In [1]:

```
#Importing the required libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

import warnings
warnings.filterwarnings("ignore")
```

In [2]:

```
#Reading the data

data=pd.read_csv('nyc_taxi_trip_duration.csv')
```

In [3]:

```
#Checking for null values

data.isnull().sum()
```

Out[3]:

```
id                    0
vendor_id             0
pickup_datetime       0
dropoff_datetime      0
passenger_count       0
pickup_longitude      0
pickup_latitude       0
dropoff_longitude     0
dropoff_latitude      0
store_and_fwd_flag    0
trip_duration         0
dtype: int64
```

In [4]:

```
#checking for data types
data.dtypes
```

Out[4]:

```
id                     object
vendor_id               int64
pickup_datetime        object
dropoff_datetime       object
passenger_count         int64
pickup_longitude      float64
pickup_latitude       float64
dropoff_longitude     float64
dropoff_latitude      float64
store_and_fwd_flag     object
trip_duration           int64
dtype: object
```

In [5]:

```
# converting strings to datetime features
data['pickup_datetime'] = pd.to_datetime(data.pickup_datetime)
data['dropoff_datetime'] = pd.to_datetime(data.dropoff_datetime)

# Converting yes/no flag to 1 and 0
data['store_and_fwd_flag'] = 1 * (data.store_and_fwd_flag.values == 'Y')
```

In [6]:

```
#Feature engineering on datetime values

data['pickup_dayofweek'] = data['pickup_datetime'].dt.dayofweek
```

```
#data['dropoff_dayofweek'] = data['dropoff_datetime'].dt.dayofweek


data['pickup_month'] = data['pickup_datetime'].dt.month
#data['dropoff_month'] = data['dropoff_datetime'].dt.month

data['pickup_week'] = data['pickup_datetime'].dt.week
#data['dropoff_week'] = data['dropoff_datetime'].dt.week

data['pickup_day'] = data['pickup_datetime'].dt.day
#data['dropoff_day'] = data['dropoff_datetime'].dt.day


data['pickup_hour'] = data['pickup_datetime'].dt.hour
#data['dropoff_hour'] = data['dropoff_datetime'].dt.hour
```

In [7]:

```
#Calculating trip distance from longitude and Latitude values

from math import sin, cos, sqrt, atan2, radians

def Distance(row):
    R = 6373.0  # approximate radius of earth in km
    x = radians(row['pickup_latitude'])
    y = radians(row['pickup_longitude'])
    x1 = radians(row['dropoff_latitude'])
    y1 = radians(row['dropoff_longitude'])

    d1 = y1 - y
    d2 = x1 - x

    x3 = sin(d2 / 2)**2 + cos(x) * cos(x1) * sin(d1 / 2)**2
    y3 = 2 * atan2(sqrt(x3), sqrt(1 - x3))
    result = R * y3

    return result
```

In [8]:

```
data['trip_distance'] = data.apply(lambda row: Distance(row), axis= 1)
data.head()
```

Out[8]:

	id	vendor_id	pickup_datetime	dropoff_datetime	passenger_count	pickup_longitude	pickup_latitude	drc
0	id1080784	2	2016-02-29 16:40:21	2016-02-29 16:47:01	1	-73.953918	40.778873	
1	id0889885	1	2016-03-11 23:35:37	2016-03-11 23:53:57	2	-73.988312	40.731743	
2	id0857912	2	2016-02-21 17:59:33	2016-02-21 18:26:48	2	-73.997314	40.721458	
3	id3744273	2	2016-01-05 09:44:31	2016-01-05 10:03:32	6	-73.961670	40.759720	
4	id0232939	1	2016-02-17 06:42:23	2016-02-17 06:56:31	1	-74.017120	40.708469	

In [9]:

```
#checking for outliers

data['trip_duration'].describe()/3600
```

Out[9]:

```
count     202.589444
mean        0.264508
```

```
std          1.073507
min          0.000278
25%          0.110278
50%          0.184167
75%          0.298611
max        538.815556
Name: trip_duration, dtype: float64
```

In [10]:
```
#removing outliers

Q1 = data['trip_duration'].quantile(0.25)
Q3 = data['trip_duration'].quantile(0.75)
IQR = Q3 - Q1    #IQR is interquartile range.

filter = (data['trip_duration'] >= Q1 - 1.5 * IQR) & (data['trip_duration'] <= Q3 + 1.5 *I
data_cleaned= data.loc[filter]
```

In [11]:
```
data_cleaned['trip_duration'].describe()/3600
```

Out[11]:
```
count    192.321944
mean       0.203375
std        0.124510
min        0.000278
25%        0.106667
50%        0.175556
75%        0.275556
max        0.581111
Name: trip_duration, dtype: float64
```

In [12]:
```
data_predict=data_cleaned
```

In [13]:
```
#seperating independent and dependent variables
x = data_predict.drop(['id','dropoff_datetime','pickup_datetime','dropoff_longitude','pick
y =data_predict['trip_duration']
x.shape, y.shape
```

Out[13]:
```
((692359, 9), (692359,))
```

In [14]:
```
## Importing the MinMax Scaler
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
x_scaled = scaler.fit_transform(x)
```

In [15]:
```
x = pd.DataFrame(x_scaled, columns = x.columns)
```

In [16]:
```
x.head()
```

Out[16]:

	vendor_id	passenger_count	store_and_fwd_flag	pickup_dayofweek	pickup_month	pickup_week	pickup_day	pic
0	1.0	0.111111	0.0	0.000000	0.2	0.153846	0.933333	
1	0.0	0.222222	0.0	0.666667	0.4	0.173077	0.333333	
2	1.0	0.222222	0.0	1.000000	0.2	0.115385	0.666667	
3	1.0	0.666667	0.0	0.166667	0.0	0.000000	0.133333	
4	0.0	0.111111	0.0	0.333333	0.2	0.115385	0.533333	

In [17]:
```
y.head()
```

Out[17]:
```
0     400
1    1100
2    1635
3    1141
4     848
Name: trip_duration, dtype: int64
```

In [18]:
```
# Importing the train test split function
from sklearn.model_selection import train_test_split
train_x,test_x,train_y,test_y = train_test_split(x , y, random_state=56)
```

In [19]:
```
from sklearn.neighbors import KNeighborsRegressor as KNN
from sklearn.metrics import mean_squared_error as mse
from sklearn.metrics import mean_absolute_error as mae
```

In [20]:
```
# Creating instance of KNN
reg = KNN(n_neighbors = 8)
```

In [21]:
```
# Fitting the model
reg.fit(train_x, train_y)
```

Out[21]:
```
KNeighborsRegressor(n_neighbors=8)
```

In [22]:
```
# Predicting over the Test Set and calculating MSE
test_predict = reg.predict(test_x)
k = mse(test_predict, test_y)
print('Test MSE    ', k )
```

```
Test MSE     109275.15509046955
```

In [23]:
```
#Predicting over the Train set and Calculating MSE

test_predict = reg.predict(train_x)
k = mse(test_predict, train_y)
print('Test MSE    ', k )
```

```
Test MSE     82917.06918566051
```

In [24]:
```
#finding best value of k neighbours

def Elbow(K):
  #initiating empty list
    test_mse = []

  #training model for evey value of K
    for i in K:
        #Instance of KNN
        reg = KNN(n_neighbors = i)
        reg.fit(train_x, train_y)
        #Appending mse value to empty list claculated using the predictions
        tmp = reg.predict(test_x)
        tmp = mse(tmp,test_y)
        test_mse.append(tmp)
```

```python
    return test_mse
```

In [25]:

```python
#Defining K range
k = range(1,40)
```

In [26]:

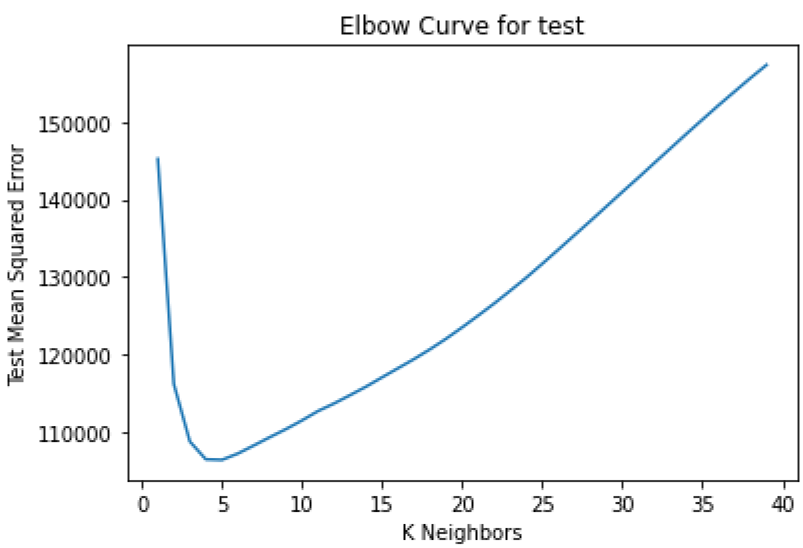
```python
# calling above defined function
test = Elbow(k)
```

In [27]:

```python
# plotting the Curves
plt.plot(k, test)
plt.xlabel('K Neighbors')
plt.ylabel('Test Mean Squared Error')
plt.title('Elbow Curve for test')
```

Out[27]:

```
Text(0.5, 1.0, 'Elbow Curve for test')
```



In [ ]:

```python
#we can see error is less when K is 5

# Creating instance of KNN

reg = KNN(n_neighbors = 5)

# Fitting the model
reg.fit(train_x, train_y)

# Predicting over the Train Set and Test Set
test_predict = reg.predict(test_x)
train_predict=reg.predict(train_x)
```

In [ ]:

```python
#Evaluation


k = mse(train_predict, train_y)
print('Train MSE    ', k )
m = mse(test_predict, test_y)
print('Test MSE     ', m )


j=mse(train_predict,train_y,squared=False)
print('Train RMSE   ',j)
```

```
n=mse(test_predict,test_y,squared=False)
print('Test RMSE    ',n)

l=mae(train_predict, train_y)
print('Train MAE     ',l)
o=mae(test_predict, test_y)
print('Test MAE     ',o)
```

In [ ]:

```
name2=['Train MSE','Test MSE']
values2=[k,m]
name3=['Train RMSE','Test RMSE']
values3=[j,n]
name4=['Train MAE','Test MAE']
values4=[l,o]
```

In [54]:

```
fig, ax = plt.subplots(1,3,figsize=(20,10))
fig.suptitle("KNN Model Scores", fontsize= 25)
ax[0].bar(name2, values2)
ax[1].bar(name3, values3)
ax[2].bar(name4, values4)
plt.show()
```