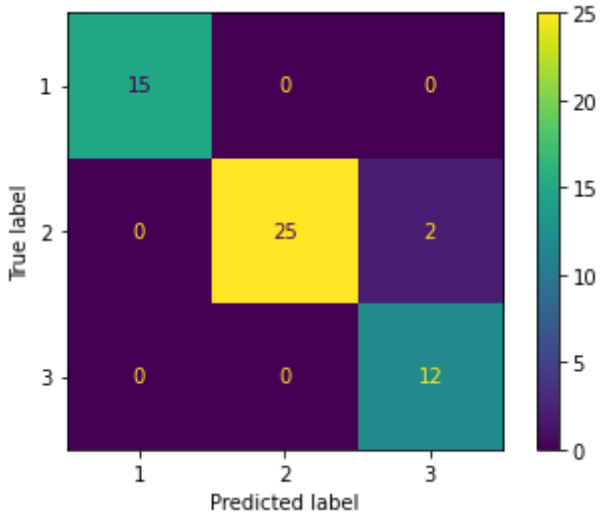
ROLL NO - 001811001035

In [ ]:

```
# WINE DATASET
# Random Forest Classifier(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[15  0  0]
 [ 0 25  2]
 [ 0  0 12]]
--------------------------------------------------
```

```
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.93      0.96        27
           3       0.86      1.00      0.92        12

    accuracy                           0.96        54
   macro avg       0.95      0.98      0.96        54
weighted avg       0.97      0.96      0.96        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9629629629629629
```

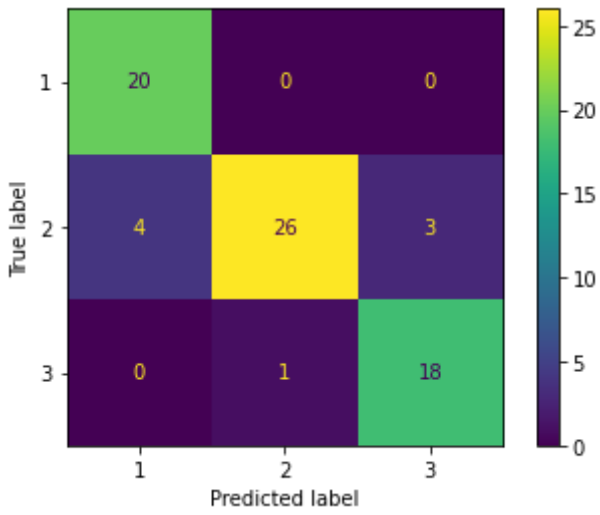


In [ ]:

```python
# WINE DATASET
# Random Forest Classifier(Without Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
```

```
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[20  0  0]
 [ 4 26  3]
 [ 0  1 18]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.83      1.00      0.91        20
           2       0.96      0.79      0.87        33
           3       0.86      0.95      0.90        19

    accuracy                           0.89        72
   macro avg       0.88      0.91      0.89        72
weighted avg       0.90      0.89      0.89        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.8888888888888888
```

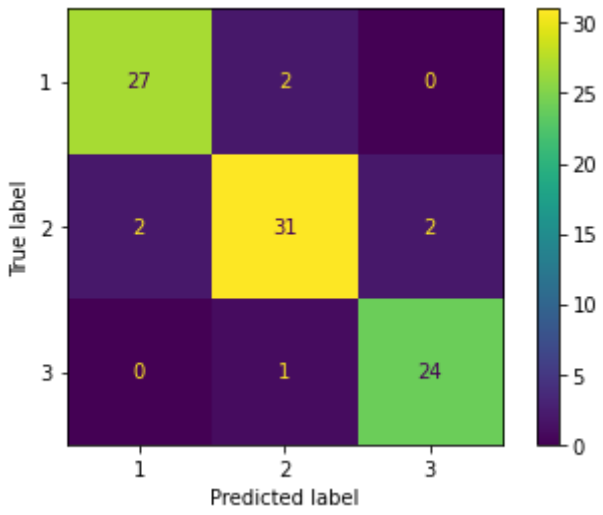


In [ ]:

```
# WINE DATASET
# Random Forest Classifier(Without Tuning)[50-50 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))
```

```
print("-------------------------------------------------")
print("-------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[27  2  0]
 [ 2 31  2]
 [ 0  1 24]]
-------------------------------------------------
-------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.93      0.93      0.93        29
           2       0.91      0.89      0.90        35
           3       0.92      0.96      0.94        25

    accuracy                           0.92        89
   macro avg       0.92      0.93      0.92        89
weighted avg       0.92      0.92      0.92        89

-------------------------------------------------
-------------------------------------------------
Accuracy:
0.9213483146067416
```

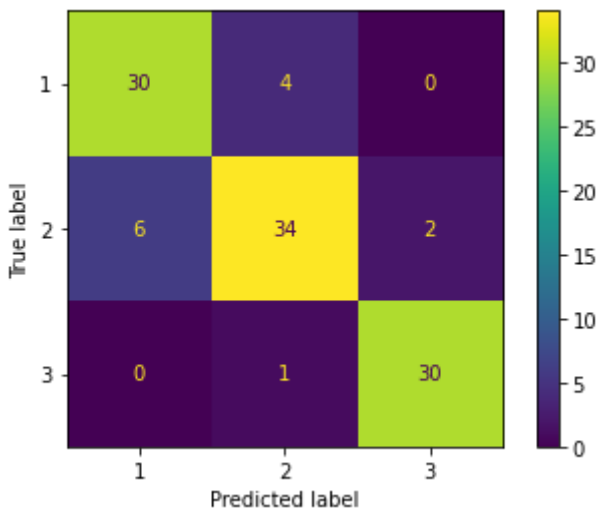


In [ ]:

```
# WINE DATASET
# Random Forest Classifier(Without Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
```

```
print("-------------------------------------------------")
print("-------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------")
print("-------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[30  4  0]
 [ 6 34  2]
 [ 0  1 30]]
-------------------------------------------------
-------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.83      0.88      0.86        34
           2       0.87      0.81      0.84        42
           3       0.94      0.97      0.95        31

    accuracy                           0.88       107
   macro avg       0.88      0.89      0.88       107
weighted avg       0.88      0.88      0.88       107

-------------------------------------------------
-------------------------------------------------
Accuracy:
0.8785046728971962
```

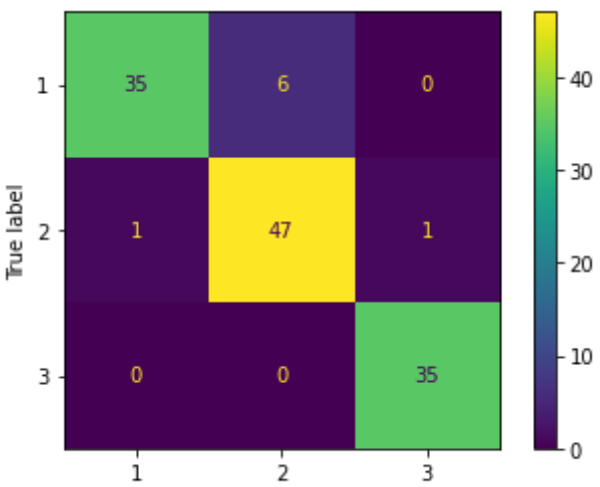


In [ ]:

```
# WINE DATASET
# Random Forest Classifier(Without Tuning)[30-70 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.7,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier
```

```
classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[35  6  0]
 [ 1 47  1]
 [ 0  0 35]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.97      0.85      0.91        41
           2       0.89      0.96      0.92        49
           3       0.97      1.00      0.99        35

    accuracy                           0.94       125
   macro avg       0.94      0.94      0.94       125
weighted avg       0.94      0.94      0.94       125

-------------------------------------------------------
-------------------------------------------------------
Accuracy:
0.936
```



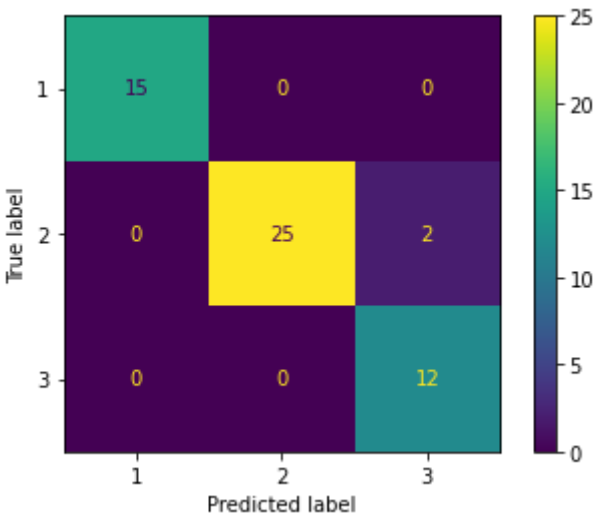
In [ ]:

```
# WINE DATASET
# Random Forest Classifier(With Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.30,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler
```

```
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

##############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

##############################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)

##############################################################################

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
```

```
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   52.9s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.6min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  7.0min finished
Confusion Matrix:
[[15  0  0]
 [ 0 25  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.93      0.96        27
           3       0.86      1.00      0.92        12

    accuracy                           0.96        54
   macro avg       0.95      0.98      0.96        54
weighted avg       0.97      0.96      0.96        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9629629629629629
```



In [ ]:

```python
# WINE DATASET
# Random Forest Classifier(With Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

################################################################################
# Showing all the parameters
```

