In [1]:
```
import numpy as np
import pandas as pd
import re
from sklearn.decomposition import PCA, FactorAnalysis
from sklearn.preprocessing import StandardScaler
from sklearn import svm
import matplotlib.pyplot as plt
import matplotlib
import os
%matplotlib inline

seed = 0


def plot_confusion_matrix(y_true, y_pred, classes,
                          normalize=False,
                          title=None,
                          cmap=plt.cm.Blues, font_size=10, fig_size=(12,10)):
    """
    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
    #classes = classes[unique_labels(y_true, y_pred)]
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        #print("Normalized confusion matrix")
    #else:
    #    print('Confusion matrix, without normalization')

    #print(cm)
    plt.rcParams.update({'font.size': font_size})
    fig, ax = plt.subplots(figsize=fig_size, dpi= 80, facecolor='w', edgecolo
r='k')
    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]),
           # ... and label them with the respective list entries
           xticklabels=classes, yticklabels=classes,
           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]):
```

Load Label Indexes

This chunk loads a file that contains the labels we want to load from the datasets as well as their indicies.

In [2]:
```
infile = open("tstat_labels_indexes.txt" ,'r')
data_field_list = []
for line in infile.readlines():
    if ":" in line:
        data_field = str(re.search('%s(.*)%s' % ("\"", "\""), line).group(1))
        index = int(re.search('%s(.*)%s' % (":", ","), line).group(1))
        data_field_list.append((data_field, index))

index_to_key_dict = {}
key_to_index_dict = {}
data_field_labels = []
for data_field, index in data_field_list:
    key_to_index_dict[data_field] = index
    index_to_key_dict[index] = data_field
    data_field_labels.append(data_field)
```

Read in a dataset file

In [3]:
```
def read_in_file(file_name):
    infile = open(file_name, 'r')
    header = infile.readline().split(' ')
    entries = []
    labels = None
    for i, line in enumerate(infile.readlines()):
        row = get_data_row(line)
        row = clean_data_row(row)
        if row != []:
            entries.append(row)
    entries = np.array(entries)
    return entries
```

Get data row

Called by the read in file function. Loads a single line from the dataset files. Super inefficient, but only loads labels which are in the data field list.

In [4]:
```
def get_data_row(line):
    global index_to_key_dict
    line = line.split(' ')
    row = []
    labels = []
    c_pkt_cnt = 0
    s_pkt_cnt = 0
    c_bytes_cnt = 0
    s_bytes_cnt = 0
    for data_field, index in data_field_list:
        #print("df:", data_field,"ix:",index)
        #print(line)


        if data_field == "client_pkt_cnt":
            try:
                c_pkt_cnt = line[index]
                c_pkt_cnt = max(float(c_pkt_cnt), 1)
            except:
                c_pkt_cnt = 1
            #if c_pkt_cnt < 32:
            #    return []
        elif data_field == "serv_pkt_cnt":
            try:
                s_pkt_cnt = line[index]
                s_pkt_cnt = max(float(s_pkt_cnt), 1)
            except:
                s_pkt_cnt = 1
        elif data_field == "client_bytes_cnt":
            try:
                c_bytes_cnt = line[index]
                c_bytes_cnt = max(float(c_bytes_cnt), 1)
            except:
                c_bytes_cnt = 1
        elif data_field == "serv_bytes_cnt":
            try:
                s_bytes_cnt = line[index]
                s_bytes_cnt = max(float(s_bytes_cnt), 1)
            except:
                s_bytes_cnt = 1

    for data_field, index in data_field_list:
        try:
            val = line[index]
            val = float(val)
        except:
            val = 0
        if data_field in ["client_pkt_cnt", "client_rst_cnt", "client_ack_cnt",
"client_pkt_data", "client_pkt_retx",
                          "client_syn_cnt", "client_fin_cnt", "client_pkt_ret
x"]:
            val /= c_pkt_cnt
        elif data_field in ["client_bytes_uniq", "client_bytes_cnt", "client_by
tes_retx"]:
            val /= c_bytes_cnt
        elif data_field in ["serv_pkt_cnt", "serv_rst_cnt", "serv_ack_cnt", "se
rv_ack_pck_cnt", "serv_pkts_data",
                             "serv_pkts_retx", "serv_syn_cnt", "serv_fin_cnt"]:
            val /= s_pkt_cnt
        elif data_field in ["serv_bytes_uniq", "serv_btyes_cnt", "serv_pkts_ret
x"]:
            val /= s_bytes_cnt
        row.append(val)
```

Clean data row

Not implemented

In [5]:
```
def clean_data_row(in_row):
    global index_to_key_dict, key_to_index_dict
    return in_row
```

Get dataset

Loads all files from a directory

In [6]:
```
def get_dataset(path):
    print(path)
    out_data = []
    for sub_dir in os.listdir(path):
        temp_path = os.path.join(path, sub_dir)
        temp_path = os.path.join(temp_path, "log_tcp_complete")
        if os.path.isfile(temp_path):
            temp_data = read_in_file(temp_path)
            #print len(temp_data), len(out_data)
            if len(temp_data) == 0:
                continue
            if out_data == []:
                out_data = temp_data
            else:
                out_data = np.concatenate((out_data, temp_data))
    return out_data
```

Load HPC datasets

Load all datasets Create numerical lables for each class, and a different set of labels for each subclass.

In [7]:
```
normal = get_dataset("./hpc/normal")
corr_01 = get_dataset("./hpc/corrupt_0.1perc")
corr_05 = get_dataset("./hpc/corrupt_0.5perc")
corr_10 = get_dataset("./hpc/corrupt_1.0perc")
delay_1_1 = get_dataset("./hpc/delay_1_var_1")
delay_5_2 = get_dataset("./hpc/delay_5_var_2")
delay_10_5 = get_dataset("./hpc/delay_10_var_5")
delay_25_20 = get_dataset("./hpc/delay_25_var_20")
drop_01 = get_dataset("./hpc/drop_01_perc")
drop_001 = get_dataset("./hpc/drop_001_perc")
drop_0005 = get_dataset("./hpc/drop_0005_perc")
dup_1 = get_dataset("./hpc/dup-1-p")
dup_2 = get_dataset("./hpc/dup_2perc")

hpc_normal = np.nan_to_num(normal)
hpc_corr_01 = np.nan_to_num(corr_01)
hpc_corr_05 =  np.nan_to_num(corr_05)
hpc_corr_10 = np.nan_to_num(corr_10)
hpc_delay_1_1 = np.nan_to_num(delay_1_1)
hpc_delay_5_2 = np.nan_to_num(delay_5_2)
hpc_delay_10_5 = np.nan_to_num(delay_10_5)
hpc_delay_25_20 = np.nan_to_num(delay_25_20)
hpc_drop_01 = np.nan_to_num(drop_01)
hpc_drop_001 = np.nan_to_num(drop_001)
hpc_drop_0005 = np.nan_to_num(drop_0005)
hpc_dup_1 = np.nan_to_num(dup_1)
hpc_dup_2 = np.nan_to_num(dup_2)
```

```
./hpc/normal
```

```
/home/dave/.local/lib/python2.7/site-packages/ipykernel_launcher.py:12: Depreca
tionWarning: elementwise comparison failed; this will raise an error in the fut
ure.
  if sys.path[0] == '':
```

```
./hpc/corrupt_0.1perc
./hpc/corrupt_0.5perc
./hpc/corrupt_1.0perc
./hpc/delay_1_var_1
./hpc/delay_5_var_2
./hpc/delay_10_var_5
./hpc/delay_25_var_20
./hpc/drop_01_perc
./hpc/drop_001_perc
./hpc/drop_0005_perc
./hpc/dup-1-p
./hpc/dup_2perc
```

In [8]:
```
normal = get_dataset("./dtn/FINAL_DATA/normal")
normal_2 = get_dataset("./dtn/DTN_LONG_DATA/normal")
corr_01 = get_dataset("./dtn/FINAL_DATA/corrupt_0.1perc")
corr_05 = get_dataset("./dtn/FINAL_DATA/corrupt_0.5perc")
corr_10 = get_dataset("./dtn/FINAL_DATA/corrupt_1.0perc")
delay_1_1 = get_dataset("./dtn/FINAL_DATA/delay_1_var_1")
delay_5_2 = get_dataset("./dtn/FINAL_DATA/delay_5_var_2")
delay_10_5 = get_dataset("./dtn/FINAL_DATA/delay_10_var_5")
delay_25_20 = get_dataset("./dtn/FINAL_DATA/delay_25_var_20")
drop_01 = get_dataset("./dtn/FINAL_DATA/drop_01_perc")
drop_01_2 = get_dataset("./dtn/DTN_LONG_DATA/one_perc")
drop_001 = get_dataset("./dtn/FINAL_DATA/drop_001_perc")
drop_001_2 = get_dataset("./dtn/DTN_LONG_DATA/tenth_perc")
drop_0005 = get_dataset("./dtn/FINAL_DATA/drop_0005_perc")
drop_0005_2 = get_dataset("./dtn/DTN_LONG_DATA/half_perc")
dup_01 = get_dataset("./dtn/FINAL_DATA/dup_0.1perc")
dup_1 = get_dataset("./dtn/FINAL_DATA/dup_1perc")
dup_2 = get_dataset("./dtn/FINAL_DATA/dup_2perc")

dtn_normal = np.nan_to_num(normal)
dtn_normal2 = np.nan_to_num(normal_2)
dtn_corr_01 = np.nan_to_num(corr_01)
dtn_corr_05 =  np.nan_to_num(corr_05)
dtn_corr_10 = np.nan_to_num(corr_10)
dtn_delay_1_1 = np.nan_to_num(delay_1_1)
dtn_delay_5_2 = np.nan_to_num(delay_5_2)
dtn_delay_10_5 = np.nan_to_num(delay_10_5)
dtn_delay_25_20 = np.nan_to_num(delay_25_20)
dtn_drop_01 = np.nan_to_num(drop_01)
dtn_drop_01_2 = np.nan_to_num(drop_01_2)
dtn_drop_001 = np.nan_to_num(drop_001)
dtn_drop_001_2 = np.nan_to_num(drop_001_2)
dtn_drop_0005 = np.nan_to_num(drop_0005)
dtn_drop_0005_2 = np.nan_to_num(drop_0005_2)
dtn_dup_01 = np.nan_to_num(dup_01)
dtn_dup_1 = np.nan_to_num(dup_1)
dtn_dup_2 = np.nan_to_num(dup_2)
```

```
./dtn/FINAL_DATA/normal
./dtn/DTN_LONG_DATA/normal
```

```
/home/dave/.local/lib/python2.7/site-packages/ipykernel_launcher.py:12: Depreca
tionWarning: elementwise comparison failed; this will raise an error in the fut
ure.
  if sys.path[0] == '':
```

```
./dtn/FINAL_DATA/corrupt_0.1perc
./dtn/FINAL_DATA/corrupt_0.5perc
./dtn/FINAL_DATA/corrupt_1.0perc
./dtn/FINAL_DATA/delay_1_var_1
./dtn/FINAL_DATA/delay_5_var_2
./dtn/FINAL_DATA/delay_10_var_5
./dtn/FINAL_DATA/delay_25_var_20
./dtn/FINAL_DATA/drop_01_perc
./dtn/DTN_LONG_DATA/one_perc
./dtn/FINAL_DATA/drop_001_perc
./dtn/DTN_LONG_DATA/tenth_perc
./dtn/FINAL_DATA/drop_0005_perc
./dtn/DTN_LONG_DATA/half_perc
./dtn/FINAL_DATA/dup_0.1perc
./dtn/FINAL_DATA/dup_1perc
./dtn/FINAL_DATA/dup_2perc
```

In [9]:
```
hpc_data = np.concatenate((hpc_normal,
                           hpc_corr_01, hpc_corr_05, hpc_corr_10,
                           hpc_delay_1_1, hpc_delay_5_2,hpc_delay_10_5,hpc_dela
y_25_20,
                           #hpc_drop_01, hpc_drop_001, hpc_drop_0005,
                           hpc_dup_1, hpc_dup_2))

hpc_data = StandardScaler().fit_transform(hpc_data)



dtn_data = np.concatenate((dtn_normal, dtn_normal2,
                           dtn_corr_01, dtn_corr_05, dtn_corr_10,
                           dtn_delay_1_1, dtn_delay_5_2,dtn_delay_10_5,dtn_dela
y_25_20,
                           #dtn_drop_01,dtn_drop_01_2, dtn_drop_001, dtn_drop_0
01_2, dtn_drop_0005, dtn_drop_0005_2,
                           dtn_dup_01,dtn_dup_1, dtn_dup_2))

dtn_data = StandardScaler().fit_transform(dtn_data)


dtn_normal = np.nan_to_num(normal)
dtn_normal2 = np.nan_to_num(normal_2)
dtn_corr_01 = np.nan_to_num(corr_01)
dtn_corr_05 =  np.nan_to_num(corr_05)
dtn_corr_10 = np.nan_to_num(corr_10)
dtn_delay_1_1 = np.nan_to_num(delay_1_1)
dtn_delay_5_2 = np.nan_to_num(delay_5_2)
dtn_delay_10_5 = np.nan_to_num(delay_10_5)
dtn_delay_25_20 = np.nan_to_num(delay_25_20)
dtn_drop_01 = np.nan_to_num(drop_01)
dtn_drop_01_2 = np.nan_to_num(drop_01_2)
dtn_drop_001 = np.nan_to_num(drop_001)
dtn_drop_001_2 = np.nan_to_num(drop_001_2)
dtn_drop_0005 = np.nan_to_num(drop_0005)
dtn_drop_0005_2 = np.nan_to_num(drop_0005_2)
dtn_dup_01 = np.nan_to_num(dup_01)
dtn_dup_1 = np.nan_to_num(dup_1)
dtn_dup_2 = np.nan_to_num(dup_2)
```

In [10]:
```
a_labels  = np.ones(len(hpc_normal  ))    *1
b_labels  = np.ones(len(hpc_corr_01  ))   *2
c_labels  = np.ones(len(hpc_corr_05  ))   *2
d_labels  = np.ones(len(hpc_corr_10  ))   *2
e_labels  = np.ones(len(hpc_delay_1_1))   *3
f_labels  = np.ones(len(hpc_delay_5_2))   *3
g_labels  = np.ones(len(hpc_delay_10_5))  *3
h_labels  = np.ones(len(hpc_delay_25_20)) *3
#i_labels  = np.ones(len(hpc_drop_01))     *4
#j_labels  = np.ones(len(hpc_drop_001))    *4
#k_labels  = np.ones(len(hpc_drop_0005))   *4
m_labels  = np.ones(len(hpc_dup_1))       *5
n_labels  = np.ones(len(hpc_dup_2))       *5

hpc_anom_type_data_labels = np.concatenate((a_labels, b_labels, c_labels, d_lab
els, e_labels,
                                            f_labels, g_labels, h_labels,
                                            #i_labels, j_labels, k_labels,
                                            m_labels, n_labels))
```

In [12]:
```
o_labels  = np.ones(len(dtn_normal  ) + len(dtn_normal2))    *1
p_labels  = np.ones(len(dtn_corr_01  ))   *2
q_labels  = np.ones(len(dtn_corr_05  ))   *2
r_labels  = np.ones(len(dtn_corr_10  ))   *2
s_labels  = np.ones(len(dtn_delay_1_1))   *3
t_labels  = np.ones(len(dtn_delay_5_2))   *3
u_labels  = np.ones(len(dtn_delay_10_5))  *3
v_labels  = np.ones(len(dtn_delay_25_20)) *3
#w_labels  = np.ones(len(dtn_drop_01 ) + len(dtn_drop_01_2))     *4
#x_labels  = np.ones(len(dtn_drop_001) + len(dtn_drop_001_2))    *4
#y_labels  = np.ones(len(dtn_drop_0005) + len(dtn_drop_0005_2))   *4
z_labels  = np.ones(len(dtn_dup_01))      *5
aa_labels  = np.ones(len(dtn_dup_1))       *5
bb_labels  = np.ones(len(dtn_dup_2))       *5

dtn_anom_type_data_labels = np.concatenate((o_labels, p_labels, q_labels, r_lab
els, s_labels,
                                            t_labels, u_labels, v_labels,
                                            #w_labels, x_labels,y_labels,
                                            z_labels,
                                            aa_labels, bb_labels))

#all_anom_type_data_labels =
```

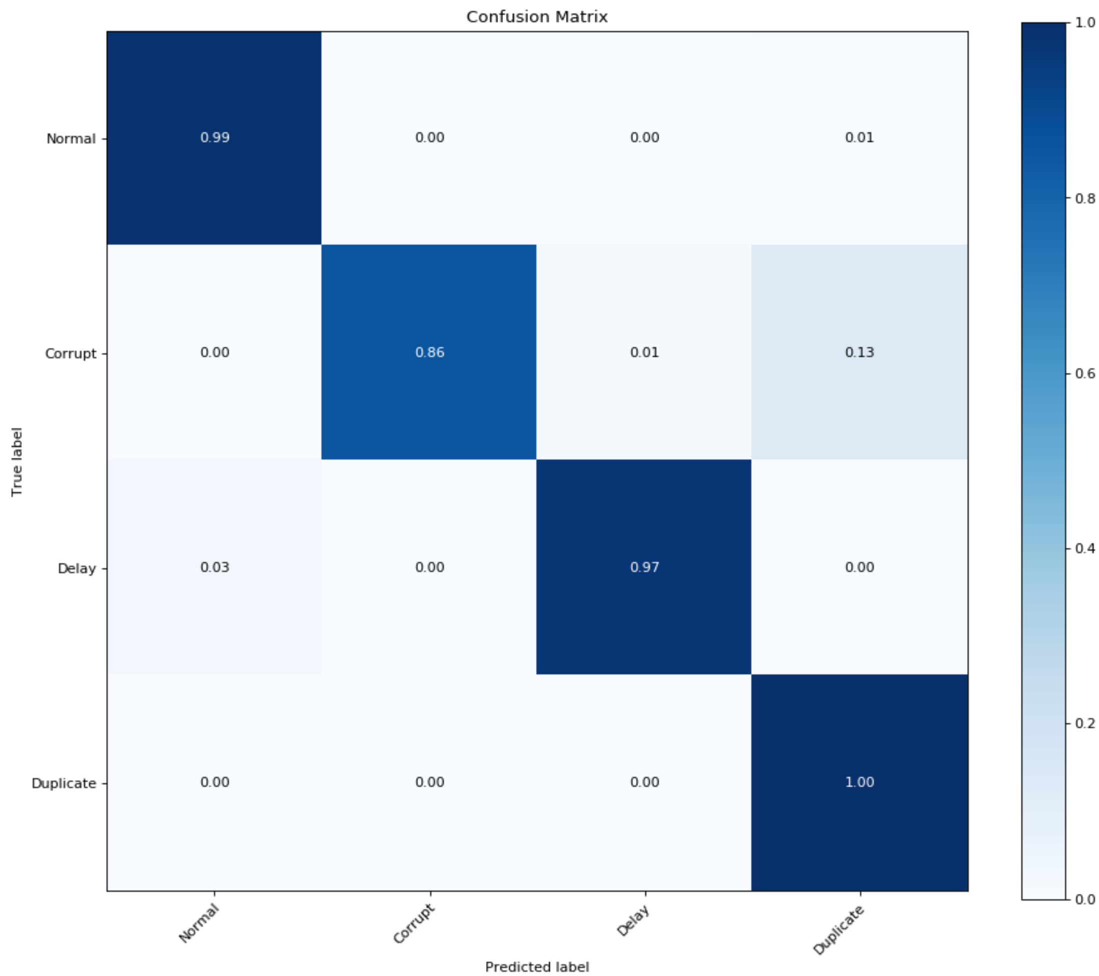
In [13]:
```
#dtn_anom_type_data_labels.shape
dtn_data.shape
```

Out[13]:
```
(2968, 89)
```

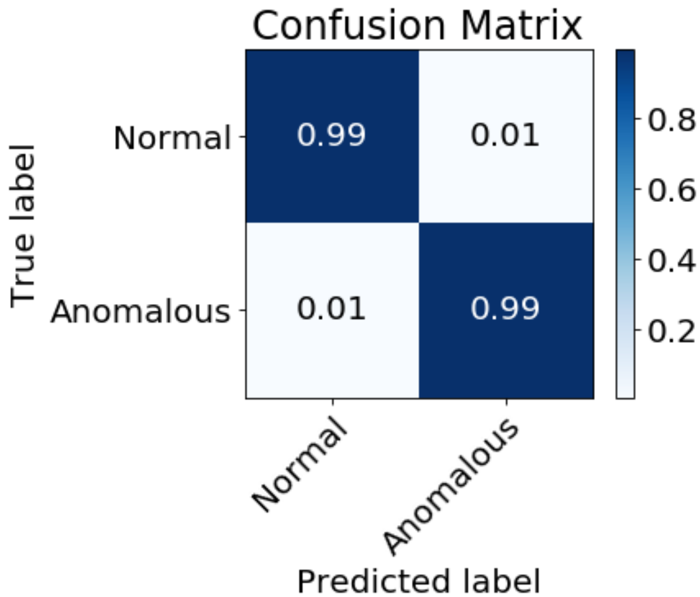
DTN Standalone

In [14]:
```
from sklearn.model_selection import train_test_split

train_data, test_data, train_labels, test_labels = train_test_split(dtn_data,
                                                                   dtn_anom_ty
pe_data_labels, test_size=0.45, random_state=3)
```

In [15]:
```
clf = svm.SVC(kernel='linear', gamma ='auto', max_iter=1000000000, class_weigh
t='balanced')
clf.fit(train_data, train_labels)
predicted_labels = clf.predict(test_data)

from sklearn.metrics import confusion_matrix

class_names = ["Normal", "Corrupt", "Delay", "Duplicate"]

plot_confusion_matrix(test_labels, predicted_labels, normalize=True,classes=cla
ss_names, title='Confusion Matrix')
plt.show()

error_cnt = 0
total_error_cnt = 0
same_class_error = 0
for i in range(len(predicted_labels)):
    if predicted_labels[i] != test_labels[i]:
        total_error_cnt += 1
        # if its normal data
        if predicted_labels[i] == 1 or test_labels[i] == 1:
            error_cnt += 1


print ("Total Error Count : ", total_error_cnt)
print ("Normal Class Error Rate : ", float(error_cnt)/float(len(predicted_label
s)) * 100, "%")
print ("Total Error Rate : ", float(total_error_cnt)/float(len(predicted_label
s)) * 100, "%")


false_pos = 0
false_neg = 0
error_cnt = 0
for i in range(len(predicted_labels)):
    # if there's an error
    if predicted_labels[i] != test_labels[i]:
        error_cnt += 1
        # if we failed to detect anomaly
        if predicted_labels[i] == 1:
            false_neg += 1
        # detected anomaly, but it normal
        else:
            false_pos += 1
print ("Total Errors", error_cnt)
print ("False Positives ", false_pos/ float(len(predicted_labels)) * 100, "%")
print ("False Negatives ", false_neg/ float(len(predicted_labels)) * 100, "%")


shortened_predicted = []
shortened_test_label = []
for i in range(len(predicted_labels)):
    if predicted_labels[i] == 1:
        shortened_predicted.append(1)
    else:
        shortened_predicted.append(2)
    if test_labels[i] == 1:
        shortened_test_label.append(1)
    else:
        shortened_test_label.append(2)

short_class_names = ["Normal", "Anomalous"]
```



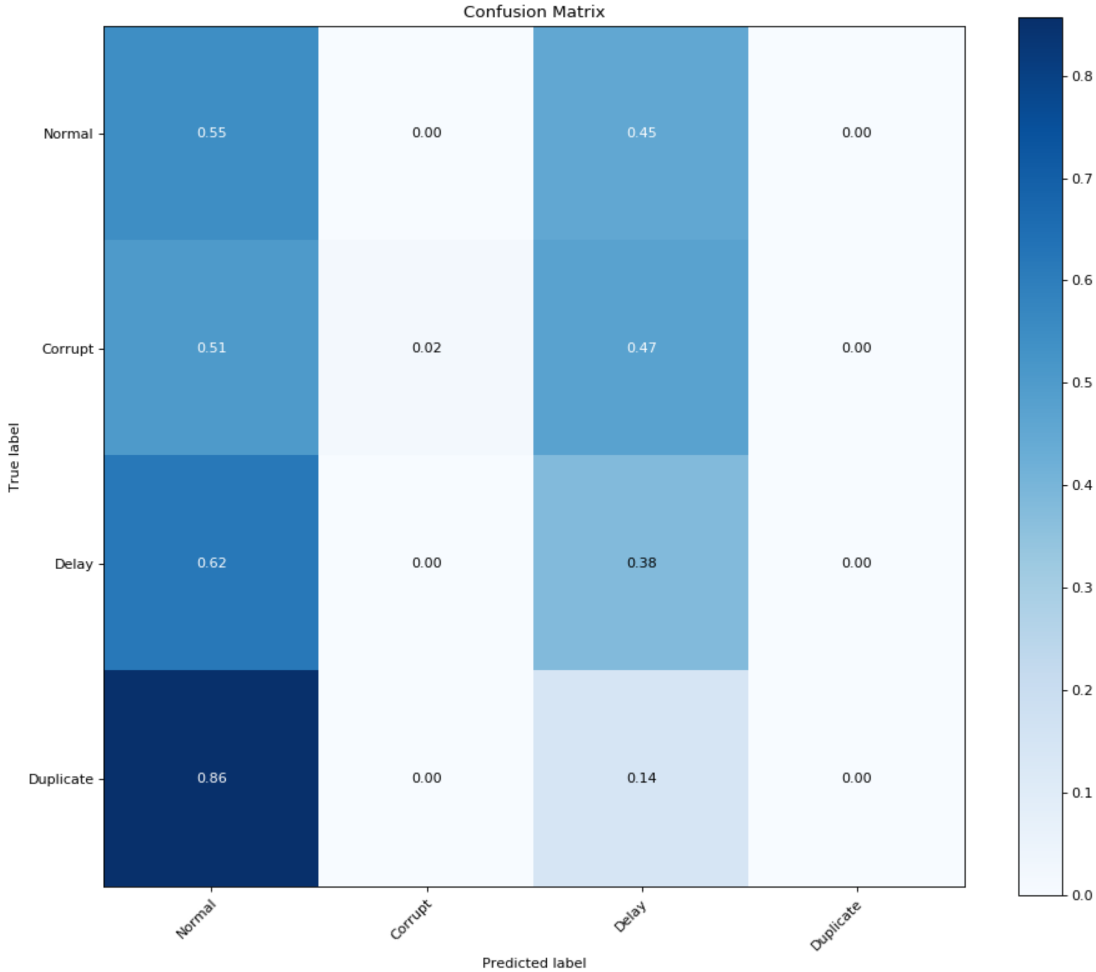

```
('Total Error Count : ', 21)
('Normal Class Error Rate : ', 0.8233532934131738, '%')
('Total Error Rate : ', 1.5718562874251496, '%')
('Total Errors', 21)
('False Positives ', 1.4221556886227544, '%')
('False Negatives ', 0.14970059880239522, '%')
```



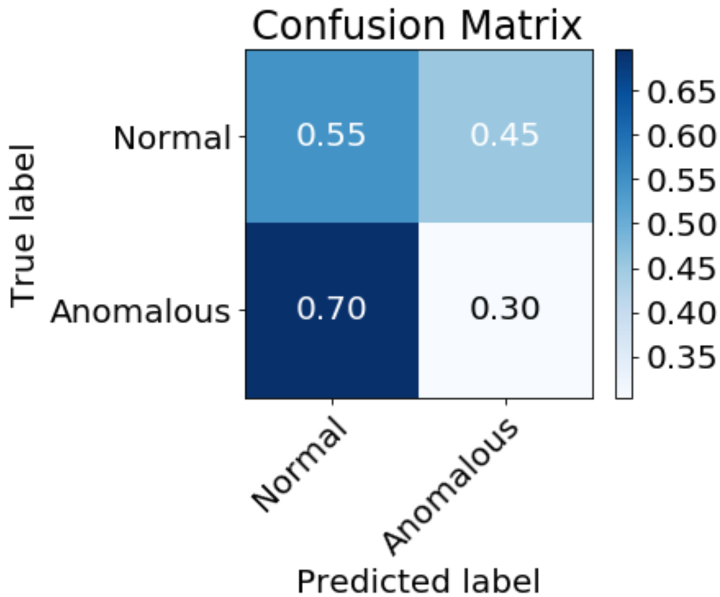
HPC Data on DTN trained SVM

In [16]:
```
from sklearn.model_selection import train_test_split

hpc_train_data, hpc_test_data, hpc_train_labels, hpc_test_labels = train_test_s
plit(hpc_data,
                                                                     hpc_anom_ty
pe_data_labels, test_size=0.45, random_state=3)
```

In [17]:
```
predicted_labels = clf.predict(hpc_test_data)

from sklearn.metrics import confusion_matrix

class_names = ["Normal", "Corrupt", "Delay", "Duplicate"]

plot_confusion_matrix(hpc_test_labels, predicted_labels, normalize=True,classe
s=class_names, title='Confusion Matrix')
plt.show()

error_cnt = 0
total_error_cnt = 0
same_class_error = 0
for i in range(len(predicted_labels)):
    if predicted_labels[i] != hpc_test_labels[i]:
        total_error_cnt += 1
        # if its normal data
        if predicted_labels[i] == 1 or hpc_test_labels[i] == 1:
            error_cnt += 1


print ("Total Error Count : ", total_error_cnt)
print ("Normal Class Error Rate : ", float(error_cnt)/float(len(predicted_label
s)) * 100, "%")
print ("Total Error Rate : ", float(total_error_cnt)/float(len(predicted_label
s)) * 100, "%")


false_pos = 0
false_neg = 0
error_cnt = 0
for i in range(len(predicted_labels)):
    # if there's an error
    if predicted_labels[i] != hpc_test_labels[i]:
        error_cnt += 1
        # if we failed to detect anomaly
        if predicted_labels[i] == 1:
            false_neg += 1
        # detected anomaly, but it normal
        else:
            false_pos += 1
print ("Total Errors", error_cnt)
print ("False Positives ", false_pos/ float(len(predicted_labels)) * 100, "%")
print ("False Negatives ", false_neg/ float(len(predicted_labels)) * 100, "%")


shortened_predicted = []
shortened_test_label = []
for i in range(len(predicted_labels)):
    if predicted_labels[i] == 1:
        shortened_predicted.append(1)
    else:
        shortened_predicted.append(2)
    if hpc_test_labels[i] == 1:
        shortened_test_label.append(1)
    else:
        shortened_test_label.append(2)

short_class_names = ["Normal", "Anomalous"]



plot_confusion_matrix(shortened_test_label, shortened_predicted, normalize=Tru
```




```
('Total Error Count : ', 20922)
('Normal Class Error Rate : ', 68.07826750773434, '%')
('Total Error Rate : ', 84.06123186950059, '%')
('Total Errors', 20922)
('False Positives ', 18.799469645224796, '%')
('False Negatives ', 65.26176222427578, '%')
```



In [18]:
```
from sklearn.model_selection import train_test_split

train_data, test_data, train_labels, test_labels = train_test_split(dtn_data,
                                                                    dtn_anom_ty
pe_data_labels, test_size=0.45, random_state=3)
```

predicted_labels = clf.predict(hpc_test_data)

from sklearn.metrics import confusion_matrix

class_names = ["Normal", "Corrupt", "Delay", "Duplicate"]

plot_confusion_matrix(hpc_test_labels, predicted_labels, normalize=True,classes=class_names, title='Confusion Matrix') plt.show()

error_cnt = 0 total_error_cnt = 0 same_class_error = 0 for i in range(len(predicted_labels)): if predicted_labels[i] != hpc_test_labels[i]: total_error_cnt += 1

```
        # if its normal data
        if predicted_labels[i] == 1 or hpc_test_labels[i] == 1:
            error_cnt += 1
```

print ("Total Error Count : ", total_error_cnt) print ("Normal Class Error Rate : ", float(error_cnt)/float(len(predicted_labels)) *100, "%") print ("Total Error Rate : ", float(total_error_cnt)/float(len(predicted_labels))* 100, "%")

false_pos = 0 false_neg = 0 error_cnt = 0 for i in range(len(predicted_labels)):

```
    # if there's an error
    if predicted_labels[i] != hpc_test_labels[i]:
        error_cnt += 1
        # if we failed to detect anomaly
        if predicted_labels[i] == 1:
            false_neg += 1
        # detected anomaly, but it normal
        else:
            false_pos += 1
```

print ("Total Errors", error_cnt) print ("False Positives ", false_pos/ float(len(predicted_labels)) *100, "%") print ("False Negatives ", false_neg/ float(len(predicted_labels))* 100, "%")

shortened_predicted = [] shortened_test_label = [] for i in range(len(predicted_labels)): if predicted_labels[i] == 1: shortened_predicted.append(1) else: shortened_predicted.append(2) if hpc_test_labels[i] == 1: shortened_test_label.append(1) else: shortened_test_label.append(2)

short_class_names = ["Normal", "Anomalous"]

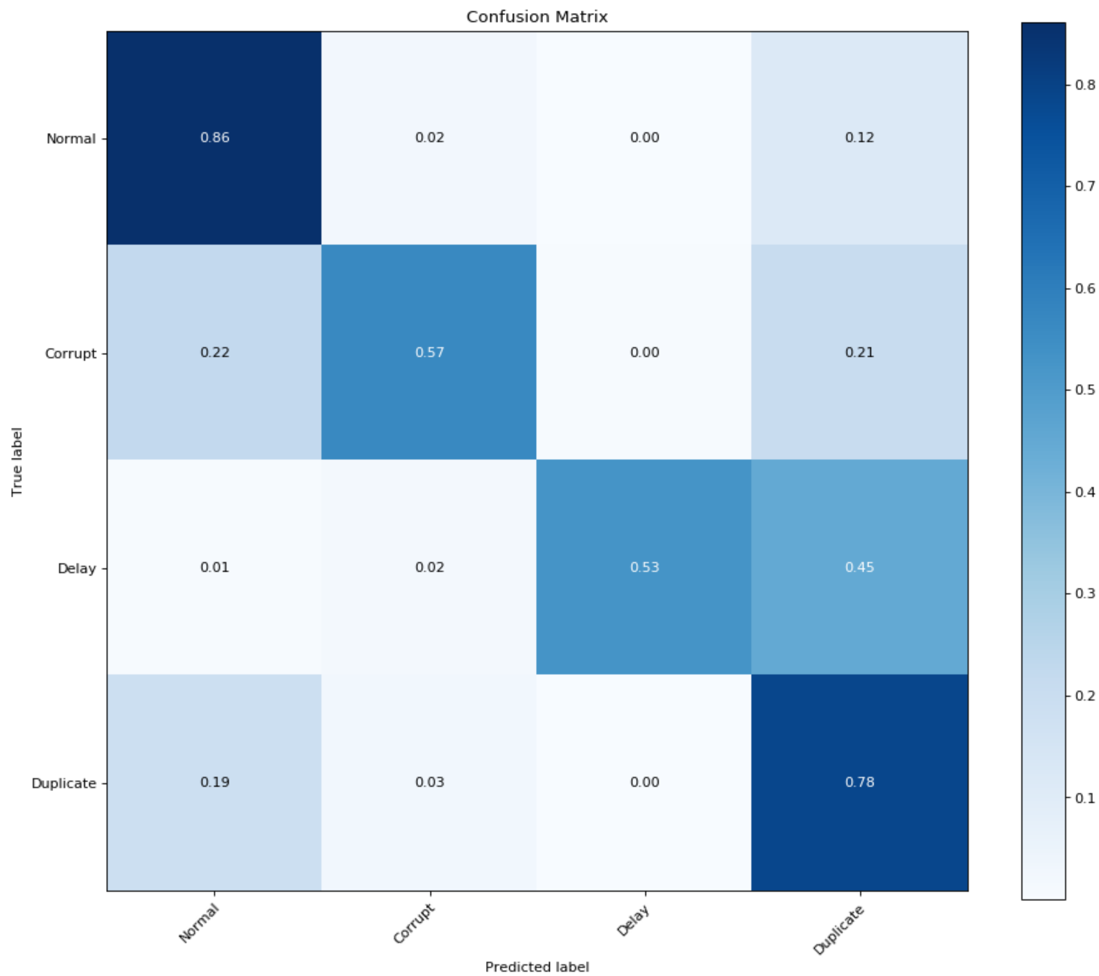
plot_confusion_matrix(shortened_test_label, shortened_predicted, normalize=True,classes=short_class_names, title='Confusion Matrix', font_size=18, fig_size=(6,5)) plt.show()

DTN Data on HPC trained SVM

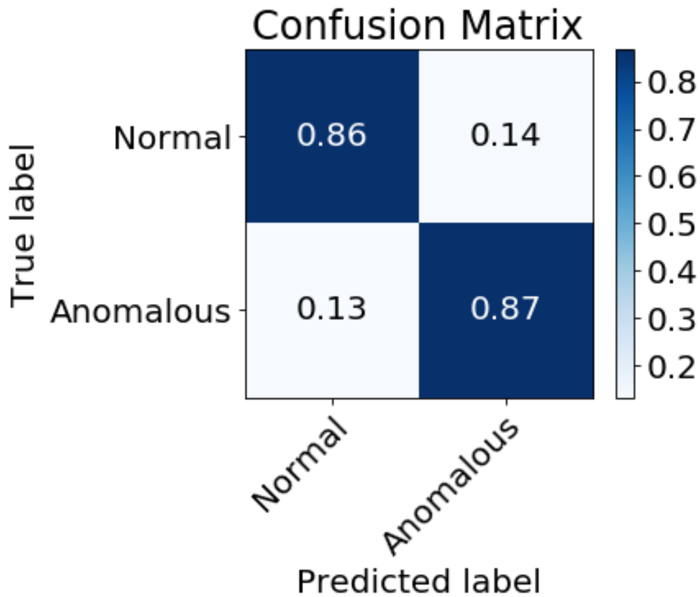
In [19]:
```
from sklearn.model_selection import train_test_split

hpc_train_data, hpc_test_data, hpc_train_labels, hpc_test_labels = train_test_s
plit(hpc_data,
                                                                                hpc_anom_ty
pe_data_labels, test_size=0.45, random_state=3)
```

In [20]:
```
clf = svm.SVC(kernel='linear', gamma ='auto', max_iter=1000000000, class_weigh
t='balanced')
clf.fit(hpc_train_data, hpc_train_labels)
predicted_labels = clf.predict(test_data)
```

In [21]:
```
predicted_labels = clf.predict(hpc_test_data)

from sklearn.metrics import confusion_matrix

class_names = ["Normal", "Corrupt", "Delay", "Duplicate"]

plot_confusion_matrix(hpc_test_labels, predicted_labels, normalize=True,classe
s=class_names, title='Confusion Matrix')
plt.show()

error_cnt = 0
total_error_cnt = 0
same_class_error = 0
for i in range(len(predicted_labels)):
    if predicted_labels[i] != hpc_test_labels[i]:
        total_error_cnt += 1
        # if its normal data
        if predicted_labels[i] == 1 or hpc_test_labels[i] == 1:
            error_cnt += 1


print ("Total Error Count : ", total_error_cnt)
print ("Normal Class Error Rate : ", float(error_cnt)/float(len(predicted_label
s)) * 100, "%")
print ("Total Error Rate : ", float(total_error_cnt)/float(len(predicted_label
s)) * 100, "%")


false_pos = 0
false_neg = 0
error_cnt = 0
for i in range(len(predicted_labels)):
    # if there's an error
    if predicted_labels[i] != hpc_test_labels[i]:
        error_cnt += 1
        # if we failed to detect anomaly
        if predicted_labels[i] == 1:
            false_neg += 1
        # detected anomaly, but it normal
        else:
            false_pos += 1
print ("Total Errors", error_cnt)
print ("False Positives ", false_pos/ float(len(predicted_labels)) * 100, "%")
print ("False Negatives ", false_neg/ float(len(predicted_labels)) * 100, "%")


shortened_predicted = []
shortened_test_label = []
for i in range(len(predicted_labels)):
    if predicted_labels[i] == 1:
        shortened_predicted.append(1)
    else:
        shortened_predicted.append(2)
    if hpc_test_labels[i] == 1:
        shortened_test_label.append(1)
    else:
        shortened_test_label.append(2)

short_class_names = ["Normal", "Anomalous"]



plot_confusion_matrix(shortened_test_label, shortened_predicted, normalize=Tru
```




```
('Total Error Count : ', 8427)
('Normal Class Error Rate : ', 13.45976134035116, '%')
('Total Error Rate : ', 33.858330989593796, '%')
('Total Errors', 8427)
('False Positives ', 21.262405078548756, '%')
('False Negatives ', 12.59592591104504, '%')
```



Merge Data

In [22]:
```
from sklearn.model_selection import train_test_split

hpc_train_data, hpc_test_data, hpc_train_labels, hpc_test_labels = train_test_s
plit(hpc_data,
                                                                     hpc_anom_ty
pe_data_labels, test_size=0.45, random_state=3)
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: