1 Implement the K Nearest Neighbor Classification using Classified Manufacturing Dataset(Student Performance)

Part 1 Import the required Python, Pandas, Matplotlib, Seaborn packages

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
```

1. Load the classified dataset into a dataframe using pandas

```
df = pd.read_csv('/content/student_performance.csv')
```

+ Code + Text

2. Check the data types of each feature(column) in the dataset.

```
print(df.dtypes)
```

```
StudentID                  int64
Name                      object
Gender                    object
AttendanceRate             int64
StudyHoursPerWeek          int64
PreviousGrade              int64
ExtracurricularActivities  int64
ParentalSupport           object
FinalGrade                 int64
dtype: object
```

3. Generate a summary of the dataset for min, max, stddev, quartile vales for 25%,50%,75%,90%,

```
summary = df.describe(percentiles=[.25, .5, .75, .90])
print(summary)
```

```
        StudentID  AttendanceRate  StudyHoursPerWeek  PreviousGrade  \
count   10.00000       10.000000          10.000000      10.000000
mean     5.50000       85.600000          17.700000      78.100000
std      3.02765        7.441625           6.848357      10.170218
min      1.00000       70.000000           8.000000      60.000000
25%      3.25000       82.750000          12.750000      71.750000
50%      5.50000       86.500000          17.500000      80.000000
75%      7.75000       90.750000          21.500000      85.750000
90%      9.10000       92.300000          25.500000      88.200000
max     10.00000       95.000000          30.000000      90.000000
```

```
       ExtracurricularActivities  FinalGrade
count                  10.000000   10.000000
mean                    1.500000   80.200000
std                     1.080123   10.097304
min                     0.000000   62.000000
25%                     1.000000   73.500000
50%                     1.500000   82.500000
75%                     2.000000   87.750000
90%                     3.000000   90.200000
max                     3.000000   92.000000
```

4. List the names of columns/features in the dataset

```
l=list(df.columns)
l[0:len(l)-2]
```

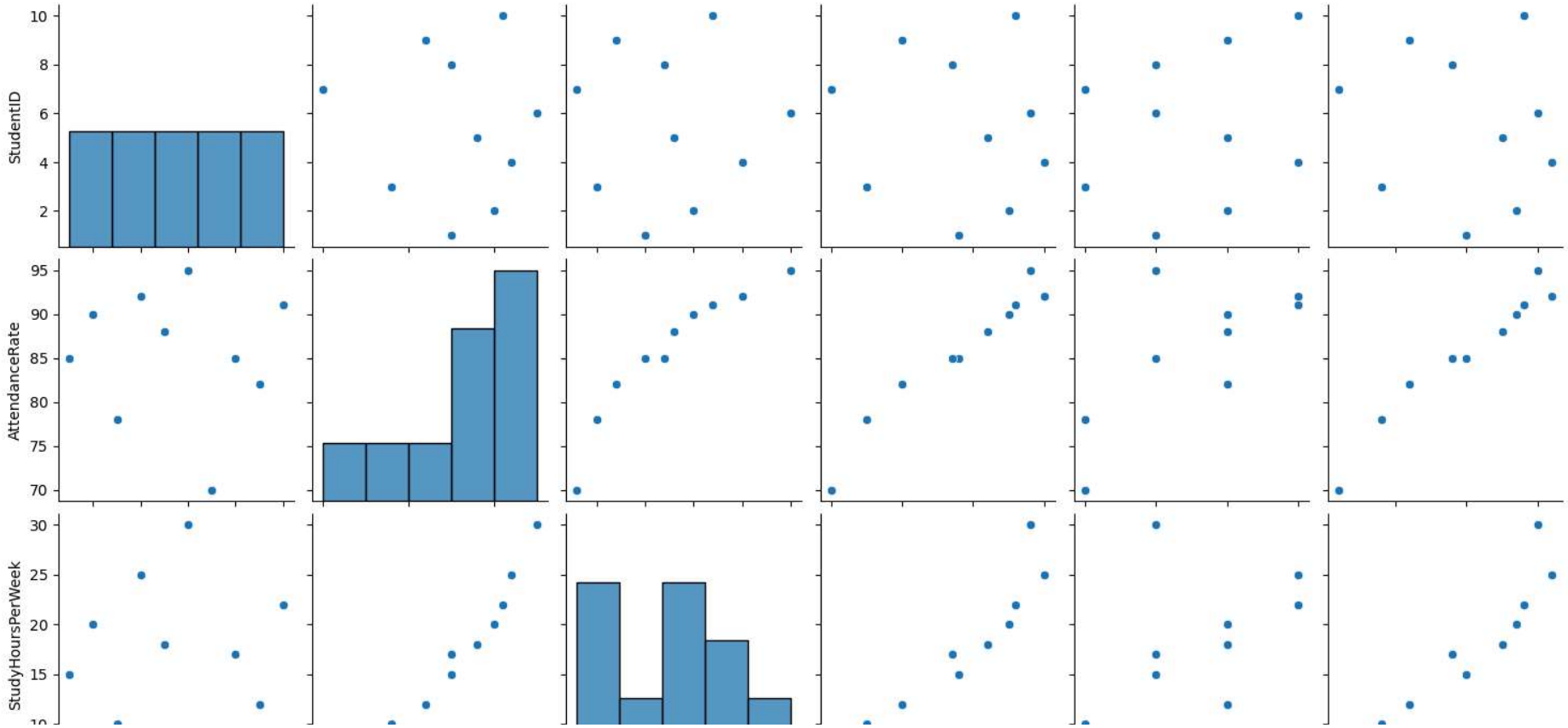
```
['StudentID',
 'Name',
 'Gender',
 'AttendanceRate',
 'StudyHoursPerWeek',
 'PreviousGrade',
 'ExtracurricularActivities']
```

```
df.describe()
```

	StudentID	AttendanceRate	StudyHoursPerWeek	PreviousGrade	ExtracurricularActivities	FinalGrade
count	10.00000	10.000000	10.000000	10.000000	10.000000	10.000000
mean	5.50000	85.600000	17.700000	78.100000	1.500000	80.200000
std	3.02765	7.441625	6.848357	10.170218	1.080123	10.097304
min	1.00000	70.000000	8.000000	60.000000	0.000000	62.000000
25%	3.25000	82.750000	12.750000	71.750000	1.000000	73.500000
50%	5.50000	86.500000	17.500000	80.000000	1.500000	82.500000
75%	7.75000	90.750000	21.500000	85.750000	2.000000	87.750000
max	10.00000	95.000000	30.000000	90.000000	3.000000	92.000000

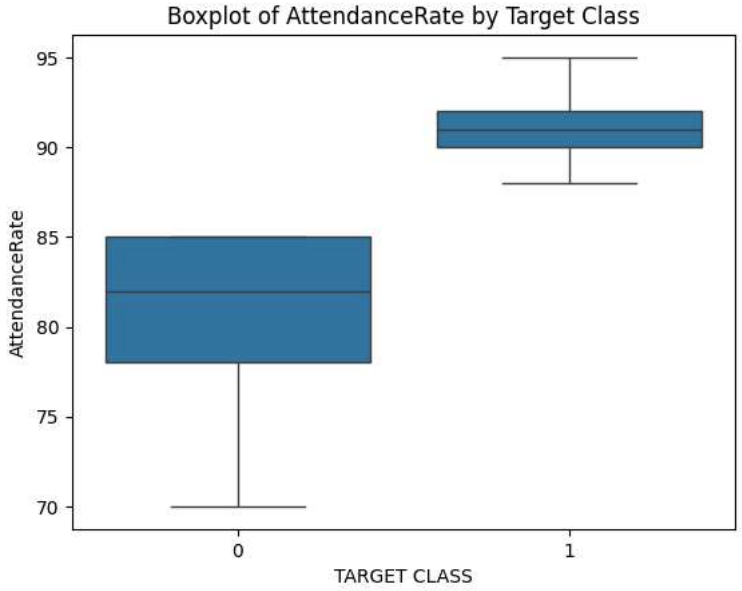
```
sns.pairplot(df)
```

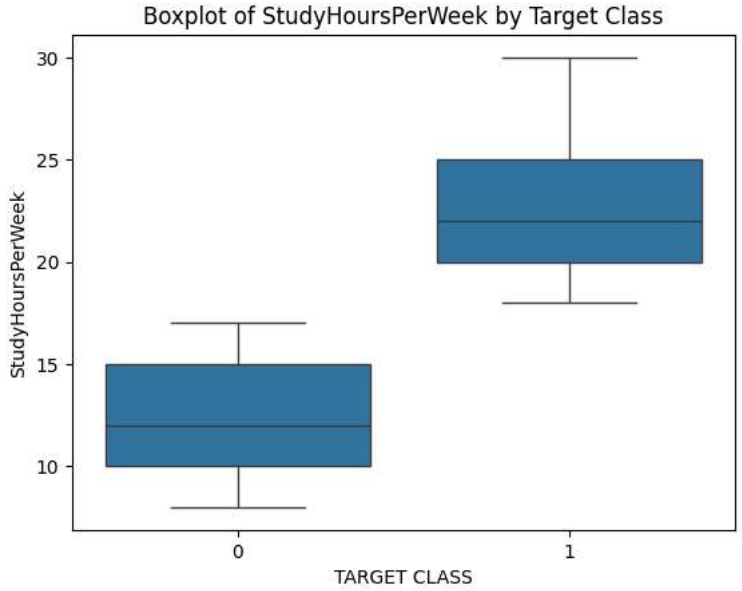
<seaborn.axisgrid.PairGrid at 0x7d1cbe975180>

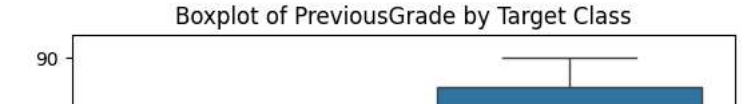



```
import seaborn as sns
import matplotlib.pyplot as plt

# Define the list of feature names
features = ['AttendanceRate', 'StudyHoursPerWeek', 'PreviousGrade', 'ExtracurricularActivities', 'ParentalSupport']

# Create a target variable (e.g., 1 if FinalGrade > 80, 0 otherwise)
df['TARGET CLASS'] = df['FinalGrade'].apply(lambda x: 1 if x > 80 else 0)

# Create a series of boxplots
for feature in features:
    sns.boxplot(x='TARGET CLASS', y=feature, data=df)
    plt.title(f'Boxplot of {feature} by Target Class')
    plt.show()
```

[4]







5. Scale the features using StandardScaler and transform the data

```
from sklearn.preprocessing import StandardScaler
X = df.drop('FinalGrade', axis=1)
y = df['FinalGrade']
X['Gender'] = X['Gender'].map({'Male': 0, 'Female': 1})
X['ParentalSupport'] = X['ParentalSupport'].map({'Low': 0, 'Medium': 1, 'High': 2})
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X[['AttendanceRate', 'StudyHoursPerWeek', 'PreviousGrade', 'ExtracurricularActivities', 'ParentalSupport', 'Gender']])
X_scaled_df = pd.DataFrame(X_scaled, columns=['AttendanceRate_scaled', 'StudyHoursPerWeek_scaled', 'PreviousGrade_scaled', 'ExtracurricularActivities_scaled', 'ParentalSupport_scaled', '(
X_scaled_df['StudentID'] = X['StudentID']
X_scaled_df['Name'] = X['Name']
X_scaled_df['FinalGrade'] = y

print(X_scaled_df.head())
```

```
   AttendanceRate_scaled  StudyHoursPerWeek_scaled  PreviousGrade_scaled  \
0              -0.084989                 -0.415581             -0.010365
1               0.623252                  0.354014              0.715151
2              -1.076526                 -1.185177             -1.357750
3               0.906548                  1.123609              1.233376
4               0.339956                  0.046176              0.404216

   ExtracurricularActivities_scaled  ParentalSupport_scaled  Gender_scaled  \
0                          -0.48795                     NaN            NaN
1                           0.48795                     NaN            NaN
2                          -1.46385                     NaN            NaN
3                           1.46385                     NaN            NaN
4                           0.48795                     NaN            NaN

   StudentID     Name  FinalGrade
0          1     John          80
1          2    Sarah          87
2          3     Alex          68
3          4  Michael          92
4          5     Emma          85
/usr/local/lib/python3.10/dist-packages/sklearn/utils/extmath.py:1137: RuntimeWarning: invalid value encountered in divide
  updated_mean = (last_sum + new_sum) / updated_sample_count
/usr/local/lib/python3.10/dist-packages/sklearn/utils/extmath.py:1142: RuntimeWarning: invalid value encountered in divide
  T = new_sum / new_sample_count
/usr/local/lib/python3.10/dist-packages/sklearn/utils/extmath.py:1162: RuntimeWarning: invalid value encountered in divide
  new_unnormalized_variance -= correction**2 / new_sample_count
```


```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
```

```
# Select only the numeric columns
numeric_cols = df.select_dtypes(include=['int64', 'float64']).columns

# Scale the numeric columns
scaler.fit(df[numeric_cols])
scaled_features = scaler.transform(df[numeric_cols])

# Create a new DataFrame with the scaled features
df_feat = pd.DataFrame(scaled_features, columns=numeric_cols)
```

```
df_feat.head()
```

	StudentID	Gender	AttendanceRate	StudyHoursPerWeek	PreviousGrade	ExtracurricularActivities	ParentalSupport	FinalGrade	TARGET CLASS
0	-1.566699	-1.0	-0.084989	-0.415581	-0.010365	-0.48795	1.083473	-0.020879	-1.0
1	-1.218544	1.0	0.623252	0.354014	0.715151	0.48795	-0.120386	0.709876	1.0
2	-0.870388	-1.0	-1.076526	-1.185177	-1.357750	-1.46385	-1.324244	-1.273600	-1.0
3	-0.522233	-1.0	0.906548	1.123609	1.233376	1.46385	1.083473	1.231843	1.0
4	-0.174078	1.0	0.339956	0.046176	0.404216	0.48795	-0.120386	0.501089	1.0

Part 2 Model training and Fit the data to Model

1. Split the data generated from list created as X, Y is distributed using train test split function as X trainY trainX testY test

```
from sklearn.model_selection import train_test_split
X = df_feat
y = df['TARGET CLASS']
X_train, X_test, y_train, y_test = train_test_split(scaled_features,df['TARGET CLASS'],test_size=0.30, random_state=101)
```

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=1)
knn.fit(X_train,y_train)
```

```
KNeighborsClassifier
KNeighborsClassifier(n_neighbors=1)
```

```
pred = knn.predict(X_test)
```

Part 3 Evaluate the Classification Quality

1. Generate the confusion matrix to estimate the correction among features
2. Generate the classi cation report using classification report

```
from sklearn.metrics import classification_report,confusion_matrix
conf_mat=confusion_matrix(y_test,pred)
print(conf_mat)
```

```
[[3]]
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:409: UserWarning: A single label was found in 'y_true' and 'y_pred'. For the confusion matrix to have the cc
  warnings.warn(
```

```
print(classification_report(y_test,pred))
```

```
              precision    recall  f1-score   support
```

```
              0       1.00      1.00      1.00         3

       accuracy                           1.00         3
      macro avg       1.00      1.00      1.00         3
   weighted avg       1.00      1.00      1.00         3
```

```
import numpy as np


from sklearn.metrics import confusion_matrix, classification_report

# Generate the confusion matrix
conf_mat = confusion_matrix(y_test, pred)

# Print the confusion matrix
print("Confusion Matrix:")
print(conf_mat)

# Generate the classification report
class_report = classification_report(y_test, pred)

# Print the classification report
print("Classification Report:")
print(class_report)
```

```
Confusion Matrix:
[[3]]
Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         3

    accuracy                           1.00         3
   macro avg       1.00      1.00      1.00         3
weighted avg       1.00      1.00      1.00         3

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:409: UserWarning: A single label was found in 'y_true' and 'y_pred'. For the confusion matrix to have the cc
  warnings.warn(
```

```
for i, error_rate in enumerate(error_rates, start=1):
    print("K Value:", i, "Error Rate:", error_rate)
```

```
K Value: 1 Error Rate: 0.0
K Value: 2 Error Rate: 0.0
K Value: 3 Error Rate: 0.3333333333333333
K Value: 4 Error Rate: 0.3333333333333333
K Value: 5 Error Rate: 1.0
K Value: 6 Error Rate: 1.0
K Value: 7 Error Rate: 1.0
```

```
error_rates = []

# Will take some time
for k in range(1, len(X_train) + 1):
    if k <= len(X_train):
        knn = KNeighborsClassifier(n_neighbors=k)
        knn.fit(X_train, y_train)
```

```
        predictions = knn.predict(X_test)
        error_rate = np.mean(predictions != y_test)
        error_rates.append(error_rate)
    else:
        break

plt.figure(figsize=(10, 6))
plt.plot(range(1, len(error_rates) + 1), error_rates, color='blue', linestyle='dashed', marker='o'
         markerfacecolor='red', markersize=8)
plt.title('Error Rate vs. K Value', fontsize=20)
plt.xlabel('K', fontsize=15)
plt.ylabel('Error (Misclassification) Rate', fontsize=15)
plt.legend(['Error Rate'])
plt.grid(True)
plt.show()
```