Tugas Mandiri

Tugas mandiri ini digunakan pada kegiatan Kursus Data Science yang merupakan pembekalan bagi mahasiswa Universitas Gunadarma untuk Skema Associate Data Scientist

Pertemuan 4 - Semester 7

1. Buatlah model klasifikasi dengan machine learning dari dataset yang diberikan dengan ketentuan :
    - Gunakan metode CRISP-DM secara terurut dan lengkap
    - Gunakan algoritma linear regression, logistic regression, dan K-NN
2. Dari ketiga algoritma yang anda pakai, algoritma yang manakah yang memiliki akurasi paling tinggi?

Data Preparation

In [1]:
```
import pandas as pd
import csv
```

In [2]:
```
df = pd.read_csv('dataset_tm_10k.csv')
```

In [3]:
```
df.shape
```

Out[3]:
```
(10787, 8)
```

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

Out[4]:

	Flight	Time	Length	Airline	AirportFrom	AirportTo	DayOfWeek	Class
0	320.0	870.0	180.0	NaN	IAH	PHX	5	0
1	3045.0	365.0	66.0	OO	DSM	MKE	2	0
2	1560.0	740.0	257.0	DL	SEA	CVG	7	0
3	1156.0	595.0	235.0	WN	SNA	MDW	7	1
4	1873.0	530.0	133.0	CO	IAH	MCO	6	1

In [5]:
```
df.tail()
```

Out[5]:

	Flight	Time	Length	Airline	AirportFrom	AirportTo	DayOfWeek	Class
10782	2821.0	610.0	50.0	MQ	DFW	SPS	2	0
10783	2618.0	839.0	118.0	XE	SDF	EWR	2	0
10784	1973.0	1160.0	124.0	DL	ATL	MIA	2	0
10785	528.0	1275.0	112.0	US	PHX	RNO	4	0
10786	2254.0	970.0	NaN	DL	ATL	CMH	4	1

In [6]:
```
df.dtypes
```

Out[6]:
```
Flight         float64
Time           float64
Length         float64
Airline         object
AirportFrom     object
AirportTo       object
DayOfWeek        int64
Class            int64
dtype: object
```

In [7]:
```
df.isna().sum()
```

Out[7]:
```
Flight           0
Time           873
Length        1343
Airline        582
AirportFrom      0
AirportTo        0
DayOfWeek        0
Class            0
dtype: int64
```

In [8]:
```
#imputasi numerik pada kolom time menggunakan mean
meanImputation = df['Time'].mean()
meanImputation
```

Out[8]:
```
803.37825297559
```

In [9]:
```
df['Time'].fillna(meanImputation,
                  inplace=True)
```

In [10]:
```
df.isna().sum()
```

Out[10]:
```
Flight           0
Time             0
Length        1343
Airline        582
AirportFrom      0
AirportTo        0
DayOfWeek        0
Class            0
dtype: int64
```

In [11]:
```
#imputasi numerik pada kolom Length menggunakan median
medianImputation = df['Length'].median()
```

```
medianImputation
```

Out[11]:
```
116.0
```

In [12]:
```
df['Length'].fillna(medianImputation,
                    inplace=True)
```

In [13]:
```
df.isna().sum()
```

Out[13]:
```
Flight          0
Time            0
Length          0
Airline       582
AirportFrom     0
AirportTo       0
DayOfWeek       0
Class           0
dtype: int64
```

In [14]:
```
#imputasi variable kategorik pada kolom airline
import numpy as np
from sklearn.impute import SimpleImputer
```

In [15]:
```
modeImputer = SimpleImputer(strategy='most_frequent')
df['Airline'] = modeImputer.fit_transform(df[['Airline']]).flatten()
```

In [16]:
```
unique_airline_values = np.unique(df['Airline'])
print(unique_airline_values)
```

```
['9E' 'AA' 'AS' 'B6' 'CO' 'DL' 'EV' 'F9' 'FL' 'HA' 'MQ' 'OH' 'OO' 'UA'
 'US' 'WN' 'XE' 'YV']
```

