

## SMAI Assignment 1

Rishabh Govind Sharma  
201201165

Code: Python  
KNN Class

\*\*\*\*\*

```
import numpy as np
import scipy
import scipy.stats
```

```
class kNN():
```

```
    def __init__(self, k=1, distance_m=None):
        self._k = k
        self.distance = distance_m
```

```
    def set_distance_measure(self,distance_m):
        self.distance = distance_m
```

```
    def _majority_label(self,Y):
        return scipy.stats.mode(Y).mode[0]
```

```
    def fit(self, X, Y):
```

```
        if (X.shape[0] == 0 ):
            raise ValueError ('No samples provided')
```

```
        self._n_features = len(X[0])
        if all([len(ii) == self._n_features for ii in X]) == False:
            raise ValueError ('Sample size is not same every sample')
```

```
        if len(X) != len(Y):
            raise ValueError ('Length Mismatch between X and Y')
```

```
        self._X = X
        self._Y = Y
```

```
    def predict(self,X):
```

```

try:
    if len(X.shape) == 1:
        X = X.reshape(1,-1)

    if (self._X.shape[1] != X.shape[1]):
        raise ValueError('Shape mismatch for test sample ')

    if self.distance == None:
        raise ValueError('Set distance measure first')

    distM = []
    for item in X:
        curY = []
        for row in self._X:
            curY.append(self.distance(row,item))
        distM.append(curY)

    pred = []

    for item in distM:
        voters_index = np.argmax(item,self._k)[0:self._k]
        votes = self._Y[voters_index]
        pred.append(self._majority_label(votes))

    return pred
except AttributeError:
    raise AttributeError('Call fit method first')

```

IRIS/Seeds/Alabone: One only needs to change the file name for the dataset supplied. Rest of the code is modular enough.

\*\*\*\*\*

```

import numpy as np
import pandas as pd
import sklearn
from sklearn.cross_validation import train_test_split as tts
from sklearn.metrics import accuracy_score, confusion_matrix
from sklearn.cross_validation import StratifiedKFold
import knn # My KNN class

```

```

def distance(X,Y):

    diff = X-Y
    return np.sqrt(np.dot(diff,diff))

def results(xtrain,xtest,ytrain,ytest,k):
    print 'Results for Knn with k =',k

    clf = knn.kNN(k=k,distance_m = distance)
    clf.fit(xtrain.values,ytrain.values)
    prd = clf.predict(xtest.values)

    print "Accuracy:",accuracy_score(ytest.values,prd)
    print 'Confusion Matrix'
    print confusion_matrix(ytest.values,prd)
    return accuracy_score(ytest.values,prd)

def result(xtrain,xtest,ytrain,ytest,k):
    print 'Results for Knn with k =',k

    clf = knn.kNN(k=k,distance_m = distance)
    clf.fit(xtrain,ytrain)
    prd = clf.predict(xtest)

    print "Accuracy:",accuracy_score(ytest,prd)
    print 'Confusion Matrix'
    print confusion_matrix(ytest,prd)
    return accuracy_score(ytest,prd)

def main():

    df = pd.read_csv('../data/iris.data',)
    df.columns=['sepal_l','sepal_w','petal_l','petal_w','label']

    tar = df['label']

    df = df.drop(['label'],axis=1)
    # Q1 split 50-50%
    rk = {}
    rk[1] = []
    rk[2] = []

```

```

rk[3] = []
for i in range(0,10):
    print 'Test run',i
    xtrain,xtest,ytrain,ytest = tts(df,tar,test_size = 0.5)
    rk[1].append(results(xtrain,xtest,ytrain,ytest,k=1))
    print
    rk[2].append(results(xtrain,xtest,ytrain,ytest,k=2))
    print
    rk[3].append(results(xtrain,xtest,ytrain,ytest,k=3))

print "Mean accuracy and variance over 10 runs with k = 1",np.mean(rk[1]),np.var(rk[1])
print
print "Mean accuracy and variance over 10 runs with k = 2",np.mean(rk[2]),np.var(rk[2])
print
print "Mean accuracy and variance over 10 runs with k = 3",np.mean(rk[3]),np.var(rk[3])

'''
Cross validation 5 fold
'''

sf = StratifiedKFold(tar,n_folds = 5)
i = 1
rk[3] = []
for train,test in sf:
    print 'Fold',i
    i = i +1
    xtrain,xtest,ytrain,ytest =
df.values[train],df.values[test],tar.values[train],tar.values[test]
    print
    rk[3].append(result(xtrain,xtest,ytrain,ytest,k=3))

print
print "Mean accuracy and variance over 5-folds",np.mean(rk[3]),np.var(rk[3])

main()

```

Iris Dataset

### **Test run 0**

Results for Knn with k = 1

Accuracy: 0.946666666667

Confusion Matrix

```
[[26 0 0]
 [ 0 22 4]
 [ 0 0 23]]
```

Results for Knn with k = 2

Accuracy: 0.96

Confusion Matrix

```
[[26 0 0]
 [ 0 23 3]
 [ 0 0 23]]
```

Results for Knn with k = 3

Accuracy: 0.946666666667

Confusion Matrix

```
[[26 0 0]
 [ 0 22 4]
 [ 0 0 23]]
```

### **Test run 1**

Results for Knn with k = 1

Accuracy: 0.946666666667

Confusion Matrix

```
[[22 0 0]
 [ 0 27 3]
 [ 0 1 22]]
```

Results for Knn with k = 2

Accuracy: 0.96

Confusion Matrix

```
[[22 0 0]
 [ 0 28 2]
 [ 0 1 22]]
```

Results for Knn with k = 3  
Accuracy: 0.946666666667  
Confusion Matrix  
[[22 0 0]  
[ 0 27 3]  
[ 0 1 22]]

## **Test run 2**

Results for Knn with k = 1  
Accuracy: 0.933333333333  
Confusion Matrix  
[[25 0 0]  
[ 0 22 3]  
[ 0 2 23]]

Results for Knn with k = 2  
Accuracy: 0.946666666667  
Confusion Matrix  
[[25 0 0]  
[ 0 23 2]  
[ 0 2 23]]

Results for Knn with k = 3  
Accuracy: 0.946666666667  
Confusion Matrix  
[[25 0 0]  
[ 0 22 3]  
[ 0 1 24]]

## **Test run 3**

Results for Knn with k = 1  
Accuracy: 0.946666666667  
Confusion Matrix  
[[24 0 0]  
[ 0 21 2]  
[ 0 2 26]]

Results for Knn with k = 2  
Accuracy: 0.933333333333

Confusion Matrix

```
[[24 0 0]
 [ 0 21 2]
 [ 0 3 25]]
```

Results for Knn with k = 3

Accuracy: 0.96

Confusion Matrix

```
[[24 0 0]
 [ 0 21 2]
 [ 0 1 27]]
```

## **Test run 4**

Results for Knn with k = 1

Accuracy: 0.906666666667

Confusion Matrix

```
[[25 0 0]
 [ 0 21 2]
 [ 0 5 22]]
```

Results for Knn with k = 2

Accuracy: 0.88

Confusion Matrix

```
[[25 0 0]
 [ 0 23 0]
 [ 0 9 18]]
```

Results for Knn with k = 3

Accuracy: 0.88

Confusion Matrix

```
[[25 0 0]
 [ 0 21 2]
 [ 0 7 20]]
```

## **Test run 5**

Results for Knn with k = 1

Accuracy: 0.986666666667

Confusion Matrix

```
[[28 0 0]
```

```
[ 0 26 0]
[ 0 1 20]]
```

Results for Knn with k = 2  
Accuracy: 0.973333333333  
Confusion Matrix  
[[28 0 0]  
[ 0 26 0]  
[ 0 2 19]]

Results for Knn with k = 3  
Accuracy: 0.973333333333  
Confusion Matrix  
[[28 0 0]  
[ 0 25 1]  
[ 0 1 20]]

## **Test run 6**

Results for Knn with k = 1  
Accuracy: 0.96  
Confusion Matrix  
[[26 0 0]  
[ 0 22 3]  
[ 0 0 24]]

Results for Knn with k = 2  
Accuracy: 0.946666666667  
Confusion Matrix  
[[26 0 0]  
[ 0 24 1]  
[ 0 3 21]]

Results for Knn with k = 3  
Accuracy: 0.946666666667  
Confusion Matrix  
[[26 0 0]  
[ 0 23 2]  
[ 0 2 22]]

## **Test run 7**



Results for Knn with k = 1  
Accuracy: 0.946666666667  
Confusion Matrix  
[[27 0 0]  
[ 0 24 2]  
[ 0 2 20]]

Results for Knn with k = 2  
Accuracy: 0.933333333333  
Confusion Matrix  
[[27 0 0]  
[ 0 24 2]  
[ 0 3 19]]

Results for Knn with k = 3  
Accuracy: 0.96  
Confusion Matrix  
[[27 0 0]  
[ 0 24 2]  
[ 0 1 21]]

## **Test run 8**

Results for Knn with k = 1  
Accuracy: 0.96  
Confusion Matrix  
[[25 0 0]  
[ 0 25 3]  
[ 0 0 22]]

Results for Knn with k = 2  
Accuracy: 0.96  
Confusion Matrix  
[[25 0 0]  
[ 0 26 2]  
[ 0 1 21]]

Results for Knn with k = 3  
Accuracy: 0.96  
Confusion Matrix  
[[25 0 0]  
[ 0 25 3]

[ 0 0 22]]

## **Test run 9**

Results for Knn with k = 1

Accuracy: 0.96

Confusion Matrix

[[25 0 0]

[ 0 23 2]

[ 0 1 24]]

Results for Knn with k = 2

Accuracy: 0.92

Confusion Matrix

[[25 0 0]

[ 0 24 1]

[ 0 5 20]]

Results for Knn with k = 3

Accuracy: 0.96

Confusion Matrix

[[25 0 0]

[ 0 24 1]

[ 0 2 23]]

Mean accuracy and variance over 10 runs with k = 1 0.949333333333 0.000384

Mean accuracy and variance over 10 runs with k = 2 0.941333333333 0.000647111111111

Mean accuracy and variance over 10 runs with k = 3 0.948 0.000584888888889

## **Cross Validation**

Fold 1

Results for Knn with k = 3

Accuracy: 0.966666666667

Confusion Matrix

[[10 0 0]

[ 0 10 0]

[ 0 1 9]]

Fold 2

Results for Knn with k = 3

Accuracy: 0.966666666667

Confusion Matrix

[[10 0 0]

[ 0 10 0]

[ 0 1 9]]

Fold 3

Results for Knn with k = 3

Accuracy: 0.933333333333

Confusion Matrix

[[10 0 0]

[ 0 8 2]

[ 0 0 10]]

Fold 4

Results for Knn with k = 3

Accuracy: 0.966666666667

Confusion Matrix

[[10 0 0]

[ 0 9 1]

[ 0 0 10]]

Fold 5

Results for Knn with k = 3

Accuracy: 1.0

Confusion Matrix

[[ 9 0 0]

[ 0 10 0]

[ 0 0 10]]

Mean accuracy and variance over 5-folds 0.966666666667 0.0004444444444444

## **Questions**

## Iris dataset

Number of Features:4

Number of instances: 150

Number of classes: 3 [Setosa, Virginica, Versicolor]

I used euclidean distance measure as flower petals would have a characteristic size.

## Seeds Dataset

Test run 0

Results for Knn with k = 1

Accuracy: 0.89898989899

Confusion Matrix

```
[[33 5 1]
```

```
 [ 2 26 0]
```

```
 [ 2 0 30]]
```

Results for Knn with k = 2

Accuracy: 0.89898989899

Confusion Matrix

```
[[36 2 1]
```

```
 [ 3 25 0]
```

```
 [ 4 0 28]]
```

Results for Knn with k = 3

Accuracy: 0.89898989899

Confusion Matrix

```
[[33 3 3]
```

```
 [ 2 26 0]
```

```
 [ 2 0 30]]
```

Test run 1

Results for Knn with k = 1

Accuracy: 0.878787878788

Confusion Matrix

```
[[28 0 3]
```

```
 [ 5 27 0]
```

```
 [ 4 0 32]]
```

Results for Knn with k = 2

Accuracy: 0.858585858586

Confusion Matrix

```
[[29 0 2]
 [ 5 27 0]
 [ 7 0 29]]
```

Results for Knn with k = 3

Accuracy: 0.868686868687

Confusion Matrix

```
[[29 0 2]
 [ 5 27 0]
 [ 6 0 30]]
```

Test run 2

Results for Knn with k = 1

Accuracy: 0.89898989899

Confusion Matrix

```
[[24 0 5]
 [ 2 34 0]
 [ 3 0 31]]
```

Results for Knn with k = 2

Accuracy: 0.878787878788

Confusion Matrix

```
[[27 0 2]
 [ 5 31 0]
 [ 5 0 29]]
```

Results for Knn with k = 3

Accuracy: 0.929292929293

Confusion Matrix

```
[[26 1 2]
 [ 3 33 0]
 [ 1 0 33]]
```

Test run 3

Results for Knn with k = 1

Accuracy: 0.858585858586

Confusion Matrix

```
[[29 0 6]
```

```
[ 4 24 0]
```

```
[ 4 0 32]]
```

Results for Knn with k = 2

Accuracy: 0.858585858586

Confusion Matrix

```
[[29 0 6]
```

```
[ 4 24 0]
```

```
[ 4 0 32]]
```

Results for Knn with k = 3

Accuracy: 0.878787878788

Confusion Matrix

```
[[28 1 6]
```

```
[ 3 25 0]
```

```
[ 2 0 34]]
```

Test run 4

Results for Knn with k = 1

Accuracy: 0.909090909091

Confusion Matrix

```
[[21 4 3]
```

```
[ 1 44 0]
```

```
[ 1 0 25]]
```

Results for Knn with k = 2

Accuracy: 0.919191919192

Confusion Matrix

```
[[24 3 1]
```

```
[ 2 43 0]
```

[ 2 0 24]]

Results for Knn with k = 3

Accuracy: 0.909090909091

Confusion Matrix

[[20 5 3]

[ 1 44 0]

[ 0 0 26]]

Test run 5

Results for Knn with k = 1

Accuracy: 0.929292929293

Confusion Matrix

[[30 1 4]

[ 2 32 0]

[ 0 0 30]]

Results for Knn with k = 2

Accuracy: 0.919191919192

Confusion Matrix

[[33 0 2]

[ 3 31 0]

[ 3 0 27]]

Results for Knn with k = 3

Accuracy: 0.919191919192

Confusion Matrix

[[30 1 4]

[ 2 32 0]

[ 1 0 29]]

Test run 6

Results for Knn with k = 1

Accuracy: 0.868686868687

Confusion Matrix



```
[[29 3 9]
 [ 0 29 0]
 [ 1 0 28]]
```

Results for Knn with k = 2  
Accuracy: 0.888888888889  
Confusion Matrix

```
[[34 1 6]
 [ 2 27 0]
 [ 2 0 27]]
```

Results for Knn with k = 3  
Accuracy: 0.888888888889  
Confusion Matrix

```
[[32 2 7]
 [ 1 28 0]
 [ 1 0 28]]
```

Test run 7

Results for Knn with k = 1  
Accuracy: 0.929292929293  
Confusion Matrix

```
[[28 3 3]
 [ 0 29 0]
 [ 1 0 35]]
```

Results for Knn with k = 2  
Accuracy: 0.919191919192  
Confusion Matrix

```
[[30 2 2]
 [ 0 29 0]
 [ 4 0 32]]
```

Results for Knn with k = 3

Accuracy: 0.909090909091

Confusion Matrix

```
[[26 4 4]
```

```
[ 0 29 0]
```

```
[ 1 0 35]]
```

Test run 8

Results for Knn with k = 1

Accuracy: 0.939393939394

Confusion Matrix

```
[[28 2 2]
```

```
[ 0 32 0]
```

```
[ 2 0 33]]
```

Results for Knn with k = 2

Accuracy: 0.949494949495

Confusion Matrix

```
[[30 1 1]
```

```
[ 1 31 0]
```

```
[ 2 0 33]]
```

Results for Knn with k = 3

Accuracy: 0.939393939394

Confusion Matrix

```
[[28 1 3]
```

```
[ 1 31 0]
```

```
[ 1 0 34]]
```

Test run 9

Results for Knn with k = 1

Accuracy: 0.848484848485

Confusion Matrix

```
[[22 1 10]
```

```
[ 4 29 0]
```

```
[ 0 0 33]]
```

Results for Knn with k = 2

Accuracy: 0.888888888889

Confusion Matrix

```
[[27 0 6]
 [ 5 28 0]
 [ 0 0 33]]
```

Results for Knn with k = 3

Accuracy: 0.848484848485

Confusion Matrix

```
[[23 1 9]
 [ 5 28 0]
 [ 0 0 33]]
```

Mean accuracy and variance over 10 runs with k = 1 0.89595959596  
0.000898887868585

Mean accuracy and variance over 10 runs with k = 2 0.89797979798  
0.000764207733905

Mean accuracy and variance over 10 runs with k = 3 0.89898989899  
0.000714212835425

Fold 1

Results for Knn with k = 3

Accuracy: 0.975

Confusion Matrix

```
[[12 1 0]
 [ 0 14 0]
 [ 0 0 13]]
```

Fold 2

Results for Knn with k = 3

Accuracy: 0.95

Confusion Matrix

```
[[11  0  2]
```

```
 [ 0 14  0]
```

```
 [ 0  0 13]]
```

Fold 3

Results for Knn with k = 3

Accuracy: 0.9

Confusion Matrix

```
[[10  2  1]
```

```
 [ 0 14  0]
```

```
 [ 1  0 12]]
```

Fold 4

Results for Knn with k = 3

Accuracy: 0.923076923077

Confusion Matrix

```
[[11  2  0]
```

```
 [ 1 12  0]
```

```
 [ 0  0 13]]
```

Fold 5

Results for Knn with k = 3

Accuracy: 0.769230769231

Confusion Matrix

```
[[ 9  0  4]
```

```
 [ 4  9  0]
```

```
 [ 1  0 12]]
```

Mean accuracy and variance over 5-folds 0.903461538462

0.00513964497041

Alabone Dataset

Test run 0

Results for Knn with k = 1

Accuracy: 0.195787458114

Confusion Matrix

```
[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  1  3  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  7 10  8  3  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  1  5 12 14 13  2  2  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  3 13 26 44 24  6  5  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  0  9 43 45 62 25  9  7  3  4  1  0  1  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  0  2 27 42 74 53 37 17 11  4  1  2  1  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  0  1  5 24 76 80 61 52 20 13  5  5  2  2  0  0  0  0  0  1  0  0
  0]
 [ 0  0  0  1  7 13 39 67 74 43 20 19 11  3  2  6  2  2  0  1  0  0  0  0
  0]
 [ 0  0  0  2  1  8 17 46 57 51 21 15  4  4  4  6  3  3  0  0  0  0  0  0
  0]
 [ 0  0  0  0  2  5 11 26 28 27 13 10  8  5  1  0  4  1  2  1  0  0  0  0
  0]
 [ 0  0  0  0  1  1  9 12 16 15 13 14 11  7  2  2  1  3  1  0  0  1  0  0
  0]
 [ 0  0  0  0  0  2  4  6 10  6  4  6  4  4  5  3  1  1  0  0  0  0  0  0
  0]
 [ 0  0  0  0  0  0  2  9  6 10  3  3  4  2  3  1  4  3  3  0  0  1  0  0
  0]
 [ 0  0  0  0  0  0  3  2  6  5  4  1  6  2  0  2  0  2  1  1  0  0  0  0
  0]
```

```

0]
[0 0 0 0 0 0 1 0 4 6 4 3 4 2 1 1 0 1 0 0 0 0 0 0
1]
[0 0 0 0 0 0 2 1 2 2 4 0 0 3 2 1 1 2 1 0 0 0 0 0
1]
[0 0 0 0 0 0 0 0 3 4 2 2 1 2 0 1 1 0 1 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 2 3 0 1 1 5 1 2 0 0 1 0 0 0 0 0
1]
[0 0 0 0 0 0 0 1 1 0 0 0 2 0 0 2 0 0 1 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 0 1 0 0 0 1 0 2 2 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0]]

```

Results for Knn with k = 2

Accuracy: 0.211105792245

Confusion Matrix

```

[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0]
 [ 0  4  3  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0]
 [ 0 13  7  7  2  1  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0]
 [ 0  2 11 16 10 10  1  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0]]

```

[ 0 0 6 21 45 27 18 4 1 1 0 1 0 0 0 0 0 0  
0 0 0 0 0 0]  
[ 0 0 2 10 70 59 47 13 5 2 0 0 1 0 0 0 0 0  
0 0 0 0 0 0]  
[ 0 0 0 7 35 53 86 55 24 6 4 1 0 0 0 0 0 0  
0 0 0 0 0 0]  
[ 0 0 0 3 14 36 107 77 68 27 6 6 3 0 0 0 0 0  
0 0 0 0 0 0]  
[ 0 0 0 2 12 16 58 89 80 35 12 2 1 1 0 2 0 0  
0 0 0 0 0 0]  
[ 0 0 0 2 3 13 28 68 67 46 9 3 1 1 0 1 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 4 8 17 33 34 22 9 10 4 0 1 1 0 0  
0 1 0 0 0 0]  
[ 0 0 0 1 2 0 11 22 23 20 8 7 8 5 1 0 0 0  
1 0 0 0 0 0]  
[ 0 0 0 0 0 2 6 9 12 7 7 3 2 5 2 1 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 6 15 12 9 3 0 6 1 0 0 0 2  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 3 4 6 5 5 1 5 3 1 2 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 4 2 6 4 4 3 3 2 0 0 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 2 2 3 3 2 1 2 4 3 0 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 0 1 4 4 3 2 0 2 0 1 0 0  
0 0 0 0 0 0]  
[ 0 0 0 0 0 0 0 1 4 5 1 1 0 3 0 1 0 0  
1 0 0 0 0 0]  
[ 0 0 0 0 0 0 0 1 1 1 2 1 0 1 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 0 0 0 0 0 0 3 0 0 1 2 0 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 1 0 0 0 0 0 0 0 0 0
  0 0 0 0 0 0]]

```

Results for Knn with k = 3

Accuracy: 0.201053135472

Confusion Matrix

```

[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 4 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 11 8 9 1 1 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 1 14 15 7 12 1 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 1 5 19 41 36 19 1 1 0 0 1 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 2 14 70 54 49 10 6 2 0 2 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 1 6 36 51 79 58 26 8 4 2 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 4 17 33 109 78 64 33 5 4 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 3 11 15 56 91 78 32 13 7 1 2 0 1 0 0
   0 0 0 0 0 0]
 [ 0 0 0 2 3 14 30 70 68 43 6 3 1 1 1 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 0 4 5 20 32 39 21 10 6 4 1 1 0 1 0
   0 0 0 0 0 0]

```



```

[ 0 0 0 1 3 0 11 25 22 22 9 7 7 1 0 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 2 6 9 16 10 3 3 2 2 3 0 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 1 2 8 15 13 7 1 1 4 1 0 0 0 1
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 3 7 7 8 3 2 3 1 0 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 5 4 6 5 3 1 1 2 1 0 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 3 5 3 3 0 0 6 0 0 0 1
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 4 3 4 2 0 2 0 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 6 4 2 1 1 1 0 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 2 1 2 1 0 0 0 1 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 3 0 0 1 1 0 1 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 1 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0]]

```

Test run 1

Results for Knn with k = 1

Accuracy: 0.213020584011

Confusion Matrix

```

[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [ 0 0 7 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

```

0 0]  
[0 3 8 10 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
0 0]  
[0 1 7 15 12 9 4 2 1 1 0 0 0 0 0 0 0 0 0 0 0  
0 0]  
[0 0 7 16 32 47 15 10 7 1 3 1 0 0 0 0 0 0 0 0 0  
0 0]  
[0 0 0 17 44 52 37 30 16 5 2 1 2 0 0 0 0 0 0 0 0  
0 0]  
[0 0 0 1 18 49 62 69 46 20 11 2 7 0 2 1 0 0 0 0 1 0 0  
0 0]  
[0 0 0 2 11 25 53 96 69 50 17 9 4 0 1 1 0 1 1 0 0 1 0 0  
0 0]  
[0 0 0 0 6 13 22 72 84 51 25 8 5 8 3 5 0 1 3 0 0 0 0 0  
0 0]  
[0 0 0 0 2 8 21 38 39 60 18 15 5 8 7 4 4 2 2 1 0 0 0 0  
0 0]  
[0 0 0 0 1 6 11 24 18 27 15 11 6 2 4 3 3 1 2 0 0 0 0 0  
0 0]  
[0 0 0 0 0 4 7 15 18 21 9 8 8 4 3 2 1 7 2 0 0 0 0 0  
0 1]  
[0 0 0 0 0 0 3 5 7 14 5 3 5 9 6 3 2 0 0 0 0 0 0 0  
0 0]  
[0 0 0 0 0 1 2 12 13 4 3 3 5 2 2 1 2 3 2 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 2 3 4 2 3 6 1 4 1 3 1 1 0 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 0 0 6 3 1 3 2 1 2 4 0 2 2 1 0 0 0 1  
1 0]  
[0 0 0 0 0 0 1 0 0 4 3 3 5 1 1 1 0 0 0 0 0 0 0 0  
1 0]  
[0 0 0 0 0 0 0 1 3 2 2 1 2 0 0 2 3 0 0 0 0 0 0 0  
0 0]

```

[0 0 0 0 0 0 0 0 2 0 1 2 3 1 1 1 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 1 3 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 1 0 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 0 1 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 0 0 0 0 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0]]

```

Results for Knn with k = 2

Accuracy: 0.22163714696

Confusion Matrix

```

[[ 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 0 0]
[ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0]
[ 0 2 0 6 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0]
[ 0 0 5 10 8 3 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0]
[ 0 0 2 11 20 12 4 3 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0]
[ 0 0 0 12 28 43 39 8 4 3 1 0 1 0 0 0 0 0 0
0 0 0 0 0 0 0 0]
[ 0 0 0 1 25 66 53 32 21 3 3 1 1 0 0 0 0 0 0
0 0 0 0 0 0 0 0]]

```

```

    0 0 0 0 0 0 0]
[ 0 0 0 1 5 34 62 79 62 29 11 3 2 0 0 0 1 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 2 16 34 81 117 63 20 2 3 2 1 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 2 6 21 45 100 74 41 7 3 4 2 0 1 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 1 5 10 32 64 55 40 7 8 7 3 1 0 0
  1 0 0 0 0 0 0]
[ 0 0 0 0 0 1 9 13 30 38 22 12 6 2 1 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 2 2 10 23 27 22 5 6 6 1 2 2 1
  1 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 7 8 13 11 8 4 6 0 2 1 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 1 1 3 12 18 8 2 2 4 2 0 0 0
  2 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 4 3 8 1 4 2 3 3 0 3 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 2 3 8 4 1 2 1 4 1 1 0
  0 1 0 0 0 0 0]
[ 0 0 0 0 0 0 1 2 1 3 3 4 1 3 1 0 0 0
  0 1 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 2 4 3 4 0 1 2 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 3 3 0 1 3 0 0 1 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 2 2 1 0 0 0 0 0 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 1 0 1 1 0 0 1 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 0 1 1 0 1 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 1 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]]
```

Results for Knn with k = 3

Accuracy: 0.213020584011

Confusion Matrix

```
[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 2 1 4 2 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 1 4 10 8 2 1 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 2 12 18 10 8 2 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 1 10 20 47 47 7 3 3 0 0 1 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 4 21 63 59 30 19 6 2 2 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 1 8 30 69 71 64 30 11 2 2 0 0 0 1 0
   0 0 0 0 0 0 0]
 [ 0 0 0 1 3 18 45 81 104 54 27 4 2 2 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 0 11 21 55 83 74 43 10 3 3 2 0 1 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 2 4 9 36 64 60 38 6 5 3 4 1 0 0
   2 0 0 0 0 0 0]
 [ 0 0 0 0 0 4 8 16 36 29 27 9 3 1 0 0 1 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 0 1 6 11 27 22 24 4 8 4 1 0 1 1
```

```

    0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 4 7 15 15 11 5 0 2 2 1 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 2 0 6 12 18 8 1 2 5 0 0 1 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 4 5 5 4 3 4 2 2 0 0 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 2 1 5 10 3 2 1 0 2 0 2 0
  1 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 1 2 4 5 3 0 2 1 0 0 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 2 2 2 3 4 0 1 1 0 0 0
  1 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 1 4 2 0 0 3 0 0 1 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 2 2 1 0 0 0 0 0 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 1 2 1 0 0 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 0 1 1 0 2 0 0 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 1 0 0 0 0 0 0
  0 0 0 0 0 0 0]]

```

Test run 2

Results for Knn with k = 1

Accuracy: 0.218286261369

Confusion Matrix

```

[[ 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 3 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]

```

[ 0 2 11 11 4 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 2 8 20 16 7 2 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 0 5 16 37 23 19 13 6 1 1 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 0 3 12 38 51 49 19 6 3 4 2 3 2 0 0 1 0 0 0 0 0  
0]  
[ 0 0 1 6 17 47 68 71 45 23 8 5 3 2 1 1 0 0 0 0 1 0 0  
0]  
[ 0 0 0 3 9 25 56 92 58 55 26 7 8 2 3 2 1 1 0 0 0 0 0  
0]  
[ 0 0 0 2 8 10 35 60 98 54 23 8 9 4 2 2 4 2 2 0 0 0 0  
0]  
[ 0 0 0 1 4 7 17 48 54 44 20 16 8 3 6 2 3 3 3 0 0 0 0  
0]  
[ 0 0 0 0 2 7 5 23 23 18 14 15 6 8 8 2 4 0 1 1 0 0 0 0  
0]  
[ 0 0 0 0 2 1 10 13 24 15 7 7 10 4 3 2 2 4 0 0 0 1 0 0  
0]  
[ 0 0 0 0 0 3 3 7 12 8 4 6 3 4 3 1 2 1 1 0 0 0 0 0  
0]  
[ 0 0 0 0 1 0 2 2 14 9 5 1 2 3 2 2 2 3 1 1 0 0 0 0  
0]  
[ 0 0 0 0 0 0 2 1 2 4 1 4 2 3 0 1 1 3 0 0 0 0 1 0  
0]  
[ 0 0 0 0 0 0 2 2 5 1 3 1 3 5 3 3 0 1 1 0 0 0 0 0  
0]  
[ 0 0 0 0 0 0 0 0 1 5 0 1 2 2 3 2 0 2 0 0 0 0 0 0  
0]  
[ 0 0 0 0 0 0 0 0 2 2 1 1 1 3 3 2 0 0 0 0 0 0 0 0  
0]  
[ 0 0 0 0 0 0 0 0 3 2 3 3 0 2 2 1 0 0 1 0 0 0 0 0  
0]

```

0]
[0 0 0 0 0 0 0 0 3 0 0 0 1 1 1 2 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 0 1 0 2 0 0 1 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 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 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 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
0]]

```

Results for Knn with k = 2

Accuracy: 0.219722355194

Confusion Matrix

```

[[0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 3 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 10 12 5 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 3 12 26 10 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 9 25 41 31 9 4 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 3 20 56 54 43 10 4 0 1 1 0 1 0 0 0 0 0 0 0 0 0]
[0 0 2 9 32 68 88 58 31 9 1 1 0 0 0 0 0 0 0 0 0 0 0]
[0 0 0 6 18 40 87 90 63 33 7 1 3 0 0 0 0 0 0 0 0 0 0]
[0 0 0 3 12 23 46 96 86 35 11 2 5 1 1 0 2 0 0 0 0 0 0]
[0 0 0 1 6 8 27 71 65 35 8 9 4 2 0 2 1 0 0 0 0 0 0]
[0 0 0 0 4 8 16 29 31 17 11 11 3 5 1 0 0 0 0 1 0 0 0]
[0 0 0 0 4 3 10 23 28 10 7 9 9 1 0 1 0 0 0 0 0 0 0]
[0 0 0 0 1 3 3 8 16 9 5 5 3 2 1 1 1 0 0 0 0 0 0]
[0 0 0 0 1 0 4 10 15 9 3 3 2 1 1 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 2 2 3 5 3 6 1 2 0 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 2 4 5 5 2 5 4 2 1 0 0 0 0 0 0 0 0]

```



```
[0 0 0 0 0 0 1 1 3 4 1 0 2 1 3 1 0 1 0 0 0 0 0 0]
[0 0 0 0 0 0 1 2 3 2 1 1 0 2 2 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 4 5 1 4 0 2 1 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 3 0 0 1 1 1 0 2 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 1 1 0 0 1 1 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 0 0 0 0 0 1 0 0 0 0 0 0 0]]
```

Results for Knn with k = 3

Accuracy: 0.217807563427

Confusion Matrix

```
[[0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 10 9 8 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 3 15 19 14 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 8 24 43 31 7 4 4 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 4 17 50 63 38 17 2 0 1 0 0 1 0 0 0 0 0 0 0 0]
 [0 0 1 9 32 68 85 62 29 9 2 1 1 0 0 0 0 0 0 0 0 0]
 [0 0 0 5 19 40 83 93 64 36 7 1 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 5 11 25 56 87 83 33 11 5 3 0 1 0 3 0 0 0 0 0]
 [0 0 0 1 8 13 26 73 62 32 9 8 4 1 0 2 0 0 0 0 0 0]
 [0 0 0 0 6 7 15 29 35 24 8 5 0 6 2 0 0 0 0 0 0 0]
 [0 0 0 1 3 4 8 21 29 15 6 10 6 0 1 1 0 0 0 0 0 0]
 [0 0 0 0 1 2 5 11 16 11 5 1 4 0 1 0 1 0 0 0 0 0]
 [0 0 0 0 1 2 4 13 15 8 2 1 1 1 2 0 0 0 0 0 0 0]
 [0 0 0 0 0 2 2 2 5 3 3 4 1 2 1 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 2 5 3 7 1 4 3 2 2 0 0 1 0 0 0 0]
 [0 0 0 0 0 0 1 4 2 4 0 0 1 2 2 2 0 0 0 0 0 0]
 [0 0 0 0 0 0 1 3 3 2 2 1 0 2 0 1 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 5 7 3 2 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 2 0 0 2 1 0 1 2 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0]]
```

```
[ 0 0 0 0 0 0 0 1 1 1 0 1 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 1 0 0 0 0 0 0 0 0 0 0 0 0]]
```

Test run 3

Results for Knn with k = 1

Accuracy: 0.217807563427

Confusion Matrix

```
[[ 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 8 8 6 3 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 3 7 18 19 6 4 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 2 5 14 30 41 28 7 8 4 2 0 0 0 0 0 0 0 1 0 0 0 0 0
  0]
 [ 0 0 10 41 47 52 19 13 2 7 1 2 2 1 0 0 0 0 0 0 0 0
  0]
 [ 0 0 5 19 39 78 52 32 19 8 10 3 0 0 1 0 0 0 0 0 0 0
  0]
 [ 0 1 5 6 26 72 93 80 39 11 12 8 2 3 1 0 1 1 0 0 0 0
  0]
 [ 0 0 0 2 10 40 59 91 46 18 17 12 9 2 1 1 2 1 1 0 0 0
  0]
 [ 0 0 1 0 7 22 56 42 56 15 15 9 10 7 4 1 3 2 0 0 0 0
  0]
 [ 0 0 0 1 9 8 23 21 24 12 15 4 1 3 1 3 0 0 0 0 0 0
  0]
 [ 0 0 0 0 3 5 9 20 18 7 7 6 5 6 3 3 1 1 0 0 1 0 0
  0]
 [ 0 0 0 0 1 4 10 9 8 7 2 5 3 4 4 2 1 3 0 0 1 0 0
  0]
 [ 0 0 0 0 0 1 9 8 6 7 6 3 5 5 1 0 1 2 0 0 0 0 0
  0]
```

```

[ 0 0 0 0 0 3 3 2 4 2 3 3 3 1 3 0 0 1 1 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 7 3 3 6 0 1 3 1 0 1 1 1 0 0 0 0 0
0]
[ 0 0 0 0 0 2 2 4 3 3 0 0 2 3 2 1 3 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 1 2 2 3 4 0 1 2 2 0 0 1 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 3 1 2 0 0 1 2 2 1 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 0 1 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 1 0 3 0 0 1 1 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 1 0 0 1 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 1 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0
0]]

```

Results for Knn with k = 2

Accuracy: 0.216371469603

Confusion Matrix

```

[[ 1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [13  9  3  4  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 5 14 21 12  6  1  0  0  0  0  0  0  0  0  0  0  0  0  0

```

```

    0 0 0 0 0 0 0]
[ 3 7 23 47 40 13 4 3 1 0 1 0 0 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 4 19 64 51 39 14 4 1 1 0 0 0 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 1 8 24 65 86 47 25 6 1 2 0 0 0 1 0 0 0
  0 0 0 0 0 0 0]
[ 0 1 6 13 45 109 90 64 17 9 4 3 0 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 2 7 17 64 83 86 29 14 3 4 3 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 1 0 17 37 77 49 40 10 5 3 5 2 3 0 1 0
  0 0 0 0 0 0 0]
[ 0 0 0 1 10 17 33 26 20 9 7 0 0 2 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 1 1 3 8 16 27 17 8 5 5 2 0 2 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 1 1 8 13 10 11 7 5 3 2 0 1 0 0 2
  0 0 0 0 0 0 0]
[ 0 0 0 0 1 2 15 11 11 3 5 1 2 3 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 4 4 6 3 2 3 1 2 2 1 0 1 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 2 8 4 5 5 2 0 1 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 2 3 7 5 2 0 2 0 3 1 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 1 2 2 2 2 4 0 1 1 2 0 0 1
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 3 2 3 1 1 2 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 1 0 2 1 0 0 0 0 0 0
  0 0 0 0 0 0 0]

```

```
[ 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0
  0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 1 0 3 0 0 2 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 1 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 0 0 0 0 1 1 0 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]]
```

Results for Knn with k = 3

Accuracy: 0.208233604596

Confusion Matrix

```
[[ 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [12 7 6 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 6 13 22 14 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 4 5 26 39 45 14 2 4 2 0 1 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 2 19 58 61 37 15 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 1 10 37 50 84 53 19 8 2 1 0 0 0 1 0 0 0 0 0 0 0
  0]
 [ 0 1 8 13 47 94 88 71 26 7 4 1 1 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 2 9 24 63 91 75 32 5 1 4 4 1 1 0 0 0 0 0 0 0
  0]
 [ 0 0 1 1 16 38 84 47 39 13 4 2 4 0 1 0 0 0 0 0 0 0
  0]]
```

```
0]
[0 0 0 2 13 20 25 32 15 10 6 1 1 0 0 0 0 0 0 0 0 0 0
0]
[0 0 1 1 2 10 16 29 18 10 5 1 1 0 1 0 0 0 0 0 0 0 0
0]
[0 0 0 1 2 10 14 9 8 8 4 2 3 0 1 0 0 2 0 0 0 0 0 0
0]
[0 0 0 1 1 6 15 11 10 3 3 2 1 1 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 3 3 9 3 3 1 3 2 0 2 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 2 10 4 6 2 1 0 1 1 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 2 5 6 5 4 0 1 0 1 0 0 0 0 1 0 0 0 0 0
0]
[0 0 0 0 0 1 5 3 2 2 0 0 1 0 3 0 0 1 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 4 1 5 1 0 0 0 1 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 1 0 1 1 1 0 0 0 1 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 1 1 1 2 0 0 2 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 0 1 1 0 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]]
```

Test run 4

Results for Knn with k = 1

Accuracy: 0.20344662518

Confusion Matrix

```
[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  5  2  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  5  8  7  4  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  2 15 11 17 12  2  3  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  5 10 25 47 21  6  4  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0
  0]
 [ 0  0  2 12 31 47 47 23 10  3  7  3  1  2  1  1  0  0  0  0  0  0  0  0
  0]
 [ 0  0  0  6 12 44 72 68 40 21  4  9  3  1  1  0  1  0  0  0  0  1  0  0
  0]
 [ 0  0  1  1  9 26 65 92 75 50 23  7  5  5  1  1  0  2  1  0  0  1  0  0
  0]
 [ 0  0  0  2  7 12 34 67 86 51 22 19  4  8  0  1  2  2  1  0  0  0  0  0
  0]
 [ 0  0  1  0  0  3 21 47 48 58 23 18  6  6  4  4  1  3  3  1  0  0  0  0
  0]
 [ 0  0  0  0  0  3  5 23 23 36  7  7  7  4  2  2  3  2  2  0  0  0  0  0
  0]
 [ 0  0  0  0  1  1 10 17 22 13 13  8  6  5  2  5  1  4  0  0  0  1  0  0
  0]
 [ 0  0  0  0  0  1  1 12  7  9  4 10  2  5  5  5  0  0  2  1  0  0  0  0
  0]
 [ 0  0  0  0  0  0  1  4  8  4  4  7  3  2  1  3  2  3  1  2  0  0  0  0
  0]
 [ 0  0  0  0  0  0  2  2  6  3  3  4  4  7  3  1  0  2  0  0  0  0  0  0
  0]
```

```

0]
[0 0 0 0 0 0 1 1 6 2 5 3 1 0 3 2 0 0 1 1 0 0 0 1
0]
[0 0 0 0 0 0 0 2 2 5 0 0 1 2 0 0 1 1 0 1 0 0 0 0
0]
[0 0 0 0 0 0 0 0 2 4 1 3 1 2 0 2 1 0 1 0 0 0 0 0
0]
[0 0 0 0 0 0 0 1 3 0 0 2 0 1 1 2 0 0 1 0 0 0 0 1
0]
[0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 3 1 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 1 0 2 1 0 0 1 1 0 0 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 1 0 0 0 0 0 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]]

```

Results for Knn with k = 2

Accuracy: 0.216371469603

Confusion Matrix

```

[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  1  7  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  6  8  9  3  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  3 14 21 19  4  1  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]

```



[ 0 0 7 17 38 42 10 5 1 0 0 0 0 0 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 2 19 45 52 54 11 2 1 3 1 0 0 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 7 16 70 90 66 17 13 1 3 0 0 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 1 2 16 44 96 100 68 27 6 2 0 3 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 3 8 20 58 90 90 31 8 6 2 0 0 1 0 1  
0 0 0 0 0 0 0]

[ 0 0 1 0 4 7 34 73 66 33 12 8 3 2 2 1 0 0  
1 0 0 0 0 0 0]

[ 0 0 0 0 2 4 14 41 28 18 7 5 2 3 2 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 1 2 2 14 25 31 14 8 6 4 0 0 2 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 2 4 13 7 11 8 6 2 4 3 1 0 1  
1 0 0 0 0 0 0]

[ 0 0 0 0 0 0 2 10 14 6 3 1 3 2 1 0 1 2  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 3 5 9 9 1 3 1 3 1 2 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 1 4 6 4 3 3 2 1 1 1 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 1 3 4 2 1 0 1 3 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 3 4 3 2 2 0 2 0 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 1 3 1 0 2 0 2 1 1 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 1 1 0 1 0 0 0 1 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0  
0 0 0 0 0 0 0]

```

    0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 1 1 0 2 1 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 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 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 0 0 1 0 0 0 0 0 0
  0 0 0 0 0 0 0]]

```

Results for Knn with k = 3

Accuracy: 0.218286261369

Confusion Matrix

```

[[ 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 0 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 7 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0]
 [ 0 0 6 8 10 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0]
 [ 0 0 1 19 15 22 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0]
 [ 0 0 0 7 12 41 42 14 2 2 0 0 0 0 0 0 0 0 0 0 0 0
   0 0]
 [ 0 0 0 5 15 52 56 41 13 4 1 1 1 0 1 0 0 0 0 0 0 0
   0 0]
 [ 0 0 0 0 6 20 56 99 67 22 9 1 1 1 1 0 0 0 0 0 0 0
   0 0]
 [ 0 0 0 1 3 16 44 98 96 68 24 11 1 1 2 0 0 0 0 0 0 0
   0 0]
 [ 0 0 0 0 4 9 17 63 91 77 40 11 3 1 2 0 0 0 0 0 0 0
   0 0]

```

```

[0 0 0 1 0 5 8 37 71 53 43 14 7 1 4 1 0 0 1 1 0 0 0 0
0 0]
[0 0 0 0 0 1 8 17 35 31 20 8 2 1 1 1 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 1 1 1 16 23 28 16 13 7 1 0 0 2 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 1 2 4 14 12 10 6 5 1 4 1 2 1 0 1 0 0 0 0
0 0]
[0 0 0 0 0 0 1 1 13 12 7 3 2 2 3 0 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 4 6 14 6 3 2 0 1 1 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 1 0 0 6 6 5 3 2 0 3 0 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 1 3 5 2 1 0 1 2 0 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 1 2 4 0 4 2 0 2 0 2 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 1 4 2 1 1 1 1 0 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 1 2 0 0 0 0 1 0 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 1 1 1 0 3 0 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 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 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
0 0]]

```

Test run 5

Results for Knn with k = 1

Accuracy: 0.205840114888

Confusion Matrix

```
[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0]
 [ 0  0  4  3  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0]
 [ 0  6  9  6  1  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0]
 [ 0  0  7 15 16 15  0  2  0  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0]
 [ 0  1  7 18 30 39 17 15  9  2  1  1  0  0  0  0  0  0  0  0  0  0  0  0
   0  0]
 [ 0  0  2  6 32 57 45 27 11 12  4  2  1  0  1  1  0  0  0  0  0  1  0  0
   0  0]
 [ 0  0  1  4 23 42 75 76 32 17  9  4  2  3  1  1  1  0  0  0  0  0  0  0
   0  0]
 [ 0  0  0  2  7 23 63 87 66 49 15 12  6  3  3  0  0  1  1  0  0  0  0  0
   0  0]
 [ 0  0  0  1  4 16 36 60 88 42 18 13  9  2  2  0  5  3  3  0  0  0  0  0
   0  0]
 [ 0  0  0  1  2  6 21 50 57 50 21 20  8 11  1  3  4  6  2  0  0  0  0  0
   0  0]
 [ 0  0  0  0  0  6 13 22 27 27  7  9  5  4  4  1  2  3  1  0  0  0  1  0
   0  0]
 [ 0  0  0  0  0  2  7 13 20 13 11  4  8  5  5  1  3  2  3  0  0  0  0  0
   0  0]
 [ 0  0  0  0  0  1  6  5 12  7  4  2  4  4  6  2  1  1  0  1  0  0  0  0
   0  0]
 [ 0  0  0  0  1  0  3  6 20  5  1  4  5  1  4  2  2  2  0  0  1  0  0  0
   0  0]
 [ 0  0  0  0  0  0  2  3  7  3  4  2  2  0  1  2  1  1  0  1  0  0  0  0
   0  0]
```

```

[0 0 0 0 0 1 0 2 5 2 3 5 4 0 2 2 0 0 2 0 0 0 0 0
 1 0]
[0 0 0 0 0 0 1 2 2 3 3 0 3 0 1 2 0 1 1 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 2 1 0 0 1 2 3 2 0 3 0 0 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 0 2 2 0 1 2 2 3 0 0 1 0 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 1 1 2 0 0 1 0 0 0 2 0 0 0 0 0 1 1
 0 0]
[0 0 0 0 0 0 0 1 0 0 2 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 0 0 0 1 1 1 0 0 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0]
[0 0 0 0 0 0 0 0 0 0 0 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]]

```

Results for Knn with k = 2

Accuracy: 0.222594542843

Confusion Matrix

```

[[ 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0]
 [ 0  0  8  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0]
 [ 0  9  9  5  0  1  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0]
 [ 0  1 14 18 16  8  0  0  0  0  0  0  0  0  0  0  0  0

```

```

    0 0 0 0 0]
[ 0 1 12 24 44 33 19 3 2 1 0 1 0 0 0 0 0 0
  0 0 0 0 0]
[ 0 0 2 14 51 59 42 17 10 4 1 0 1 1 0 0 0 0
  0 0 0 0 0]
[ 0 0 3 7 28 57 100 67 16 8 1 2 0 2 0 0 0 0
  0 0 0 0 0]
[ 0 0 1 5 12 28 96 105 61 23 3 2 1 1 0 0 0 0
  0 0 0 0 0]
[ 0 0 0 2 9 18 66 85 74 28 7 8 4 0 1 0 0 0
  0 0 0 0 0]
[ 0 0 1 1 5 10 34 84 65 37 10 7 3 3 0 3 0 0
  0 0 0 0 0]
[ 0 0 0 0 2 8 17 29 35 20 6 6 4 3 2 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 2 4 10 21 24 11 7 4 7 2 4 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 3 9 11 11 6 4 5 2 3 1 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 1 0 6 11 20 8 2 1 3 2 1 1 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 2 5 9 4 2 2 2 1 1 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 1 1 5 6 3 1 5 2 1 0 3 0 0
  1 0 0 0 0]
[ 0 0 0 0 0 0 1 5 3 2 3 0 2 1 1 0 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 2 2 2 0 3 3 1 0 0 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 6 3 0 0 3 0 0 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 2 3 1 0 0 0 1 0 1 0
  0 0 0 0 0]

```

```
[ 0 0 0 0 0 0 0 1 0 1 1 0 0 0 1 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 0 1 1 0 1 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]]
```

Results for Knn with k = 3

Accuracy: 0.218764959311

Confusion Matrix

```
[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 1 6 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 9 8 5 1 1 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 3 13 16 17 8 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 1 9 29 39 37 18 3 2 0 1 1 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 0 4 15 47 64 39 17 11 3 1 0 0 1 0 0 0 0
  0 0 0 0 0]
 [ 0 0 2 5 35 49 93 67 27 7 1 3 0 2 0 0 0 0
  0 0 0 0 0]
 [ 0 0 1 6 15 29 91 104 70 17 3 2 0 0 0 0 0 0
  0 0 0 0 0]
 [ 0 0 0 1 10 15 69 86 86 18 9 6 2 0 0 0 0 0
  0 0 0 0 0]
 [ 0 0 1 0 2 13 45 78 71 31 12 7 2 0 0 1 0 0
  0 0 0 0 0]
 [ 0 0 0 0 3 8 19 37 28 22 5 5 1 3 1 0 0 0
  0 0 0 0 0]
 [ 0 0 0 0 2 3 7 29 24 12 10 4 3 2 1 0 0 0
```

```

    0 0 0 0 0]
[ 0 0 0 0 0 2 9 11 13 7 3 6 2 1 1 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 2 2 5 12 18 4 2 4 3 2 3 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 1 2 5 10 3 2 2 2 0 1 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 1 1 4 9 3 3 3 1 1 1 1 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 2 5 3 2 3 0 2 1 0 1 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 1 3 2 2 1 2 1 0 0 1 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 6 3 0 0 3 0 0 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 1 0 0 2 3 0 1 1 0 0 0 1 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 2 0 1 0 0 0 0 1 0 0 0
  0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 0 1 0 1 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]]

```

Test run 6

Results for Knn with k = 1

Accuracy: 0.202489229296

Confusion Matrix

```

[[ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [ 0 1 4 2 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [ 1 2 9 7 3 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]

```



[0 1 10 12 17 7 2 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0  
0 0]  
[0 1 5 13 26 48 21 5 5 1 4 1 0 0 0 0 0 0 1 0 0 0 0 0  
0 0]  
[0 0 1 11 33 64 33 28 6 3 5 0 4 0 0 0 0 0 0 0 1 0 0  
0 0]  
[0 0 0 3 24 51 70 63 47 19 7 4 2 2 1 0 0 0 0 0 0 0 0  
0 0]  
[0 0 0 1 7 27 69 83 59 42 24 12 9 3 0 0 1 1 1 0 0 0 0 0  
0 0]  
[0 0 0 1 5 14 33 51 78 46 29 16 8 9 4 2 6 2 4 0 0 0 0 0  
0 0]  
[0 0 0 1 6 7 21 53 51 41 25 20 10 7 4 2 4 3 3 0 0 0 0 0  
0 0]  
[0 0 0 0 0 6 10 20 25 14 20 9 6 2 1 1 3 0 2 2 0 0 0 0  
0 0]  
[0 0 0 0 0 4 10 14 23 21 9 9 5 0 3 3 0 0 2 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 6 5 7 8 10 8 2 4 8 2 1 0 2 1 0 0 0 0  
0 0]  
[0 0 0 0 0 0 3 8 11 7 7 5 2 3 3 1 2 2 3 0 1 0 0 0  
0 0]  
[0 0 0 0 0 0 2 4 5 3 5 6 3 2 2 3 0 1 2 0 0 0 0 0  
0 0]  
[0 0 0 0 0 1 2 0 2 4 3 6 2 3 1 1 0 1 1 0 0 0 0 1  
0 0]  
[0 0 0 0 0 0 0 1 3 5 6 1 0 1 2 2 1 1 1 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 0 0 0 2 3 3 0 0 2 0 1 0 4 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 0 0 2 1 3 1 0 2 0 1 0 0 1 0 0 0 0 0  
0 0]  
[0 0 0 0 0 0 1 1 0 1 1 0 1 1 1 1 0 0 1 0 0 0 0 0  
0 0]

```

0 0]
[0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 0 1 0 2 0 0 2 1 0 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 1 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0]]

```

Results for Knn with k = 2

Accuracy: 0.226424126376

Confusion Matrix

```

[[ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 2  2  4  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 1  7 11  5  2  0  0  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  2 12 21 11  5  1  0  0  0  0  0  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  1  8 19 48 38 12  4  0  0  0  1  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  0  1 18 57 60 30 16  3  2  1  0  0  1  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  0  1  7 34 66 86 60 28  7  2  2  0  0  0  0  0  0
   0  0  0  0  0  0  0  0]
 [ 0  0  0  2 16 44 86 105 51 18  7  7  3  0  0  0  0  0
   0  0  0  0  0  0  0  0]

```

[ 0 0 0 2 9 18 58 88 69 41 11 5 1 2 2 1 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 2 7 9 28 79 65 39 17 4 3 0 2 2 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 11 14 25 30 15 14 7 1 1 0 0 2 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 4 17 22 27 10 8 10 2 0 1 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 0 7 10 14 11 9 4 2 3 2 0 0 0  
1 0 0 0 0 0 0]

[ 0 0 0 0 0 0 5 12 16 6 7 3 2 2 2 1 1 0  
1 0 0 0 0 0 0]

[ 0 0 0 0 0 0 3 7 7 5 4 4 1 3 1 2 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 1 2 4 5 4 3 5 0 2 1 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 1 2 6 5 4 1 0 2 2 0 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 2 0 3 2 4 1 0 1 1 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 2 1 1 3 1 1 2 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 1 0 1 0 3 1 0 0 1 1 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 1 0 1 0 4 0 0 0 0 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 1 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 1 0 0 0 0 0 0  
0 0 0 0 0 0 0]

0 0 0 0 0 0 0 0]]

Results for Knn with k = 3

Accuracy: 0.216371469603

Confusion Matrix

```
[[ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 1 3 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 6 11 7 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 12 17 15 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 9 19 41 46 11 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 1 17 50 65 34 16 3 0 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 1 8 36 64 81 61 31 8 2 0 0 1 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 0 1 20 45 83 97 64 16 5 4 3 1 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 1 2 9 23 53 94 71 33 8 8 3 1 1 1 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 1 1 6 8 37 74 66 42 14 6 2 0 0 1 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 0 0 0 9 18 30 32 14 10 6 0 1 1 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 0 0 1 5 20 24 22 14 7 9 1 0 0 0 0 0 0 0 0 0 0 0 0
  0]
 [ 0 0 0 0 1 0 10 15 9 10 9 4 2 2 0 1 0 0 1 0 0 0 0 0 0
  0]
 [ 0 0 0 0 0 1 4 14 14 9 5 4 2 2 1 0 1 0 1 0 0 0 0 0 0
  0]
```

```
[ 0 0 0 0 0 0 3 5 12 4 4 5 2 2 0 1 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 1 4 5 9 3 2 1 0 2 1 0 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 1 2 8 4 5 0 0 2 2 0 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 1 1 3 4 4 1 0 0 1 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 1 2 1 5 0 0 1 0 0 0 0 0 1 0 0 0 0
0]
[ 0 0 0 0 0 1 0 1 1 1 1 1 1 0 1 1 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 1 2 0 0 0 2 0 1 0 0 0 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0
0]]
```

Test run 7

Results for Knn with k = 1

Accuracy: 0.196744853997

Confusion Matrix

```
[[ 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 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 0 5 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0]
[ 0 0 8 13 5 5 3 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0]]
```

0]  
[ 0 0 1 12 11 19 18 2 3 0 1 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 0 2 3 17 37 46 18 7 6 1 1 0 2 0 0 0 0 0 0 0 0  
0]  
[ 0 0 0 1 7 40 51 38 38 12 3 2 0 3 1 0 0 1 0 0 0 0 0  
0]  
[ 0 0 0 2 3 14 49 65 73 45 24 6 6 2 2 2 0 0 0 0 0 0  
0]  
[ 0 0 0 0 0 8 21 65 82 71 58 14 10 7 3 1 2 0 1 0 0 0 0  
0]  
[ 0 0 0 0 1 4 8 28 69 73 57 14 15 7 11 1 2 2 6 1 0 0 0  
0]  
[ 0 0 0 0 1 2 8 22 43 49 49 18 18 7 6 1 1 7 3 1 0 0 1 0  
0]  
[ 0 0 0 0 0 3 6 13 24 29 26 8 6 3 6 2 2 2 0 2 0 0 1 0  
0]  
[ 0 0 0 0 0 1 4 9 13 15 14 11 7 5 6 3 1 3 4 0 0 0 2 0  
0]  
[ 0 0 0 0 0 0 2 7 4 7 11 7 3 6 4 5 2 2 2 1 0 0 1 0  
0]  
[ 0 0 0 0 0 0 1 2 4 12 7 3 5 3 4 3 1 0 0 0 0 1 0 0  
0]  
[ 0 0 0 0 0 0 0 2 2 4 6 3 8 1 2 3 1 0 2 1 0 0 1 1  
0]  
[ 0 0 0 0 0 0 1 0 2 2 3 1 2 3 3 4 1 0 1 0 1 0 0 0  
0]  
[ 0 0 0 0 0 0 0 0 1 1 3 3 1 2 3 4 1 0 1 0 0 0 0 1  
0]  
[ 0 0 0 0 0 0 0 0 2 1 4 2 0 2 0 1 1 1 0 1 0 0 0 0  
0]  
[ 0 0 0 0 0 0 0 0 1 2 2 1 3 2 1 1 2 1 0 0 0 0 0 0  
0]

```
[0 0 0 0 0 0 0 1 0 0 0 0 3 1 1 0 2 0 0 0 0 0 0 0
0]
[0 0 0 0 0 0 0 0 0 0 1 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 2 0 0 1 1 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 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]]
```

Results for Knn with k = 2

Accuracy: 0.22163714696

Confusion Matrix

```
[[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 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 1 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 12 12 8 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 8 11 17 18 12 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 3 4 32 47 36 12 4 1 1 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 1 2 14 51 62 45 15 4 1 2 0 0 0 0 0 0 0 0 0 0 0]
[0 0 0 2 5 26 68 87 68 27 6 0 3 1 0 0 0 0 0 0 0 0 0]
[0 0 0 0 1 12 30 99 94 69 27 7 2 2 0 0 0 0 0 0 0 0 0]
[0 0 0 0 2 4 15 53 82 85 36 7 5 3 6 0 1 0 0 0 0 0 0]
[0 0 0 0 1 5 13 34 66 63 35 14 5 1 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 5 8 18 28 39 18 5 4 3 1 0 0 2 0 2 0 0 0]
[0 0 0 0 0 1 7 14 19 20 13 9 9 5 1 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 3 9 10 14 6 8 4 3 3 0 2 1 0 1 0 0 0 0]
[0 0 0 0 0 0 1 5 10 11 7 3 3 1 2 2 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 3 2 10 6 3 6 2 1 3 0 0 0 1 0 0 0 0]
[0 0 0 0 0 0 1 0 3 5 7 2 1 1 2 1 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 2 7 2 5 1 0 2 2 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 4 1 2 2 2 2 0 1 0 0 0 1 0 0 0 0]]
```

```
[0 0 0 0 0 1 0 0 1 2 3 3 1 2 2 0 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 1 0 0 0 1 3 1 1 0 1 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 1 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 0 0 0 0 0 1 0 0 0 0 0 0 0 0]]
```

Results for Knn with k = 3

Accuracy: 0.223073240785

Confusion Matrix

```
[[ 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 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]
 [ 0 0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 7 15 7 3 3 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 5 14 14 20 14 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 2 7 30 43 42 10 3 2 1 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 1 16 45 63 45 22 5 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 1 6 27 65 88 70 23 6 3 3 1 0 0 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 0 1 11 36 85 107 57 34 4 5 2 1 0 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 1 0 5 20 51 76 79 46 10 4 3 3 1 0 0 0
   0 0 0 0 0 0]
 [ 0 0 0 0 1 4 14 34 69 55 41 12 4 1 1 0 1 0 0
   0 0 0 0 0 0]
 [ 0 0 0 0 0 5 9 20 28 35 18 7 4 1 3 0 0 1 0
   1 1 0 0 0 0]]
```



```

[ 0 0 0 0 0 0 1 8 12 25 22 11 8 5 4 1 0 0 1
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 5 9 11 15 7 5 6 2 3 0 1 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 2 11 15 12 1 3 0 0 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 2 4 10 6 5 4 1 1 1 1 0
 1 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 1 5 4 7 2 0 1 2 0 1 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 2 8 2 4 1 1 1 2 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 4 2 3 1 2 0 2 1 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 0 0 1 3 5 3 0 0 2 0 1 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 1 0 1 0 3 1 0 1 0 1 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0
 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 1 0 1 1 0 0 1 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]]

```

Test run 8

Results for Knn with k = 1

Accuracy: 0.201053135472

Confusion Matrix

```

[[ 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]
 [ 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]
 [ 0 0 1 6 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

```

0 0 0]  
[0 0 3 9 9 3 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
0 0 0]  
[0 0 1 8 14 14 12 2 1 3 0 0 1 0 0 0 0 0 0 0 0 0  
0 0 0]  
[0 0 1 7 13 26 43 21 4 7 3 0 1 2 0 0 0 0 0 0 0 0  
0 0 0]  
[0 0 0 2 8 44 52 47 17 9 8 3 3 1 0 0 0 0 0 0 0 0  
0 0 0]  
[0 0 0 1 8 19 55 74 35 32 21 13 8 3 2 1 1 1 0 0 0 0 0  
0 0 0]  
[0 0 0 0 5 5 23 64 78 69 47 30 10 8 4 3 1 0 1 1 0 0 1 0  
0 0 0]  
[0 0 0 0 2 6 11 47 52 89 50 25 16 5 4 7 3 1 1 3 1 0 0 0  
0 0 0]  
[0 0 0 1 0 2 11 22 59 54 39 29 19 9 3 6 3 0 2 1 1 0 0 0  
0 0 0]  
[0 0 0 0 0 2 3 15 24 28 22 15 7 3 4 2 3 3 0 1 0 0 1 1  
0 0 0]  
[0 0 0 0 0 1 1 4 9 19 12 10 8 11 4 1 3 2 2 2 0 0 0 0  
0 0 0]  
[0 0 0 0 0 0 0 5 7 11 3 4 5 8 8 7 3 1 0 2 1 0 0 0  
0 0 0]  
[0 0 0 0 0 0 1 3 2 13 6 6 4 2 2 3 1 1 0 2 1 1 0 0  
1 0 0]  
[0 0 0 0 0 0 1 1 2 2 3 6 3 6 1 2 1 1 3 0 0 0 0 0  
0 0 0]  
[0 0 0 0 0 0 1 2 3 3 4 0 7 2 0 1 1 0 1 1 0 0 0 0  
0 0 0]  
[0 0 0 0 0 0 0 1 2 3 3 4 2 3 1 1 0 2 3 1 0 0 0 0  
0 0 0]  
[0 0 0 0 0 0 0 1 0 3 2 1 2 0 0 0 2 0 0 1 0 0 0 0  
0 0 0]

```
[ 0 0 0 0 0 0 0 0 0 1 1 2 3 2 3 0 0 2 0 0 0 1 0 0 0
  0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 0 1 0 0 1 1 0 2 0 0 0 0 0 0 1
  0 0 0]
[ 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 0 1 0 0 0 0 0 0 0 0
  0 0 0]
[ 0 0 0 0 0 0 0 1 0 0 1 0 2 0 0 0 0 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 0 0 0 0 0 0 0 0 0 0 0 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 1 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]]
```

Results for Knn with k = 2

Accuracy: 0.208233604596

Confusion Matrix

```
[[ 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 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 0 0 0]
 [ 0 0 2 6 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0 0]
 [ 0 0 6 10 6 4 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0 0]
 [ 0 0 2 11 15 21 7 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0 0]
 [ 0 0 1 11 20 49 29 11 2 2 1 1 1 0 0 0 0 0 0
   0 0 0 0 0 0 0 0 0]
 [ 0 0 1 2 14 74 55 32 9 4 3 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0 0]]
```

```

    0 0 0 0 0 0 0 0]
[ 0 0 0 1 9 30 74 79 42 26 9 2 1 0 0 0 1 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 1 6 9 48 105 79 60 26 7 5 1 2 0 0 0
  1 0 0 0 0 0 0 0]
[ 0 0 0 0 3 10 19 75 74 84 32 12 5 1 3 2 2 0
  1 0 0 0 0 0 0 0]
[ 0 0 0 1 1 5 15 42 73 62 33 12 11 2 2 0 2 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 6 5 20 34 25 22 10 6 1 0 1 1 1
  0 2 0 0 0 0 0 0]
[ 0 0 0 0 1 0 5 12 10 27 9 7 9 5 2 1 1 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 8 11 13 6 10 5 4 4 2 1 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 2 0 5 8 14 6 4 2 1 2 1 4 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 3 4 3 3 7 3 4 0 2 1 0
  1 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 3 5 6 5 0 2 1 3 0 0 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 1 2 9 3 3 1 2 1 0 0 2
  1 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 3 2 2 1 1 0 0 1 1 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 1 4 3 3 1 2 0 1 0 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 0 0 4 0 1 1 0 0 0 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0
  0 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 2 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 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 0 0 0 0 0 0 1 1 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]]
```

Results for Knn with k = 3

Accuracy: 0.212063188128

Confusion Matrix

```
[[ 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 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 4 4 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 6 9 8 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 3 8 20 17 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 1 8 21 47 29 15 1 3 2 0 1 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 1 4 14 77 43 37 11 5 2 0 0 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 0 1 7 35 69 76 49 22 9 4 2 0 0 0 0 0 0 0 0 0
  0 0]
 [0 0 0 0 5 13 47 97 95 52 19 14 4 3 0 0 0 0 1 0 0 0
  0 0]
 [0 0 0 0 3 11 20 75 71 81 36 16 7 1 0 1 1 0 0 0 0 0
  0 0]
 [0 0 0 1 1 5 17 42 67 62 39 11 12 1 2 0 1 0 0 0 0 0
  0 0]
 [0 0 0 0 0 7 4 20 35 24 21 11 8 1 1 1 0 0 0 1 0 0 0
  0 0]]
```

```

0 0]
[0 0 0 0 0 2 6 11 10 31 7 7 9 5 0 1 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 1 13 10 12 7 9 5 4 2 2 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 2 1 5 7 15 8 3 2 0 1 2 3 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 1 4 3 5 2 7 3 3 0 4 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 1 2 8 5 5 0 2 0 3 0 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 1 2 2 9 4 5 1 0 0 0 1 0 1 0 0 0 0 0
0 0]
[0 0 0 0 0 0 1 0 2 2 3 1 1 0 0 0 2 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 2 3 3 3 2 2 0 0 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 1 0 0 3 1 1 0 0 0 1 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0
0 0]
[0 0 0 0 0 0 0 0 2 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 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 1 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 0 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0]]

```

Test run 9

Results for Knn with k = 1

Accuracy: 0.206797510771

Confusion Matrix

[[ 0 1 0  
0]  
[ 0 1 3 1 0  
0]  
[ 0 4 8 7 2 0 3 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 1 11 16 17 11 2 3 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 1 3 11 38 33 17 5 4 3 1 1 0 0 0 0 0 0 0 0 0 0 0  
0]  
[ 0 1 0 5 43 45 39 28 9 6 5 2 1 1 0 0 0 0 0 0 0 0 0  
0]  
[ 0 0 0 3 24 44 65 73 37 21 8 4 0 1 1 2 0 1 0 0 0 0 0  
0]  
[ 0 0 0 4 10 27 56 90 63 55 22 6 5 5 1 1 0 1 1 0 0 1 0  
0]  
[ 0 0 0 0 10 8 49 61 91 49 29 13 6 6 4 1 4 1 2 0 0 0 0  
0]  
[ 0 0 0 1 0 4 24 53 59 46 29 14 6 8 3 1 0 1 3 1 0 0 0  
0]  
[ 0 0 0 0 1 6 10 22 25 18 12 11 3 5 7 4 4 1 2 0 0 0 0  
0]  
[ 0 0 0 0 1 1 7 10 19 15 15 7 8 2 2 1 1 4 2 0 0 0 0  
0]  
[ 0 0 0 0 1 3 4 4 7 10 6 5 4 3 7 1 2 1 1 1 0 1 0 0  
0]  
[ 0 0 0 0 0 1 3 5 10 7 6 4 4 2 2 3 2 4 2 0 0 0 0 0  
0]  
[ 0 0 0 0 0 0 5 4 5 4 1 6 3 0 1 4 0 3 0 0 0 0 0 0  
0]  
[ 0 0 0 0 0 1 0 2 7 1 3 4 2 1 0 4 0 1 1 0 0 0 0 0  
0]  
[ 0 0 0 0 0 0 1 0 2 5 3 0 3 1 1 1 1 2 0 0 0 0 0 0  
0]

```

0]
[ 0 0 0 0 0 0 0 1 2 2 1 2 3 1 0 1 0 0 1 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 3 0 1 1 2 2 1 0 1 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 0 2 1 2 0 1 0 0 1 1 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 0 0 3 0 0 0 1 1 1 0 0 0 0 0 0 0
0]
[ 0 0 0 0 0 0 0 0 0 1 0 2 0 0 1 1 0 0 0 0 0 1 0 0
0]
[ 0 0 0 0 0 0 0 0 0 1 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 0 0 0 1 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]]

```

Results for Knn with k = 2

Accuracy: 0.232168501675

Confusion Matrix

```

[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]
 [ 0 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]
 [ 0 7 10 4 3 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]
 [ 0 3 17 18 21 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]
 [ 0 2 6 17 49 24 13 3 1 2 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]
 [ 0 1 3 9 57 58 37 16 3 1 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0 0]

```



[ 0 0 0 7 36 63 84 62 22 9 0 0 0 1 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 4 16 38 79 116 57 26 7 1 2 2 0 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 1 18 18 64 85 93 37 5 7 3 0 1 0 2 0  
0 0 0 0 0 0 0]

[ 0 0 0 2 3 11 34 80 74 31 6 6 2 1 1 2 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 6 5 14 34 30 17 11 5 2 3 2 1 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 6 10 18 25 11 8 6 5 2 2 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 1 6 11 10 5 10 6 4 3 3 2 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 2 6 9 13 9 5 3 4 1 1 1 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 6 5 6 4 2 6 4 0 2 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 1 2 6 6 3 2 3 1 2 0 1 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 2 2 3 4 3 0 1 2 1 1 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 2 5 1 2 2 1 0 1 0 0 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 1 3 0 3 1 1 1 0 0 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 0 0 3 1 2 0 1 0 0 0 1  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 0 1 1 1 0 0 0 1 1 1 0  
0 0 0 0 0 0 0]

[ 0 0 0 0 0 0 0 0 1 1 2 0 1 1 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 1 0 0 0

```

    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 1 0 0 0 0 0 0 0
  0 0 0 0 0 0 0]]

```

Results for Knn with k = 3

Accuracy: 0.226902824318

Confusion Matrix

```

[[ 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 1 3 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 7 10 4 3 0 1 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 2 17 20 19 4 1 0 0 0 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 1 7 17 37 35 15 3 0 2 0 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 1 3 8 56 61 40 13 2 0 1 0 0 0 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 9 36 54 84 68 23 9 0 0 0 1 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 5 16 34 85 109 63 26 7 0 1 2 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 1 17 21 53 88 95 36 13 5 3 1 0 0 1 0
   0 0 0 0 0 0 0]
 [ 0 0 0 2 3 11 43 76 64 32 10 8 1 1 1 1 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 5 5 15 34 32 19 11 6 1 3 0 0 0 0
   0 0 0 0 0 0 0]
 [ 0 0 0 0 4 5 12 18 23 14 8 7 1 1 0 1 0 0
   1 0 0 0 0 0 0]]

```

```

[ 0 0 0 0 0 8 10 6 11 10 8 2 4 1 1 0 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 1 1 7 9 14 9 3 3 3 1 1 1 1 1
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 4 9 8 5 1 3 3 0 2 1 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 1 5 6 7 2 1 4 0 1 0 0 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 2 3 4 3 2 0 2 2 1 1 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 3 3 4 1 1 1 0 0 1 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 2 3 0 2 1 1 1 0 0 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 2 1 0 2 0 2 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 1 3 1 0 0 1 0 0 0 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 1 1 1 0 1 2 0 0 0 0 0 0
 0 0 0 0 0 0 0]
[ 0 0 0 0 0 0 0 0 0 1 1 0 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 0 0 0 1 0 0 0 0 0 0
 0 0 0 0 0 0 0]]

```

Mean accuracy and variance over 10 runs with k = 1 0.206127333652  
5.73429262354e-05

Mean accuracy and variance over 10 runs with k = 2 0.219626615606  
4.44004371298e-05

## Fold 1

## Results for Knn with $k = 3$

Accuracy: 0.171764705882

## Confusion Matrix

```
[[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 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 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 0 0]
[0 0 3 5 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 4 6 7 4 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 0 3 15 18 14 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 1 2 15 27 19 10 2 3 0 0 0 0 0 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 0 1 4 17 24 29 21 14 3 0 1 0 0 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 0 3 5 11 28 32 28 16 6 4 2 2 1 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 0 0 2 8 16 28 32 20 9 5 3 1 1 0 0 2 0 0 0 0
  0 0 0 0]
[0 0 0 0 2 5 2 21 28 18 12 2 5 1 1 0 1 0 0 0 0 0
  0 0 0 0]
[0 0 0 0 0 1 4 6 12 15 5 2 5 1 2 1 0 0 0 0 0 0 0
  0 0 0 0]
[0 0 0 0 1 0 0 5 5 17 5 4 1 2 0 1 0 0 0 0 0 0 0
  0 0 0 0]]
```

```

[0 0 0 0 0 0 0 3 5 6 5 0 4 3 0 0 0 0 0 0 0 0 0 0
 0 0 0 0]
[0 0 0 0 0 0 1 2 3 7 4 1 0 2 0 0 1 0 0 0 0 0 0 0
 0 0 0 0]
[0 0 0 0 0 0 0 1 3 4 4 1 0 0 0 1 0 0 0 0 0 0 0 0
 0 0 0 0]
[0 0 0 0 0 0 0 2 1 4 2 2 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 1 2 3 0 0 2 0 1 0 0 0 0 0 0 0
 0 0 0 0]
[0 0 0 0 0 0 0 0 1 2 0 1 0 1 1 0 1 0 0 0 0 0 0 0
 0 0 0 0]
[0 0 0 0 0 1 0 0 0 1 1 2 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 1 0 1 1 0 0 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 1 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 1 0 0 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 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 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 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 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0]]

```

Fold 2

Results for Knn with k = 3

Accuracy: 0.236623067776

Confusion Matrix

```
[[ 0  3  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 3  4  4  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 1  5  7  4  6  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  1  5 17 11 15  1  2  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  1  4 19 18 24  9  1  2  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2  6 24 35 28 14  2  2  0  1  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  3 10 29 53 25 11  2  1  2  2  0  0  0  0  0  0  0  0]
 [ 0  0  0  2  1 22 42 39 12  6  1  2  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  1  2 10 28 25 20  6  5  0  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  2  3  8 16 11  8  5  0  0  1  0  0  0  0  0  0  0  0]
 [ 0  0  0  1  1  7 13 13  2  2  0  1  0  0  1  0  0  0  0  0  0]
 [ 0  0  0  1  0  6  7  3  4  1  2  0  1  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  1  2  5  8  2  0  0  1  0  1  0  0  0  1  0  0  0]
 [ 0  0  0  0  0  2  3  3  1  2  3  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  1  0  3  4  1  2  0  0  0  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  1  1  0  4  1  1  0  1  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  1  1  2  0  1  1  0  1  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  2  2  1  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  2  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  1  1  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  1  0  0  0  0  0  0  0  0  0  0]]
```

Fold 3

Results for Knn with k = 3

Accuracy: 0.206482593037

Confusion Matrix

```
[[ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 1  0  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  2  5  3  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0]]
```

```

[0 0 4 7 8 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[0 1 6 11 18 12 2 1 0 0 0 1 0 0 0 0 0 0 0 0]
[0 0 0 10 18 27 16 5 0 2 0 0 0 0 0 0 0 0 0 0]
[0 0 1 3 13 28 29 27 6 5 1 1 0 0 0 0 0 0 0 0]
[0 0 0 1 6 23 38 32 22 10 3 2 0 0 0 1 0 0 0 0]
[0 0 0 2 4 7 23 33 29 19 5 1 2 1 0 1 0 0 0 0]
[0 0 1 0 1 7 16 32 18 17 2 1 0 1 0 1 0 0 0 0]
[0 0 0 0 1 0 8 15 12 11 3 1 0 0 0 1 0 0 1 0]
[0 0 0 0 1 4 6 6 11 6 5 0 1 0 0 0 1 0 0 0]
[0 0 0 0 0 2 7 4 4 3 0 3 1 0 0 0 0 1 0 0]
[0 0 0 0 0 1 4 5 4 2 1 1 1 0 2 0 0 0 0 0]
[0 0 0 0 0 1 3 1 2 1 2 1 2 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 3 3 0 2 0 1 1 1 1 0 0 0 0]
[0 0 0 0 0 0 2 2 1 1 0 1 0 1 0 0 0 0 0 0]
[0 0 0 0 0 0 1 1 1 0 2 0 0 0 1 0 0 0 0 0]
[0 0 0 0 0 0 0 2 0 0 0 1 1 0 1 0 0 0 0 0]
[0 0 0 0 0 1 0 1 0 1 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 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0]

```

Fold 4

Results for Knn with k = 3

Accuracy: 0.24246079614

Confusion Matrix

```

[[0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [2 3 4 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 6 10 5 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 1 11 17 15 6 0 1 1 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 6 18 19 22 9 4 0 0 0 0 0 0 0 0 0 0 0 0]
 [0 0 2 14 26 38 23 5 1 1 2 0 0 0 1 0 0 0 0 0]
 [0 0 1 7 9 26 49 23 18 4 1 0 0 0 0 0 0 0 0 0]
 [0 0 0 4 6 22 33 42 11 6 1 1 0 1 0 0 0 0 0 0]
 [0 0 0 3 4 17 33 19 16 2 0 0 2 1 0 0 0 0 0 0]

```

```
[0 0 0 1 3 10 8 14 10 4 3 0 0 0 0 0 0 0 0 0]
[0 0 0 1 1 3 6 12 10 2 3 2 0 0 0 0 0 0 0 0]
[0 0 0 0 0 4 7 7 2 2 2 0 0 1 0 0 0 0 0 0]
[0 0 0 0 0 0 5 7 5 1 1 0 0 0 0 0 1 0 0 0]
[0 0 0 0 0 1 1 5 1 0 3 2 0 0 0 0 0 0 0 0]
[0 0 0 0 0 2 3 3 3 0 0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 1 1 0 4 2 0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 1 1 2 0 0 1 0 1 0 0 0 0 0 0]
[0 0 0 0 0 0 0 1 1 0 1 2 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 1 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 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0]]
```

Fold 5

Results for Knn with k = 3

Accuracy: 0.235436893204

Confusion Matrix

```
[[ 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [ 5 2 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [ 1 3 5 13 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
 [ 1 3 7 17 15 4 1 1 1 1 0 0 0 0 0 0 0 0 0 0]
 [ 0 2 4 19 19 21 8 1 1 1 1 0 1 0 0 0 0 0 0 0]
 [ 0 1 1 9 25 38 27 8 4 0 0 0 0 0 0 0 0 0 0 0]
 [ 0 0 1 6 10 25 50 29 13 3 0 0 0 0 0 0 0 0 0 0]
 [ 0 0 0 4 6 23 34 37 16 1 3 1 1 0 0 0 0 0 0 0]
 [ 0 0 0 0 1 10 36 21 17 3 7 0 1 0 1 0 0 0 0 0]
 [ 0 0 0 3 3 7 13 11 9 4 2 0 1 0 0 0 0 0 0 0]
 [ 0 0 0 1 2 4 9 10 5 2 3 2 0 1 1 0 0 0 0 0]
 [ 0 0 0 0 4 5 5 2 6 1 0 0 0 1 0 0 0 1 0 0]
 [ 0 0 0 1 0 0 5 3 7 0 1 3 0 0 0 0 0 0 0 0]
 [ 0 0 0 0 0 0 2 4 3 1 0 0 2 1 0 0 0 0 0 0]
 [ 0 0 0 0 1 0 2 4 2 0 0 0 1 0 0 1 0 0 0 0]
 [ 0 0 0 0 0 0 1 4 1 0 1 0 1 0 0 0 0 0 0 0]]
```



```
[0 0 0 0 0 0 3 1 1 1 0 0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 1 1 0 1 2 0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 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 1 0 0 0 0 0 0 0 0 0 0 0]]
```

Mean accuracy and variance over 5-folds 0.218553611208  
0.000703603020851