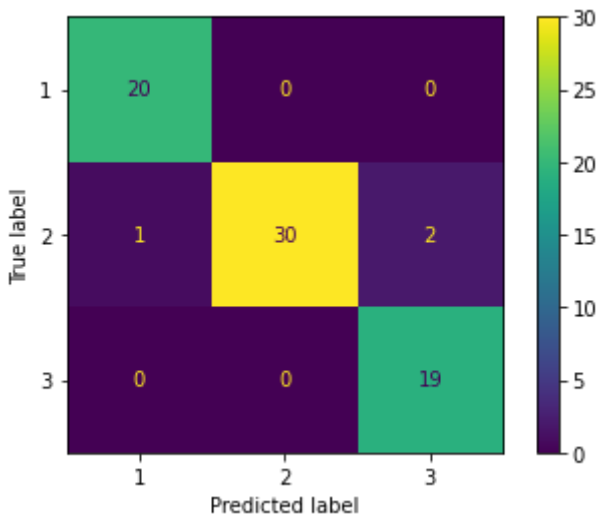
```
from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)
```

```
################################################################################

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))
```

```
import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
```

```
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   52.2s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.6min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  7.0min finished
Confusion Matrix:
[[20  0  0]
 [ 1 30  2]
 [ 0  0 19]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.95      1.00      0.98        20
           2       1.00      0.91      0.95        33
           3       0.90      1.00      0.95        19

    accuracy                           0.96        72
   macro avg       0.95      0.97      0.96        72
weighted avg       0.96      0.96      0.96        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9583333333333334
```



In [ ]:

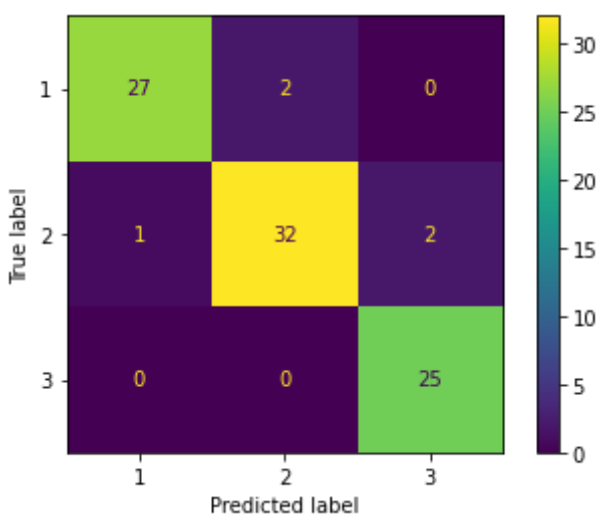
```python
# WINE DATASET
# Random Forest Classifier(With Tuning)[50-50 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

##############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

##############################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
```

```
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)

################################################################################

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)
```

```
y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   52.4s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.6min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  7.0min finished
Confusion Matrix:
[[27  2  0]
 [ 1 32  2]
 [ 0  0 25]]
--------------------------------------------------
```

```
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.96      0.93      0.95        29
           2       0.94      0.91      0.93        35
           3       0.93      1.00      0.96        25

    accuracy                           0.94        89
   macro avg       0.94      0.95      0.95        89
weighted avg       0.94      0.94      0.94        89

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9438202247191011
```



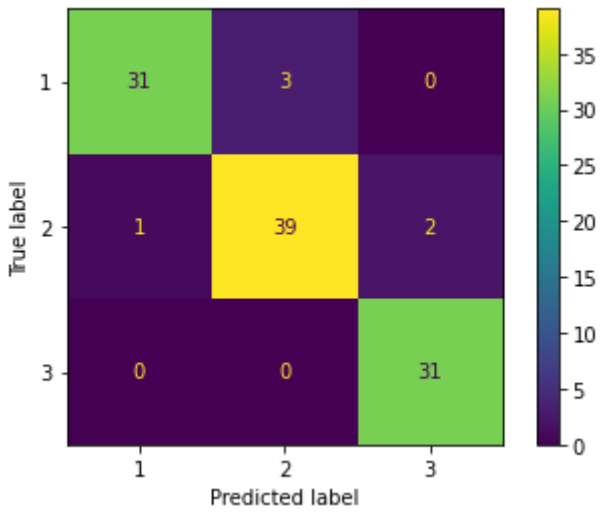
In [ ]:

```python
# WINE DATASET
# Random Forest Classifier(With Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
```

```
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)

################################################################################

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   52.0s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.6min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  6.9min finished
Confusion Matrix:
[[31  3  0]
 [ 1 39  2]
 [ 0  0 31]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.97      0.91      0.94        34
           2       0.93      0.93      0.93        42
           3       0.94      1.00      0.97        31

    accuracy                           0.94       107
   macro avg       0.95      0.95      0.95       107
weighted avg       0.94      0.94      0.94       107
```

```
--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9439252336448598
```



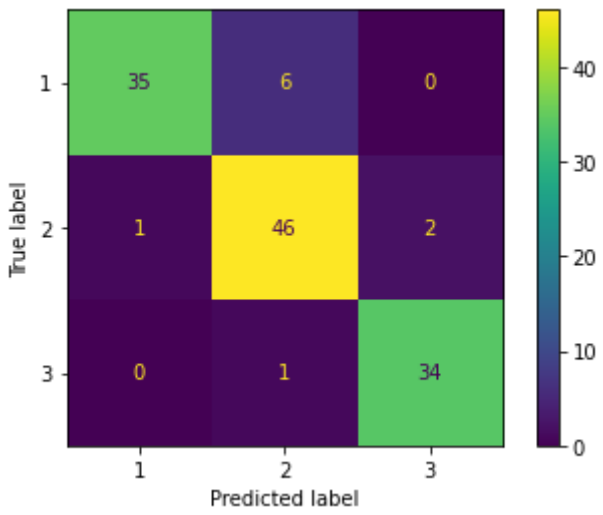
In [ ]:

```
# WINE DATASET
# Random Forest Classifier(With Tuning)[30-70 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)

###############################################################################
```

```python
# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))
```

```python
import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   51.3s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.5min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  6.8min finished
Confusion Matrix:
[[35  6  0]
 [ 1 46  2]
 [ 0  1 34]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.97      0.85      0.91        41
           2       0.87      0.94      0.90        49
           3       0.94      0.97      0.96        35

    accuracy                           0.92       125
   macro avg       0.93      0.92      0.92       125
weighted avg       0.92      0.92      0.92       125

-------------------------------------------------------
-------------------------------------------------------
Accuracy:
0.92
```

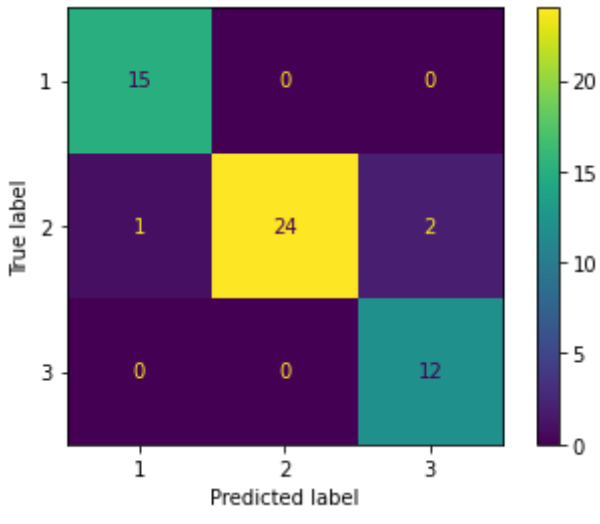


In [ ]:
```
##########################################################################################################
```

In [ ]:
```
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.30,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[15  0  0]
 [ 1 24  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
```

```
Performance Evaluation
              precision    recall  f1-score   support

           1       0.94      1.00      0.97        15
           2       1.00      0.89      0.94        27
           3       0.86      1.00      0.92        12

    accuracy                           0.94        54
   macro avg       0.93      0.96      0.94        54
weighted avg       0.95      0.94      0.94        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9444444444444444
```

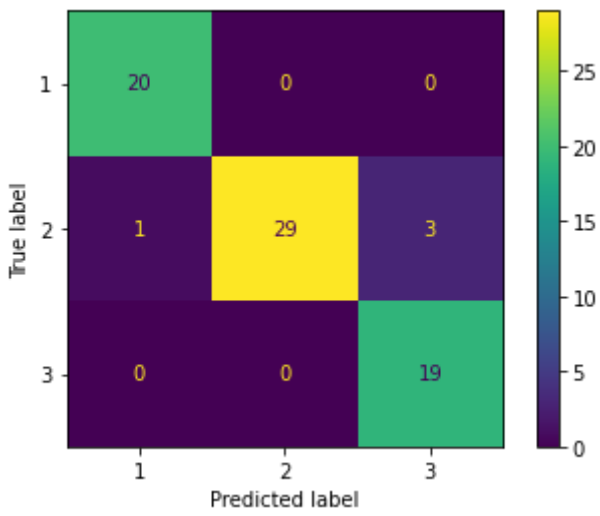


In [ ]:

```python
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
```

```
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[20  0  0]
 [ 1 29  3]
 [ 0  0 19]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.95      1.00      0.98        20
           2       1.00      0.88      0.94        33
           3       0.86      1.00      0.93        19

    accuracy                           0.94        72
   macro avg       0.94      0.96      0.95        72
weighted avg       0.95      0.94      0.94        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9444444444444444
```

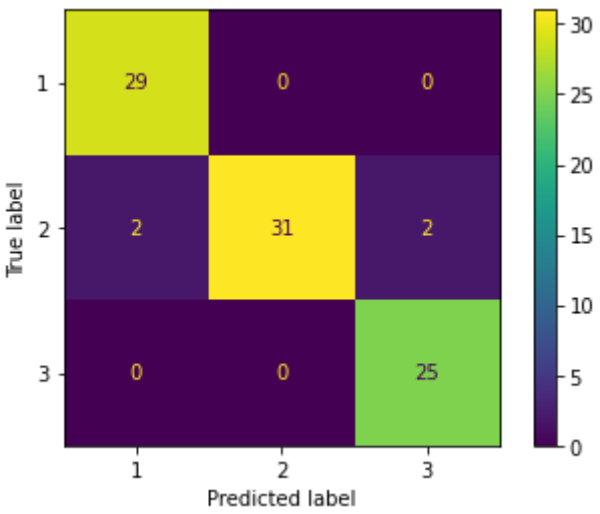


In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[50-50 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
```

```
print(classification_report(y_test, y_pred))


print("-----------------------------------------------------")
print("-----------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[29  0  0]
 [ 2 31  2]
 [ 0  0 25]]
-----------------------------------------------------
-----------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.94      1.00      0.97        29
           2       1.00      0.89      0.94        35
           3       0.93      1.00      0.96        25

    accuracy                           0.96        89
   macro avg       0.95      0.96      0.96        89
weighted avg       0.96      0.96      0.95        89

-----------------------------------------------------
-----------------------------------------------------
Accuracy:
0.9550561797752809
```

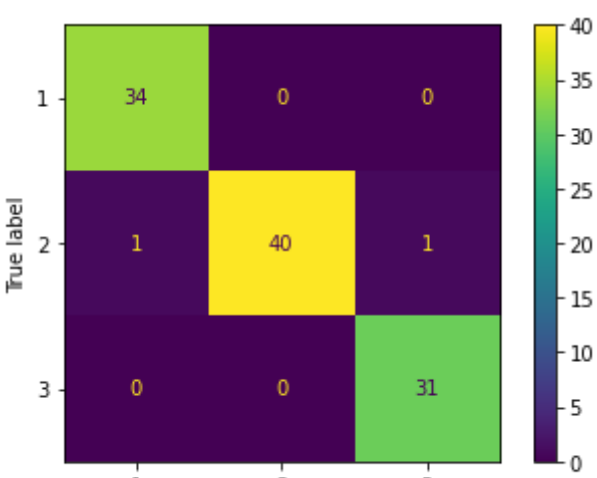


In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)


col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)
```

```
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[34  0  0]
 [ 1 40  1]
 [ 0  0 31]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.97      1.00      0.99        34
           2       1.00      0.95      0.98        42
           3       0.97      1.00      0.98        31

    accuracy                           0.98       107
   macro avg       0.98      0.98      0.98       107
weighted avg       0.98      0.98      0.98       107

-------------------------------------------------------
-------------------------------------------------------
Accuracy:
0.9813084112149533
```



In [ ]:

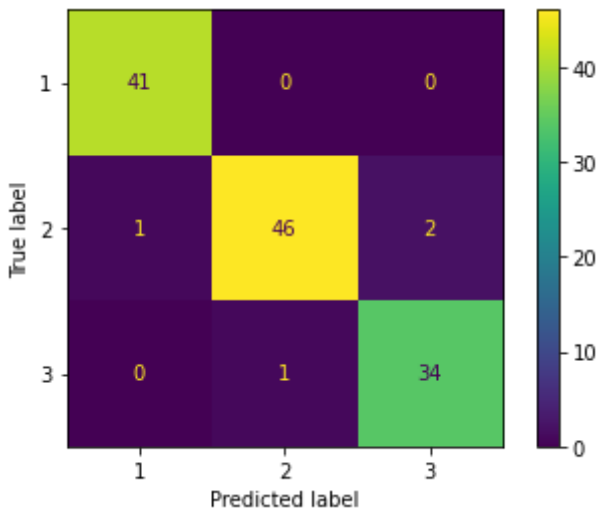
```
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[30-70 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.7,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler
```

```
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))
```

```
import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[41  0  0]
 [ 1 46  2]
 [ 0  1 34]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.98      1.00      0.99        41
           2       0.98      0.94      0.96        49
           3       0.94      0.97      0.96        35

    accuracy                           0.97       125
   macro avg       0.97      0.97      0.97       125
weighted avg       0.97      0.97      0.97       125

-------------------------------------------------------
-------------------------------------------------------
Accuracy:
0.968
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
```



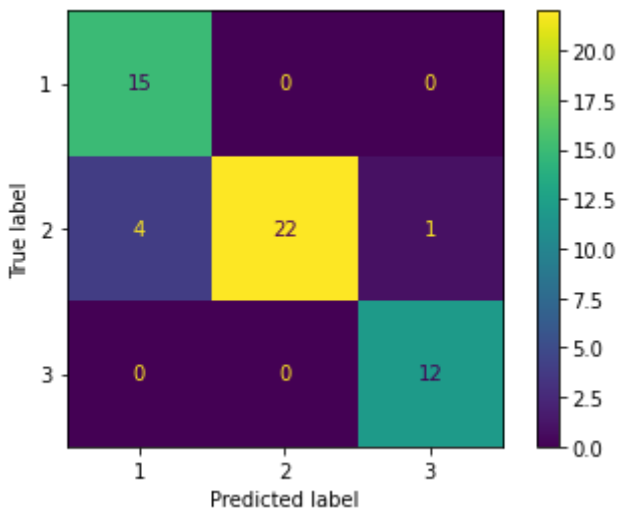
In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name
```

```
X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

###############################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
```

```
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[15  0  0]
 [ 4 22  1]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.79      1.00      0.88        15
           2       1.00      0.81      0.90        27
           3       0.92      1.00      0.96        12

    accuracy                           0.91        54
   macro avg       0.90      0.94      0.91        54
weighted avg       0.92      0.91      0.91        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9074074074074074
```



In [ ]:

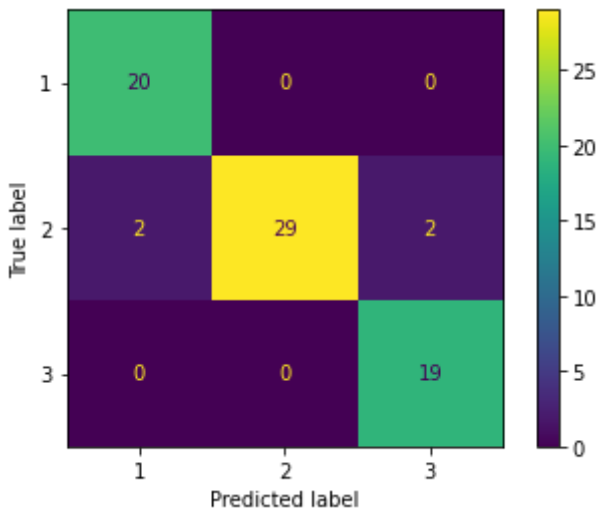
```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)
col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
```

```
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)
```

```
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[20  0  0]
 [ 2 29  2]
 [ 0  0 19]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
```

```
              precision    recall  f1-score   support

           1       0.91      1.00      0.95        20
           2       1.00      0.88      0.94        33
           3       0.90      1.00      0.95        19

    accuracy                           0.94        72
   macro avg       0.94      0.96      0.95        72
weighted avg       0.95      0.94      0.94        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9444444444444444
```



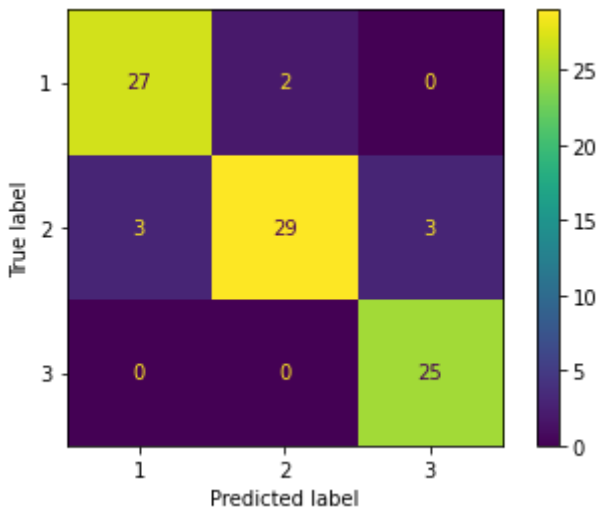
In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[50-50 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

###############################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
```

```python
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[27  2  0]
 [ 3 29  3]
 [ 0  0 25]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.90      0.93      0.92        29
           2       0.94      0.83      0.88        35
           3       0.89      1.00      0.94        25

    accuracy                           0.91        89
   macro avg       0.91      0.92      0.91        89
weighted avg       0.91      0.91      0.91        89

-------------------------------------------------------
-------------------------------------------------------
Accuracy:
0.9101123595505618
```

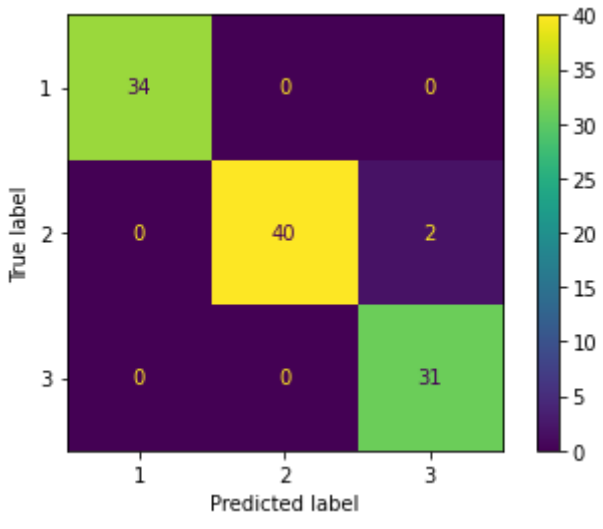


In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features


parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

###############################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
```

