In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.model_selection import train_test_split
from sklearn import metrics
from sklearn.metrics import accuracy_score, precision_score, recall_score
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.neural_network import MLPClassifier

df=pd.read_csv("wdbc.data", header=None)
df.head()
```

Out[1]:

	0	1	2	3	4	5	6	7	8	9	...	22
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	...	25.38
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	...	24.99
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	...	23.57
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	...	14.91
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	...	22.54

5 rows × 32 columns

In [2]:

```
#Separate the features from the label
X, y = df.iloc[:, 2:], df.iloc[:, 1]

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=.7)
```

1.Random forest classifier

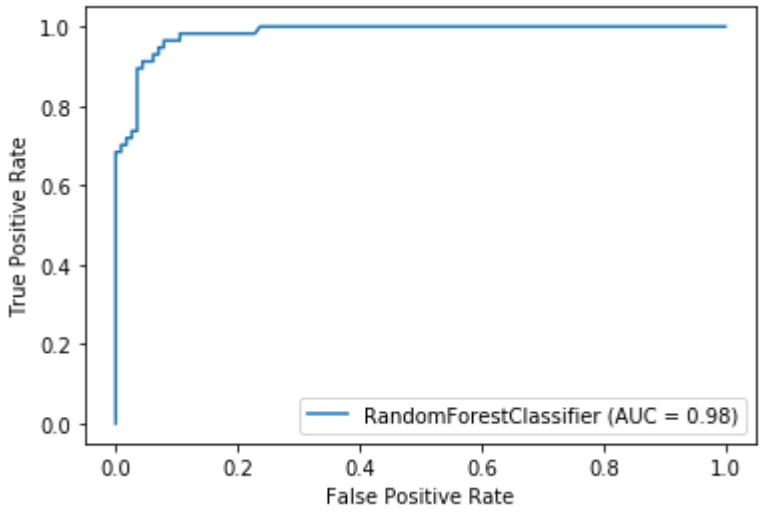
In [7]:

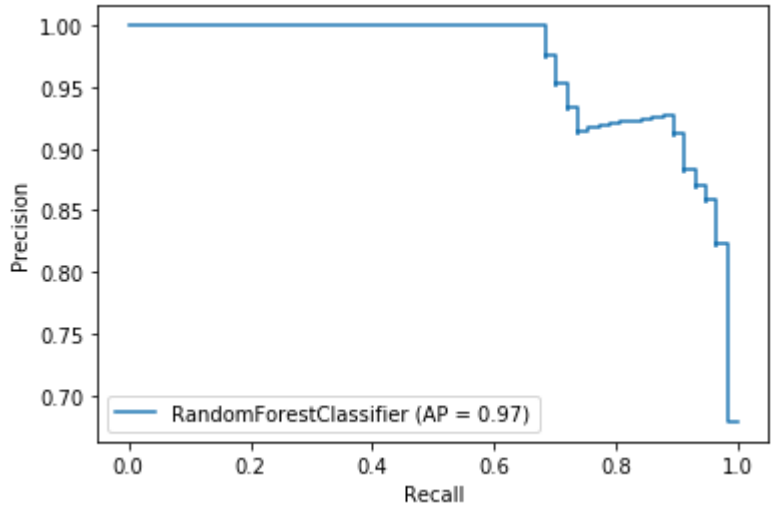
```
# Implement the Random forest classifier
acc_train,acc_test,rec,prc,auc = 0.0,0.0,0.0,0.0,0.0
clf = RandomForestClassifier(max_depth=1, random_state=10)
for i in range(0,20):
    clf.fit(X_train, y_train)
    y_pred=clf.predict(X_test)
    y_pred_train=clf.predict(X_train)
    y_score=clf.predict_proba(X_test)[:,1]
    acc_train+=accuracy_score(y_train,y_pred_train)
    acc_test+=accuracy_score(y_test,y_pred)
    rec+=recall_score(y_test,y_pred,pos_label='M')
    prc+=precision_score(y_test,y_pred,pos_label='M')
    fpr,tpr,threshold = metrics.roc_curve(y_test, y_score, pos_label='M')
    auc+= metrics.roc_auc_score(y_test, y_score)

acc_train,acc_test,rec,prc,auc = np.around(acc_train/20,4), np.around(acc_test/20,4), np.around(
rec/20,4),np.around(prc/20,4),np.around(auc/20,4)
print('RF: accuracy_train=',acc_train,'accuracy_test=',acc_test,'recall=',rec,'precision=',prc,
"AUROC=",auc)
metrics.plot_roc_curve(clf, X_test, y_test)
metrics.plot_precision_recall_curve(clf, X_test, y_test)
```

```
RF: accuracy_train= 0.9422 accuracy_test= 0.9006 recall= 0.7719 precision= 0.9167
AUROC= 0.9831
```

Out[7]:

```
<sklearn.metrics._plot.precision_recall_curve.PrecisionRecallDisplay at 0x2a52a240
748>
```





2.SVM with rbf classifier

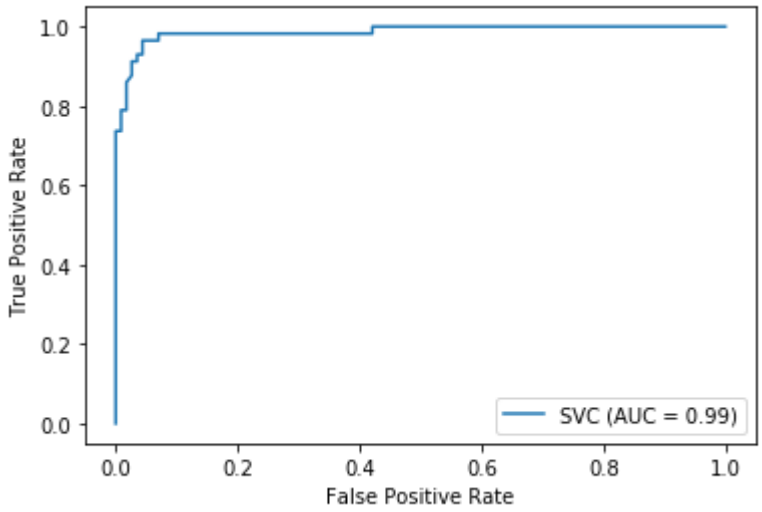
In [4]:

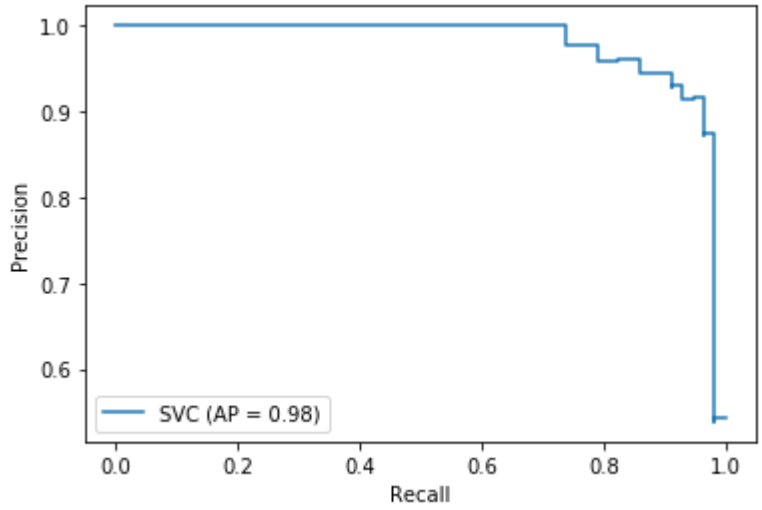
```
# Implement the Random forest classifier
acc_train,acc_test,rec,prc,auc = 0.0,0.0,0.0,0.0,0.0
clf = SVC(C=1e4, kernel='rbf', random_state=100, gamma='scale',probability=True)
for i in range(0,20):
    clf.fit(X_train, y_train)
    y_pred=clf.predict(X_test)
    y_pred_train=clf.predict(X_train)
    y_score=clf.predict_proba(X_test)[:,1]
    acc_train+=accuracy_score(y_train,y_pred_train)
    acc_test+=accuracy_score(y_test,y_pred)
    rec+=recall_score(y_test,y_pred,pos_label='M')
    prc+=precision_score(y_test,y_pred,pos_label='M')
    fpr,tpr,threshold = metrics.roc_curve(y_test, y_score, pos_label='M')
    auc+= metrics.roc_auc_score(y_test, y_score)

acc_train,acc_test,rec,prc,auc = np.around(acc_train/20,4), np.around(acc_test/20,4), np.around(
rec/20,4),np.around(prc/20,4),np.around(auc/20,4)
print('SVM with RBF kernel: accuracy_train=',acc_train,'accuracy_test=',acc_test,'recall=',rec,
'precision=',prc,"AUROC=",auc)
metrics.plot_roc_curve(clf, X_test, y_test)
metrics.plot_precision_recall_curve(clf, X_test, y_test)
```

```
SVM with RBF kernel: accuracy_train= 0.9698 accuracy_test= 0.9474 recall= 0.9123 p
recision= 0.9286 AUROC= 0.9862
```

Out[4]:

```
<sklearn.metrics._plot.precision_recall_curve.PrecisionRecallDisplay at 0x2a5299e9
d08>
```





3.MLP classifier

In [6]:

```
# Implement the MLP classifier

acc_train,acc_test,rec,prc,auc = 0.0,0.0,0.0,0.0,0.0
mlp = MLPClassifier(hidden_layer_sizes=(10,),activation='tanh',max_iter=10000,random_state=np.ra
ndom.randint(1,10))
for i in range(0,20):
    mlp.fit(X_train, y_train)
    y_pred=mlp.predict(X_test)
    y_pred_train=mlp.predict(X_train)
    y_score=mlp.predict_proba(X_test)[:,1]
    acc_train+=accuracy_score(y_train,y_pred_train)
    acc_test+=accuracy_score(y_test,y_pred)
    rec+=recall_score(y_test,y_pred,pos_label='M')
    prc+=precision_score(y_test,y_pred,pos_label='M')
    fpr,tpr,threshold = metrics.roc_curve(y_test, y_score, pos_label='M')
    auc+= metrics.roc_auc_score(y_test, y_score)

acc_train,acc_test,rec,prc,auc = np.around(acc_train/20,4), np.around(acc_test/20,4), np.around(
rec/20,4),np.around(prc/20,4),np.around(auc/20,4)
print('MLP: accuracy_train=',acc_train,'accuracy_test=',acc_test,'recall=',rec,'precision=',prc,
"AUROC=",auc)
metrics.plot_roc_curve(mlp, X_test, y_test)
metrics.plot_precision_recall_curve(mlp, X_test, y_test)
```

```
MLP: accuracy_train= 0.9497 accuracy_test= 0.9357 recall= 0.9123 precision= 0.8966
AUROC= 0.9826
```

Out[6]:

```
<sklearn.metrics._plot.precision_recall_curve.PrecisionRecallDisplay at 0x2a52a24c
108>
```