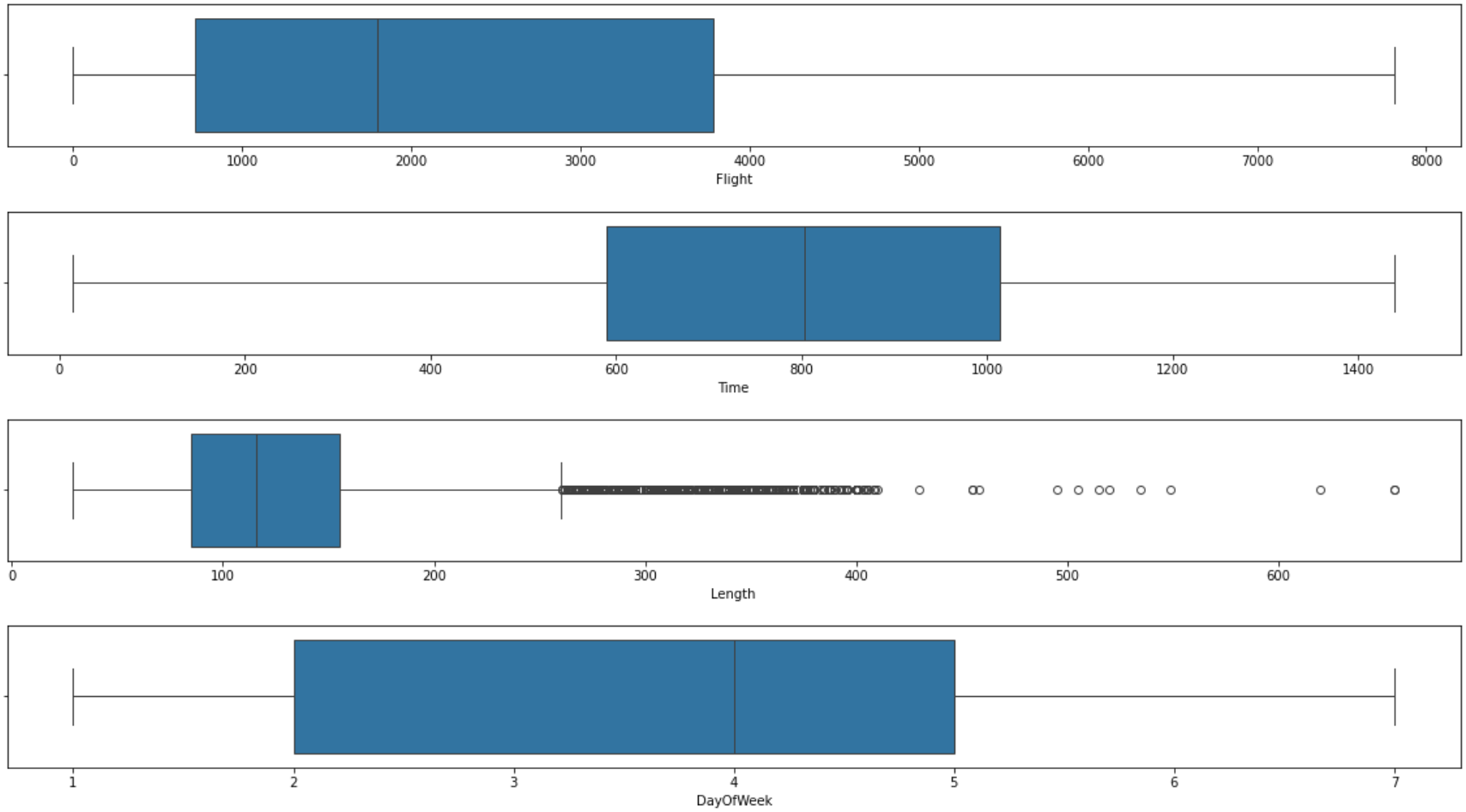
In [17]:
```
df.isna().sum()
```

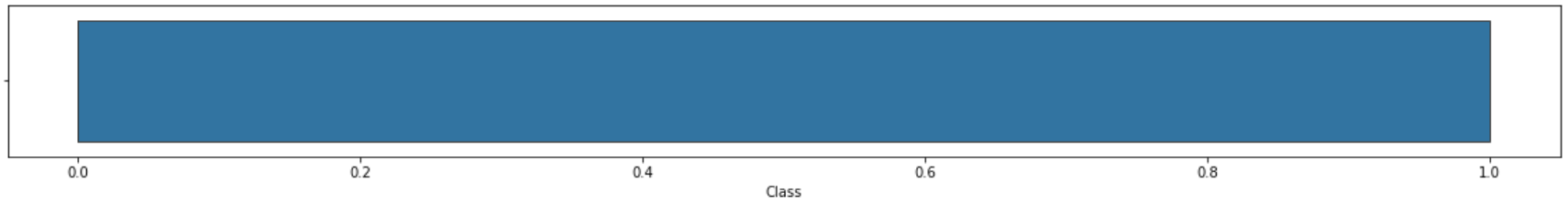
Out[17]:
```
Flight        0
Time          0
Length        0
Airline       0
AirportFrom   0
AirportTo     0
DayOfWeek     0
Class         0
dtype: int64
```

Melakukan Winsorizing terhaadap Outlier

In [18]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

In [19]:
```
df_outlier = df.select_dtypes(exclude=['object'])
for column in df_outlier:
        plt.figure(figsize=(20,2))
        sns.boxplot(data=df_outlier, x=column)
```





In [20]:
```
df['Length'].max()
```

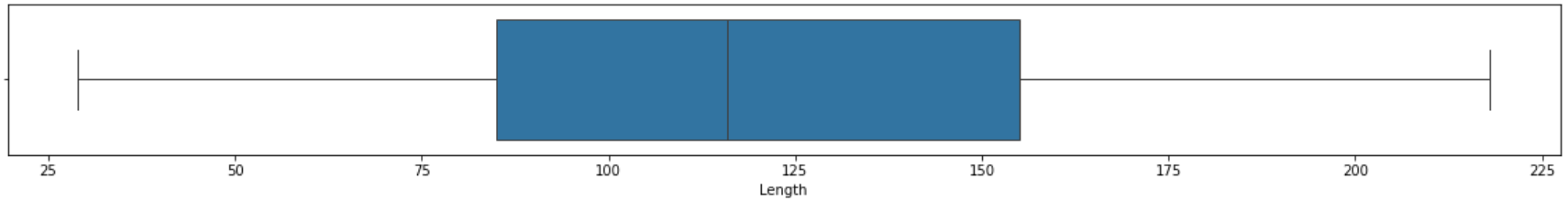
Out[20]:
```
655.0
```

In [21]:
```
from scipy.stats.mstats import winsorize
```

In [22]:
```
df['Length'] = winsorize(df['Length'], limits=[0, 0.1])
```

In [23]:
```
plt.figure(figsize=(20,2))
sns.boxplot(data=df, x=df['Length'])
```

Out[23]:
```
<Axes: xlabel='Length'>
```



In [24]:
```
df['Length'].max()
```

Out[24]:
```
218.0
```

In [25]:
```
df.shape
```

Out[25]:
```
(10787, 8)
```

Melakukan Scalling

In [26]:
```
# Membuang Kolom "Flight"
df = df.iloc[:,1:]
```

In [27]:
```
df.head(3)
```

Out[27]:

	Time	Length	Airline	AirportFrom	AirportTo	DayOfWeek	Class
0	870.0	180.0	WN	IAH	PHX	5	0
1	365.0	66.0	OO	DSM	MKE	2	0
2	740.0	218.0	DL	SEA	CVG	7	0

In [28]:
```
# Scaling
from sklearn.preprocessing import RobustScaler
```

In [29]:
```
scaler = RobustScaler()
df[['Time','Length']] = scaler.fit_transform(df[['Time','Length']])
df.head()
```