```
print("-------------------------------------------------")
print("-------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------")
print("-------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[34  0  0]
 [ 0 40  2]
 [ 0  0 31]]
-------------------------------------------------
-------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        34
           2       1.00      0.95      0.98        42
           3       0.94      1.00      0.97        31

    accuracy                           0.98       107
   macro avg       0.98      0.98      0.98       107
weighted avg       0.98      0.98      0.98       107

-------------------------------------------------
-------------------------------------------------
Accuracy:
0.9813084112149533
```



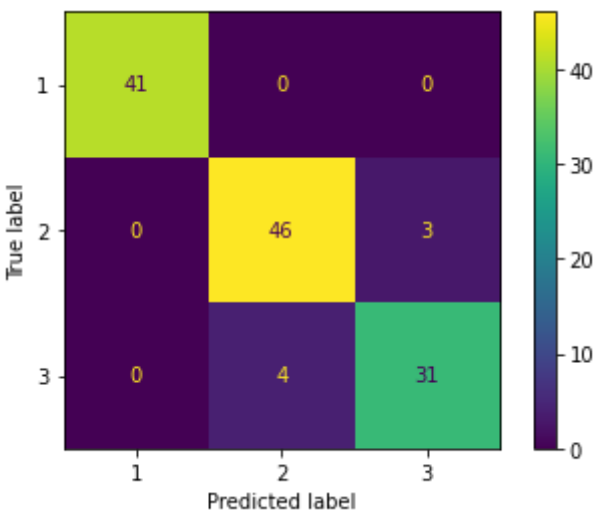
In [ ]:

```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[30-70 split]
```

```
import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.7,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

###############################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)


y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:
```

```
{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[41  0  0]
 [ 0 46  3]
 [ 0  4 31]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        41
           2       0.92      0.94      0.93        49
           3       0.91      0.89      0.90        35

    accuracy                           0.94       125
   macro avg       0.94      0.94      0.94       125
weighted avg       0.94      0.94      0.94       125

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.944
```



In [ ]:

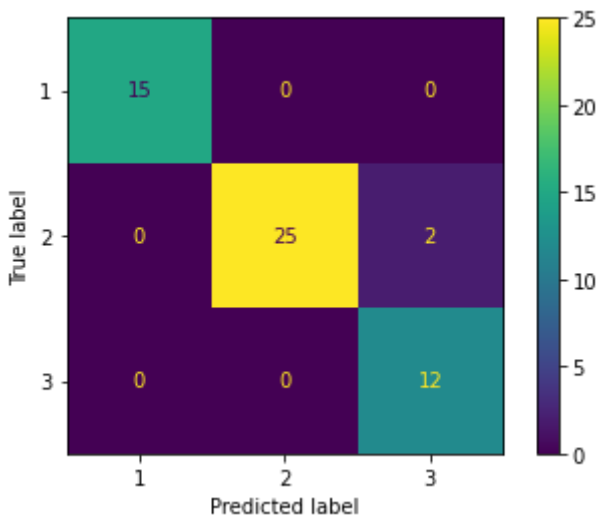
```
##########################################################################################################################
```

In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)
```

```
# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[15  0  0]
 [ 0 25  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.93      0.96        27
           3       0.86      1.00      0.92        12

    accuracy                           0.96        54
   macro avg       0.95      0.98      0.96        54
weighted avg       0.97      0.96      0.96        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9629629629629629
```

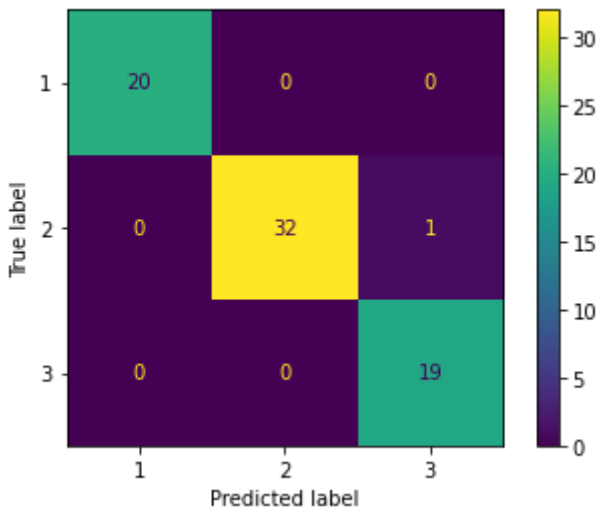


In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name
```

```
X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[20  0  0]
 [ 0 32  1]
 [ 0  0 19]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        20
           2       1.00      0.97      0.98        33
           3       0.95      1.00      0.97        19

    accuracy                           0.99        72
   macro avg       0.98      0.99      0.99        72
weighted avg       0.99      0.99      0.99        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9861111111111112
```

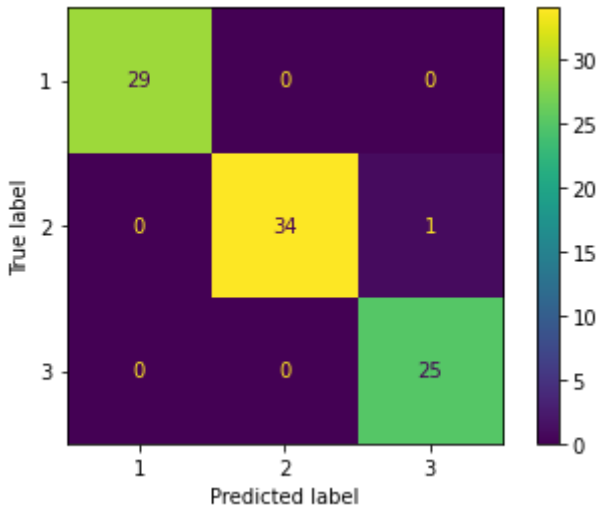


In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[50-50 split]


import pandas as pd
import numpy as np
```

```python
# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)
y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

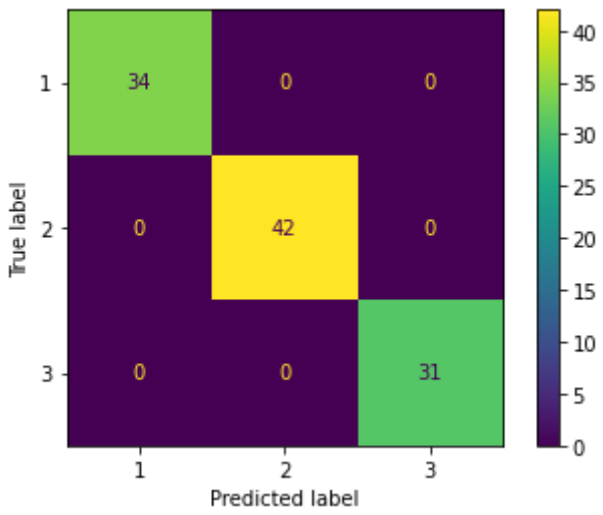
```
Confusion Matrix:
[[29  0  0]
 [ 0 34  1]
 [ 0  0 25]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        29
           2       1.00      0.97      0.99        35
           3       0.96      1.00      0.98        25

    accuracy                           0.99        89
   macro avg       0.99      0.99      0.99        89
weighted avg       0.99      0.99      0.99        89

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9887640449438202
```



In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[34  0  0]
 [ 0 42  0]
 [ 0  0 31]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        34
           2       1.00      1.00      1.00        42
           3       1.00      1.00      1.00        31

    accuracy                           1.00       107
   macro avg       1.00      1.00      1.00       107
weighted avg       1.00      1.00      1.00       107

--------------------------------------------------
--------------------------------------------------
Accuracy:
1.0
```

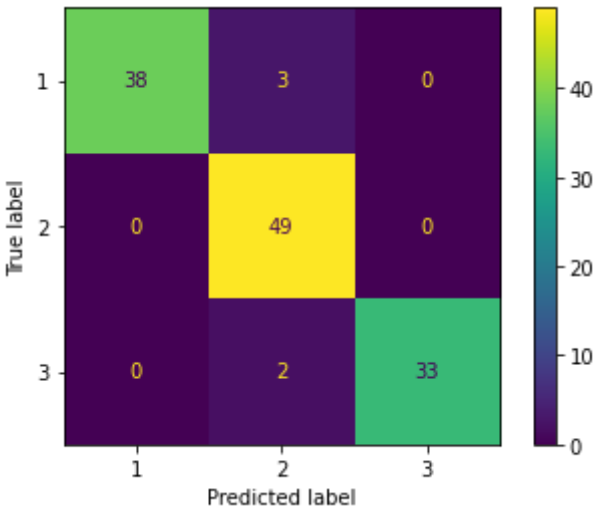


In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[30-70 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.7,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```

```
Confusion Matrix:
[[38  3  0]
 [ 0 49  0]
 [ 0  2 33]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      0.93      0.96        41
           2       0.91      1.00      0.95        49
           3       1.00      0.94      0.97        35
```

```
    accuracy                           0.96       125
   macro avg       0.97      0.96      0.96       125
weighted avg       0.96      0.96      0.96       125

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.96
```



In [ ]:

```
# WINE DATASET
# SVM(With Tuning)[70-30 split]
import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.svm import SVC

classifier = SVC()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)
```

```python
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'rbf',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
{'C': [0.1, 1, 10, 100],
 'gamma': [1, 0.1, 0.01, 0.001],
 'kernel': ['rbf', 'poly', 'sigmoid']}
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
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[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
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[CV] ................... C=10, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=10, gamma=0.001, kernel=sigmoid ...............................
[CV] ................ C=10, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=10, gamma=0.001, kernel=sigmoid ...............................
[CV] ................ C=10, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=10, gamma=0.001, kernel=sigmoid ...............................
[CV] ................ C=10, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=10, gamma=0.001, kernel=sigmoid ...............................
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[CV] C=10, gamma=0.001, kernel=sigmoid ...............................
[CV] ................ C=10, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ......................................
[CV] ....................... C=100, gamma=1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ......................................
[CV] ....................... C=100, gamma=1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ......................................
[CV] ....................... C=100, gamma=1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ......................................
[CV] ....................... C=100, gamma=1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ......................................
[CV] ....................... C=100, gamma=1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=1, kernel=poly .....................................
[CV] ...................... C=100, gamma=1, kernel=poly, total=   0.0s
[CV] C=100, gamma=1, kernel=poly .....................................
[CV] ...................... C=100, gamma=1, kernel=poly, total=   0.0s
[CV] C=100, gamma=1, kernel=poly .....................................
[CV] ...................... C=100, gamma=1, kernel=poly, total=   0.0s
[CV] C=100, gamma=1, kernel=poly .....................................
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[CV] C=100, gamma=1, kernel=poly .....................................
[CV] ...................... C=100, gamma=1, kernel=poly, total=   0.0s
[CV] C=100, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=100, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=100, gamma=1, kernel=sigmoid, total=   0.0s
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[CV] ................... C=100, gamma=1, kernel=sigmoid, total=   0.0s
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[CV] ..................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] ..................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] .................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ...................................
[CV] .................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ...................................
[CV] .................... C=100, gamma=0.1, kernel=poly, total=   0.0s
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[CV] .................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
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[CV] ................. C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
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[CV] .................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly ..................................
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[CV] ................... C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ................ C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ...............................
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[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
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[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
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[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
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[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
Confusion Matrix:
[[15  0  0]
 [ 0 26  1]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.96      0.98        27
           3       0.92      1.00      0.96        12

    accuracy                           0.98        54
   macro avg       0.97      0.99      0.98        54
weighted avg       0.98      0.98      0.98        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9814814814814815
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    0.9s finished
```

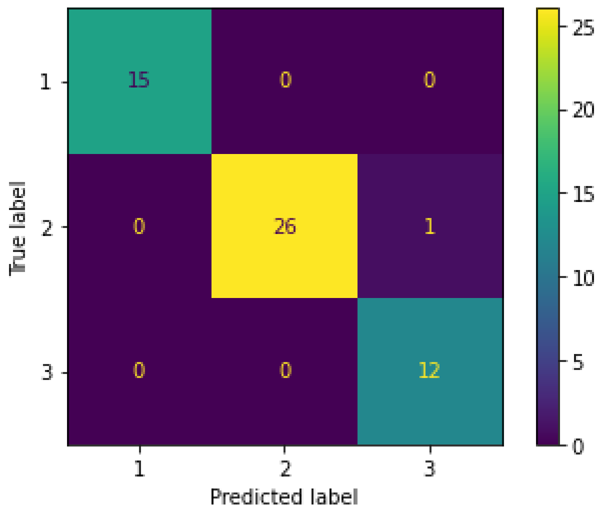

In [ ]:

```
# WINE DATASET
# SVM(With Tuning)[60-40 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.6,test_size=0.4,random_state=10)


# Feature Scaling
```

```python
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.svm import SVC

classifier = SVC()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

################################################################################

from sklearn.model_selection import GridSearchCV
# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'rbf',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
{'C': [0.1, 1, 10, 100],
 'gamma': [1, 0.1, 0.01, 0.001],
 'kernel': ['rbf', 'poly', 'sigmoid']}
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ...................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ...................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ...................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ...................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
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[CV] C=0.1, gamma=1, kernel=rbf ......................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
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[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly .....................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ....................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
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[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
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[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
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[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
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[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
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[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
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[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
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[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
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[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
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[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
Confusion Matrix:
[[20  0  0]
 [ 0 32  1]
 [ 0  0 19]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        20
           2       1.00      0.97      0.98        33
           3       0.95      1.00      0.97        19

    accuracy                           0.99        72
   macro avg       0.98      0.99      0.99        72
weighted avg       0.99      0.99      0.99        72

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9861111111111112
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    0.9s finished
```

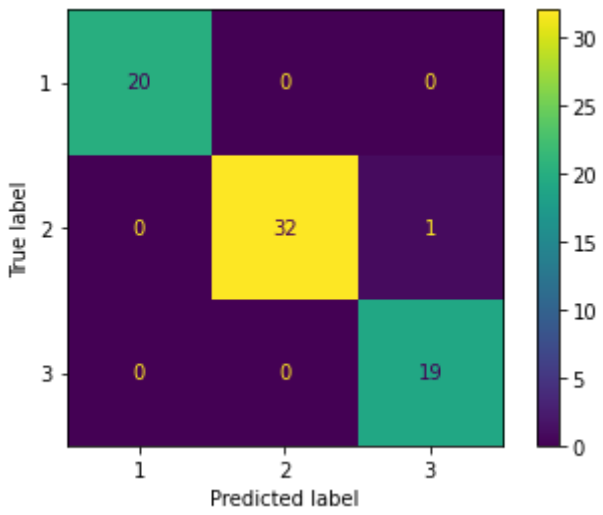

In [ ]:

```
# WINE DATASET
# SVM(With Tuning)[50-50 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.5,test_size=0.5,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.svm import SVC

classifier = SVC()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")
```

```python
print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'rbf',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
{'C': [0.1, 1, 10, 100],
 'gamma': [1, 0.1, 0.01, 0.001],
 'kernel': ['rbf', 'poly', 'sigmoid']}
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
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[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
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[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
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[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
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[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
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[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
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[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly .................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
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[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ..............................
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[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ..............................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf .................................
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[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
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[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
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[CV] C=0.1, gamma=0.01, kernel=poly ..................................
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[CV] C=0.1, gamma=0.01, kernel=poly ..................................
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[CV] C=0.1, gamma=0.01, kernel=poly ..................................
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[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
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[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
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[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
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[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
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[CV] C=1, gamma=1, kernel=rbf ........................................
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[CV] ..................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=0.1, kernel=rbf ......................................
[CV] ....................... C=1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=0.1, kernel=rbf ......................................
[CV] ....................... C=1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] C=1, gamma=0.1, kernel=rbf ......................................
[CV] ....................... C=1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=0.1, kernel=rbf ......................................
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[CV] ....................... C=1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] ................... C=1, gamma=0.1, kernel=sigmoid, total=   0.0s
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[CV] ................... C=1, gamma=0.1, kernel=sigmoid, total=   0.0s
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[CV] .................. C=1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=0.01, kernel=sigmoid .................................
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[CV] C=1, gamma=0.01, kernel=sigmoid .................................
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[CV] .................. C=1, gamma=0.01, kernel=sigmoid, total=   0.0s
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[CV] C=100, gamma=0.001, kernel=sigmoid .............................
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Confusion Matrix:
[[29  0  0]
 [ 0 34  1]
 [ 0  0 25]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        29
           2       1.00      0.97      0.99        35
           3       0.96      1.00      0.98        25

    accuracy                           0.99        89
   macro avg       0.99      0.99      0.99        89
weighted avg       0.99      0.99      0.99        89

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9887640449438202
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    0.9s finished
```

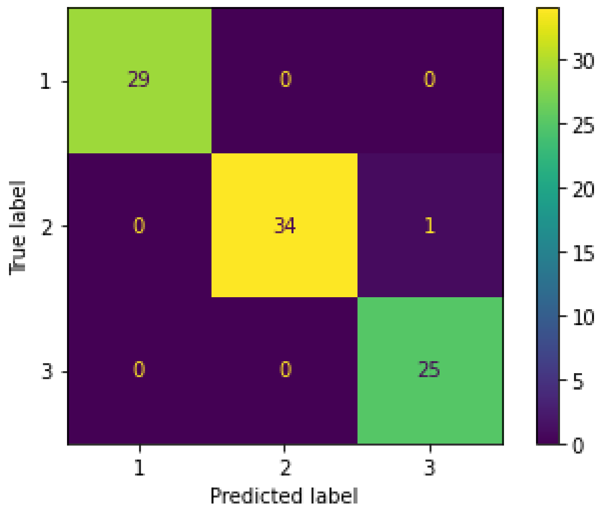

In [ ]:

```python
# WINE DATASET
# SVM(With Tuning)[40-60 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.4,test_size=0.6,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.svm import SVC
```

```python
classifier = SVC()

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

###############################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
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{'C': [0.1, 1, 10, 100],
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Fitting 5 folds for each of 48 candidates, totalling 240 fits
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[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
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[CV] C=10, gamma=0.01, kernel=poly ...................................
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[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
Confusion Matrix:
[[34  0  0]
 [ 0 42  0]
 [ 0  0 31]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        34
           2       1.00      1.00      1.00        42
           3       1.00      1.00      1.00        31

    accuracy                           1.00       107
   macro avg       1.00      1.00      1.00       107
weighted avg       1.00      1.00      1.00       107

--------------------------------------------------
--------------------------------------------------
Accuracy:
1.0
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    0.9s finished
```

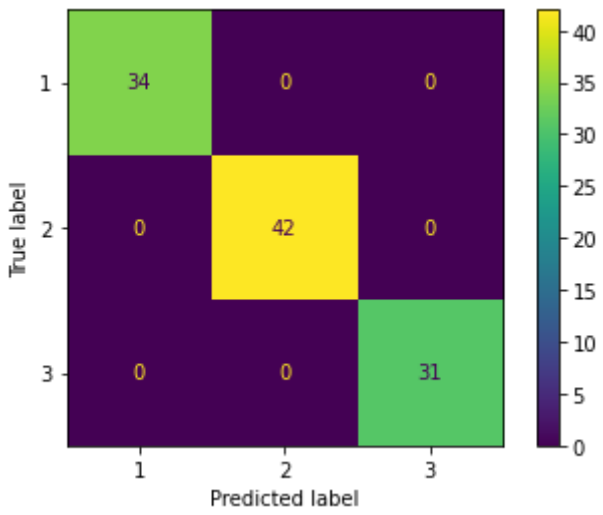

In [ ]:

```
# WINE DATASET
# SVM(With Tuning)[30-70 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.3,test_size=0.7,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Classification
from sklearn.svm import SVC

classifier = SVC()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")
```

```python
print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```

```
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'rbf',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
{'C': [0.1, 1, 10, 100],
 'gamma': [1, 0.1, 0.01, 0.001],
 'kernel': ['rbf', 'poly', 'sigmoid']}
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ...................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
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[CV] C=0.1, gamma=1, kernel=sigmoid .................................
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[CV] C=0.1, gamma=1, kernel=sigmoid .................................
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[CV] C=0.1, gamma=1, kernel=sigmoid .................................
[CV] .................. C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
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[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
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[CV] C=0.1, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
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[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
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[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
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[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
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[CV] C=0.1, gamma=0.001, kernel=poly .................................
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
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[CV] C=100, gamma=1, kernel=sigmoid .................................
[CV] .................. C=100, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=1, kernel=sigmoid .................................
[CV] .................. C=100, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] .................... C=100, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ..................................
[CV] ................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ..................................
[CV] ................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ..................................
[CV] ................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ..................................
[CV] ................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=poly ..................................
[CV] ................... C=100, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.1, kernel=sigmoid ...............................
[CV] ................ C=100, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ................... C=100, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly .................................
[CV] .................. C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly .................................
[CV] .................. C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly .................................
[CV] .................. C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly .................................
[CV] .................. C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=poly .................................
[CV] .................. C=100, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.01, kernel=sigmoid ..............................
[CV] ............... C=100, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
```
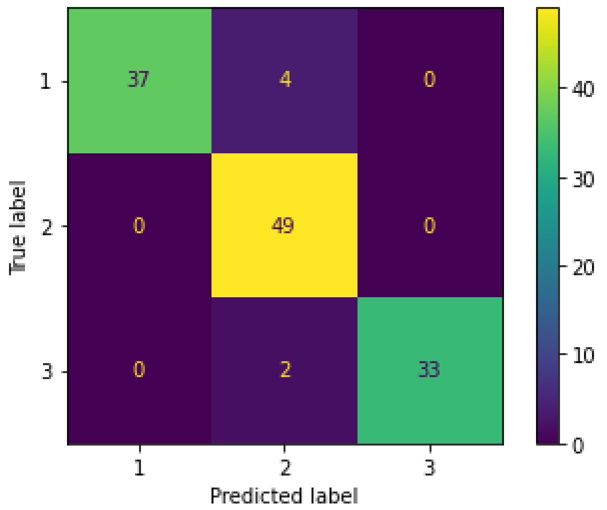

```
[CV] .................. C=100, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
Confusion Matrix:
[[37  4  0]
 [ 0 49  0]
 [ 0  2 33]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      0.90      0.95        41
           2       0.89      1.00      0.94        49
           3       1.00      0.94      0.97        35

    accuracy                           0.95       125
   macro avg       0.96      0.95      0.95       125
weighted avg       0.96      0.95      0.95       125

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.952
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    0.9s finished
```



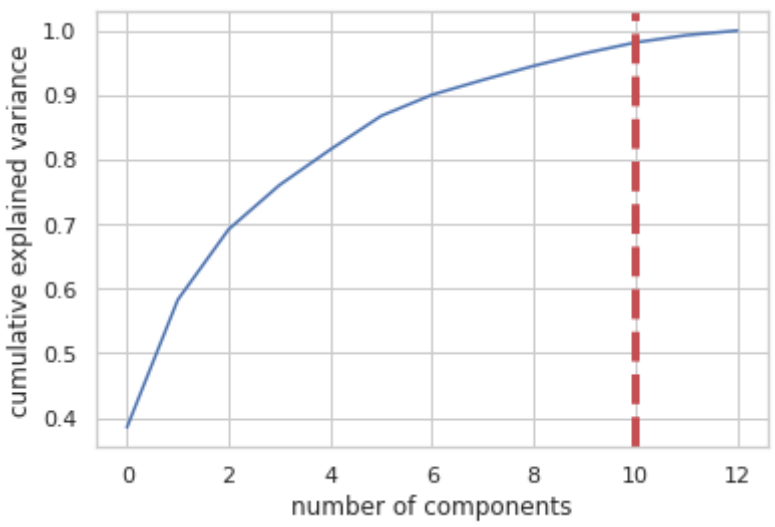
In [ ]:

```
##########################################################################################################################
```

In [ ]:

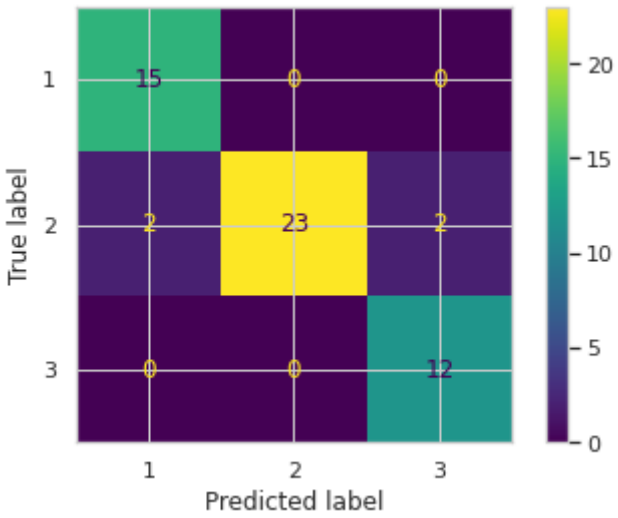
```
# WINE DATASET
# Random Forest Classifier(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```python
# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)



# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()
classifier.fit(X_train, y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```




```
None
Confusion Matrix:
[[15  0  0]
 [ 2 23  2]
 [ 0  0 12]]
-------------------------------------------------------
-------------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.88      1.00      0.94        15
           2       1.00      0.85      0.92        27
           3       0.86      1.00      0.92        12

    accuracy                           0.93        54
   macro avg       0.91      0.95      0.93        54
weighted avg       0.94      0.93      0.93        54

-------------------------------------------------------
-------------------------------------------------------
```

```
Accuracy:
0.9259259259259259
```

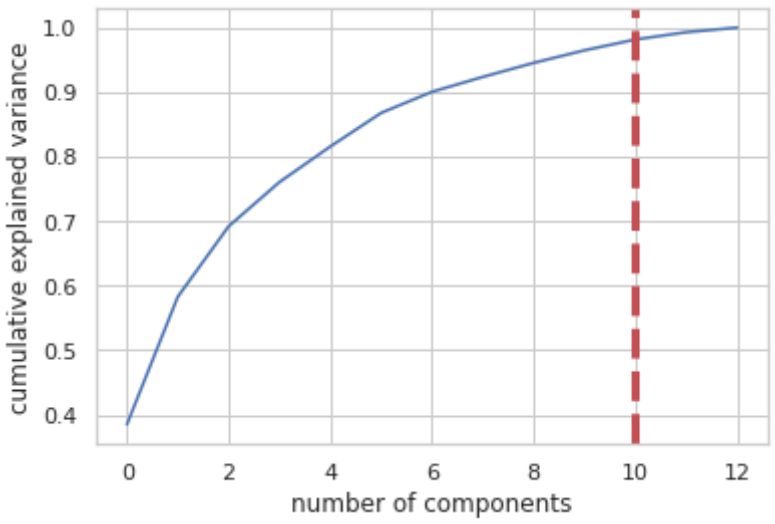


In [ ]:

```
# WINE DATASET
# Random Forest Classifier(With Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.30,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)

# Classification
from sklearn.ensemble import RandomForestClassifier

classifier = RandomForestClassifier()

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]
```

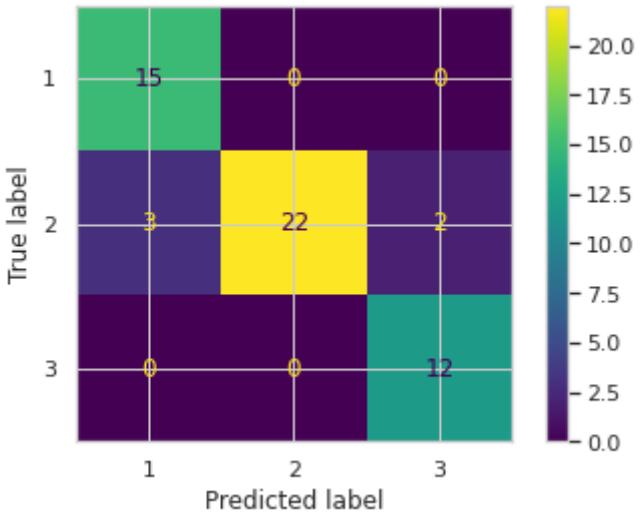
```
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
pprint(random_grid)

################################################################################

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = RandomForestClassifier()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = classifier, param_distributions = random_grid, n_iter = 100, cv = 3, verbose=2, random_
# Fit the random search model
rf_random.fit(X_train, y_train)
```

```
y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```




```
None
Parameters currently in use:

{'bootstrap': True,
 'ccp_alpha': 0.0,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'max_samples': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 100,
 'n_jobs': None,
 'oob_score': False,
 'random_state': None,
 'verbose': 0,
```

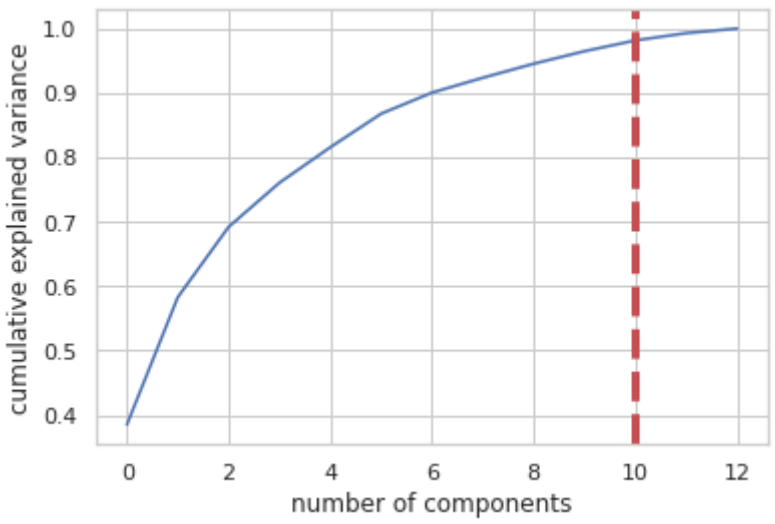
```
 'warm_start': False}
{'bootstrap': [True, False],
 'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
 'max_features': ['auto', 'sqrt'],
 'min_samples_leaf': [1, 2, 4],
 'min_samples_split': [2, 5, 10],
 'n_estimators': [200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000]}
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 2 concurrent workers.
[Parallel(n_jobs=-1)]: Done  37 tasks      | elapsed:   53.5s
[Parallel(n_jobs=-1)]: Done 158 tasks      | elapsed:  3.6min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed:  6.8min finished
Confusion Matrix:
[[15  0  0]
 [ 3 22  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       0.83      1.00      0.91        15
           2       1.00      0.81      0.90        27
           3       0.86      1.00      0.92        12

    accuracy                           0.91        54
   macro avg       0.90      0.94      0.91        54
weighted avg       0.92      0.91      0.91        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9074074074074074
```



In [ ]:

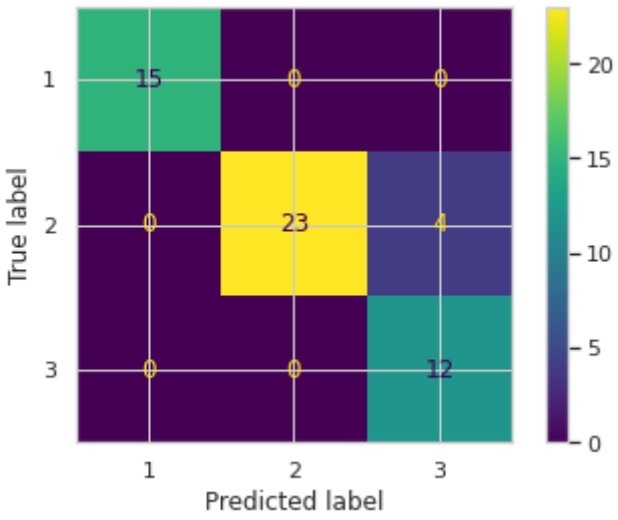
```python
# WINE DATASET
# Multi Layer Perceptron(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.30,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
```

```
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)

# Classification using MLP
from sklearn.neural_network import MLPClassifier

classifier = MLPClassifier()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```



None

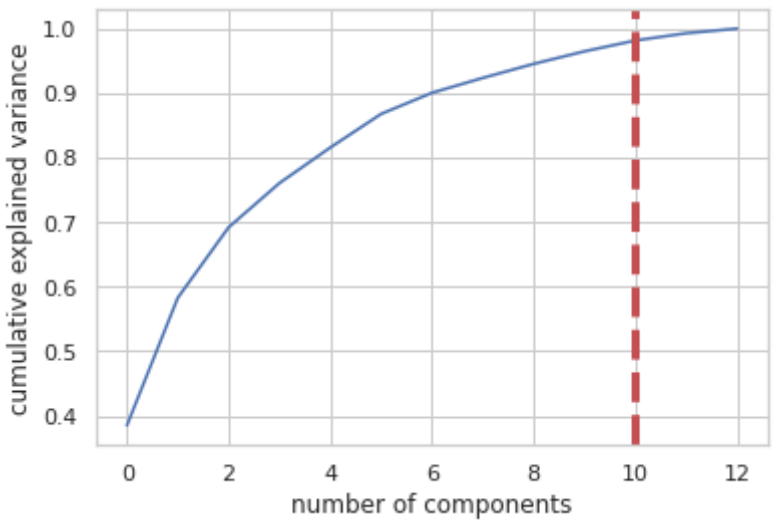
```
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
Confusion Matrix:
[[15  0  0]
 [ 0 23  4]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.85      0.92        27
           3       0.75      1.00      0.86        12

    accuracy                           0.93        54
   macro avg       0.92      0.95      0.93        54
weighted avg       0.94      0.93      0.93        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9259259259259259
```



In [ ]:

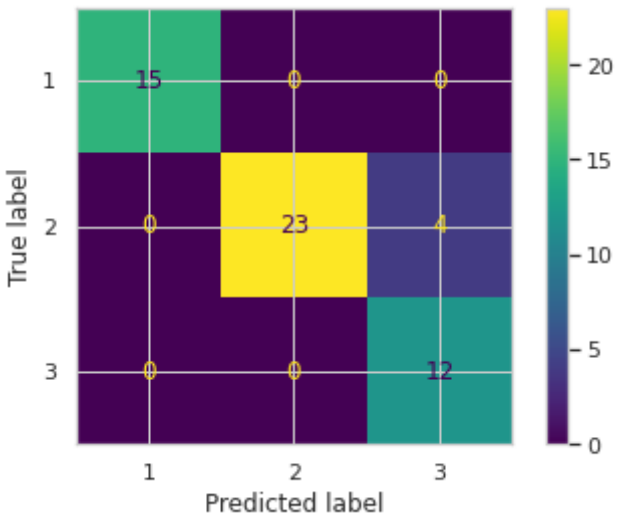
```
# WINE DATASET
# Multi Layer Perceptron(With Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)


# Classification
from sklearn.neural_network import MLPClassifier
classifier = MLPClassifier(max_iter=100)

###############################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

###############################################################################
# Creating a set of important sample features

parameter_space = {
    'hidden_layer_sizes': [(50,50,50), (50,100,50), (100,)],
    'activation': ['tanh', 'relu'],
    'solver': ['sgd', 'adam'],
```

```
    'alpha': [0.0001, 0.05],
    'learning_rate': ['constant','adaptive'],
}
pprint(parameter_space)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = MLPClassifier(max_iter=100)
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(classifier, parameter_space, n_jobs=-1, cv=3)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("-------------------------------------------------------")
print("-------------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("-------------------------------------------------------")
print("-------------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```




```
None
Parameters currently in use:
{'activation': 'relu',
 'alpha': 0.0001,
 'batch_size': 'auto',
 'beta_1': 0.9,
 'beta_2': 0.999,
 'early_stopping': False,
 'epsilon': 1e-08,
 'hidden_layer_sizes': (100,),
 'learning_rate': 'constant',
 'learning_rate_init': 0.001,
 'max_fun': 15000,
 'max_iter': 100,
 'momentum': 0.9,
 'n_iter_no_change': 10,
 'nesterovs_momentum': True,
 'power_t': 0.5,
 'random_state': None,
 'shuffle': True,
 'solver': 'adam',
 'tol': 0.0001,
 'validation_fraction': 0.1,
 'verbose': False,
 'warm_start': False}
{'activation': ['tanh', 'relu'],
 'alpha': [0.0001, 0.05],
 'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50), (100,)],
 'learning_rate': ['constant', 'adaptive'],
 'solver': ['sgd', 'adam']}
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py:571: ConvergenceWarning: Stochastic Optimi
zer: Maximum iterations (100) reached and the optimization hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
```

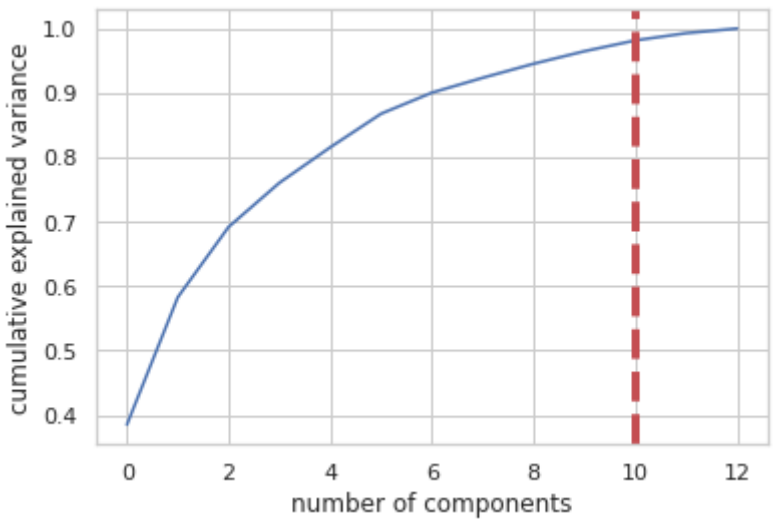
```
Confusion Matrix:
[[15  0  0]
 [ 0 23  4]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.85      0.92        27
           3       0.75      1.00      0.86        12

    accuracy                           0.93        54
   macro avg       0.92      0.95      0.93        54
weighted avg       0.94      0.93      0.93        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9259259259259259
```



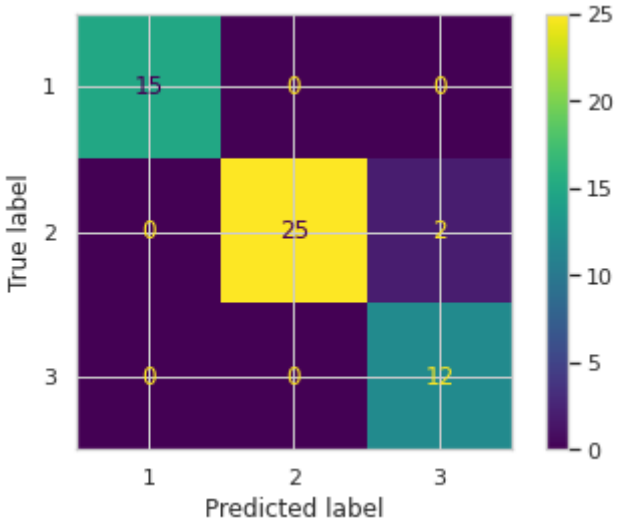
In [ ]:

```
# WINE DATASET
# SVM(Without Tuning)[70-30 split]


import pandas as pd
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)
```

```
# Classification
from sklearn.svm import SVC

classifier = SVC()
classifier.fit(X_train,y_train)

y_pred = classifier.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")


print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))

import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(classifier, X_test, y_test)
plt.show()
```




```
None
Confusion Matrix:
[[15  0  0]
 [ 0 25  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.93      0.96        27
           3       0.86      1.00      0.92        12

    accuracy                           0.96        54
   macro avg       0.95      0.98      0.96        54
weighted avg       0.97      0.96      0.96        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9629629629629629
```

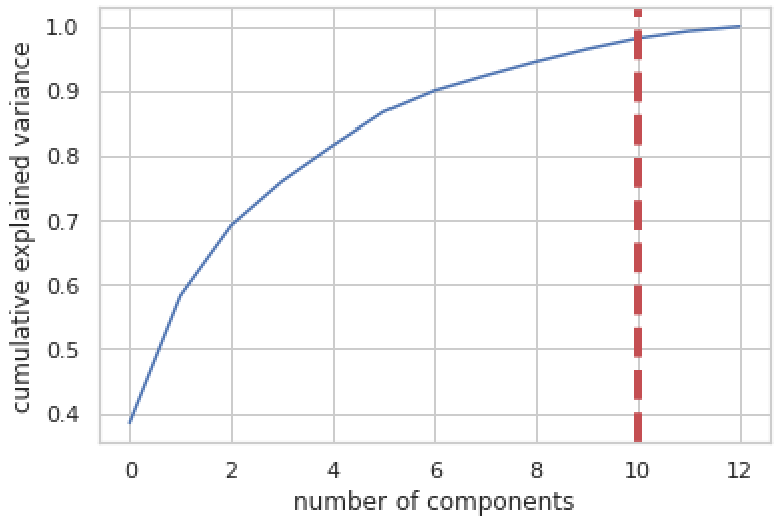


In [ ]:

```
# WINE DATASET
# SVM(With Tuning)[70-30 split]


import pandas as pd
```

```
import numpy as np

# Dataset Preparation
df = pd.read_csv("wine.data",header=None)

col_name = ['Class','Alcohol','Malic acid','Ash','Alcalinity of ash','Magnesium','Total phenols','Flavanoids',
            'Nonflavanoid phenols','Proanthocyanins','Color intensity','Hue','OD280/OD315 of diluted wines','Proline']


df.columns = col_name


X = df.drop(['Class'], axis=1)
y = df['Class']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.3,random_state=10)


# Feature Scaling
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)


# Finding the important parameters that contribute to most of the variance in the data.

import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA

pca_test = PCA(n_components=13)
pca_test.fit(X_train)
sns.set(style='whitegrid')
plt.plot(np.cumsum(pca_test.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance')
plt.axvline(linewidth=4, color='r', linestyle = '--', x=10, ymin=0, ymax=1)
display(plt.show())

# So we can see that we have 10 important parameters

pca = PCA(n_components=10)
pca.fit(X_train)
X_train = pca.transform(X_train)
X_test = pca.transform(X_test)


# Classification
from sklearn.svm import SVC

classifier = SVC()

################################################################################
# Showing all the parameters

from pprint import pprint
# Look at parameters used by our current forest
print('Parameters currently in use:\n')
pprint(classifier.get_params())

################################################################################
# Creating a set of important sample features

param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001],'kernel': ['rbf', 'poly', 'sigmoid']}

pprint(param_grid)

################################################################################

from sklearn.model_selection import GridSearchCV

# Use the random grid to search for best hyperparameters
# First create the base model to tune
classifier = SVC()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

rf_random = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
rf_random.fit(X_train, y_train)

y_pred = rf_random.predict(X_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("--------------------------------------------------")
print("--------------------------------------------------")
```

```python
print("Performance Evaluation")
print(classification_report(y_test, y_pred))


print("--------------------------------------------------")
print("--------------------------------------------------")

print("Accuracy:")
print(accuracy_score(y_test, y_pred))


import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix
plot_confusion_matrix(rf_random, X_test, y_test)
plt.show()
```




```
None
Parameters currently in use:

{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'rbf',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
{'C': [0.1, 1, 10, 100],
 'gamma': [1, 0.1, 0.01, 0.001],
 'kernel': ['rbf', 'poly', 'sigmoid']}
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=rbf ....................................
[CV] ....................... C=0.1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=poly ...................................
[CV] ...................... C=0.1, gamma=1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=1, kernel=sigmoid ................................
[CV] ................... C=0.1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=rbf ..................................
[CV] ..................... C=0.1, gamma=0.1, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly .................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
```

```
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=poly ...................................
[CV] .................... C=0.1, gamma=0.1, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.1, kernel=sigmoid ................................
[CV] ................. C=0.1, gamma=0.1, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=rbf ...................................
[CV] .................... C=0.1, gamma=0.01, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=poly ..................................
[CV] ................... C=0.1, gamma=0.01, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.01, kernel=sigmoid ...............................
[CV] ................ C=0.1, gamma=0.01, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=rbf ..................................
[CV] ................... C=0.1, gamma=0.001, kernel=rbf, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=poly .................................
[CV] .................. C=0.1, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=0.1, gamma=0.001, kernel=sigmoid ..............................
[CV] ............... C=0.1, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=1, kernel=rbf ........................................
[CV] ......................... C=1, gamma=1, kernel=rbf, total=   0.0s
[CV] C=1, gamma=1, kernel=poly .......................................
[CV] ........................ C=1, gamma=1, kernel=poly, total=   0.0s
[CV] C=1, gamma=1, kernel=poly .......................................
[CV] ........................ C=1, gamma=1, kernel=poly, total=   0.0s
[CV] C=1, gamma=1, kernel=poly .......................................
[CV] ........................ C=1, gamma=1, kernel=poly, total=   0.0s
[CV] C=1, gamma=1, kernel=poly .......................................
[CV] ........................ C=1, gamma=1, kernel=poly, total=   0.0s
[CV] C=1, gamma=1, kernel=poly .......................................
[CV] ........................ C=1, gamma=1, kernel=poly, total=   0.0s
```

```
[CV] C=1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
[CV] C=1, gamma=1, kernel=sigmoid ..................................
[CV] ................... C=1, gamma=1, kernel=sigmoid, total=   0.0s
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[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=poly ................................
[CV] ................. C=100, gamma=0.001, kernel=poly, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
[CV] C=100, gamma=0.001, kernel=sigmoid .............................
[CV] .............. C=100, gamma=0.001, kernel=sigmoid, total=   0.0s
Confusion Matrix:
[[15  0  0]
 [ 0 25  2]
 [ 0  0 12]]
--------------------------------------------------
--------------------------------------------------
Performance Evaluation
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        15
           2       1.00      0.93      0.96        27
           3       0.86      1.00      0.92        12

    accuracy                           0.96        54
   macro avg       0.95      0.98      0.96        54
weighted avg       0.97      0.96      0.96        54

--------------------------------------------------
--------------------------------------------------
Accuracy:
0.9629629629629629
[Parallel(n_jobs=1)]: Done 240 out of 240 | elapsed:    1.0s finished
```

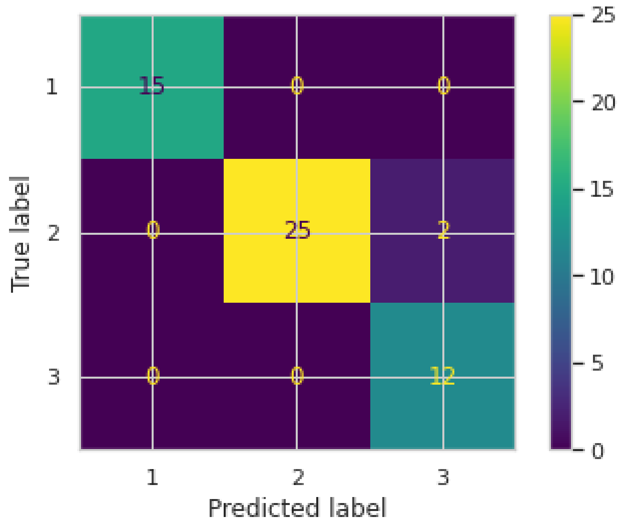

In [ ]: