Untitled

October 31, 2019

1 ALEXIS CARBILLET

```
In [1]: ## import librairies
        import pandas
        from sklearn.cluster import KMeans
        import matplotlib.pyplot as plt
        import csv
        from sklearn.model_selection import train_test_split
        from sklearn.naive_bayes import MultinomialNB
        from sklearn.linear_model import Perceptron, LogisticRegression
        from sklearn.tree import DecisionTreeClassifier
        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.svm import SVC
        from sklearn.metrics import f1_score
        from sklearn.ensemble import RandomForestClassifier
        from sklearn.neural_network import MLPClassifier
        from sklearn.model_selection import cross_val_score
        import numpy as np
        import warnings
```

```
In [2]: warnings.filterwarnings('ignore')
```

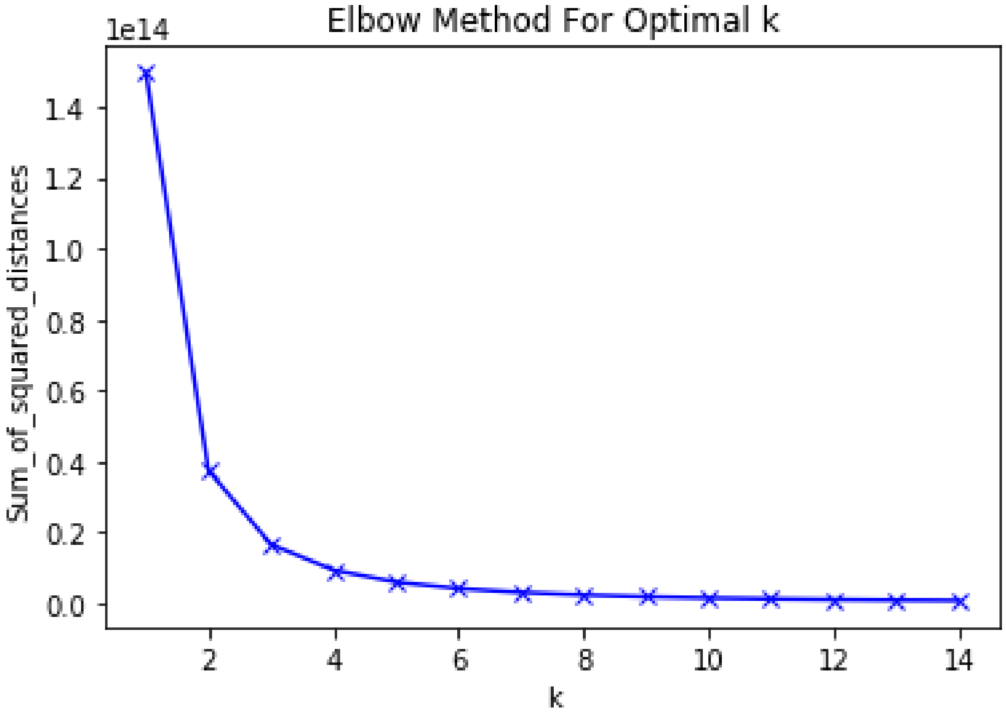
```
In [3]: ## import data
        df = pandas.read_csv('project_pump.csv', sep=';')
        (n,p)=df.shape
```

```
In [4]: ##  Preprocessing dataset
        print((n,p))
        c=df.columns.values

        c=pandas.DataFrame.transpose(pandas.DataFrame(c))
        c.columns=df.columns.values
        # simply concatenate both dataframes
        c=c.append(df)

        print(c.shape)

        df.columns = ['Unix', 'Samples','Time','Sampling', 'Data']
        m=0

        for i in range(n):
            s=df['Data'][i]
            s=s.rstrip(']')
            s=s.lstrip('[')
            s=s.split(',')
            p2=len(s)
            for j in range(p2):
                m+=float(s[j]) # replace list by its mean
            df['Data'][i]=str(m/p2)
```

```
(881, 5)
(882, 5)
```

```
In [5]: ## How many cluster?
        Sum_of_squared_distances = []
        K = range(1,15)
        for k in K:
            km = KMeans(n_clusters=k)
            km = km.fit(df)
            Sum_of_squared_distances.append(km.inertia_)

        plt.figure()
        plt.plot(K, Sum_of_squared_distances, 'bx-')
        plt.xlabel('k')
        plt.ylabel('Sum_of_squared_distances')
        plt.title('Elbow Method For Optimal k')
```

```
Out[5]: Text(0.5, 1.0, 'Elbow Method For Optimal k')
```

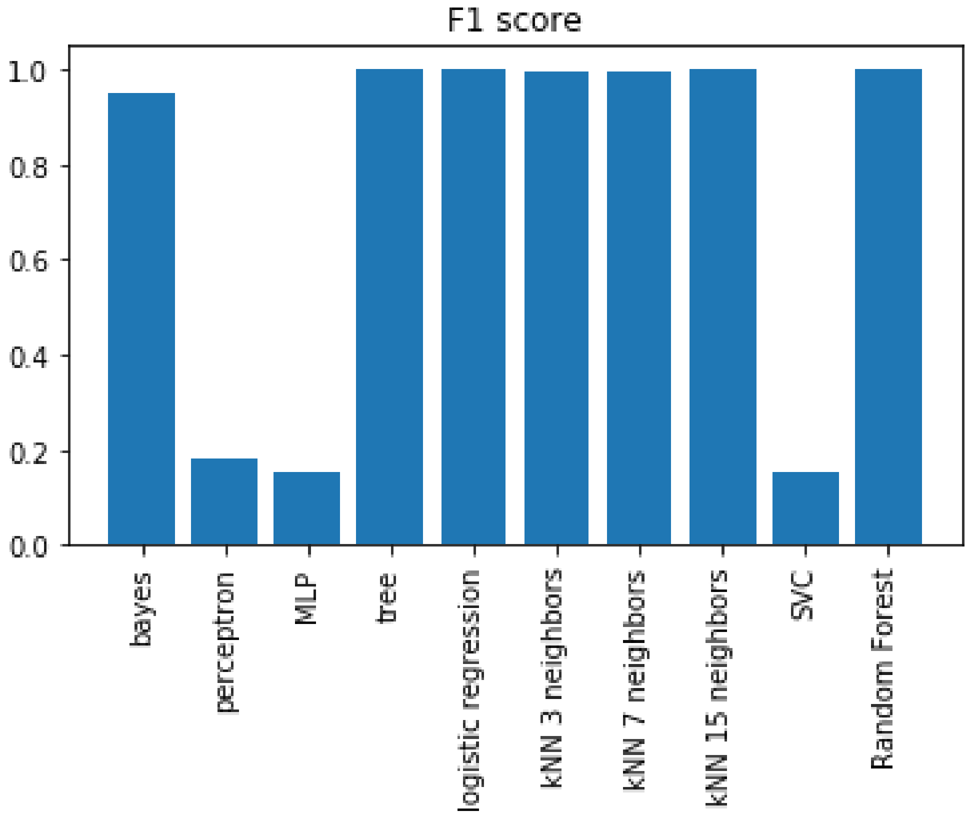


```
In [6]: ## In the plot above the elbow is at k=3 indicating the optimal k for this
        # dataset is 3
        kmeans = KMeans(n_clusters=3, random_state=0).fit(df)
```

```
In [7]: ## machine learning
        labels=kmeans.labels_

        def fit(nb,train,test,y,yt,height_f1,type):
            nb.fit(train, y)
            z=f1_score(yt, nb.predict(test),average='weighted')
            print('the f1 score obtained with ',type,' is:',z)
            height_f1.append(z)

        def ml(train,test,y,yt):
            height_f1=[]
            bars=['bayes','perceptron','MLP','tree','logistic regression','kNN 3 neighbors',
                  'kNN 7 neighbors','kNN 15 neighbors','SVC','Random Forest']
            # bayes
            nb = MultinomialNB()
            fit(nb,train,test,y,yt,height_f1,'bayes')
            # perceptron
            nb = Perceptron(tol=1e-3, random_state=0)
            fit(nb,train,test,y,yt,height_f1,'perceptron')
            # multi-layer perceptron
            nb = MLPClassifier(solver='lbfgs', alpha=1e-5,
                               hidden_layer_sizes=(5, 2), random_state=1)
            fit(nb,train,test,y,yt,height_f1,'multi-layer perceptron')
            # tree classifier
            nb = DecisionTreeClassifier(random_state=0)
            fit(nb,train,test,y,yt,height_f1,'tree')
            # logistic regression
            nb = LogisticRegression(random_state=0, solver='lbfgs',
                                    multi_class='multinomial')
            fit(nb,train,test,y,yt,height_f1,'logistic regression')
            # kNN 3
            nb = KNeighborsClassifier(n_neighbors=3)
            fit(nb,train,test,y,yt,height_f1,'kNN 3 neighbors')
            # kNN 7
            nb = KNeighborsClassifier(n_neighbors=7)
            fit(nb,train,test,y,yt,height_f1,'kNN 7 neighbors')
            # kNN 15
            nb = KNeighborsClassifier(n_neighbors=15)
            fit(nb,train,test,y,yt,height_f1,'kNN 15 neighbors')
            # SVC
            nb = SVC(gamma='auto')
            fit(nb,train,test,y,yt,height_f1,'SVC')
            # random forest
            nb = RandomForestClassifier(n_estimators=100, max_depth=2, random_state=0)
            fit(nb,train,test,y,yt,height_f1,'random forest')
            y_pos = np.arange(len(bars))
            plt.figure()

            title='F1 score'
            plt.title(title)
            plt.bar(y_pos, height_f1)  # Create bars
            plt.xticks(y_pos, bars, rotation=90) # Create names on the x-axis
            plt.subplots_adjust(bottom=0.3, top=0.95) # Custom the subplot layout
            plt.show()    # Show graphic
            print('the best one  is ',bars[height_f1.index(max(height_f1))],
                  ' with a F1 score of ',height_f1[height_f1.index(max(height_f1))])
```

```
In [8]: X_train, X_test, y_train, y_test = train_test_split( df, labels,
                                                            test_size=0.20, random_state=42)
        ml(X_train,X_test,y_train,y_test)
```

```
the f1 score obtained with  bayes  is: 0.949066391754719
the f1 score obtained with  perceptron  is: 0.1817365198685672
the f1 score obtained with  multi-layer perceptron  is: 0.15208166630295097
the f1 score obtained with  tree  is: 1.0
the f1 score obtained with  logistic regression  is: 1.0
the f1 score obtained with  kNN 3 neighbors  is: 0.9943474321779405
the f1 score obtained with  kNN 7 neighbors  is: 0.9943474321779405
the f1 score obtained with  kNN 15 neighbors  is: 1.0
the f1 score obtained with  SVC  is: 0.15208166630295097
the f1 score obtained with  random forest  is: 1.0
```



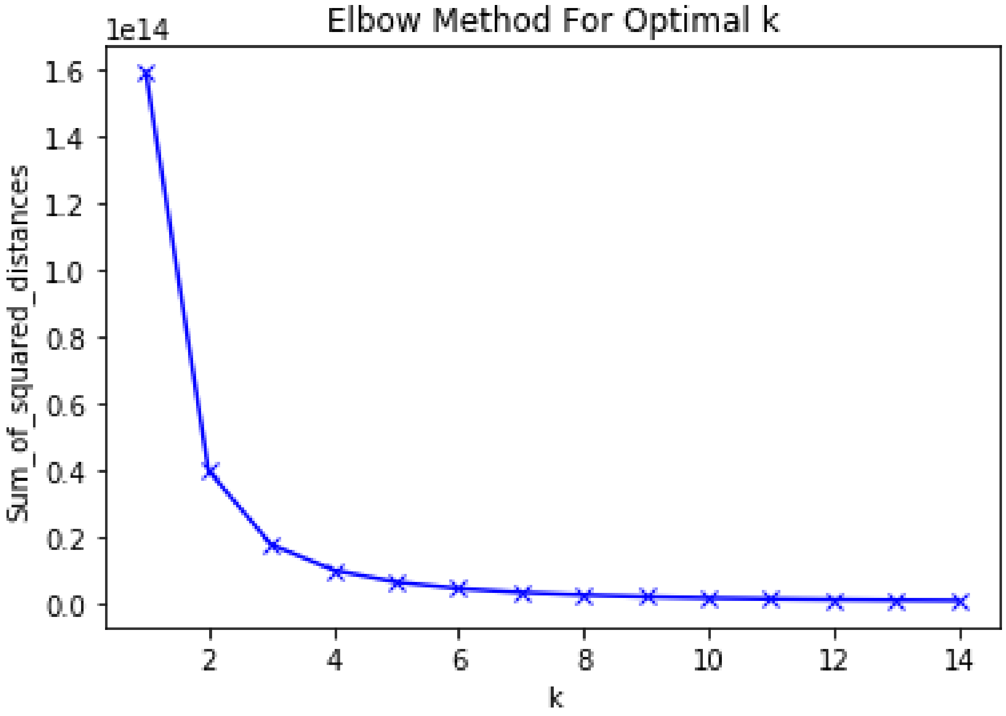
```
the best one  is  tree  with a F1 score of  1.0
```

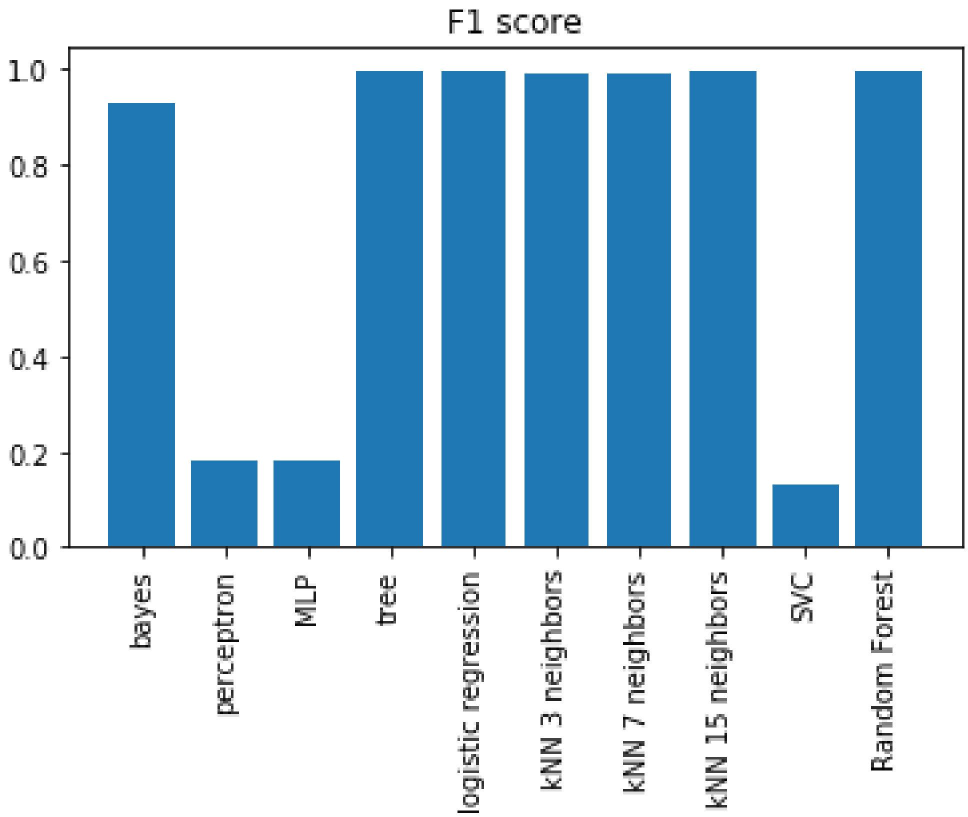
```
In [9]: ## write in a new csv the results
        df['Cluster'] = pandas.Series(labels, index=df.index)
        df.to_csv('project_pump_modified.csv')
```

```
In [10]: ## bonus
         df2 = pandas.read_csv('project_fan.csv', sep=';',
                               encoding='utf-8', engine='c')
         (n,p)=df2.shape
         print((n,p))
         c=df2.columns.values

         c=pandas.DataFrame.transpose(pandas.DataFrame(c))
         c.columns=df2.columns.values
```

```python
# simply concatenate both dataframes
c=c.append(df2)

print(c.shape)
df2.columns = ['Unix', 'Samples','Time','Sampling', 'Data']
m=0

for i in range(n):
    s=df2['Data'][i]
    s=s.rstrip(']')
    s=s.lstrip('[')
    s=s.split(',')
    p2=len(s)
    for j in range(p2):
        m+=float(s[j]) # replace list by its mean
    df2['Data'][i]=str(m/p2)

Sum_of_squared_distances = []
K = range(1,15)
for k in K:
    km = KMeans(n_clusters=k)
    km = km.fit(df2)
    Sum_of_squared_distances.append(km.inertia_)

plt.figure()
plt.plot(K, Sum_of_squared_distances, 'bx-')
plt.xlabel('k')
plt.ylabel('Sum_of_squared_distances')
plt.title('Elbow Method For Optimal k')
# still 3 states
kmeans = KMeans(n_clusters=3, random_state=0).fit(df2)
labels=kmeans.labels_
X_train, X_test, y_train, y_test = train_test_split( df2, labels,
                                                    test_size=0.20,
                                                    random_state=42)
ml(X_train,X_test,y_train,y_test)
df2['Cluster'] = pandas.Series(labels, index=df2.index)
df2.to_csv('project_fan_modified.csv')
```

```
(899, 5)
(900, 5)
the f1 score obtained with  bayes  is: 0.9277228277764332
the f1 score obtained with  perceptron  is: 0.18148148148148147
the f1 score obtained with  multi-layer perceptron  is: 0.18148148148148147
the f1 score obtained with  tree  is: 0.9944434266327394
the f1 score obtained with  logistic regression  is: 0.9944434266327394
the f1 score obtained with  kNN 3 neighbors  is: 0.9888834582382969
the f1 score obtained with  kNN 7 neighbors  is: 0.9888834582382969
the f1 score obtained with  kNN 15 neighbors  is: 0.9944434266327394
the f1 score obtained with  SVC  is: 0.12950191570881225
the f1 score obtained with  random forest  is: 0.9944434266327394
```





```
the best one  is  tree  with a F1 score of  0.9944434266327394
```