Out[29]:

	Time	Length	Airline	AirportFrom	AirportTo	DayOfWeek	Class
0	0.157127	0.914286	WN	IAH	PHX	5	0
1	-1.033911	-0.714286	OO	DSM	MKE	2	0
2	-0.149477	1.457143	DL	SEA	CVG	7	0
3	-0.491458	1.457143	WN	SNA	MDW	7	1
4	-0.644760	0.242857	CO	IAH	MCO	6	1

Linear Regression

In [30]:
```
#copy untuk linear regression
df_lr = df.copy()
```

In [31]:
```
# Membuat variabel independen (x) dan variabel dependen(y)
X = df_lr[['Time']]
y = df_lr['Class']
```

Pada tahap selanjutnya, data dibagi menjadi 2 bagian:

- Data Latih (Training Data): untuk mengembangkan model : 70%
- Data Uji (Testing Data): untuk Mengukur performansi model 30%

In [32]:
```
# Membagi dataset ke data latih dan data uji

# Import fungsi train_test_split untuk membagi data dari libray sklearn dan modul model_selection
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3, random_state=0)
```

In [33]:
```
from sklearn.linear_model import LinearRegression
```

In [34]:
```
# Memanggil objek LinearRegression ke dalam variabel mlr
lr = LinearRegression()

# Melatih model
lr.fit(X_train, y_train)
```

Out[34]:
```
LinearRegression()
```

In [35]:
```
# Memprediksi model
y_pred_lr = lr.predict(X_test)
# Nilai prediksi
print("Prediction for test set: {}".format(y_pred_lr))
```

```
Prediction for test set: [0.35403114 0.44670824 0.53691394 ... 0.45125022 0.39555048 0.48995755]
```

In [36]:
```
# Membandingkan nilai sebenarnya dengan nilai prediksi menggunakan linear regression
lr_diff = pd.DataFrame({'Actual value': y_test, 'Predicted value': y_pred_lr})
lr_diff.head()
```

Out[36]:

	Actual value	Predicted value
7823	1	0.354031
6132	0	0.446708
9949	0	0.536914
10440	0	0.519367
9097	1	0.447944

In [37]:
```
# Menerapkan threshold pada variabel y_pred_lr ke dalam variabel y_predict_class
y_predict_class = [1 if prob > 0.5 else 0 for prob in y_pred_lr]
```

In [38]:
```
# Import Library
from sklearn.metrics import accuracy_score

# Menghitung Akurasi
print("Accuracy:"
      , round(accuracy_score(y_test, y_predict_class), 3)) # Membulatkan nilai akurasi menjadi tiga angka di belakang k
```

```
Accuracy: 0.562
```

Logistic Regression

In [39]:
```
# copy untuk Logistic Regression
df_lg = df.copy()
```

In [40]:
```
# Menyimpan nama kolom yang berjenis kategori ke dalam variabel cat_col
cat_col = ['Airline','AirportFrom','AirportTo','DayOfWeek']
```

In [41]:
```
# Encoding Kolom Kategori
from sklearn import preprocessing
le = preprocessing.LabelEncoder()
df_lg[cat_col] = df_lg[cat_col].apply(le.fit_transform)
```

In [42]:
```
df.head()
```

Out[42]:

	Time	Length	Airline	AirportFrom	AirportTo	DayOfWeek	Class
0	0.157127	0.914286	WN	IAH	PHX	5	0
1	-1.033911	-0.714286	OO	DSM	MKE	2	0
2	-0.149477	1.457143	DL	SEA	CVG	7	0
3	-0.491458	1.457143	WN	SNA	MDW	7	1
4	-0.644760	0.242857	CO	IAH	MCO	6	1

In [43]:
```
# Membuat variabel independen (X) dan variabel dependen (y)
X = df_lg.iloc[:,0:-1].values
y = df_lg.iloc[:,-1].values
```

In [44]:
```
# Membagi dataset ke data latih dan data uji
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3, random_state=0)
```

In [45]:
```
# Membuat Model - LogisticRegression
from sklearn.linear_model import LogisticRegression
```

In [46]:
```
reg = LogisticRegression(solver='lbfgs', max_iter=1000)
```

In [47]:
```
reg.fit(X_train, y_train)
y_pred = reg.predict(X_test)
```

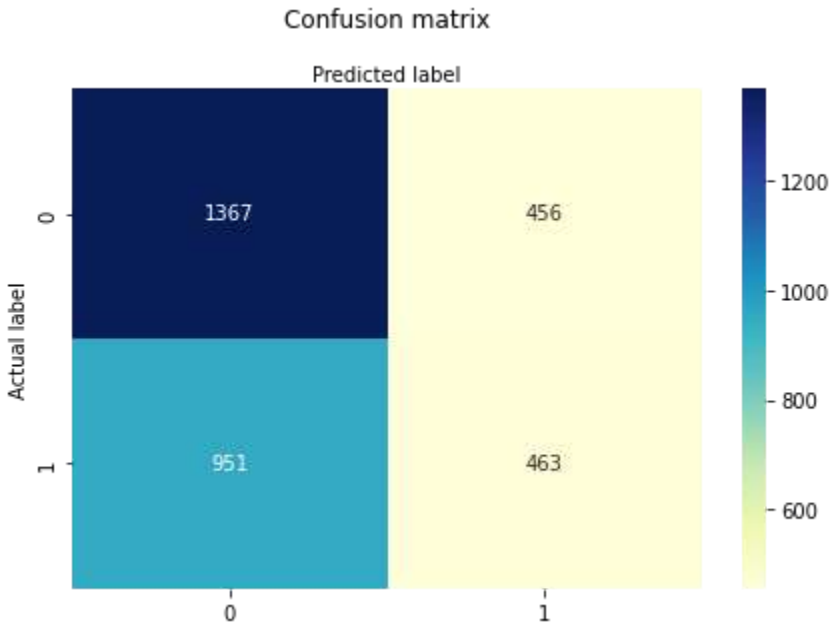
In [48]:
```
# Membuat Confusion Matrix
from sklearn import metrics

cnf_matrix = metrics.confusion_matrix(y_test, y_pred)
cnf_matrix
```

Out[48]:
```
array([[1367,  456],
       [ 951,  463]])
```

In [49]:
```
# Visualisasi Confusion Matrix dengan Heatmap

# Import Library
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
class_names=[0,1] # Label kelas yang akan ditampilkan pada sumbu x dan y
fig, ax = plt.subplots() #Membuat objek gambar dan sumbu menggunakan
tick_marks = np.arange(len(class_names)) # Membuat array dengan rentang jumlah kelas yang ada

# Menentukan tanda-tanda pada sumbu x dan y sesuai dengan array yang telah dibuat
plt.xticks(tick_marks, class_names)
plt.yticks(tick_marks, class_names)

# Membuat Heatmap
sns.heatmap(pd.DataFrame(cnf_matrix) #Parameter yang akan divisualisasi
            , annot=True # Menampilkan nilai di dalam kotak heatmap
            , cmap="YlGnBu" # Skema warna pada heatmap, "YlGnBu" adalah kombinasi antara Yellow (Kuning), Green (Hijau)
            ,fmt='g') #Mengatur format angka menjadi notasi umum (general notation)

# Mengatur posisi label sumbu x ke bagian atas heatmap
ax.xaxis.set_label_position("top")

# Mengatur tampilan grafik agar lebih rapi.
plt.tight_layout()

# Mengatur judul grafik, label pada sumbu y dan x
plt.title('Confusion matrix', y=1.1)
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
```

Out[49]:
```
Text(0.5, 257.44, 'Predicted label')
```



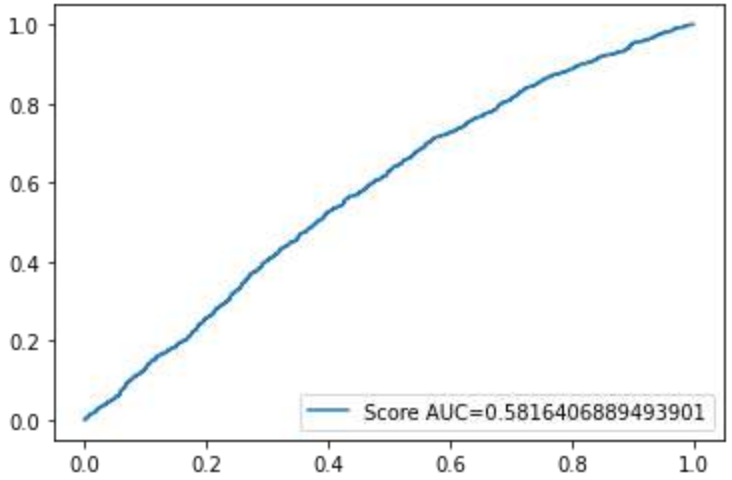
In [50]:
```
# Import library
from sklearn.metrics import classification_report

# Mendefinisikan nama kelas dalam array
target_names = ['Not Delayed', 'Delayed']

print(classification_report(y_test # Array target yang berisi label aktual
                            , y_pred # Array target yang berisi label prediksi
                            , target_names=target_names)) #Memberikan nama kelas yang akan ditampilkan
```

```
              precision    recall  f1-score   support

 Not Delayed       0.59      0.75      0.66      1823
     Delayed       0.50      0.33      0.40      1414

    accuracy                           0.57      3237
   macro avg       0.55      0.54      0.53      3237
weighted avg       0.55      0.57      0.55      3237
```

In [51]:
```
import matplotlib.pyplot as plt
```

In [52]:
```
# Memperoleh probabilitas prediksi kelas positif (y=1) dari model klasifikasi reg untuk data uji (X_test)
y_pred_proba = reg.predict_proba(X_test)[::,1]
```

```
# Menghitung false positive rate (fpr), true positive rate (tpr), dan threshold yang terkait dengan kurva ROC.
fpr, tpr, _ = metrics.roc_curve(y_test, #Label aktual
                                y_pred_proba)

# Menghitung nilai AUC dari kurva ROC
auc = metrics.roc_auc_score(y_test, y_pred_proba)

# Membuat plot untuk kurva ROC
plt.plot(fpr,tpr
         ,label="Score AUC="+str(auc)) #Label "Score AUC" ditambahkan ke legenda untuk menampilkan nilai AUC di grafik

# Menampilkan legenda di lokasi keempat (kanan bawah) pada grafik
plt.legend(loc=4)

# Menampilkan grafik
plt.show()
```



K-NN

In [57]:
```
# copy untuk K-NN
df_knn = df.copy()
```

In [58]:
```
# Membuat Model - Import Library
from sklearn.model_selection import cross_val_score, KFold
```

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, classification_report, roc_auc_score
```

In [59]:
```
knn = KNeighborsClassifier(n_neighbors= 3) # Menentukan jumlah tetangga terdekat (nearest neighbors)

# Melatih model
knn.fit(X_train, y_train)

# Melakukan validasi silang dengan membagi data pelatihan menjadi 5 lipatan (folds)
k = KFold(n_splits = 5)

# Menghitung skor akurasi untuk setiap lipatan menggunakan metode validasi silang yang telah ditentukan
score = cross_val_score(knn
                        , X_train, y_train
                        , scoring = 'accuracy' #Parameter yang ingin digunakan
                        , cv = k).mean() # cv=k -> jumlah lipatan, .mean() -> menghitung rata-rata skor akurasi

# Mencetak skor akurasi pada set data pelatihan dengan pembulatan ke 3 desimal
print("Accuracy on the training set:", round(score, 3))
```

```
Accuracy on the training set: 0.557
```

In [60]:
```
y_pred = knn.predict(X_test)
print("Accuracy on the test set:", round(accuracy_score(y_test, y_pred), 3))
```

```
Accuracy on the test set: 0.545
```

In [61]:
```
from sklearn.metrics import classification_report
target_names = ['Not Delayed', 'Delayed']
print(classification_report(y_test, y_pred, target_names=target_names))
```

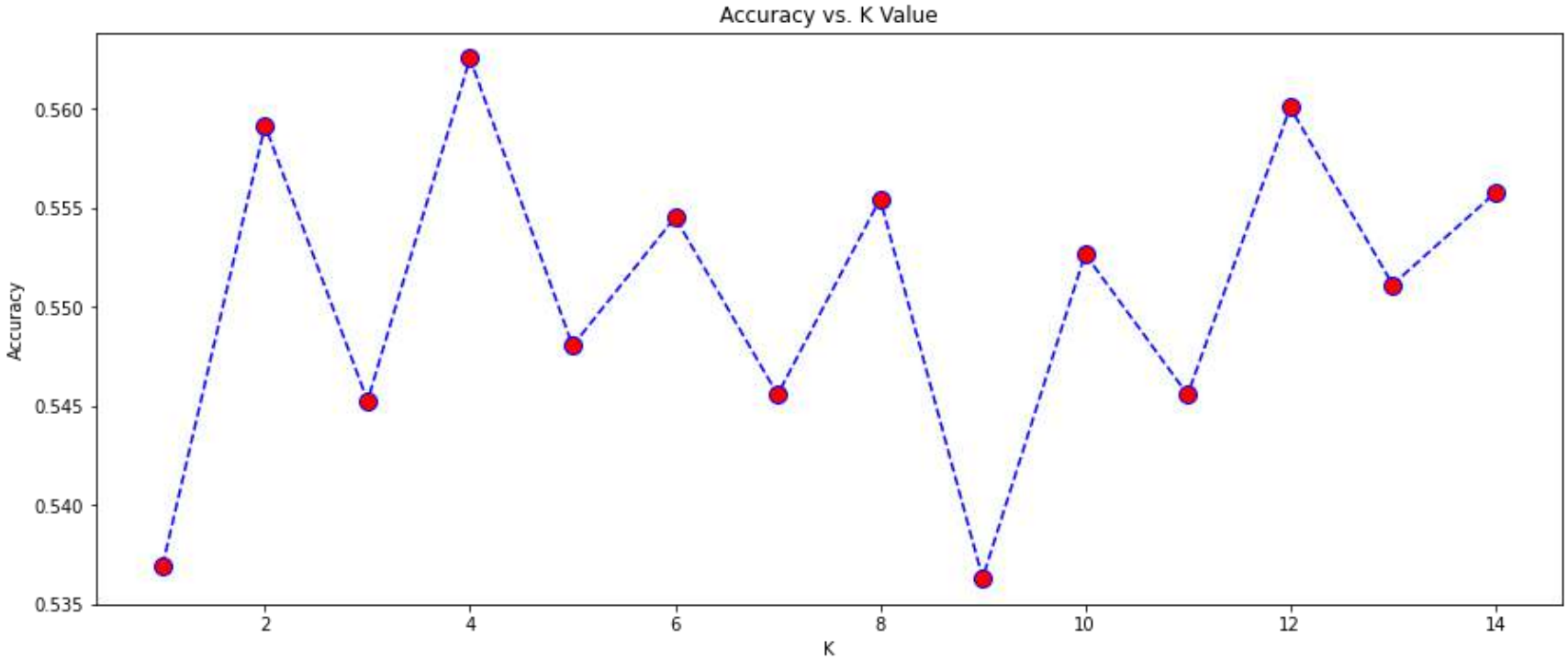
```
              precision    recall  f1-score   support

 Not Delayed       0.59      0.60      0.60      1823
     Delayed       0.48      0.47      0.47      1414

    accuracy                           0.55      3237
   macro avg       0.54      0.54      0.54      3237
weighted avg       0.54      0.55      0.54      3237
```

In [62]:
```
# Membuat list kosong dalam variabel accuracy
accuracy = []

# Membuat loop dengan rentang nilai i dari 1-14 (Exclude 15)
# Loop akan menguji setiap n dari 1-14 untuk mencari n dengan akurasi yang paling tinggi
```

```
for i in range(1,15):
    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train,y_train)
    pred_i = knn.predict(X_test)
    accuracy_i = accuracy_score(y_test, pred_i)

    # Menyimpan skor akurasi pada setiap iterasi ke dalam list "accuracy"
    accuracy.append(accuracy_i)
```

In [63]:
```
import matplotlib.pyplot as plt
```

In [64]:
```
# Melihat akurasi dari setiap iterasi pada line chart
plt.figure(figsize=(15,6))
plt.plot(range(1,15, 1), accuracy, color='blue', linestyle='dashed', marker='o',
         markerfacecolor='red', markersize=10)
plt.title('Accuracy vs. K Value')
plt.xlabel('K')
plt.ylabel('Accuracy')
plt.show()
```



In [65]:
```
# Dapat dilihat dari grafik di atas bahwa akurasi paling tinggi didapatkan dengan n = 14
knn = KNeighborsClassifier(n_neighbors = 4)
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)
```

In [66]:
```
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy on the test set: {round(accuracy * 100, 2)}%")
```

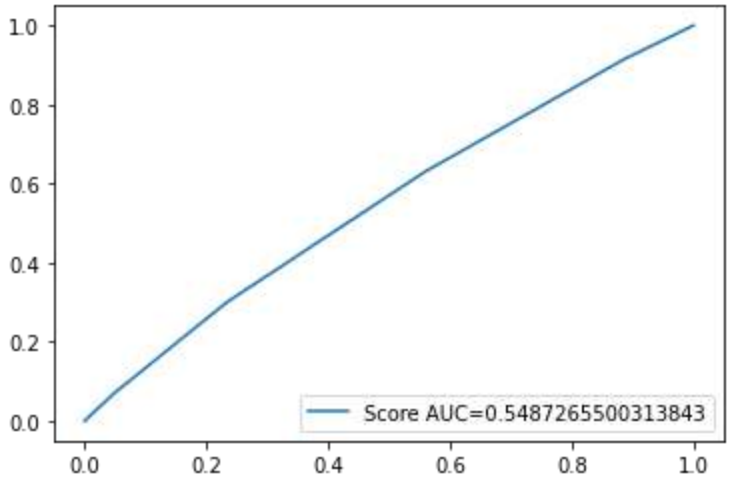
```
Accuracy on the test set: 56.26%
```

In [67]:
```
print(classification_report(y_test, y_pred, target_names=target_names))
```

```
              precision    recall  f1-score   support

 Not Delayed       0.59      0.77      0.66      1823
     Delayed       0.50      0.30      0.38      1414

    accuracy                           0.56      3237
   macro avg       0.54      0.53      0.52      3237
weighted avg       0.55      0.56      0.54      3237
```

In [68]:
```
import sklearn.metrics as metrics
import matplotlib.pyplot as plt
```

In [69]:
```
# Memperoleh probabilitas prediksi kelas positif (y=1) dari model klasifikasi KNN untuk data uji (X_test)
y_pred_proba = knn.predict_proba(X_test)[::,1]

fpr, tpr, _ = metrics.roc_curve(y_test,  y_pred_proba)
auc = metrics.roc_auc_score(y_test, y_pred_proba)
plt.plot(fpr,tpr,label="Score AUC="+str(auc))
plt.legend(loc=4)
plt.show()
```



Dari ketiga algoritma yang anda pakai, algoritma yang manakah yang memiliki akurasi paling tinggi?

Berdasarkan pemodelan yang telah dilakukan, akurasi yang didapatkan dari tiap algoritma adalah :

1. Algoritma Linear Regression : Accuracy: 0.562
2. Algoritma Logistic Regression : Accuracy: 0.57
3. Algoritma KNN : Accuracy: 0.56

Algoritma Logistic Regression memiliki Akurasi tertinggi dengan nilai desimal 0.57 atau 57 %

In [ ]: