K-Nearest Neighbors Classifier

In [1]:

```
%matplotlib inline
import numpy as np
import matplotlib
import scipy
import sklearn
from matplotlib import pyplot as plt
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import roc_curve
from sklearn.metrics import auc
from sklearn.metrics import confusion_matrix
from sklearn import svm
from sklearn import metrics
from sklearn.model_selection import cross_val_score, cross_val_predict
import warnings
warnings.filterwarnings("ignore", category=FutureWarning)
```

In [2]:

```
X = np.genfromtxt("AggregatedData.csv", delimiter=",", usecols=(1, 3, 4, 5))
y = np.genfromtxt("AggregatedData.csv", delimiter=",", usecols=8)

m,n = X.shape
print('Number of features:', n)
print('Number of data points', m)

X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.25, random_
state=0)
```

```
Number of features: 4
Number of data points 1500
```

In [3]:

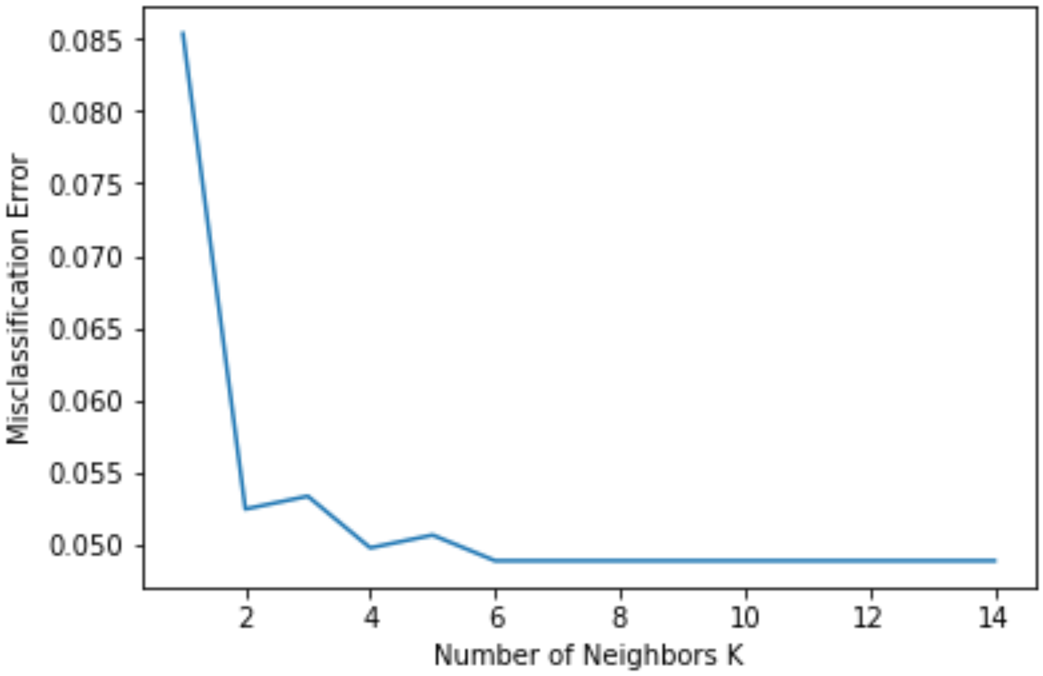
```
myList = list(range(1,15))

MSE = []

for k in myList:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X_train, y_train, cv=10, scoring='accuracy')
    MSE.append(1-scores.mean())

plt.plot(myList, MSE)
plt.xlabel('Number of Neighbors K')
plt.ylabel('Misclassification Error')
plt.show()

print("Reccomended K: ", myList[np.argmin(MSE)])
```




```
Reccomended K:  6
```

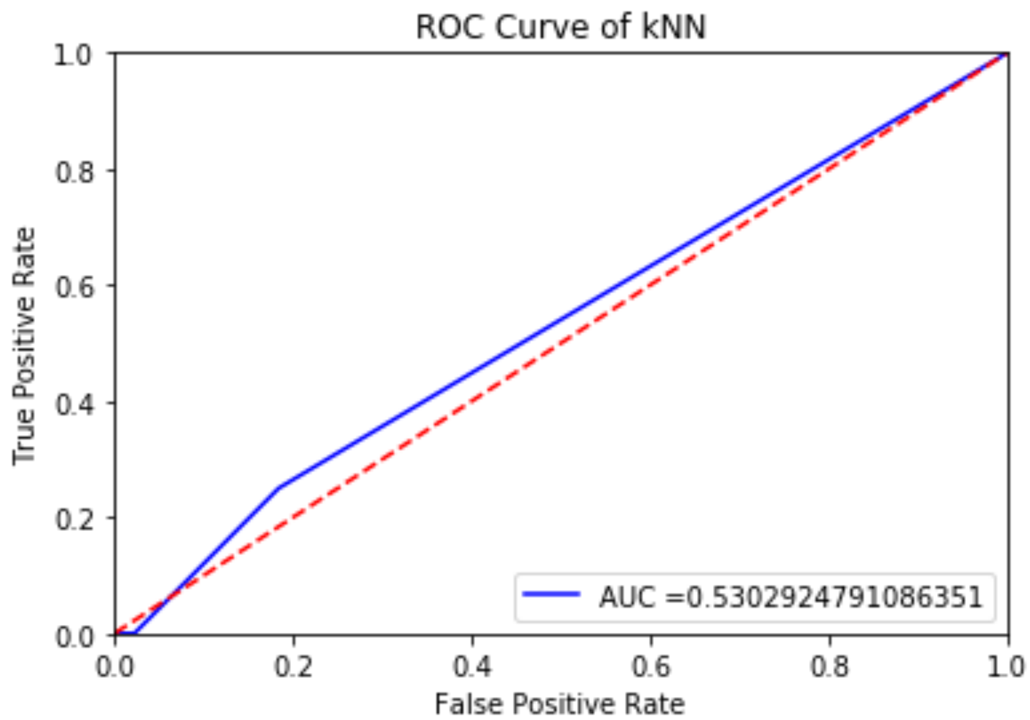
In [4]:

```
knn = KNeighborsClassifier(n_neighbors = 6)
knn.fit(X_train,y_train)
result = knn.score(X_test, y_test)
y_scores = knn.predict_proba(X_test)
predictions = knn.predict(X_test)
print("Accuracy: %.3f%%" % (result*100.0))
fpr, tpr, threshold = roc_curve(y_test, y_scores[:, 1])
roc_auc = auc(fpr, tpr)

plt.title('Receiver Operating Characteristic')
plt.plot(fpr, tpr, 'b', label = "AUC =" +str(roc_auc))
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.xlim([0, 1])
plt.ylim([0, 1])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.title('ROC Curve of kNN')
plt.show()

#https://scikit-learn.org/stable/auto_examples/model_selection/plot_roc.html
```

```
Accuracy: 95.733%
```



In [5]:

```
classifier = svm.SVC(kernel='linear', C=0.01)
y_pred = classifier.fit(X_train, y_train).predict(X_test)

def plot_confusion_matrix(y_true, y_pred,
                          normalize=False,
                          title=None,
                          cmap=plt.cm.Blues):
    """
```

```
    This function prints and plots the confusion matrix.

    Normalization can be applied by setting `normalize=True`.
    """
    if not title:
        if normalize:
            title = 'Normalized confusion matrix'
        else:
            title = 'Confusion matrix, without normalization'

    # Compute confusion matrix
    cm = confusion_matrix(y_true, y_pred)
    # Only use the labels that appear in the data
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        print("Normalized confusion matrix")
    else:
        print('Confusion matrix, without normalization')

    print(cm)

    fig, ax = plt.subplots()
    im = ax.imshow(cm, interpolation='nearest', cmap=cmap)
    ax.figure.colorbar(im, ax=ax)
    # We want to show all ticks...
    ax.set(xticks=np.arange(cm.shape[1]),
           yticks=np.arange(cm.shape[0]),
           xticklabels=["No Outbreak", "Outbreak"], yticklabels=["No Outbreak",
"Outbreak"],
           title=title,
           ylabel='True label',
           xlabel='Predicted label')

    # Rotate the tick labels and set their alignment.
    plt.setp(ax.get_xticklabels(), rotation=45, ha="right",
             rotation_mode="anchor")

    # Loop over data dimensions and create text annotations.
    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i in range(cm.shape[0]):
        for j in range(cm.shape[1]):
            ax.text(j, i, format(cm[i, j], fmt),
                    ha="center", va="center",
                    color="white" if cm[i, j] > thresh else "black")
    fig.tight_layout()
    return ax

#https://scikit-learn.org/stable/auto_examples/model_selection/plot_confusion_ma
trix.html
```

In [6]:

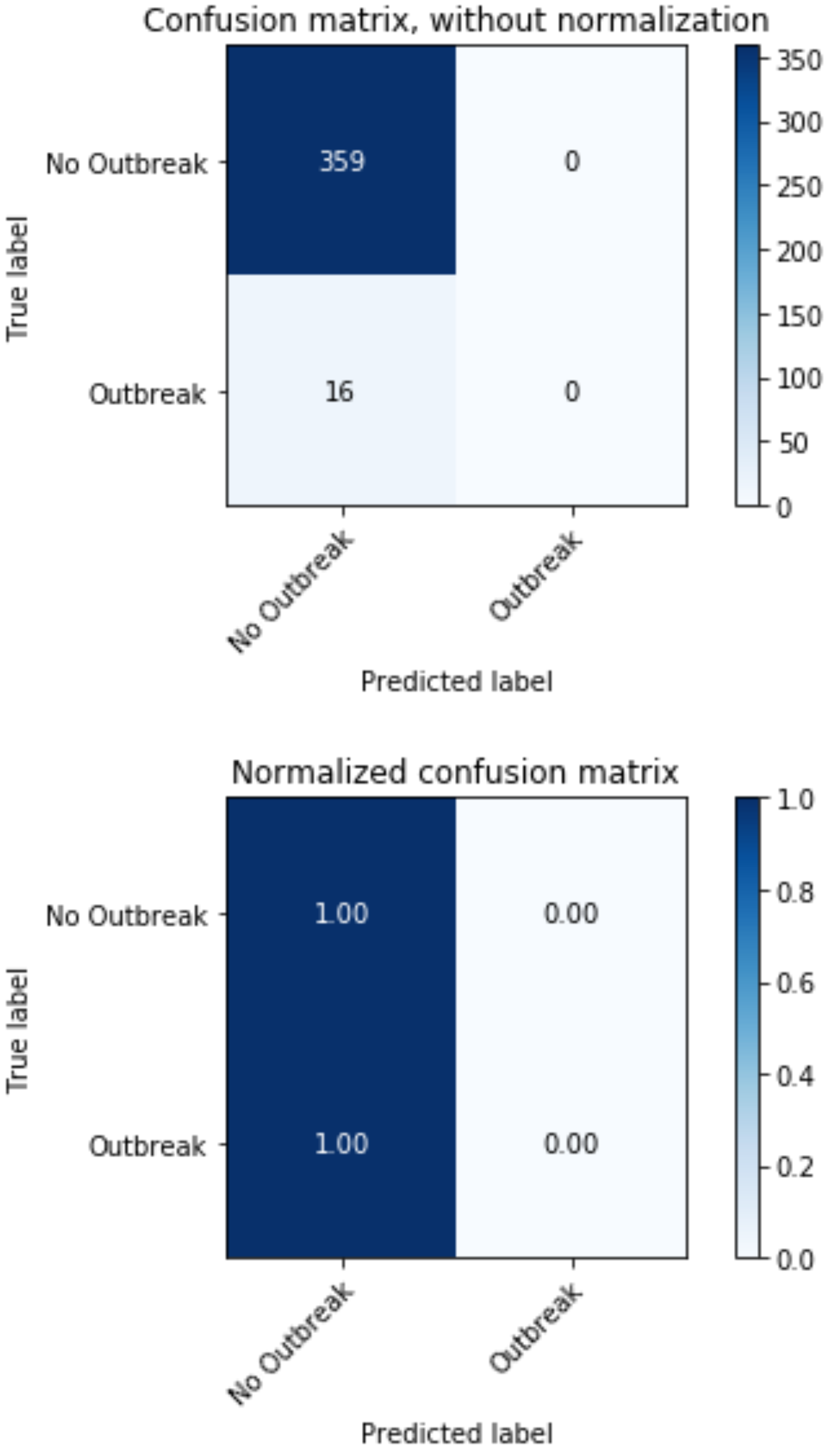
```
np.set_printoptions(precision=2)
plot_confusion_matrix(y_test, y_pred,title='Confusion matrix, without normalizat
ion')

plot_confusion_matrix(y_test, y_pred, normalize=True,title='Normalized confusion
matrix')

plt.show()

#https://scikit-learn.org/stable/auto_examples/model_selection/plot_confusion_ma
trix.html
```

```
Confusion matrix, without normalization
[[359   0]
 [ 16   0]]
Normalized confusion matrix
[[1. 0.]
 [1. 0.]]
```



Splitting into Train and Test Sets

In [7]:

```
from sklearn import model_selection
from sklearn.linear_model import LogisticRegression

test_size = 0.25
X_train, X_test, Y_train, Y_test = model_selection.train_test_split(X, y, test_s
ize=test_size, random_state=0)
model = LogisticRegression()
model.fit(X_train, Y_train)
result = model.score(X_test, Y_test)
print("Accuracy: %.3f%%" % (result*100.0))

#https://scikit-learn.org/stable/modules/cross_validation.html
```

```
Accuracy: 95.733%
```

Leave One Out CV

In [8]:

```
from sklearn.model_selection import LeaveOneOut
from sklearn.neighbors import NearestNeighbors

X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.25, random_
state=0, stratify=y)

loo = LeaveOneOut()
loo.get_n_splits(X)

loocv = model_selection.LeaveOneOut()
model = LogisticRegression()
results = model_selection.cross_val_score(model, X, y, cv=loocv)
print("Accuracy: %.3f%% Standard Deviation (%.3f%%)" % (results.mean()*100.0, re
sults.std()*100.0))

#https://scikit-learn.org/stable/modules/cross_validation.html
```

```
Accuracy: 95.267% Standard Deviation (21.235%)
```

As you can see in the standard deviation, the score has more variance than the k-fold cross validation results. (See Below)

K-Fold Cross Validation

In [9]:

```
kfold = model_selection.KFold(n_splits=6, random_state=0)
clf = svm.SVC(kernel='linear', C=1).fit(X_train, y_train)
clf_test = svm.SVC(kernel='linear', C=1).fit(X_test, y_test)
model = LogisticRegression()
results = model_selection.cross_val_score(clf, X, y, cv=kfold)
print("Accuracy: %.3f%% Standard Deviation (%.3f%%)" % (results.mean()*100.0, re
sults.std()*100.0))

#https://scikit-learn.org/stable/modules/cross_validation.html
```

```
Accuracy: 95.267% Standard Deviation (1.590%)
```

The result is a more reliable estimate of the performance of the algorithm on new data given your test data. It is more accurate because the algorithm is trained and evaluated multiple times on different data.

Repeated Random Test-Train Splits

A variation on k-fold cross validation that creates a random 25/75 split and repeats the process of splitting and evaluation multiple times.

In [10]:

```
test_size = 0.25
kfold = model_selection.ShuffleSplit(n_splits=10, test_size=test_size, random_st
ate=0)
model = LogisticRegression()
results = model_selection.cross_val_score(model, X, y, cv=kfold)
print("Accuracy: %.3f%% Standard Deviation (%.3f%%)" % (results.mean()*100.0, re
sults.std()*100.0))

#https://scikit-learn.org/stable/modules/cross_validation.html
```

```
Accuracy: 95.173% Standard Deviation (1.336%)
```