DMG2 Assignment 2 : Problem 2

In [1]:
```
import pandas as pd
import numpy as np
import os
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
import itertools

from sklearn.preprocessing import StandardScaler
from sklearn.svm import LinearSVC

from anytree import Node,RenderTree
from anytree.exporter import DotExporter

from IPython.display import Image

# warnings.filterwarnings('ignore')
```

In [2]:
```
#DATA_DIR = 'D:\\ISB\\Term3\\DMG2\\assignment\\assignment1\\datasets\\mnist'
DATA_DIR = '/home/jishnu/Documents/ISB/Term3/dmg2/assignments/hw_assignment1
/dmg2/datasets/mnist'
WORK_DIR = '/home/jishnu/Documents/ISB/Term3/dmg2/assignments/assignment2'
```

In [3]:
```
train = pd.DataFrame(columns=['V{}'.format(i) for i in range(1,785)] + ['lab
el'])
test = pd.DataFrame(columns=['V{}'.format(i) for i in range(1,785)] + ['labe
l'])
for num in range(10):
    # Consolidating training data
    temp_train = pd.read_csv(os.path.join(DATA_DIR,'train{0}.csv'.format(num
)),usecols=['V{}'.format(i) for i in range(1,785)])
    temp_train['label'] = num
    train = train.append(temp_train,ignore_index=True)
    # Consolidating test data
    temp_test = pd.read_csv(os.path.join(DATA_DIR,'test{0}.csv'.format(num))
,usecols=['V{}'.format(i) for i in range(1,785)])
    temp_test['label'] = num
    test = test.append(temp_test,ignore_index=True)
```

In [4]:
```
train.head()
```

Out[4]:

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	...	V776	V777	V778	V779	V780	V781	V782	V783	V
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
2	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
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0

5 rows × 785 columns

In [5]:
```
train = train.dropna()
test = test.dropna()
```

```
In [6]: train.isnull().values.any()

Out[6]: False
```

```
In [7]: test.isnull().values.any()

Out[7]: False
```

Building Binary Heirarchical Classifier using Linear SVM

```
In [8]: train_test_acc = pd.DataFrame(columns=['node','training_acc','test_acc'])
```

Building tree data structure using Anytree module

Building dictionary of Nodes(Anytree Data Structure)

```
In [9]: root = Node("root")
        node_dict = {'0' : Node("Class_0",parent=root),
                     '1' : Node("Class_1",parent=root),
                     '2' : Node("Class_2",parent=root),
                     '3' : Node("Class_3",parent=root),
                     '4' : Node("Class_4",parent=root),
                     '5' : Node("Class_5",parent=root),
                     '6' : Node("Class_6",parent=root),
                     '7' : Node("Class_7",parent=root),
                     '8' : Node("Class_8",parent=root),
                     '9' : Node("Class_9",parent=root)
                    }
```

Iterating through all class labels, and building binary heirarchical classifier

In [10]:
```
train_svm = train
train_svm['label'] = train_svm['label'].astype('str')

test_svm = test
test_svm['label'] = test_svm['label'].astype('str')

classes = [str(num) for num in range(10)]
# svm_classes = {}
# train_scores = {}

while len(classes) > 2:
    svm_classes = {}
    train_scores = {}
    test_scores = {}
    for classNo,nestedClassNo in itertools.combinations(classes, 2):
        # Building training and test data for pair of classes
        train_temp = train_svm.loc[train_svm['label'].isin([classNo,nestedCl
assNo])]
        X_train = train_temp.iloc[:,:784]
        Y_train = train_temp.iloc[:,784]
        test_temp = test_svm.loc[test_svm['label'].isin([classNo,nestedClass
No])]
        X_test = test_temp.iloc[:,:784]
        Y_test = test_temp.iloc[:,784]
        # Fitting SVM classifier on pair of classes
        svm_classes['{0}_{1}'.format(classNo,nestedClassNo)] = LinearSVC(ran
dom_state=0)
        svm_classes['{0}_{1}'.format(classNo,nestedClassNo)].fit(X_train,Y_t
rain.astype('int'))
        # Calculating scores on training and test data
        train_scores['{0}_{1}'.format(classNo,nestedClassNo)] = svm_classes[
'{0}_{1}'.format(classNo,nestedClassNo)].score(X_train,Y_train.astype('int')
)
        test_scores['{0}_{1}'.format(classNo,nestedClassNo)] = svm_classes['
{0}_{1}'.format(classNo,nestedClassNo)].score(X_test,Y_test.astype('int'))

    # Finding class pair with least training accuracy
    min_class_pair = min(train_scores,key=train_scores.get)

    # Appending training and test accuracies to dataframe
    train_test_acc = train_test_acc.append({'node' : min_class_pair,
                                            'training_acc' : train_scores[mi
n_class_pair],
                                            'test_acc' : test_scores[min_cla
ss_pair]},
                                           ignore_index=True)

    # Updating classes list
    classes = [val for val in classes if val not in min_class_pair.split('_'
)]
    classes.append(''.join(min_class_pair.split('_')))

    # Updating Nodes
    node_dict[''.join(min_class_pair.split('_'))] = Node('Class_{0}'.format(
min_class_pair),parent=root)
    for key in min_class_pair.split('_'):
        node_dict[key].parent = node_dict[''.join(min_class_pair.split('_'))
]

    # Relabeling train_svm
    train_svm.loc[train_svm['label'].isin(min_class_pair.split('_')),'label'
] = ''.join(min_class_pair.split('_'))

    # Relabeling test_svm
    test_svm.loc[test_svm['label'].isin(min_class_pair.split('_')),'label']
= ''.join(min_class_pair.split('_'))

    print(classes)
```

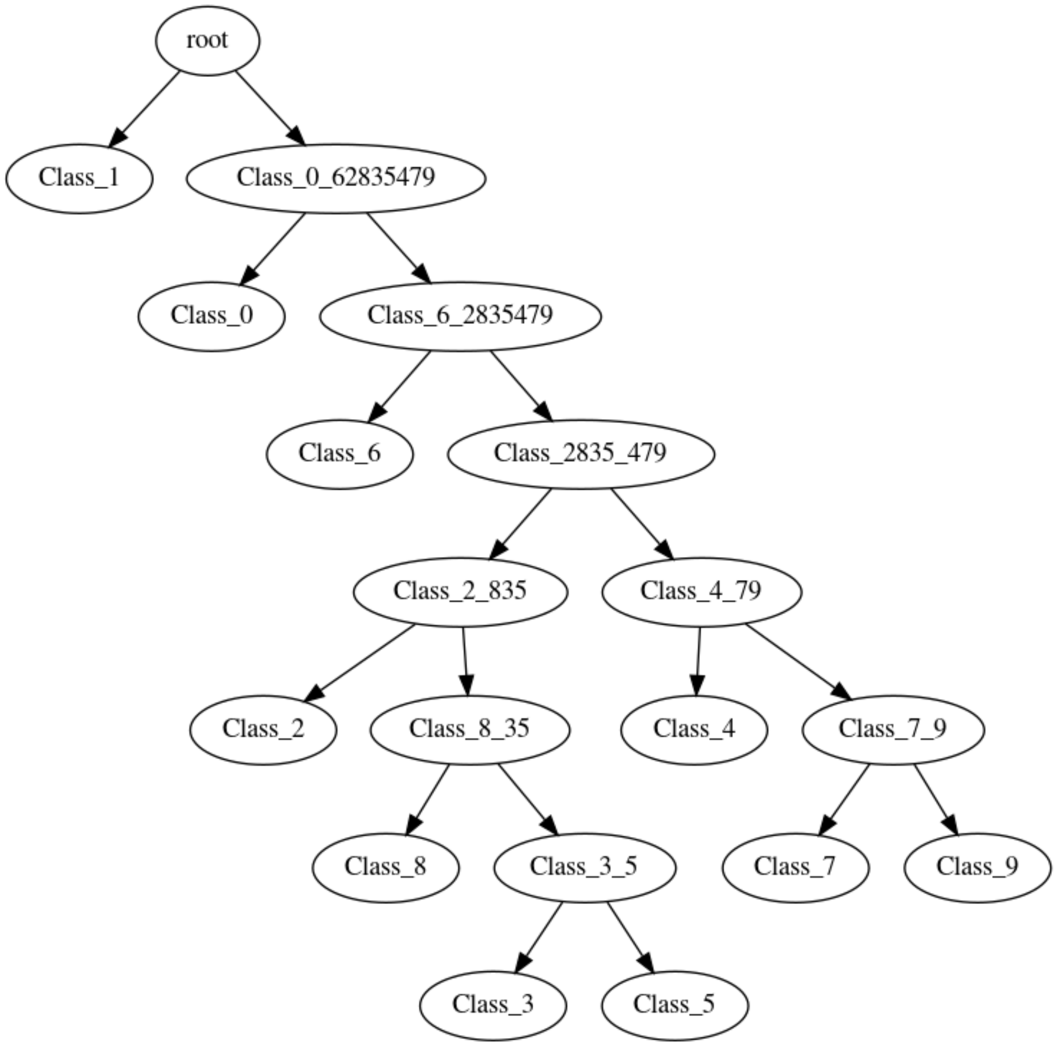
```
['0', '1', '2', '3', '4', '5', '6', '8', '79']
['0', '1', '2', '4', '6', '8', '79', '35']
['0', '1', '2', '4', '6', '79', '835']
['0', '1', '4', '6', '79', '2835']
['0', '1', '6', '2835', '479']
['0', '1', '6', '2835479']
['0', '1', '62835479']
['1', '062835479']
```

Plotting entire tree

```
In [11]: DotExporter(root).to_picture("{0}/img/root.png".format(WORK_DIR))
```

```
In [12]: Image(filename="{0}/img/root.png".format(WORK_DIR))
```

```
Out[12]:
```



Training and Test Accuracies at each node

```
In [14]: print(train_test_acc)
```

```
         node  training_acc  test_acc
0         7_9      0.873740  0.864943
1         3_5      0.950036  0.925982
2        8_35      0.915282  0.901197
3       2_835      0.956234  0.940488
4        4_79      0.969990  0.952593
5    2835_479      0.972226  0.959338
6   6_2835479      0.980794  0.974700
7  0_62835479      0.990421  0.985431
```