Assignment2

June 8, 2017

1 Load the dataset

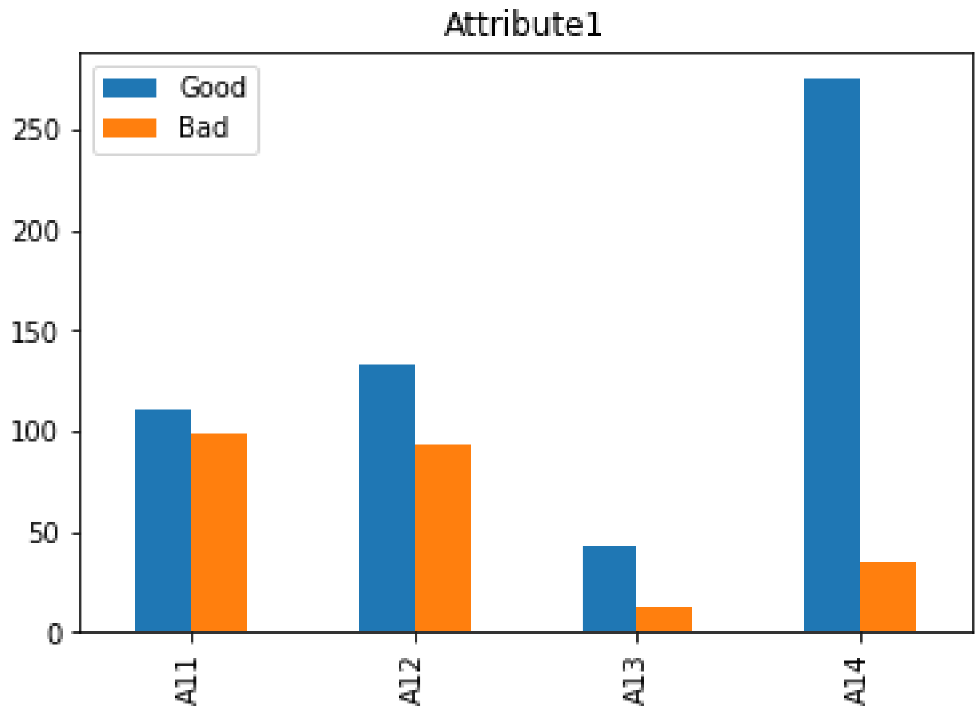
```
In [1]: import pandas as pd
        df=pd.read_csv("datasets/train.tsv",delimiter="\t")
        df_good=df[df["Label"]==1]
        df_bad=df[df["Label"]==2]
        print("Done reading")
```

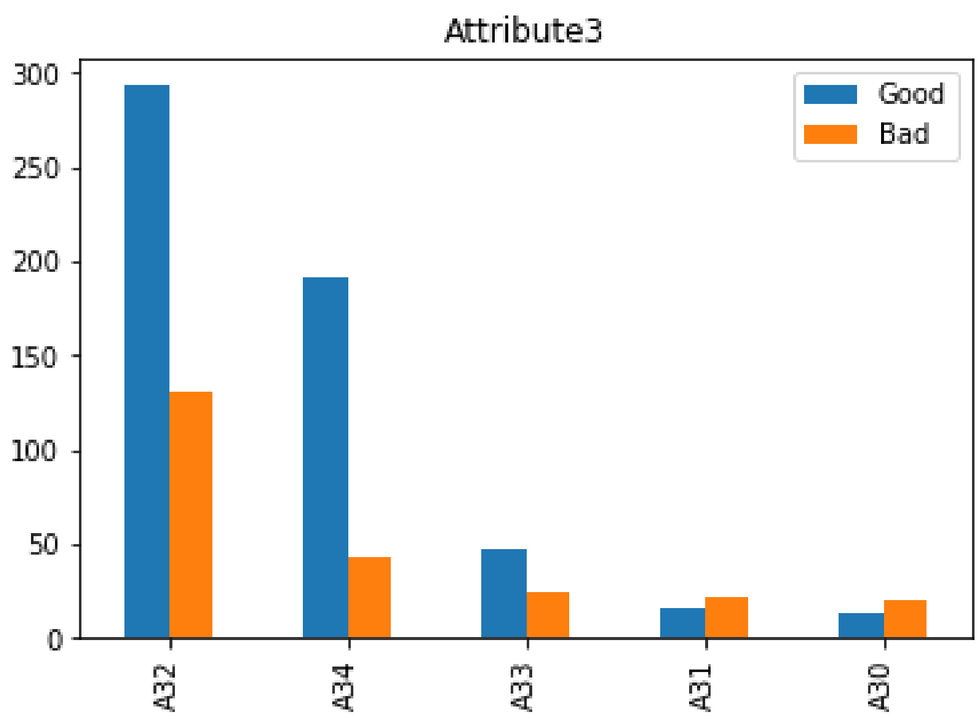
```
Done reading
```

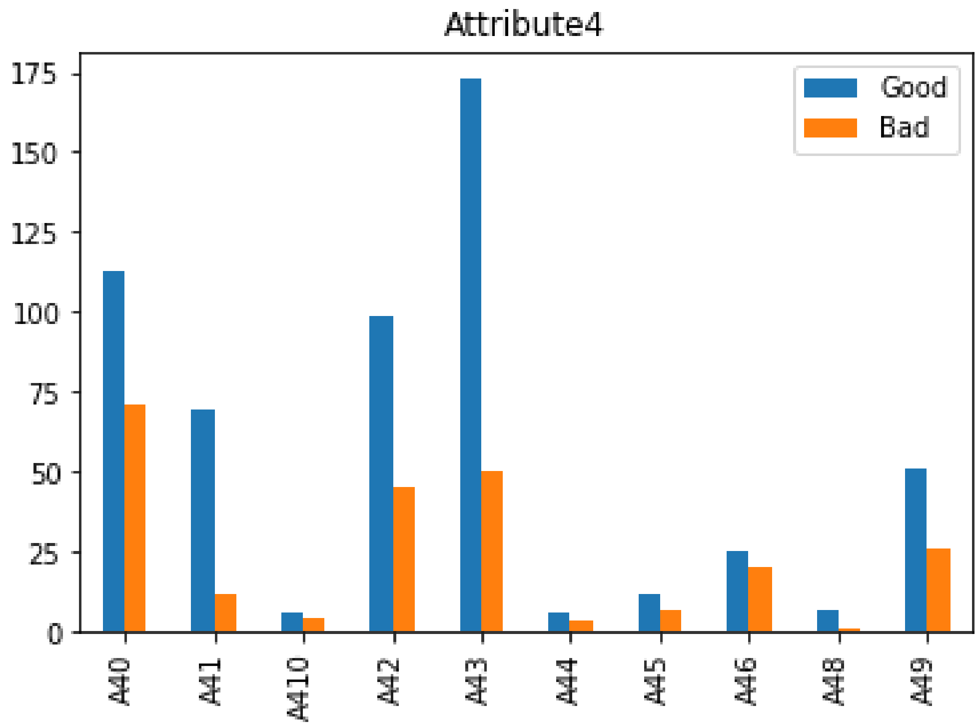
2 Categorical Histograms

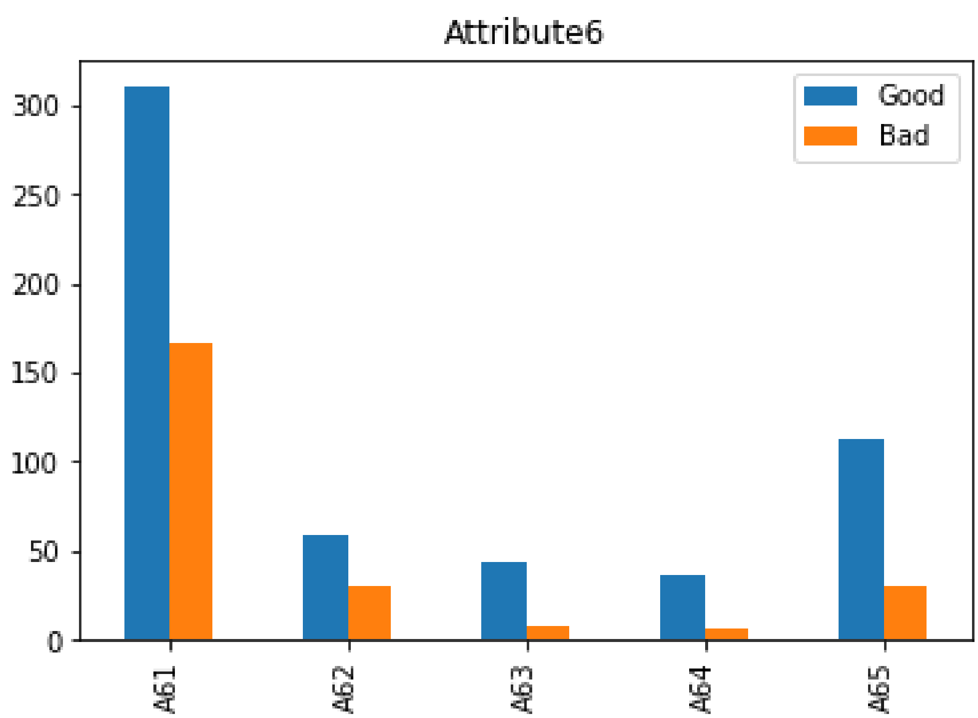
Observing the histograms,We think that attribute1,attribute3,attribute4 and attribute7 can provide significant information as they have more than 3 values and you can see the deffernce between the goods and the bads.

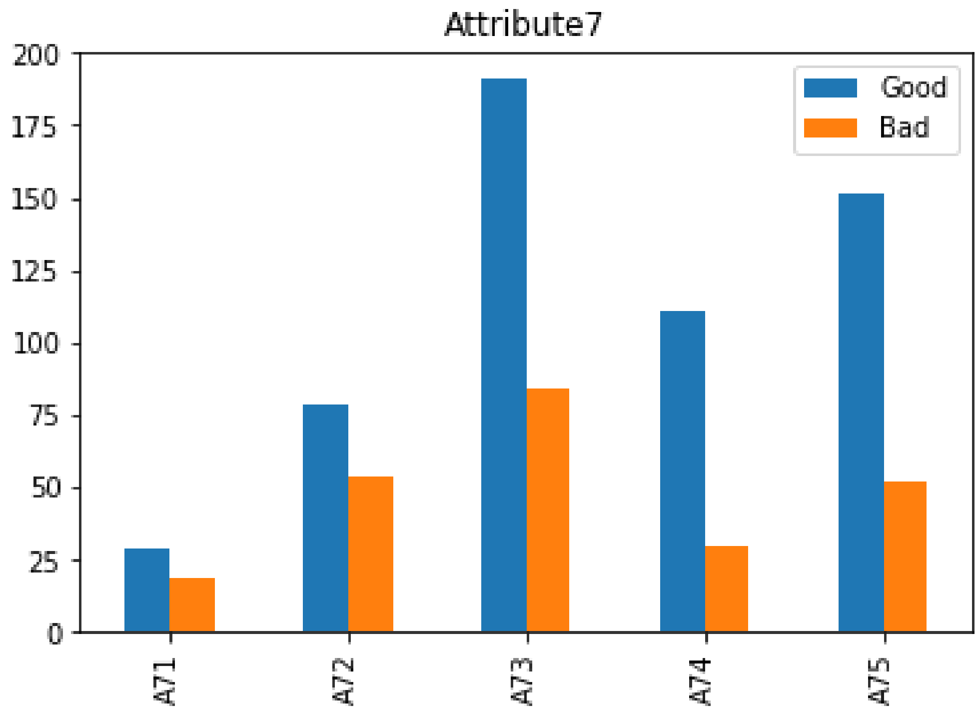
```
In [2]: import matplotlib.pyplot as plt
        cat_cat=["Attribute1","Attribute3","Attribute4","Attribute6","Attribute7","
                 "Attribute12","Attribute14","Attribute15","Attribute17","Attribute
        for a_cat in cat_cat:
            new_df=pd.DataFrame({"Good":df_good[a_cat].value_counts(),"Bad":df_bad[
                                 columns=["Good","Bad"])
            new_df.plot(kind="bar",title=a_cat)
            plt.show()
```

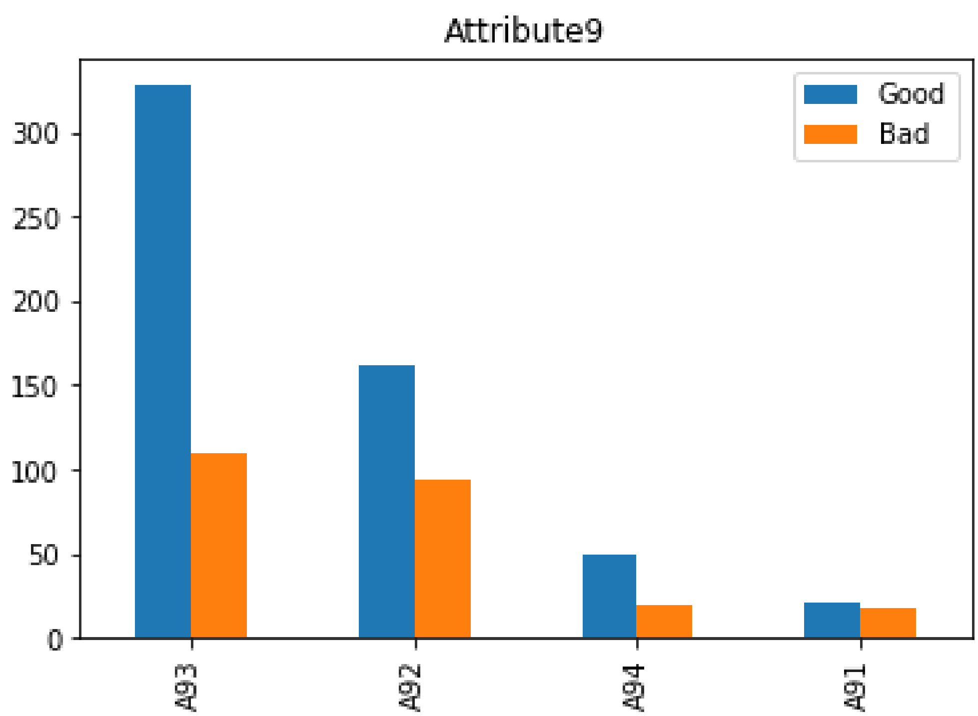

Attribute1
Good
Bad
250
200
150
100
50
0
A11
A12
A13
A14

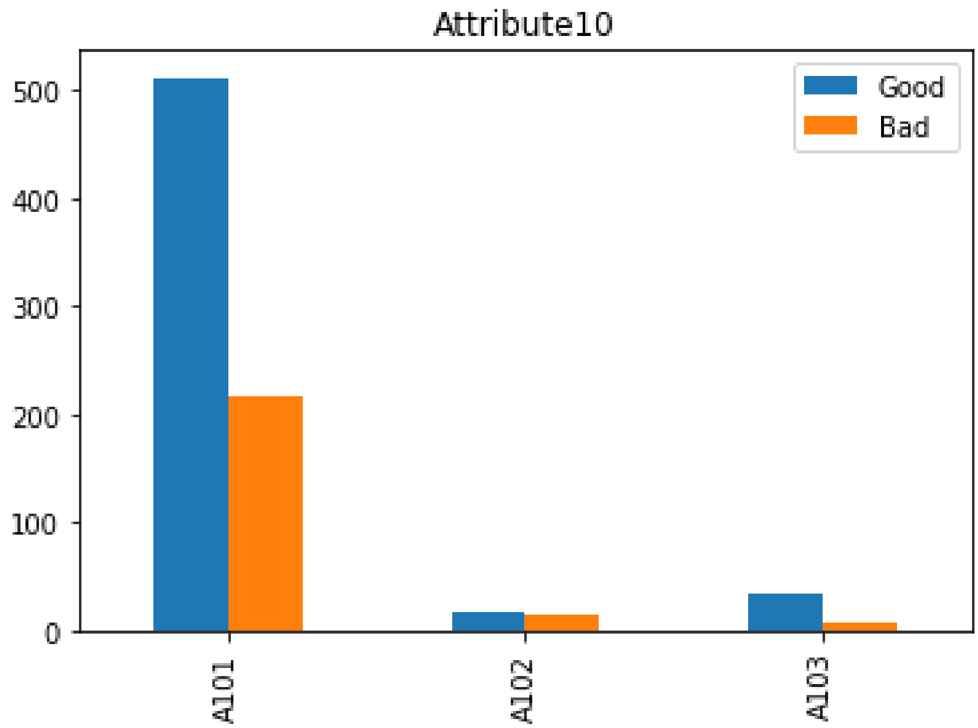

Attribute3
Good
Bad
300
250
200
150
100
50
0
A32
A34
A33
A31
A30

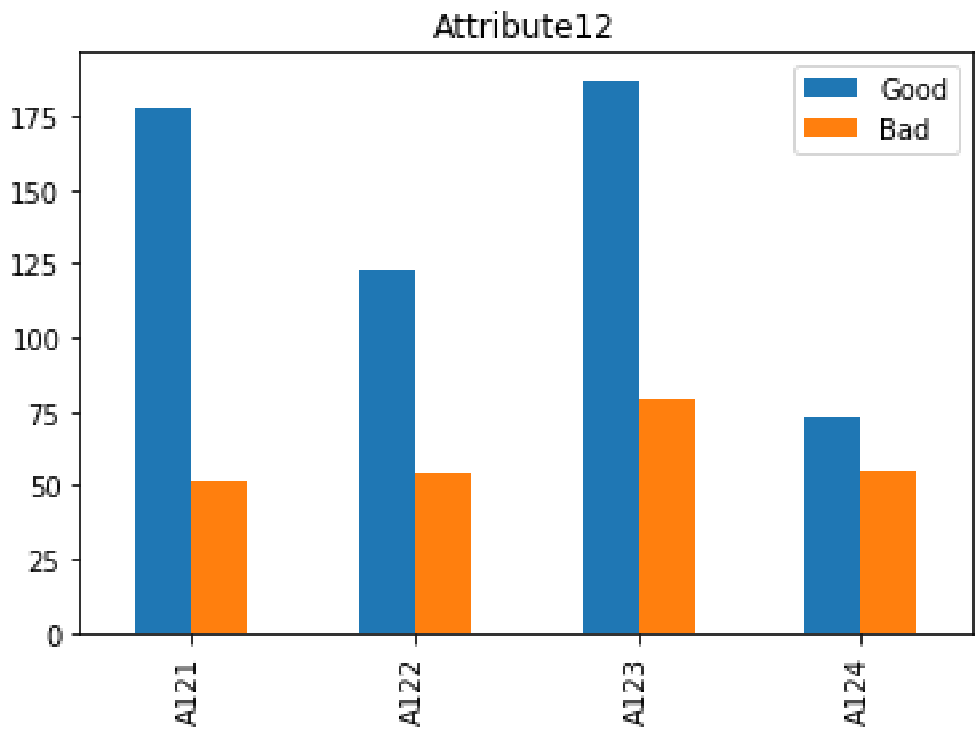

Attribute4
Good
Bad
175
150
125
100
75
50
25
0
A40
A41
A410
A42
A43
A44
A45
A46
A48
A49

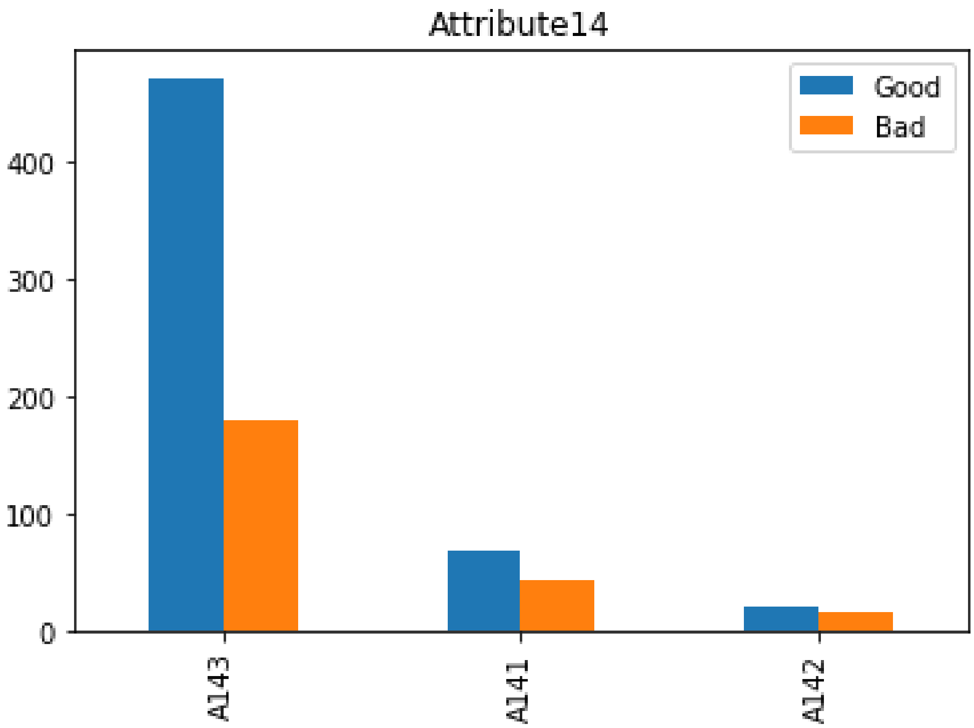

Attribute6
Good
Bad
300
250
200
150
100
50
0
A61
A62
A63
A64
A65

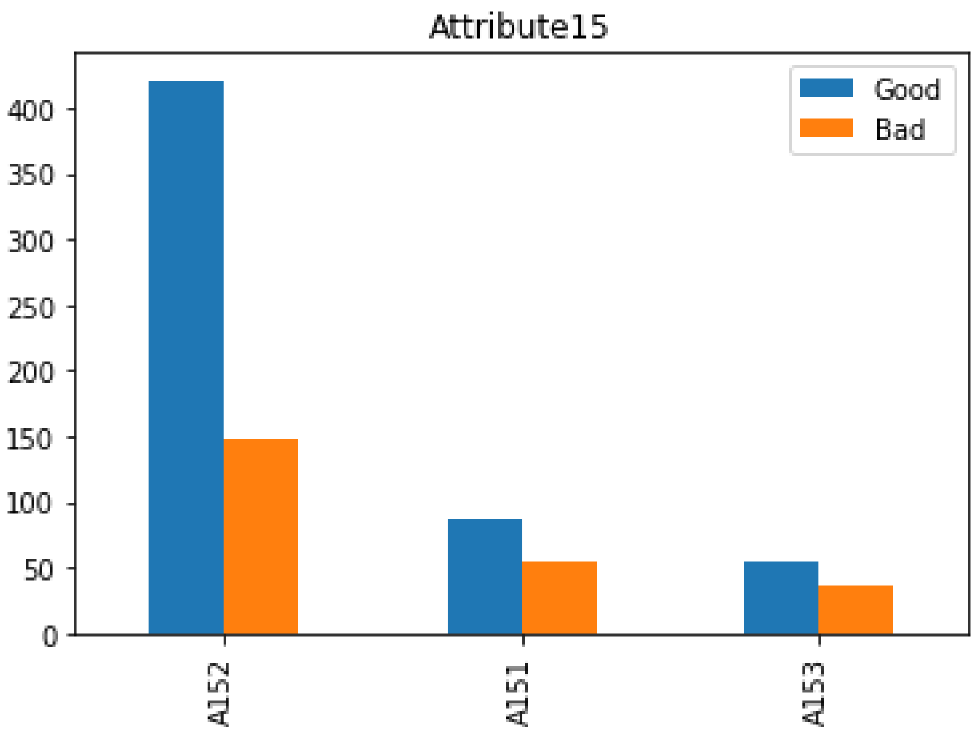

Attribute7
Good
Bad
0
25
50
75
100
125
150
175
200
A71
A72
A73
A74
A75

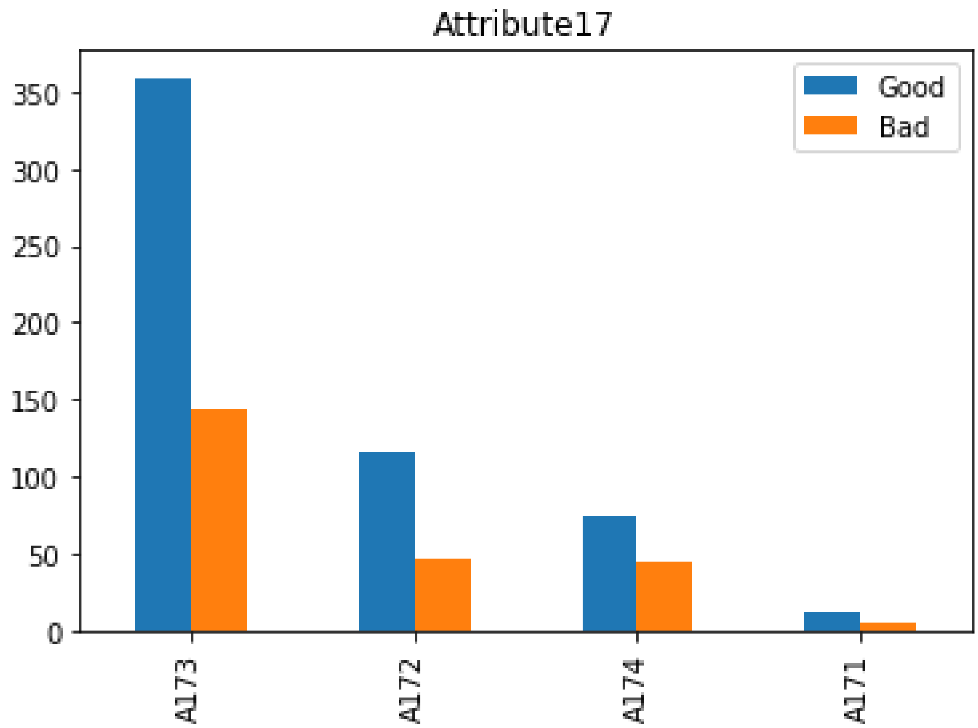

Attribute9
Good
Bad
0
50
100
150
200
250
300
A93
A92
A94
A91

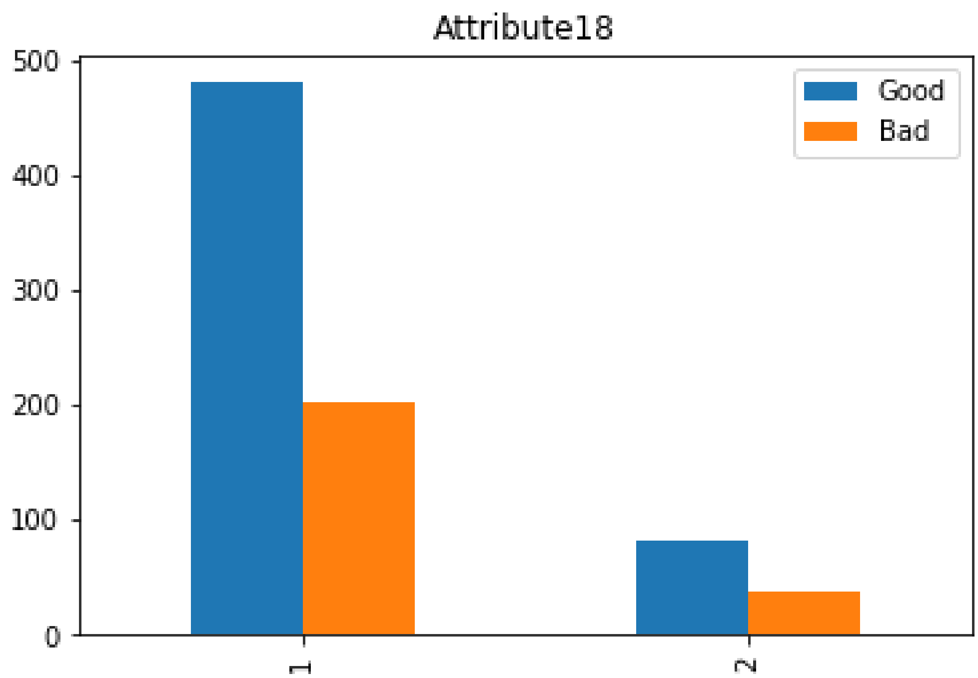

Attribute10
Good
Bad
500
400
300
200
100
0
A101
A102
A103

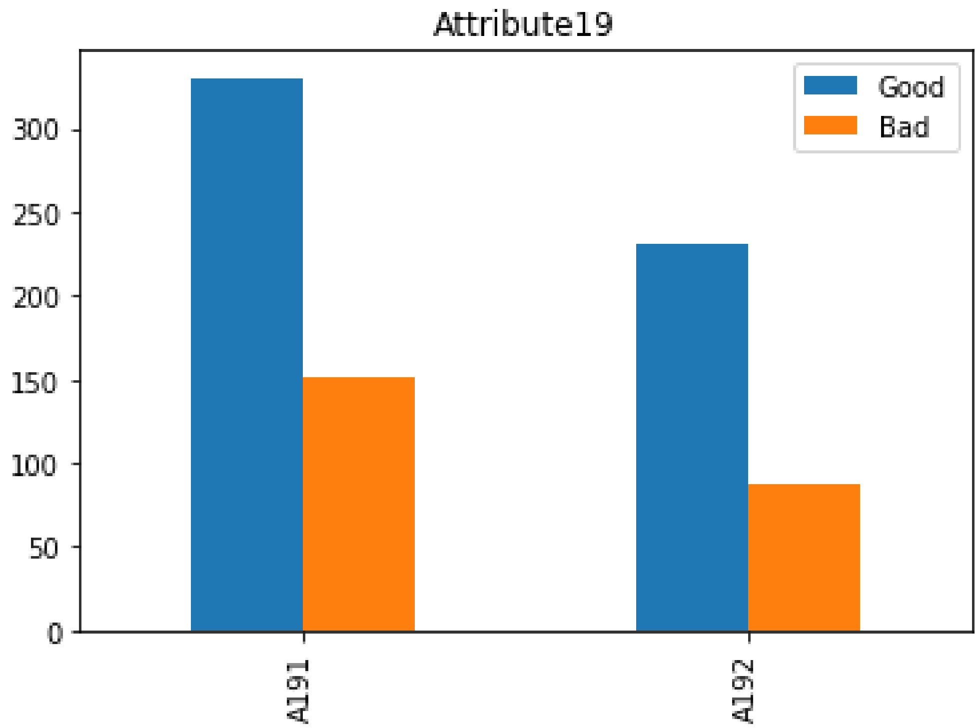

Attribute12
Good
Bad
175
150
125
100
75
50
25
0
A121
A122
A123
A124

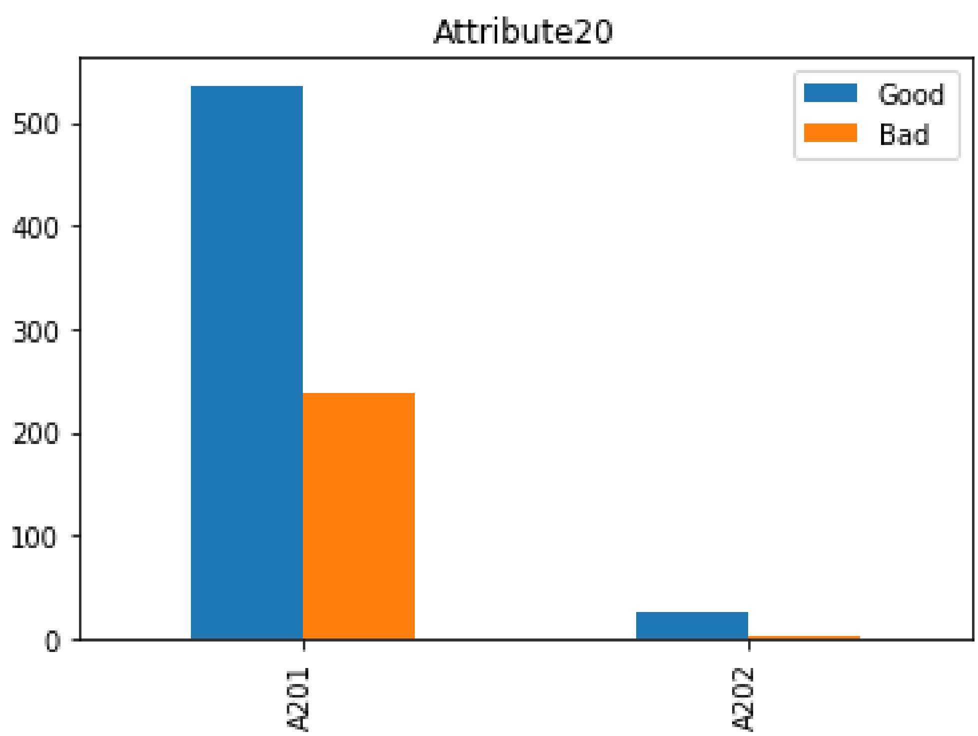

Attribute14
Good
Bad
400
300
200
100
0
A143
A141
A142


Attribute15
Good
Bad
400
350
300
250
200
150
100
50
0
A152
A151
A153


Attribute17
Good
Bad
350
300
250
200
150
100
50
0
A173
A172
A174
A171


Attribute18
Good
Bad
500
400
300
200
100
0
1
2

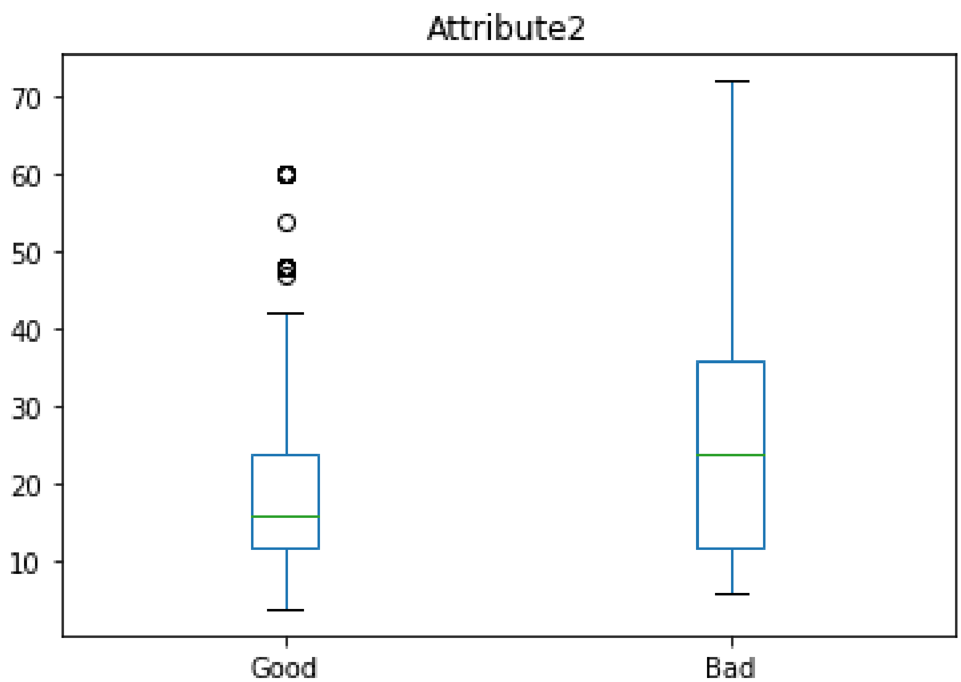

Attribute19
Good
Bad
300
250
200
150
100
50
0
A191
A192

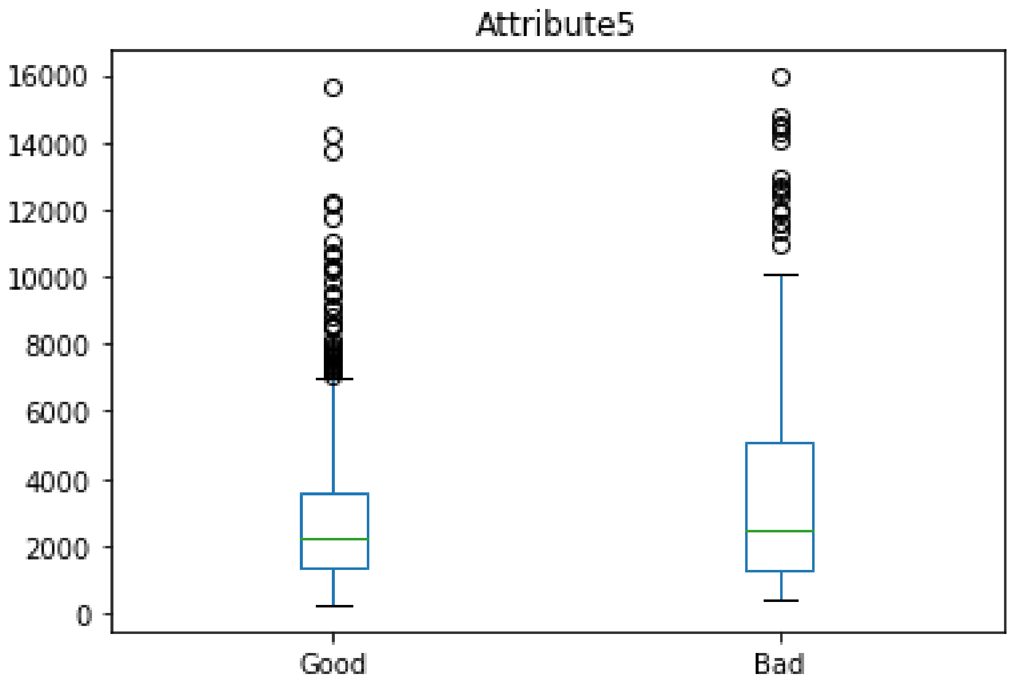

Attribute20
Good
Bad
500
400
300
200
100
0
A201
A202

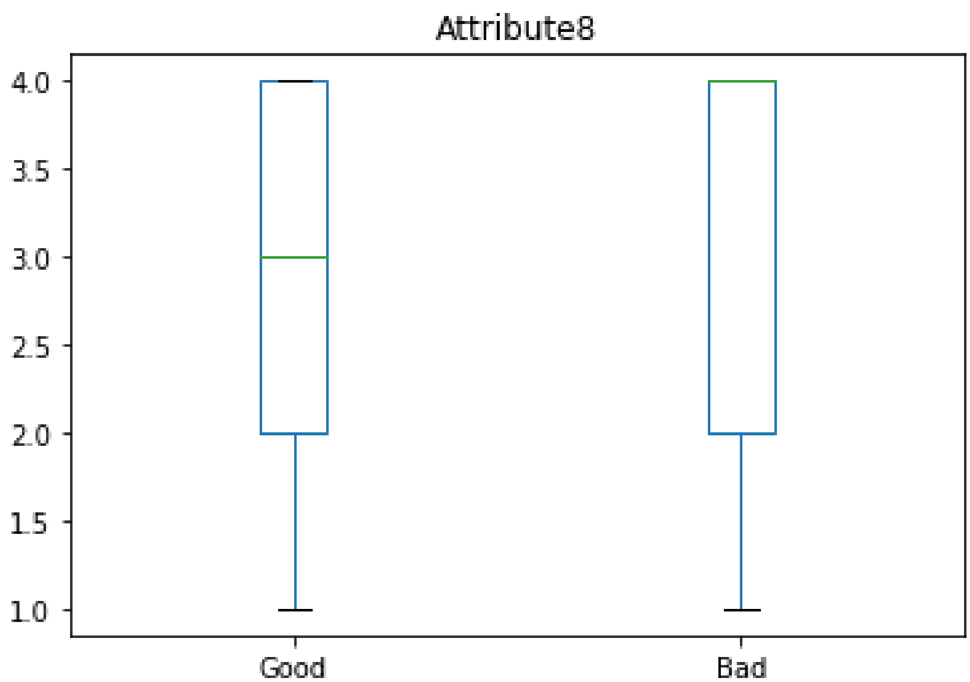
3 Numerical box plots

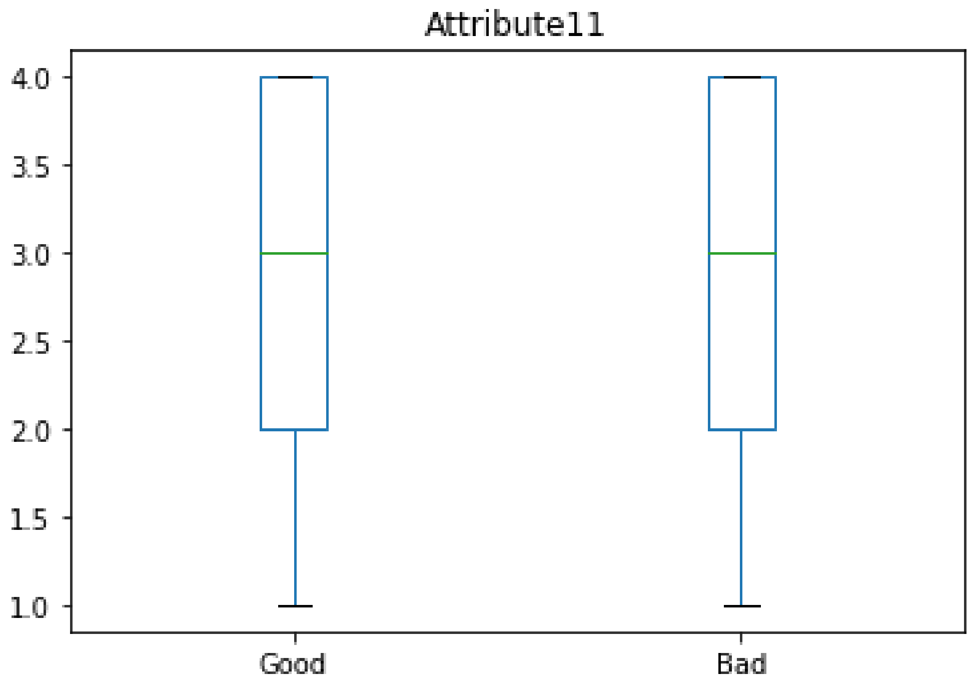
In these box plots , It's easy to say that the attribute2 and attribute5 provide significant information while the other attributes seem to be more unimportant.(Maybe Attribute8 is important?)

```
In [3]: numerical_cat=["Attribute2","Attribute5","Attribute8","Attribute11","Attrib
        for a_cat in numerical_cat:
            new_df=pd.DataFrame({"Good":df_good[a_cat],"Bad":df_bad[a_cat]},
                                columns=["Good","Bad"])
            new_df.plot(kind="box",title=a_cat)
            plt.show()
```

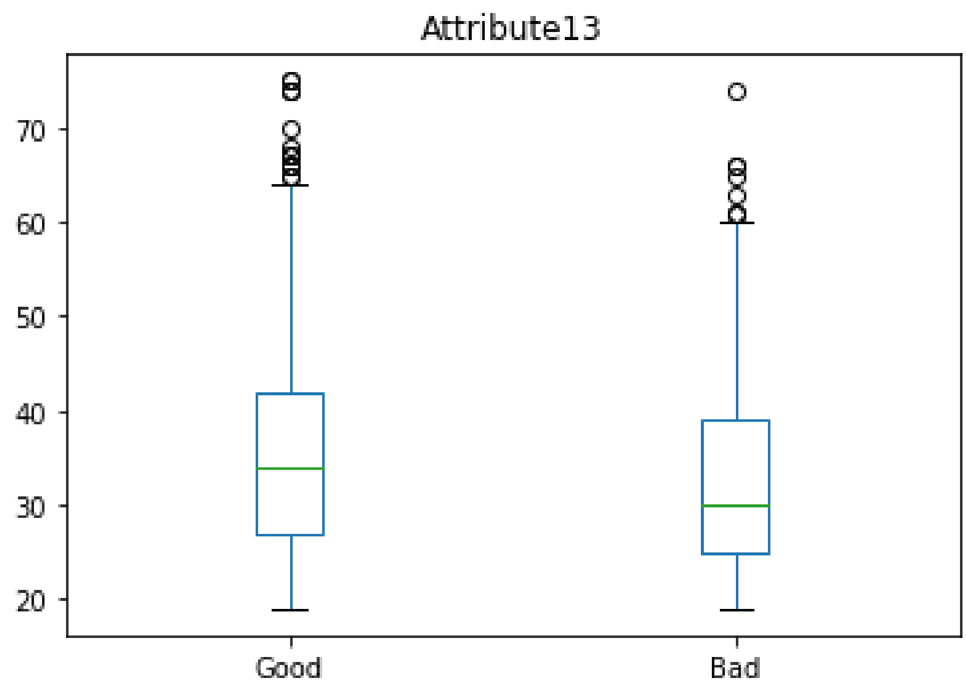



Attribute5
16000
14000
12000
10000
8000
6000
4000
2000
0
Good
Bad

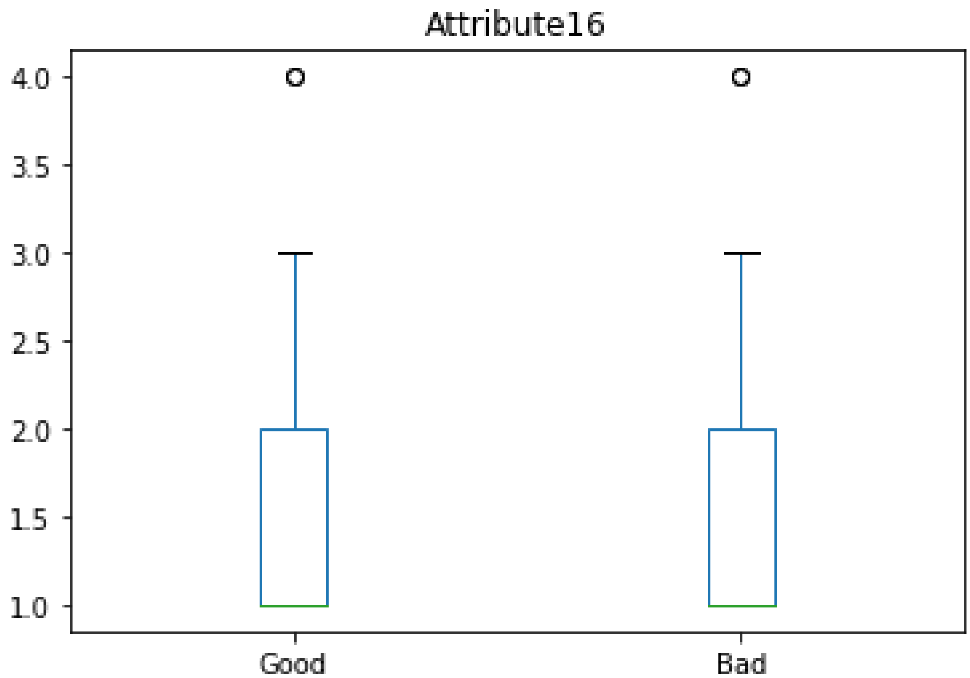

Attribute8
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Good
Bad



Attribute11
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Good
Bad



Attribute13
70
60
50
40
30
20
Good
Bad



4 Classifiers

Convert categorical in numeratic and cut the id and label columns

```
In [4]: #Copy the dataset
        cat_trans=dict()
        new_df=df.copy()
        for a_cat in cat_cat:
            the_cat_new=pd.Categorical(df[a_cat])
            cat_trans[a_cat]=the_cat_new.categories
            new_df[a_cat]=the_cat_new.codes

        #cut the unnecessary
        cat_not_needed=["Label","Id"]
        cat_needed=df.columns.difference(cat_not_needed)
        all_results=dict()
```

5 Random Forest

```
In [5]: from sklearn.ensemble import RandomForestClassifier
        from sklearn.model_selection import KFold
        from sklearn.metrics import accuracy_score
```

```
n_splits=10
kf = KFold(n_splits=n_splits,shuffle=True)
avg_acc=0
for train,test in kf.split(new_df[cat_needed]):
    #geting the correct slices
    my_data=new_df[cat_needed].loc[train]
    labels=new_df["Label"][train]
    #initializeing and fiting the Classifier
    rf_clf=RandomForestClassifier()
    rf_clf.fit(my_data,labels)
    #geting the predictions
    my_pred=rf_clf.predict(new_df[cat_needed].loc[test])
    #the metrics
    acc=accuracy_score(new_df["Label"][test],my_pred)
    avg_acc+=acc/n_splits
print(avg_acc)
all_results["Random Forest"]=avg_acc
```

```
0.74125
```

6 SVM

```
In [6]: from sklearn import svm
        n_splits=10
        kf = KFold(n_splits=n_splits,shuffle=True)
        avg_acc=0
        for train,test in kf.split(new_df[cat_needed]):
            #initializeing and fiting the Classifier
            svm_clas=svm.SVC()
            #geting the correct slices
            my_data=new_df[cat_needed].loc[train]
            labels=new_df["Label"][train]
            svm_clas.fit(my_data,labels)
            #geting the predictions
            my_pred=svm_clas.predict(new_df[cat_needed].loc[test])
            #the metrics
            acc=accuracy_score(new_df["Label"][test],my_pred)
            avg_acc+=acc/n_splits
        print(avg_acc)
        all_results["SVM"]=avg_acc
```

```
0.70125
```

7 Naive Bayes (Gaussian NB)

```
In [7]: from sklearn.naive_bayes import GaussianNB
        n_splits=10
        kf = KFold(n_splits=n_splits,shuffle=True)
        avg_acc=0
        for train,test in kf.split(new_df[cat_needed]):
            #initializeing and fiting the Classifier
            nbg=GaussianNB()
            #geting the correct slices
            my_data=new_df[cat_needed].loc[train]
            labels=new_df["Label"][train]
            nbg.fit(my_data,labels)
            #geting the predictions
            my_pred=nbg.predict(new_df[cat_needed].loc[test])
            #the metrics
            acc=accuracy_score(new_df["Label"][test],my_pred)
            avg_acc+=acc/n_splits
        print(avg_acc)
        all_results["Naive Bayes"]=avg_acc
```

```
0.725
```

8 Write the file of the classifiers

```
In [8]: my_file=open("Evalution_Metric_10fold.csv","w")
        for a_clasifier in ["Static Measure","Naive Bayes","Random Forest","SVM"]:
            my_file.write(a_clasifier+"\t")
        my_file.write("\n")
        my_file.write("Accuracy\t")
        for a_clasifier in ["Naive Bayes","Random Forest","SVM"]:
            my_file.write("%.2f\t" % all_results[a_clasifier])
        my_file.write("\n")
        my_file.write("\n")
        my_file.close()
        print("Done writting Evalution_Metric_10fold.csv ")
```

```
Done writting Evalution_Metric_10fold.csv
```

9 Calculation of Every Information Gain

```
In [9]: from collections import Counter
        from math import log

        def my_log(number):
```

```
    if(number<=0):
        return 0.0
    else:
        return log(number)

count_goods=len(df[df["Label"]==1])
count_bads=len(df[df["Label"]==2])
amount=count_goods+count_bads

pos_goods=count_goods/amount
pos_bad=count_bads/amount

df_entropy=-pos_goods*my_log(pos_goods)-pos_bad*my_log(pos_bad)
# attributes that must group
change=["Attribute2","Attribute5","Attribute13"]
# entropy of every feature
endropy_dict=dict()
# information gain of every feature with this dataset
information_gain=dict()
# posibility of every value of every feature
total_pos=dict()
for feature in df[cat_needed].columns:
    counter_good=Counter()
    counter_bad=Counter()
    counter_att=Counter()

    #for one feature
    feature_df=df[feature]
    #if needed, group it
    if(feature in change):
        feature_df=pd.qcut(df[feature],5)
    #count for every value the number of good and bad
    for i in range(amount):
        counter_att[feature_df[i]]+=1
        if df["Label"][i]==1:
            counter_good[feature_df[i]]+=1
        else:
            counter_bad[feature_df[i]]+=1
# posibility of every value from an attribute
    bad=dict()
    good=dict()
    pos=dict()
    for att in counter_att:
        pos[att]=(counter_att[att]/amount)
        good[att]=(counter_good[att]/counter_att[att])
        bad[att]=(counter_bad[att]/counter_att[att])
# entropy of every value from an attribute
    temp_endropy_dict=dict()
```

```
        for att in pos:
            endropy=-good[att]*my_log(good[att])-bad[att]*my_log(bad[att])
            temp_endropy_dict[att]=endropy
        total_pos[feature]=pos
        #global dict of entropy from every value every feature
        endropy_dict[feature]=temp_endropy_dict
    #information gain of every feature
    for feature in endropy_dict:
        temp_sum=0
        for att in total_pos[feature]:
            temp_sum+=total_pos[feature][att]*endropy_dict[feature][att]
        information_gain[feature]=df_entropy-temp_sum
```

10 Random Forest - All accuracies

One feature is taken out in each loop

```
In [20]: from collections import OrderedDict

         from sklearn.ensemble import RandomForestClassifier
         from sklearn.model_selection import KFold
         from sklearn.metrics import accuracy_score

         def get_accur(cur_df,cat_use):
             n_splits=10
             kf = KFold(n_splits=n_splits,shuffle=True)
             avg_acc=0
             for train,test in kf.split(cur_df[cat_use]):
                 #geting the correct slices
                 my_data=cur_df[cat_use].loc[train]
                 labels=cur_df["Label"][train]
                 #initializeing and fiting the Classifier
                 rf_clf=RandomForestClassifier(random_state=123)
                 rf_clf.fit(my_data,labels)
                 #geting the predictions
                 my_pred=rf_clf.predict(cur_df[cat_use].loc[test])
                 #the metrics
                 acc=accuracy_score(cur_df["Label"][test],my_pred)
                 avg_acc+=acc/n_splits
             return avg_acc


         information_gain_sorted=[(k,information_gain[k]) for k in sorted(informati

         new_cat_not_needed=cat_not_needed.copy()
         values=[]
```

```
x_data=[]
for num_feature,feature in zip(range(len(information_gain_sorted)-1,0,-1),
    new_cat_not_needed.append(feature[0])
    new_cat_needed=df.columns.difference(new_cat_not_needed)
    cur_accur=get_accur(new_df,new_cat_needed)
    values.insert(0,cur_accur)
    sort_name=feature[0].replace("Attribute","A")
    x_data.insert(0,sort_name+"#"+str(num_feature))
```

11 Table with the features and information gains

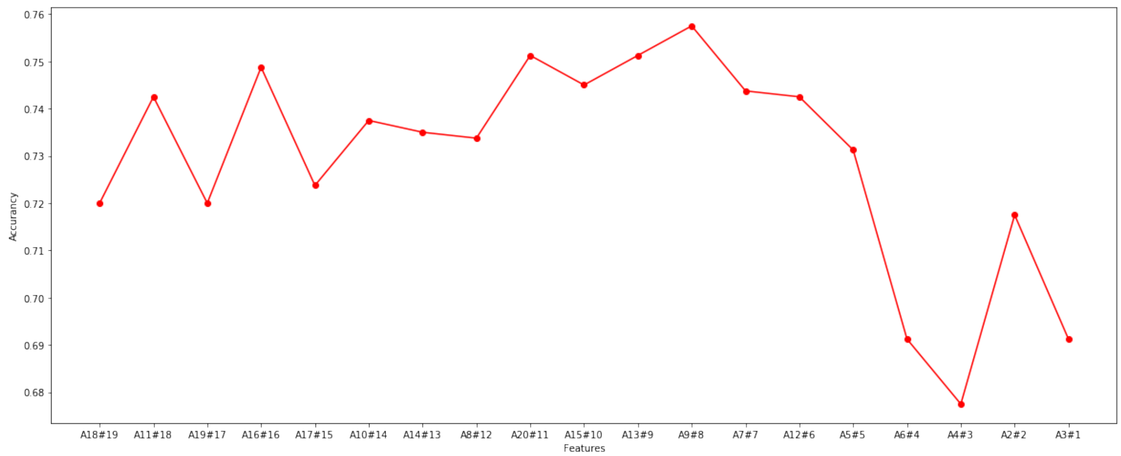
```
In [21]: # print(information_gain_sorted)
         print("---------------------------------------------")
         print("| Feature              | Information Gain    |")
         print("---------------------------------------------")
         for feat in information_gain_sorted:
             print("|  %15s    | %15f      |" %(feat[0],feat[1]))
         print("---------------------------------------------")
```

```
---------------------------------------------
| Feature              | Information Gain    |
---------------------------------------------
|      Attribute18     |        0.000090     |
|      Attribute11     |        0.000153     |
|      Attribute19     |        0.000834     |
|      Attribute16     |        0.001661     |
|      Attribute17     |        0.002038     |
|      Attribute10     |        0.003933     |
|      Attribute14     |        0.004881     |
|       Attribute8     |        0.005081     |
|      Attribute20     |        0.005340     |
|      Attribute15     |        0.008054     |
|      Attribute13     |        0.008141     |
|       Attribute9     |        0.008835     |
|       Attribute7     |        0.010084     |
|      Attribute12     |        0.010332     |
|       Attribute5     |        0.010601     |
|       Attribute6     |        0.015387     |
|       Attribute4     |        0.018644     |
|       Attribute2     |        0.022030     |
|       Attribute3     |        0.026263     |
|       Attribute1     |        0.065037     |
---------------------------------------------
```

12 Plot with the different amount of features

We chose the state tha we have 8 attributes(at the point that we take out the attribute9) , because after some executions this point has a good accuracy almost every time.

```
In [22]: import numpy as np
         x_np=np.array(range(len(information_gain_sorted)-1,0,-1))
         plt.figure(figsize=(20, 8))
         plt.xticks(x_np,x_data)
         plt.plot(x_np,values,"ro-")
         plt.xlabel("Features")
         plt.ylabel("Accurancy")
         plt.show()
```



13 Random Forest For The Test Set

We use some of the features

```
In [23]: #Keep the best categories from the research we did above
         best_cat_not_needed=cat_not_needed.copy()
         best_cat_not_needed+=["Attribute18","Attribute11","Attribute19","Attribute
         best_cat_needed=df.columns.difference(best_cat_not_needed)
```

```
In [24]: test_df=pd.read_csv("datasets/test.tsv",delimiter="\t")
         # print(test_df)
         final_test_df=test_df[best_cat_needed].copy()
         for a_cat in cat_cat:
             if(a_cat in best_cat_needed):
                 the_cat_new=pd.Categorical(test_df[a_cat],categories=cat_trans[a_c
                 final_test_df[a_cat]=the_cat_new.codes
```

```
In [25]: best_clf_ever=RandomForestClassifier()
         best_clf_ever.fit(new_df[best_cat_needed],new_df["Label"])
         my_predictons=best_clf_ever.predict(final_test_df)
```

14 Write The Prediction At The File

```
In [26]: my_file=open("testSet_Predictions.csv","w")
         for a_clasifier in ["Client_ID","Predicted_Label"]:
             my_file.write(a_clasifier+"\t")
         my_file.write("\n")
         for i in range(len(my_predictons)):
             my_file.write(str(test_df["Id"][i])+"\t")
             if(my_predictons[i]==1):
                 my_file.write("Good\n")
             else:
                 my_file.write("Bad\n")

         my_file.write("\n")
         my_file.close()
         print("Done writting testSet_Predictions.csv")
```

```
Done writting testSet_Predictions.csv
```

```
In [ ]:
```