In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
```

In [2]:

```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Mounted at /content/gdrive
```

In [2]:

```
import os
import glob

# SAVING ADDRESSES OF DATASETS & ADDING .TXT EXTENSION TO IT
all_files = os.listdir("/content/gdrive/My Drive/App Dataset/App
Dataset/Dataset/B/sys/")
txt_files = glob.glob("/content/gdrive/My Drive/App Dataset/App
Dataset/Dataset/B/sys/*.txt")

all_filesM = os.listdir("/content/gdrive/My Drive/App Dataset/App
Dataset/Dataset/M/sys/")
txt_filesM = glob.glob("/content/gdrive/My Drive/App Dataset/App
Dataset/Dataset/M/sys/*.txt")
```

In [9]:

```
# Function to read the text document and return a list containg all the lines in
the document
def wordsInFile(k):
  with open(k, 'rt') as fd:
    lines1 = fd.readlines()
  return lines1

# Function to return pandas data frame with tf idf values for each feature in
feature vector corressponding to each document
def CreateDataFrame(vectors,vectorizer):
  feature_names = vectorizer.get_feature_names()
  dense = vectors.todense()
  denselist = dense.tolist()
  df = pd.DataFrame(denselist, columns=feature_names)
  return df, denselist

# Function to return evaluation metrics of a machine learning model
def EvaluationMetrics(y_test,svm_predict):
  Accuracy = accuracy_score(y_test, svm_predict)
  Precision = precision_score(y_test, svm_predict)
  Recall = recall_score(y_test, svm_predict)
  F1 = f1_score(y_test, svm_predict)
  return Accuracy, Precision, Recall, F1

def PrecisionRecallCurve(X_test, y_test, X_train, y_train,clf):
  y_scores_clf = clf.fit(X_train, y_train).decision_function(X_test)
  precision, recall, thresholds = precision_recall_curve(y_test, y_scores_clf)
  closest_zero = np.argmin(np.abs(thresholds))
```

```
    closest_zero_p = precision[closest_zero]
    closest_zero_r = recall[closest_zero]
    plt.figure()
    plt.plot(precision, recall)
    plt.plot(closest_zero_p, closest_zero_r, 'o', markersize = 8)
    plt.xlabel('Precision')
    plt.ylabel('Recall')
    plt.title('Precision-Recall Curve')
    plt.show()
    return
def ROCCurve(X_test, y_test, X_train, y_train,clf):
    y_scores_clf = clf.fit(X_train, y_train).decision_function(X_test)
    fpr_clf, tpr_clf, _ = roc_curve(y_test, y_scores_clf)
    roc_auc_clf = auc(fpr_clf, tpr_clf)
    plt.figure()
    plt.plot(fpr_clf, tpr_clf, lw=3)
    plt.xlabel('False Positive Rate')
    plt.ylabel('True Positive Rate')
    plt.title('ROC curve')
    plt.plot([0, 1], [0, 1], linestyle='--')
    plt.show()
    return
```

1 WORD - TFIDF

In [14]:

```
kk1=[]
# Each document is converted into a string and is stored in the list kk1

# Storing documents of class 'B'
for ii in range(np.size(txt_files)):
    s=wordsInFile(txt_files[ii])
    # Converting list of words in the given document into a string
    listToStr1 = ' '.join(s)
    kk1.append(listToStr1)

# Storing documents of class 'M'
for ii in range(np.size(txt_filesM)):
    s=wordsInFile(txt_filesM[ii])
    listToStr11 = ' '.join(s)
    kk1.append(listToStr11)

vectorizer = TfidfVectorizer()
vectors = vectorizer.fit_transform(kk1)
feature_names = vectorizer.get_feature_names()
dense = vectors.todense()
denselist = dense.tolist()
df = pd.DataFrame(denselist, columns=feature_names)
df
```

Out[14]:

	_llseek	bind	capget	clock_gettime	clone	close	connect	dup	epoll_create1	epoll_ctl	epol
0	0.0	0.0	0.0	0.000000	0.000000	0.002278	0.0	0.000275	0.0	0.000700	0
1	0.0	0.0	0.0	0.000000	0.002044	0.047800	0.0	0.006314	0.0	0.012594	0
2	0.0	0.0	0.0	0.963973	0.000181	0.006951	0.0	0.002163	0.0	0.006890	0
3	0.0	0.0	0.0	0.000000	0.006893	0.092947	0.0	0.009260	0.0	0.027104	0
4	0.0	0.0	0.0	0.000000	0.000000	0.004204	0.0	0.004288	0.0	0.010773	0

	_llseek	bind	capget	clock_gettime	clone	close	connect	dup	epoll_create1	epoll_ctl	epol
4	0.0	0.0	0.0	0.000000	0.000000	0.024394	0.0	0.004288	0.0	0.010772	0
...	...	...	...	...	...	...	...	...	...	...	
5817	0.0	0.0	0.0	0.000000	0.000243	0.017372	0.0	0.006604	0.0	0.010490	0
5818	0.0	0.0	0.0	0.000000	0.007724	0.020212	0.0	0.004399	0.0	0.002720	0
5819	0.0	0.0	0.0	0.000000	0.004529	0.014022	0.0	0.003968	0.0	0.001812	0
5820	0.0	0.0	0.0	0.000000	0.001023	0.005222	0.0	0.002818	0.0	0.004891	0
5821	0.0	0.0	0.0	0.000000	0.002020	0.036577	0.0	0.016281	0.0	0.023472	0

5822 rows × 102 columns

LINEAR SVC MODEL

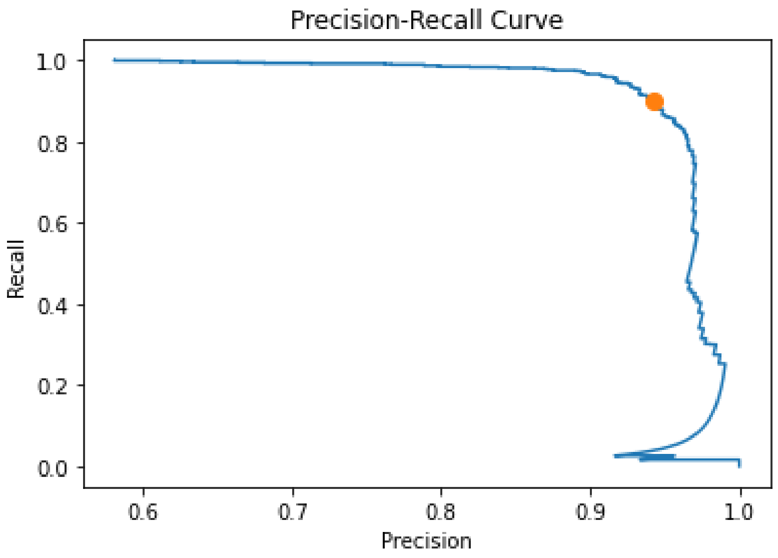
In [21]:

```
from sklearn.svm import LinearSVC
from sklearn.svm import SVC
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_scor
e

# Accuracy = TP + TN / (TP + TN + FP + FN)
# Precision = TP / (TP + FP)
# Recall = TP / (TP + FN)
# F1 = 2 * Precision * Recall / (Precision + Recall)

# Class B is labelled as 0 & Class M is labelled as 1
# No of samples = 5822
# size of feature vector = 102
y=np.zeros((5822,))
y[int(np.size(txt_files)):5822]=1
X=denselist

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state = 0)
clf = LinearSVC(C=9).fit(X_train, y_train)

print('Accuracy of Linear SVC classifier on training set:',clf.score(X_train, y_tr
ain))
print('Accuracy of Linear SVC classifier on test set:',clf.score(X_test, y_test))

svm_predicted = clf.predict(X_test)
confusion = confusion_matrix(y_test, svm_predicted)
print('\n Confusion matrix for SVM classifier (linear, C=9)\n', confusion)

Accuracy, Precision, Recall, F1 = EvaluationMetrics(y_test,svm_predicted)
print('\n Accuracy:',Accuracy,'\n Precision:',Precision,'\n Recall:',Recall,'\n F1
:',F1)
```

```
Accuracy of Linear SVC classifier on training set: 0.9244159413650939
Accuracy of Linear SVC classifier on test set: 0.9093406593406593

 Confusion matrix for SVM classifier (linear, C=9)
 [[564  46]
 [ 86 760]]

 Accuracy: 0.9093406593406593
 Precision: 0.9429280397022333
 Recall: 0.8983451536643026
 F1: 0.9200968523002422
```

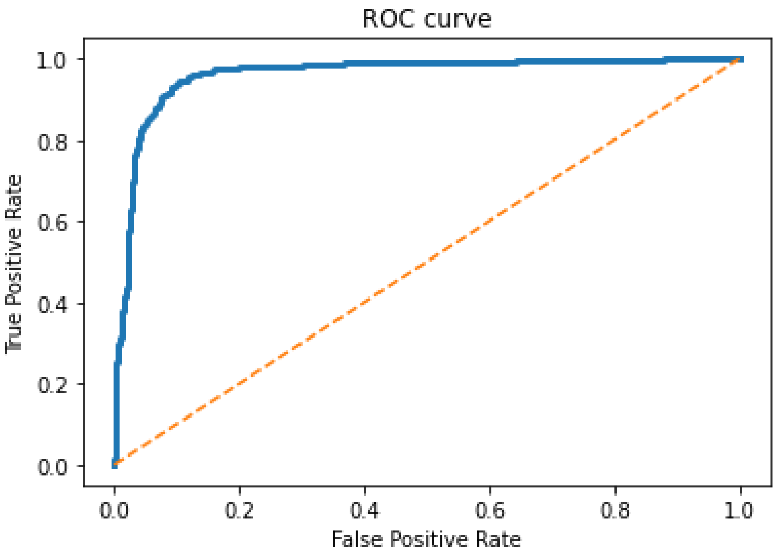
In [24]:

```
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import precision_recall_curve

PrecisionRecallCurve(X_test, y_test, X_train, y_train,clf)
```



In [25]:

```
ROCCurve(X_test, y_test, X_train, y_train,clf)
```



KERNEL SVC MODEL

In [22]:

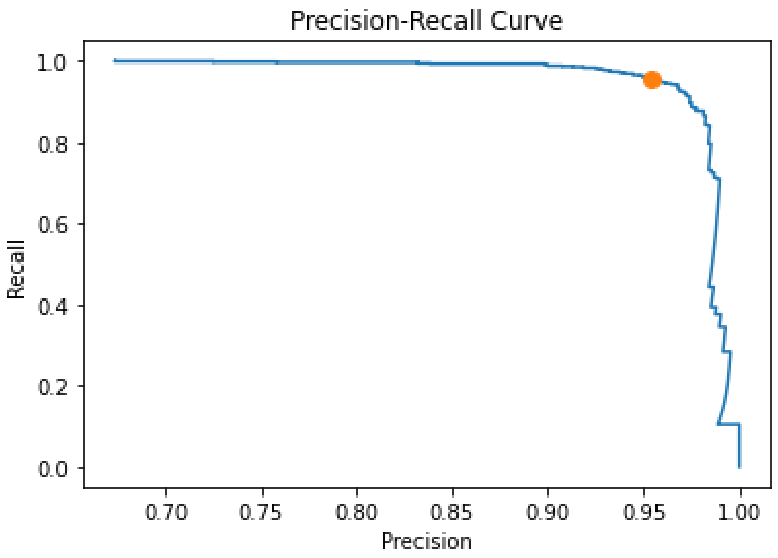
```
clfrbf = SVC(kernel = 'rbf', gamma = 7,C = 9).fit(X_train, y_train)

print('Accuracy of kernel SVC classifier on training set:',clfrbf.score(X_train, y_train))
print('Accuracy of kernel SVC classifier on test set:',clfrbf.score(X_test, y_test))

svm_predicted1 = clfrbf.predict(X_test)
confusion1 = confusion_matrix(y_test, svm_predicted1)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=9, gamma=7)\n', confusion1)
```

```
Accuracy_rbf, Precision_rbf, Recall_rbf, F1_rbf = EvaluationMetrics(y_test,svm_predicted1)
print('\n Accuracy:',Accuracy_rbf,'\n Precision:',Precision_rbf,'\n Recall:',Recall_rbf,'\n F1:',F1_rbf)
```

```
Accuracy of kernel SVC classifier on training set: 0.972972972972973
Accuracy of kernel SVC classifier on test set: 0.9471153846153846

 Confusion matrix for SVM classifier (RBF kernel, C=9, gamma=7)
 [[571  39]
 [ 38 808]]

 Accuracy: 0.9471153846153846
 Precision: 0.9539551357733176
 Recall: 0.9550827423167849
 F1: 0.9545186060248081
```

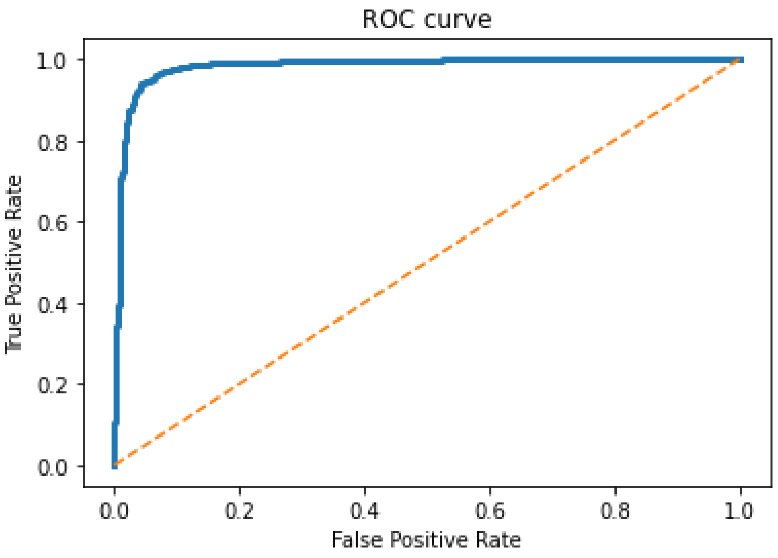
In [26]:

```
PrecisionRecallCurve(X_test, y_test, X_train, y_train,clfrbf)
```



In [27]:

```
ROCCurve(X_test, y_test, X_train, y_train, clfrbf)
```



1 WORD - BOOLEAN

In [37]:

```
#  Creating a matrix for boolean occurence of calls
boolean=np.zeros([5822,102])
for ii in range(5822):
  for jj in range(102):
    if denselist[ii][jj]>0.0:
      boolean[ii][jj]=1
    else:
      boolean[ii][jj]=0

X1=boolean
X_trainB, X_testB, y_trainB, y_testB = train_test_split(X1, y, random_state = 0)

clf2 = LinearSVC(C=2).fit(X_trainB, y_trainB)
print('Accuracy of Linear SVC classifier on training set:',clf2.score(X_trainB, y_
trainB))
print('Accuracy of Linear SVC classifier on test set:',clf2.score(X_testB, y_testB
))

svm_predicted2 = clf2.predict(X_testB)
confusion2 = confusion_matrix(y_testB, svm_predicted2)

print('\n Confusion matrix for SVM classifier (linear, C=9)\n', confusion2)

AccuracyB, PrecisionB, RecallB, F1B = EvaluationMetrics(y_testB,svm_predicted2)
print('\n Accuracy:',AccuracyB,'\n Precision:',PrecisionB,'\n Recall:',RecallB,'\n
F1:',F1B)
```

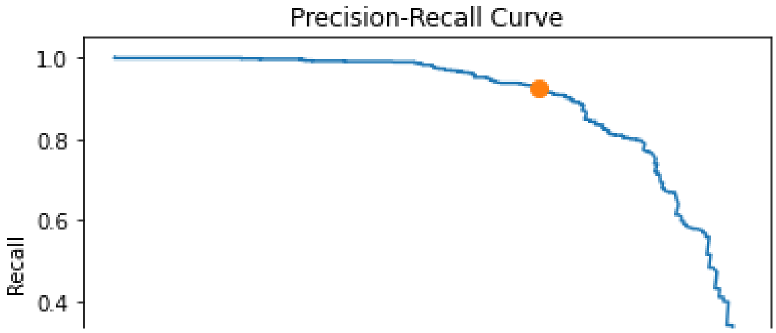
```
Accuracy of Linear SVC classifier on training set: 0.9040311497938617
Accuracy of Linear SVC classifier on test set: 0.8887362637362637

 Confusion matrix for SVM classifier (linear, C=9)
 [[513  97]
 [ 65 781]]

 Accuracy: 0.8887362637362637
 Precision: 0.8895216400911162
 Recall: 0.9231678486997635
 F1: 0.9060324825986079
```

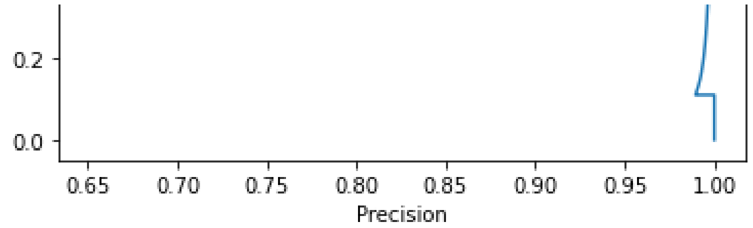
```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```

In [30]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```

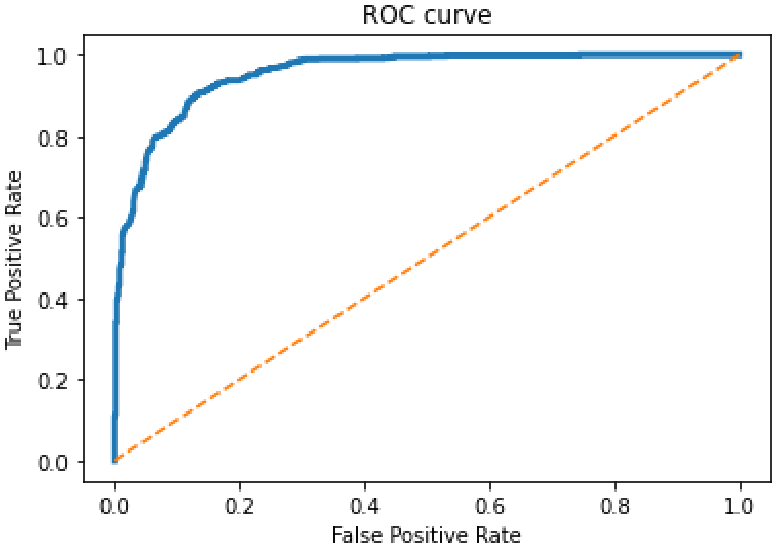




In [31]:

```
ROCCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```



In [32]:

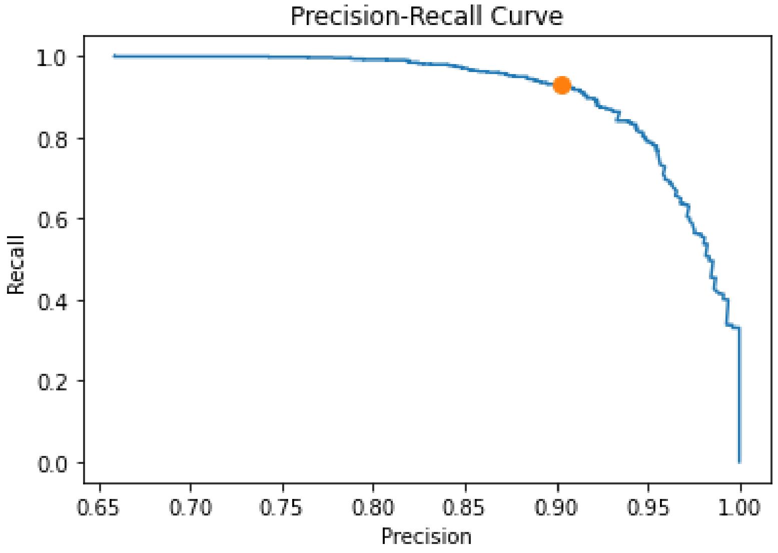
```
clfrbf2 = SVC(kernel = 'rbf', gamma = 0.1,C = 0.9).fit(X_trainB, y_trainB)

print('Accuracy of Linear SVC classifier on training set:',clfrbf2.score(X_trainB,
y_trainB))
print('Accuracy of Linear SVC classifier on test set:',clfrbf2.score(X_testB, y_te
stB))

svm_predicted11 = clfrbf2.predict(X_testB)
confusion11 = confusion_matrix(y_testB, svm_predicted11)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)\n', c
onfusion11)

Accuracy_rbfB, Precision_rbfB, Recall_rbfB, F1_rbfB = EvaluationMetrics(y_testB,sv
m_predicted11)
print('\n Accuracy:',Accuracy_rbfB,'\n Precision:',Precision_rbfB,'\n Recall:',Rec
all_rbfB,'\n F1:',F1_rbfB)
```

```
Accuracy of Linear SVC classifier on training set: 0.913421896472744
Accuracy of Linear SVC classifier on test set: 0.9010989010989011

 Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)
 [[527  83]
 [ 61 785]]

 Accuracy: 0.9010989010989011
 Precision: 0.9043778801843319
 Recall: 0.9278959810874704
 F1: 0.9159859976662778
```

```
F1: 0.9159859976662778
```

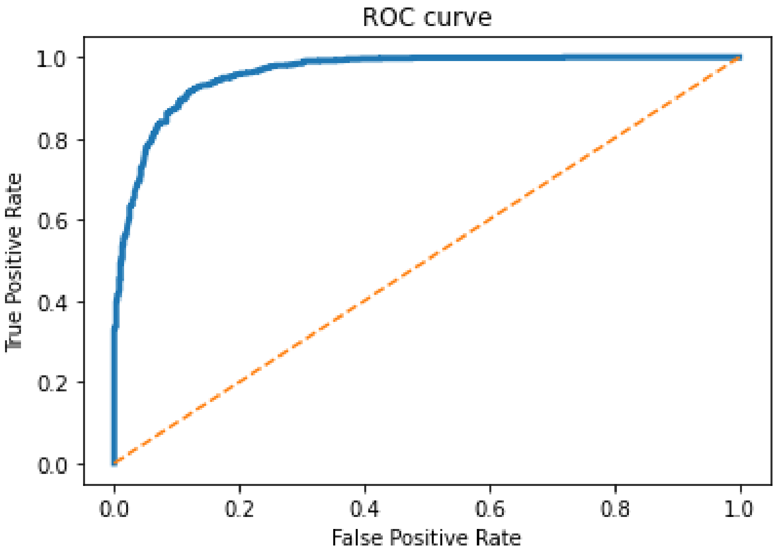
In [33]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clfrbf2)
```



In [34]:

```
ROCCurve(X_testB, y_testB, X_trainB, y_trainB, clfrbf2)
```



2 WORD - TFIDF

In [35]:

```
khg11=[]
for ii in range(np.size(txt_files)):
  kh1=[]
  hh=wordsInFile(txt_files[ii])
  for jj in range(1,np.size(hh)):
    a=[hh[jj],hh[jj-1]]
    bb= '-'.join(a)
    kh1.append(bb)
  khg1 = ' '.join(kh1)
  khg1=khg1.replace('\n','')
  khg11.append(khg1)

for ii in range(np.size(txt_filesM)):
  kh12=[]
  hh2=wordsInFile(txt_filesM[ii])
  for jj in range(1,np.size(hh2)):
    a2=[hh2[jj],hh2[jj-1]]
    bb2= '-'.join(a2)
    kh12.append(bb2)
  khg12 = ' '.join(kh12)
  khg12=khg12.replace('\n','')
  khg11.append(khg12)

vectorizer = TfidfVectorizer(ngram_range=(2,2))
vectors3 = vectorizer.fit_transform(khg11)
feature_names3 = vectorizer.get_feature_names()
dense3 = vectors3.todense()
denselist4 = dense3.tolist()
dff1 = pd.DataFrame(denselist4, columns=feature_names3)
dff1
```

Out[35]:

	_llseek _llseek	_llseek clock_gettime	_llseek close	_llseek epoll_pwait	_llseek fcntl64	_llseek fstat64	_llseek fstatat64	_llseek fsync	_llseek ftruncate64	_llseek futex	_lls geteui
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
...	...	...	...	...	...	...	...	...	...	...	
5817	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5818	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5819	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5821	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

5822 rows × 3199 columns

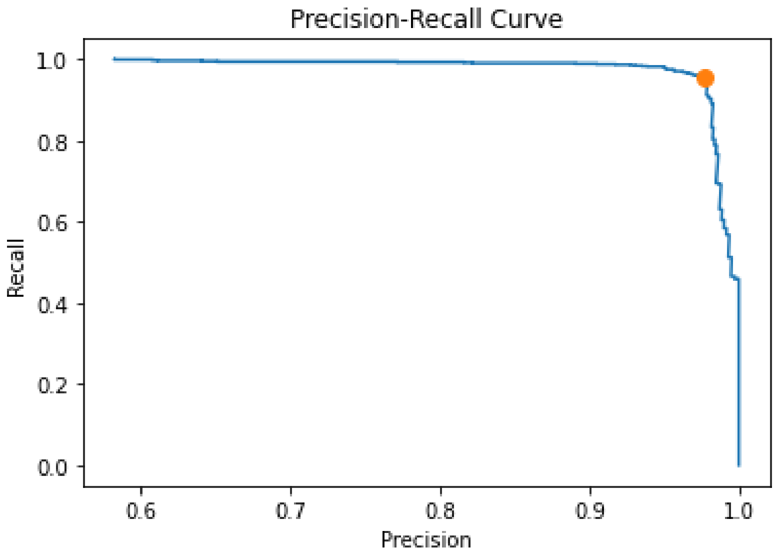
In [40]:

```
y=np.zeros((5822,))
y[2475:5822]=1
X=denselist4

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state = 0)
clf = LinearSVC(C=7).fit(X_train, y_train)

print('Accuracy of Linear SVC classifier on training set:',clf.score(X_train, y_tr
ain))
print('Accuracy of Linear SVC classifier on test set:',clf.score(X_test, y_test))

svm_predicted = clf.predict(X_test)
confusion = confusion_matrix(y_test, svm_predicted)
print('\n Confusion matrix for SVM classifier (linear, C=7)\n', confusion2)

Accuracy2, Precision2, Recall2, F12 = EvaluationMetrics(y_test,svm_predicted)
print('\n Accuracy:',Accuracy2,'\n Precision:',Precision2,'\n Recall:',Recall2,'\n
F1:',F12)
```

```
Accuracy of Linear SVC classifier on training set: 0.9649564819056344
Accuracy of Linear SVC classifier on test set: 0.9615384615384616

 Confusion matrix for SVM classifier (linear, C=7)
 [[513  97]
 [ 65 781]]

 Accuracy: 0.9615384615384616
 Precision: 0.9770531400966184
 Recall: 0.9562647754137116
 F1: 0.966547192353644
```

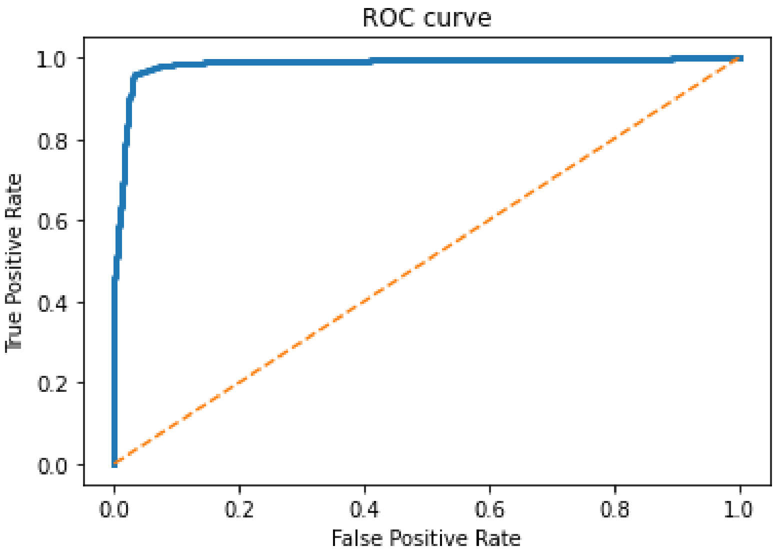
In [41]:

```
PrecisionRecallCurve(X_test, y_test, X_train, y_train,clf)
```



In [42]:

```
ROCCurve(X_test, y_test, X_train, y_train,clf)
```



In [45]:

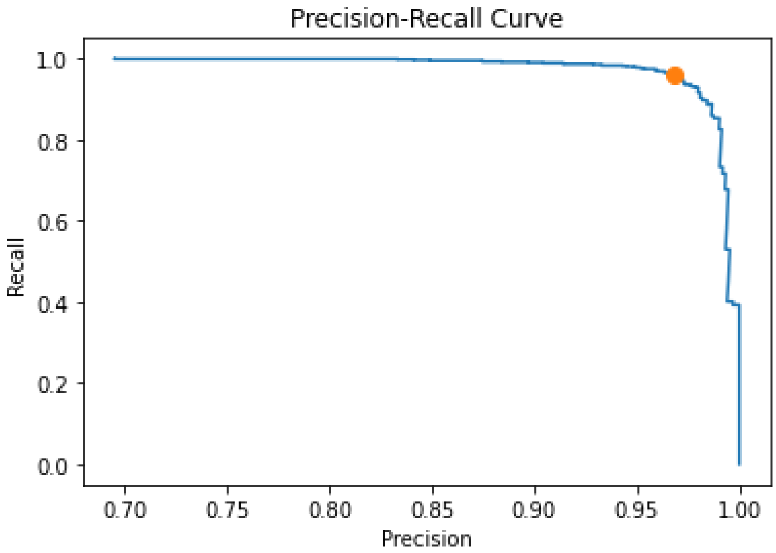
```
clfrbf = SVC(kernel = 'rbf', gamma = 1,C = 7).fit(X_train, y_train)

print('Accuracy of kernel SVC classifier on training set:',clfrbf.score(X_train, y_train))
print('Accuracy of kernel SVC classifier on test set:',clfrbf.score(X_test, y_test))
```

```
svm_predicted1 = clfrbf.predict(X_test)
confusion1 = confusion_matrix(y_test, svm_predicted1)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=7, gamma=1)\n', confu
sion1)

Accuracy_rbf2, Precision_rbf2, Recall_rbf2, F1_rbf2 = EvaluationMetrics(y_test,svm
_predicted1)
print('\n Accuracy:',Accuracy_rbf2,'\n Precision:',Precision_rbf2,'\n Recall:',Rec
all_rbf2,'\n F1:',F1_rbf2)
```

```
Accuracy of kernel SVC classifier on training set: 0.9688502061383417
Accuracy of kernel SVC classifier on test set: 0.9574175824175825

 Confusion matrix for SVM classifier (RBF kernel, C=7, gamma=1)
 [[583  27]
 [ 35 811]]

 Accuracy: 0.9574175824175825
 Precision: 0.9677804295942721
 Recall: 0.958628841607565
 F1: 0.9631828978622328
```

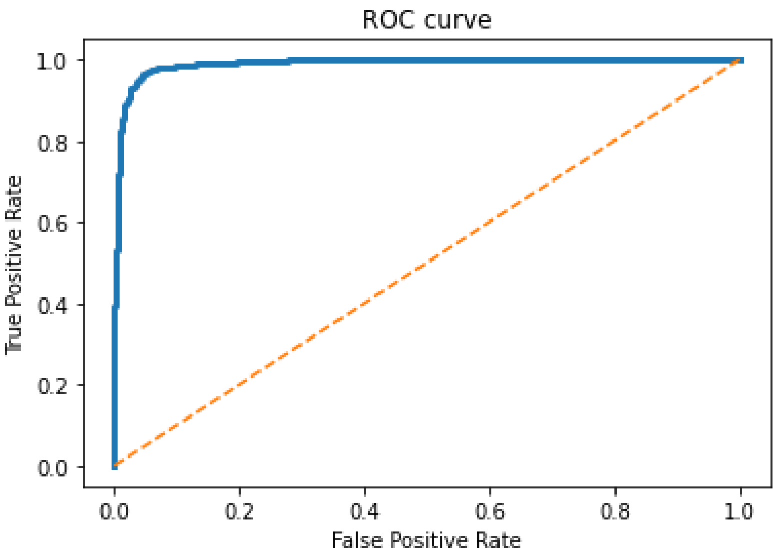
In [46]:

```
PrecisionRecallCurve(X_test, y_test, X_train, y_train,clfrbf)
```



In [48]:

```
ROCCurve(X_test, y_test, X_train, y_train,clfrbf)
```



2 WORD- BOOLEAN

In [50]:

```
boolean1=np.zeros([5822,3199])
for ii in range(5822):
  for jj in range(3199):
    if denselist4[ii][jj]>0.0:
      boolean1[ii][jj]=1
    else:
      boolean1[ii][jj]=0

X1=boolean1
X_trainB, X_testB, y_trainB, y_testB = train_test_split(X1, y, random_state = 0)

clf2 = LinearSVC(C=1).fit(X_trainB, y_trainB)
print('Accuracy of Linear SVC classifier on training set:',clf2.score(X_trainB, y_
trainB))
print('Accuracy of Linear SVC classifier on test set:',clf2.score(X_testB, y_testB
))

svm_predicted2 = clf2.predict(X_testB)
confusion2 = confusion_matrix(y_testB, svm_predicted2)

print('\n Confusion matrix for SVM classifier (linear, C=1)\n', confusion2)

Accuracy2B, Precision2B, Recall2B, F12B = EvaluationMetrics(y_testB,svm_predicted2
)
print('\n Accuracy:',Accuracy2B,'\n Precision:',Precision2B,'\n Recall:',Recall2B,
'\n F1:',F12B)
```

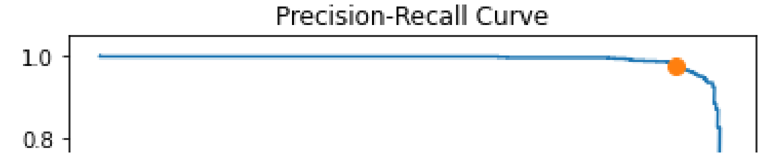
```
Accuracy of Linear SVC classifier on training set: 1.0
Accuracy of Linear SVC classifier on test set: 0.9684065934065934

 Confusion matrix for SVM classifier (linear, C=1)
 [[583  27]
 [ 19 827]]

 Accuracy: 0.9684065934065934
 Precision: 0.968384074941452
 Recall: 0.9775413711583925
 F1: 0.9729411764705882
```

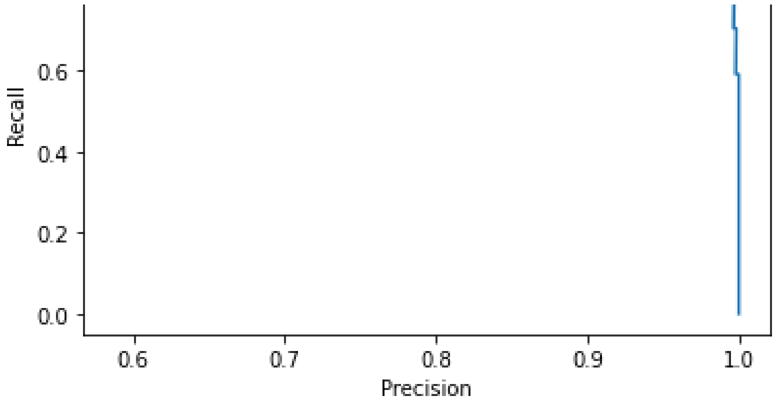
```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```

In [51]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```

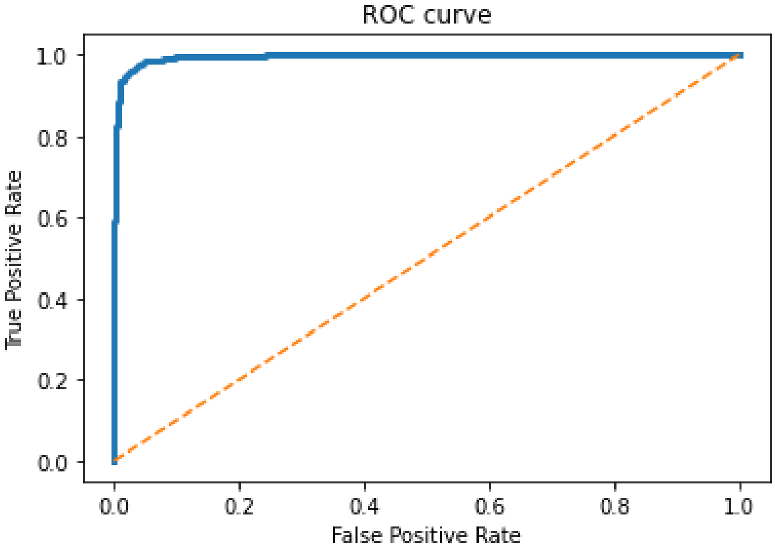




In [52]:

```
ROCCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/svm/_base.py:947:
ConvergenceWarning: Liblinear failed to converge, increase the number of iteration
s.
  "the number of iterations.", ConvergenceWarning)
```



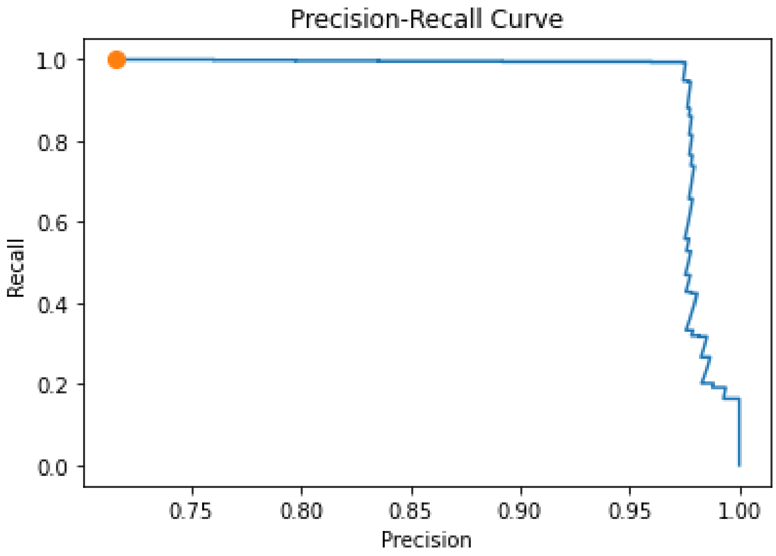
In [54]:

```
clfrbf2 = SVC(kernel = 'rbf', gamma = 0.1,C = 0.9).fit(X_trainB, y_trainB)

print('Accuracy of Linear SVC classifier on training set:',clfrbf2.score(X_trainB,
y_trainB))
print('Accuracy of Linear SVC classifier on test set:',clfrbf2.score(X_testB, y_te
stB))

svm_predicted11 = clfrbf2.predict(X_testB)
confusion11 = confusion_matrix(y_testB, svm_predicted11)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)\n', c
onfusion11)

Accuracy_rbf2B, Precision_rbf2B, Recall_rbf2B, F1_rbf2B = EvaluationMetrics(y_test
B,svm_predicted11)
print('\n Accuracy:',Accuracy_rbf2B,'\n Precision:',Precision_rbf2B,'\n Recall:',R
ecall_rbf2B,'\n F1:',F1_rbf2B)
```

```
Accuracy of Linear SVC classifier on training set: 1.0
Accuracy of Linear SVC classifier on test set: 0.584478021978022

 Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)
 [[   5 605]
 [   0 846]]
 [   0 846]]

 Accuracy: 0.584478021978022
 Precision: 0.5830461750516885
 Recall: 1.0
 F1: 0.7366129734436221
```

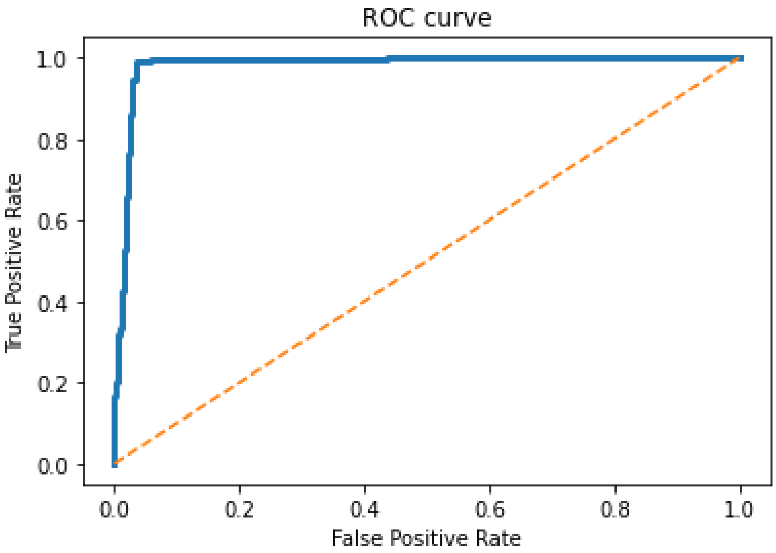
In [55]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clfrbf2)
```



In [56]:

```
ROCCurve(X_testB, y_testB, X_trainB, y_trainB, clfrbf2)
```



3 WORD - TFIDF

In [5]:

```
khgg11=[]
for ii in range(0,int(np.size(txt_files)/2) -20):
  khgg1=[]
  hhh=wordsInFile(txt_files[ii])
  for jj in range(2,int(np.size(hhh))):
    a=[hhh[jj],hhh[jj-1],hhh[jj-2]]
    bb= '-'.join(a)
    khgg1.append(bb)
  khgg1 = ' '.join(khgg1)
  khgg1=khgg1.replace('\n','')
  khgg11.append(khgg1)

for ii in range(0,int(np.size(txt_filesM)/2)-20):
  khgg12=[]
  hhh=wordsInFile(txt_filesM[ii])
  for jj in range(2,int(np.size(hhh))):
    a=[hhh[jj],hhh[jj-1],hhh[jj-2]]
    bb= '-'.join(a)
    khgg12.append(bb)
  khgg12 = ' '.join(khgg12)
  khgg12=khgg12.replace('\n','')
  khgg11.append(khgg12)

vectorizer11 = TfidfVectorizer(ngram_range=(3,3))
vectors112 = vectorizer11.fit_transform(khgg11)
feature_names112 = vectorizer11.get_feature_names()
dense112 = vectors112.todense()
denselist112 = dense112.tolist()
dff112 = pd.DataFrame(denselist112,columns=feature_names112)
dff112
```

Out[5]:

	_llseek _llseek _llseek	_llseek _llseek clock_gettime	_llseek _llseek close	_llseek _llseek fcntl64	_llseek _llseek fstat64	_llseek _llseek fstatat64	_llseek _llseek fsync	_llseek _llseek futex	_llseek _llseek ioctl	_llseek _llseek lseek	_llseek _llseek madvise	_llse _llse mma
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
...	...	...	...	...	...	...	...	...	...	...	...	
2865	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2866	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2867	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2868	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2869	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

2870 rows × 34196 columns

In [7]:

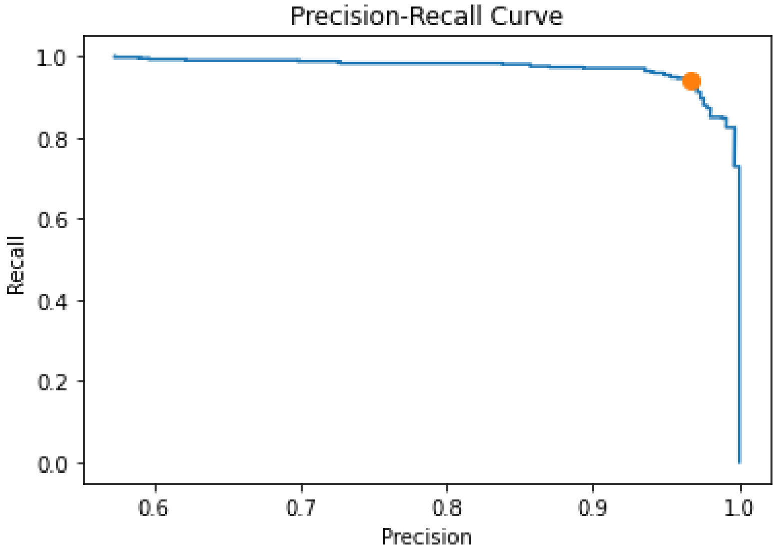
```
from sklearn.svm import LinearSVC
from sklearn.svm import SVC
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_scor
e
y=np.zeros((2870,))
y[int(np.size(txt_files)/2) -20:2870]=1
X=denselist112
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state = 0)

clf = LinearSVC(C=9).fit(X_train, y_train)
```

```
print('Accuracy of Linear SVC classifier on training set:',clf.score(X_train, y_tr
ain))
print('Accuracy of Linear SVC classifier on test set:',clf.score(X_test, y_test))

svm_predicted = clf.predict(X_test)
confusion = confusion_matrix(y_test, svm_predicted)
print('\n Confusion matrix for SVM classifier (linear, C=9)\n', confusion)

Accuracy3, Precision3, Recall3, F13 = EvaluationMetrics(y_test,svm_predicted)
print('\n Accuracy:',Accuracy3,'\n Precision:',Precision3,'\n Recall:',Recall3,'\n
F1:',F13)
```

```
Accuracy of Linear SVC classifier on training set: 0.9725836431226765
Accuracy of Linear SVC classifier on test set: 0.947075208913649

 Confusion matrix for SVM classifier (linear, C=9)
 [[299  13]
 [ 25 381]]

 Accuracy: 0.947075208913649
 Precision: 0.9670050761421319
 Recall: 0.9384236453201971
 F1: 0.9524999999999999
```

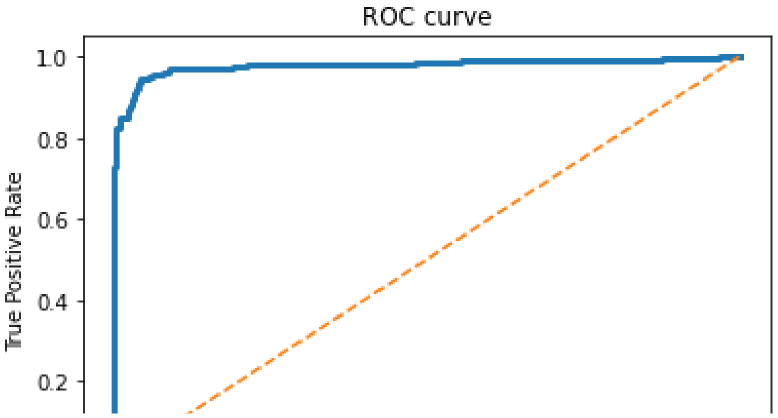
In [11]:

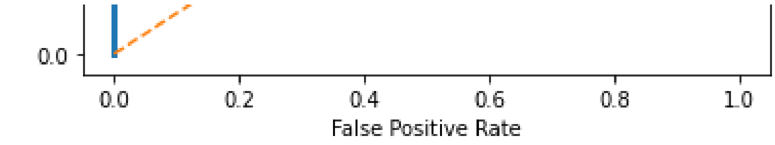
```
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import precision_recall_curve
PrecisionRecallCurve(X_test, y_test, X_train, y_train,clf)
```



In [12]:

```
ROCCurve(X_test, y_test, X_train, y_train,clf)
```





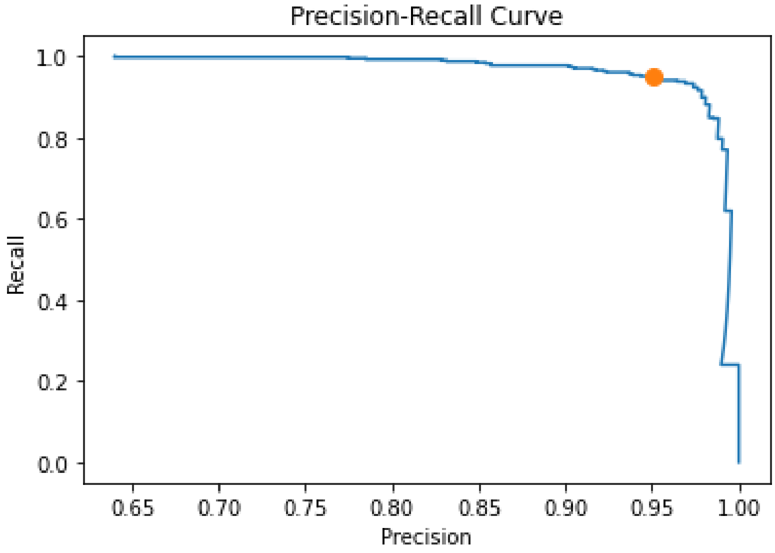
In [13]:

```
clfrbf = SVC(kernel = 'rbf', gamma = 7,C = 9).fit(X_train, y_train)

print('Accuracy of kernel SVC classifier on training set:',clfrbf.score(X_train, y_train))
print('Accuracy of kernel SVC classifier on test set:',clfrbf.score(X_test, y_test))

svm_predicted1 = clfrbf.predict(X_test)
confusion1 = confusion_matrix(y_test, svm_predicted1)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=9, gamma=7)\n', confusion1)

Accuracy_rbf3, Precision_rbf3, Recall_rbf3, F1_rbf3 = EvaluationMetrics(y_test,svm_predicted1)
print('\n Accuracy:',Accuracy_rbf3,'\n Precision:',Precision_rbf3,'\n Recall:',Recall_rbf3,'\n F1:',F1_rbf3)
```

```
Accuracy of kernel SVC classifier on training set: 0.9934944237918215
Accuracy of kernel SVC classifier on test set: 0.9401114206128134

 Confusion matrix for SVM classifier (RBF kernel, C=9, gamma=7)
 [[289  23]
 [ 20 386]]

 Accuracy: 0.9401114206128134
 Precision: 0.9437652811735942
 Recall: 0.9507389162561576
 F1: 0.9472392638036811
```

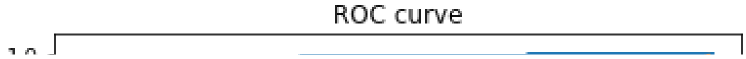
In [63]:

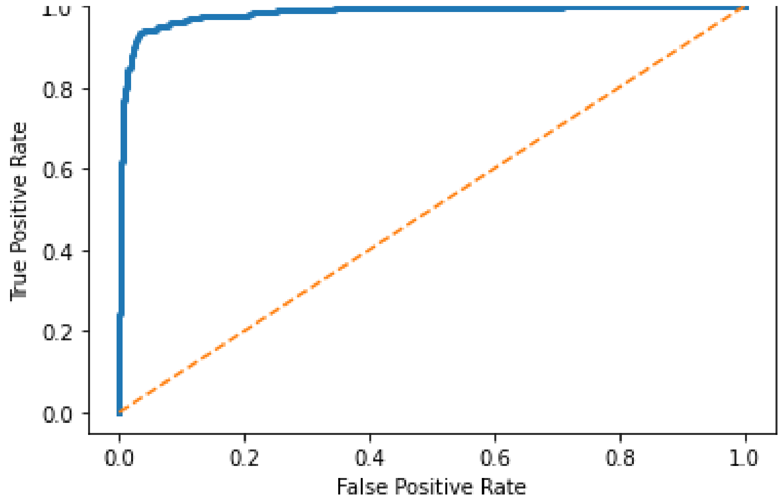
```
PrecisionRecallCurve(X_test, y_test, X_train, y_train,clfrbf)
```



In [64]:

```
ROCCurve(X_test, y_test, X_train, y_train,clfrbf)
```





3 WORD- BOOLEAN

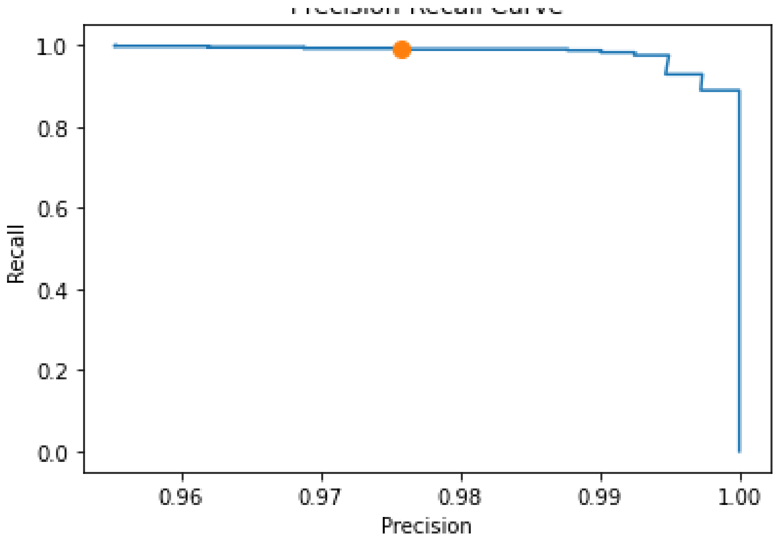
In [15]:

```
boolean=np.zeros([2870,34196])
for ii in range(2870):
  for jj in range(34196):
    if denselist112[ii][jj]>0.0:
      boolean[ii][jj]=1
    else:
      boolean[ii][jj]=0
X1=boolean
X_trainB, X_testB, y_trainB, y_testB = train_test_split(X1, y, random_state = 0)

clf2 = LinearSVC(C=2).fit(X_trainB, y_trainB)
print('Accuracy of Linear SVC classifier on training set:',clf2.score(X_trainB, y_
trainB))
print('Accuracy of Linear SVC classifier on test set:',clf2.score(X_testB, y_testB
))

svm_predicted2 = clf2.predict(X_testB)
confusion2 = confusion_matrix(y_testB, svm_predicted2)

print('\n Confusion matrix for SVM classifier (linear, C=2)\n', confusion2)

Accuracy3B, Precision3B, Recall3B, F13B = EvaluationMetrics(y_testB,svm_predicted2
)
print('\n Accuracy:',Accuracy3B,'\n Precision:',Precision3B,'\n Recall:',Recall3B,
'\n F1:',F13B)
```

```
Accuracy of Linear SVC classifier on training set: 1.0
Accuracy of Linear SVC classifier on test set: 0.9818941504178273

 Confusion matrix for SVM classifier (linear, C=2)
 [[303   9]
 [  4 402]]

 Accuracy: 0.9818941504178273
 Precision: 0.9781021897810219
 Recall: 0.9901477832512315
 F1: 0.9840881272949816
```

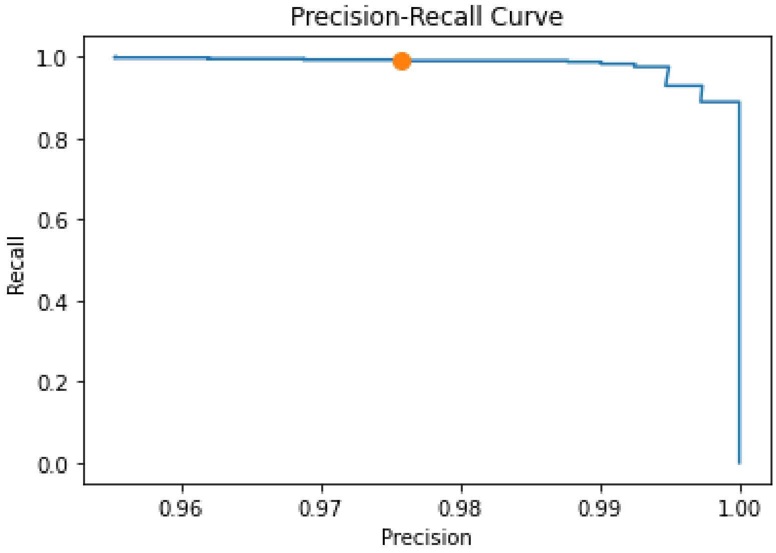
In [16]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```



In [17]:

```
PrecisionRecallCurve(X_testB, y_testB, X_trainB, y_trainB, clf2)
```



In [18]:

```
clfrbf2 = SVC(kernel = 'rbf', gamma = 0.1,C = 0.9).fit(X_trainB, y_trainB)

print('Accuracy of Linear SVC classifier on training set:',clfrbf2.score(X_trainB, y_trainB))
print('Accuracy of Linear SVC classifier on test set:',clfrbf2.score(X_testB, y_testB))

svm_predicted11 = clfrbf2.predict(X_testB)
confusion11 = confusion_matrix(y_testB, svm_predicted11)

print('\n Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)\n', confusion11)

Accuracy_rbfB, Precision_rbfB, Recall_rbfB, F1_rbfB = EvaluationMetrics(y_testB,svm_predicted11)
print('\n Accuracy:',Accuracy_rbfB,'\n Precision:',Precision_rbfB,'\n Recall:',Recall_rbfB,'\n F1:',F1_rbfB)
```

```
Accuracy of Linear SVC classifier on training set: 1.0
Accuracy of Linear SVC classifier on test set: 0.5710306406685237

 Confusion matrix for SVM classifier (RBF kernel, C=0.1, gamma=0.9)
 [[  4 308]
 [  0 406]]
```

```
Accuracy: 0.5710306406685237
Precision: 0.5686274509803921
Recall: 1.0
F1: 0.725
```

CONCLUSION

THE BEST MODEL HAS BEEN FOUND OUT TO BE 3 WORD SEQUENCES AS FEATURE VECTOR AND BOOLEAN OCCURENCE OF CALL WITH LINEAR SUPPORT VECTOR MACHINE ML MODEL

CLUSTERING

K MEANS

In [ ]:

```
from sklearn.cluster import KMeans
from sklearn.feature_extraction.text import TfidfVectorizer
kk1=[]
for ii in range(np.size(txt_files)):
  s=wordsInFile(txt_files[ii])
  listToStr1 = ' '.join(s)
  kk1.append(listToStr1)
for ii in range(np.size(txt_filesM)):
  s=wordsInFile(txt_filesM[ii])
  listToStr2 = ' '.join(s)
  kk1.append(listToStr2)
vectorizer = TfidfVectorizer()
X = vectorizer.fit_transform(kk1)
```

In [22]:

```
true_k = 2
X1=X
model = KMeans(n_clusters=true_k, init='k-means++', max_iter=100, n_init=1)
model.fit(X)
order_centroids = model.cluster_centers_.argsort()[:, ::-1]
terms = vectorizer.get_feature_names()
```

In [19]:

```
s=wordsInFile(txt_filesM[12])
kkb1=' '.join(s)
X12 = vectorizer.transform([kkb1])
predicted = model.predict(X12)
print(predicted)
# CLASS 0 FOR 'M' & CLASS 1 FOR 'B' FILES
```

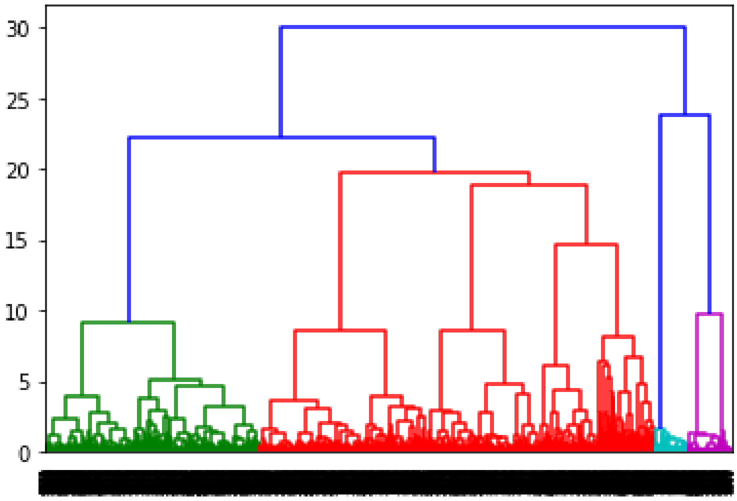
```
[0]
```

AGGLOMERATIVE

In [25]:

```
from scipy.cluster.hierarchy import ward, dendrogram
from sklearn.cluster import AgglomerativeClustering
```

```
cls = AgglomerativeClustering(n_clusters = 2)
cls_assignment = cls.fit_predict(X1.toarray())

plt.figure()
dendrogram(ward(X1.toarray()))
plt.show()
```



In [ ]:

```
cls_assignment
```

DBSCAN

In [30]:

```
from sklearn.cluster import DBSCAN
dbscan = DBSCAN(eps = 2, min_samples = 2)
cls = dbscan.fit_predict(X)
cls
```

Out[30]:

```
array([0, 0, 0, ..., 0, 0, 0])
```

THE BEST CLUSTERING MODEL IS K MEANS ON THE GIVEN DATASET. THIS IS DUE TO THE GREATER ACCURACY & PRECISION THAT THE MODEL HAS SHOWN