Importing Libraries:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sbs
from sklearn.linear_model import LinearRegression,LogisticRegression
from sklearn.metrics import mean_squared_error
from sklearn.cluster import KMeans,AgglomerativeClustering
from scipy import stats
from scipy.stats import zscore
from sklearn.tree import DecisionTreeClassifier, plot_tree
from scipy.cluster.hierarchy import dendrogram, linkage
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score,r2_score
from sklearn.preprocessing import StandardScaler
```

Improting Dataset:

```
file=pd.read_csv("students_data.csv")
file.head()
file.drop(columns=['Unnamed: 3'], inplace=True)
first_row=file[:0:3]
first_row_list=list(first_row)
```

Finding Shape (m*n):

```
file.shape
file.shape
```

```
(599, 3)
```

Checking Nan Values:

```
file.isnull().sum()
```

```
Oliver Thompson       300
Harvard University    300
2                     311
dtype: int64
```

Giving Names to Columns:

```
columns_name = ['Student_Name', 'University_Name', 'Student_CGPA']
new_column_names = {}
for i, col in enumerate(file.columns):
    new_column_names[col] = columns_name[i]
file.rename(columns=new_column_names, inplace=True)
file = file.append(pd.Series(first_row_list, index=file.columns), ignore_index=True)
file
```

```
<ipython-input-35-9331c10b9164>:6: FutureWarning: The frame.append method is deprecated an
  file = file.append(pd.Series(first_row_list, index=file.columns), ignore_index=True)
```

	Student_Name	University_Name	Student_CGPA
0	Emma Johnson	Stanford University	3.82
1	Liam Smith	Massachusetts Institute of Technology (MIT)	3.6
2	Olivia Brown	University of Cambridge	2.93
3	Noah Davis	University of Oxford	3.3
4	Ava Wilson	California Institute of Technology (Caltech)	2.95
...	...	...	...

Dropping "Useless" Column Because It have all rows=Nan:

599 NaN NaN NaN

```
file.columns
```

```
Index(['Student_Name', 'University_Name', 'Student_CGPA'], dtype='object')
```

600 rows × 3 columns

Now Converting "Student_CGPA" column data type into 'float64":

```
file.Student_CGPA=pd.to_numeric(file.Student_CGPA,errors='coerce')
file.dtypes
```

```
Student_Name        object
University_Name     object
Student_CGPA       float64
dtype: object
```

Drooping Nan Values:

```
file=file.dropna()
```

Removing Duplicate rows:

```
file=file.drop_duplicates()
```

```
file.head()
```

	Student_Name	University_Name	Student_CGPA
0	Emma Johnson	Stanford University	3.82
1	Liam Smith	Massachusetts Institute of Technology (MIT)	3.60
2	Olivia Brown	University of Cambridge	2.93
3	Noah Davis	University of Oxford	3.30
4	Ava Wilson	California Institute of Technology (Caltech)	2.95

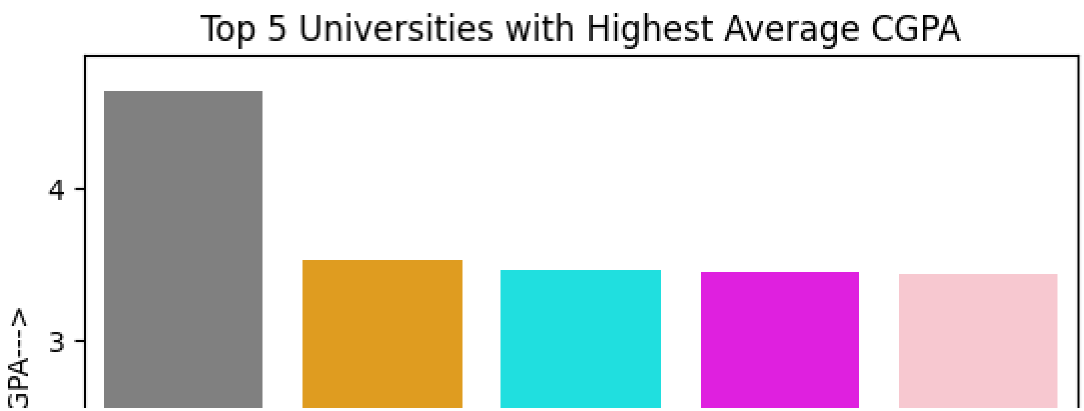
What are the top 5 universities with the highest average CGPA?

```
top_5_universities=file.groupby('University_Name')['Student_CGPA'].mean().nlargest(5)
print(top_5_universities)
```

```
University_Name
University of Southampton                    4.626667
University of Toronto                        3.525000
University of Southern California (USC)     3.455000
University of Bristol                        3.440000
University of Michigan, Ann Arbor            3.433333
Name: Student_CGPA, dtype: float64
```

Visualization OF top 5 Universities with highest average CGPA:

```
colors = ["grey", "orange", "cyan", "magenta", "pink"]
sbs.barplot(x=top_5_universities.index, y=top_5_universities.values, palette=colors)
plt.xlabel('University--->')
plt.ylabel('Average CGPA--->')
plt.title('Top 5 Universities with Highest Average CGPA')
plt.xticks(rotation=45)
plt.show()
```



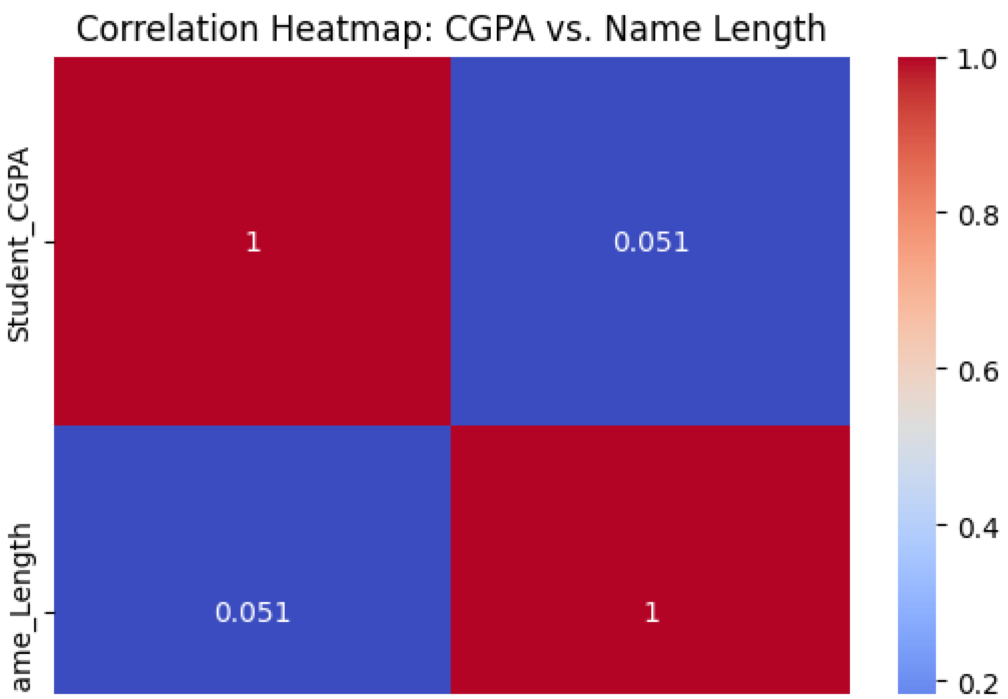
Is there a correlation between the CGPA and the length of the student's name?

```
file['Name_Length'] = file['Student_Name'].str.len()
correlation = file[['Student_CGPA', 'Name_Length']].corr()
print("Correlation coefficient=",correlation)
```

```
Correlation coefficient=              Student_CGPA  Name_Length
Student_CGPA       1.00000      0.05133
Name_Length        0.05133      1.00000
```

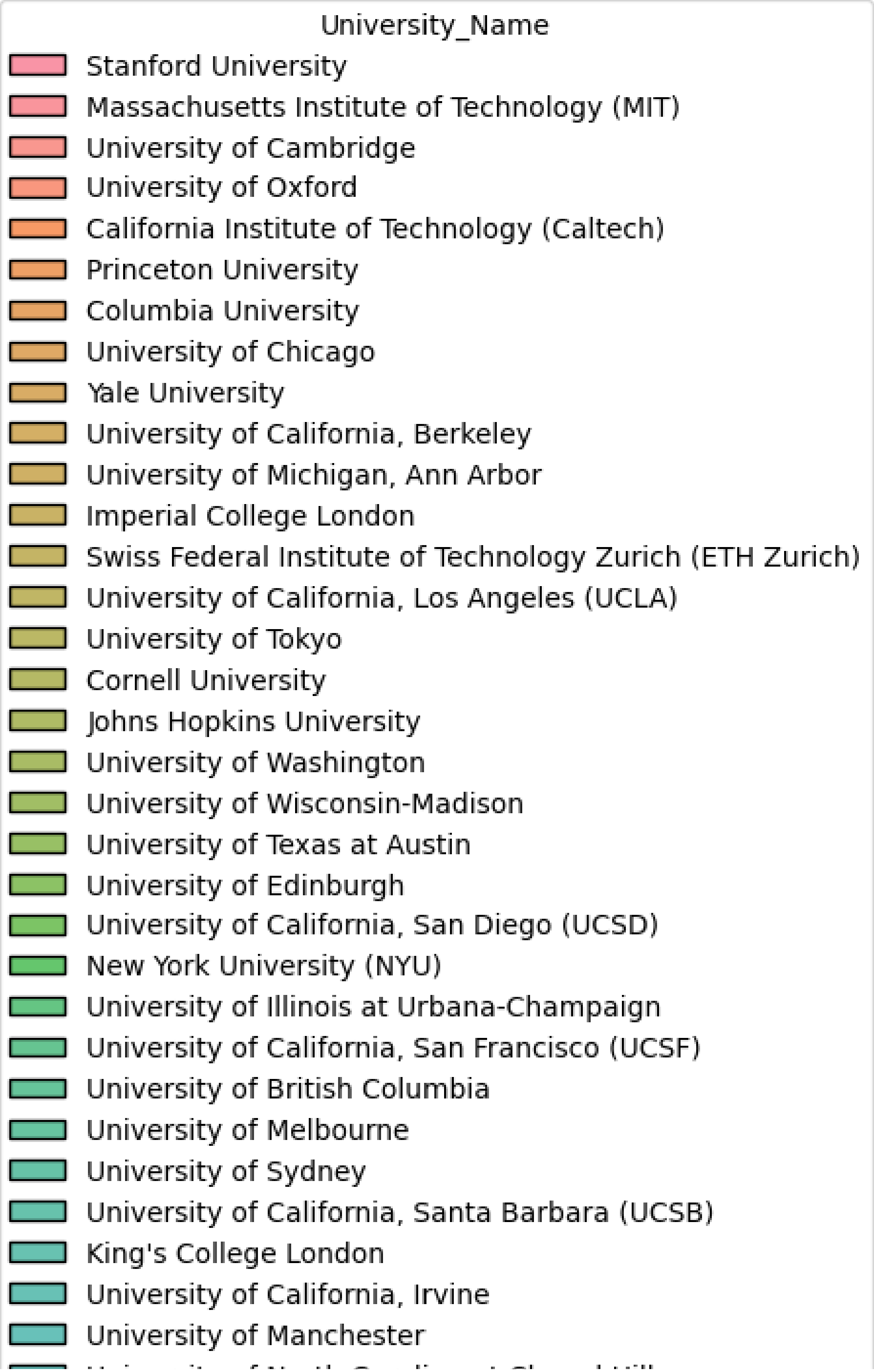
Visualization between CGPA and length of Student Name ⁉

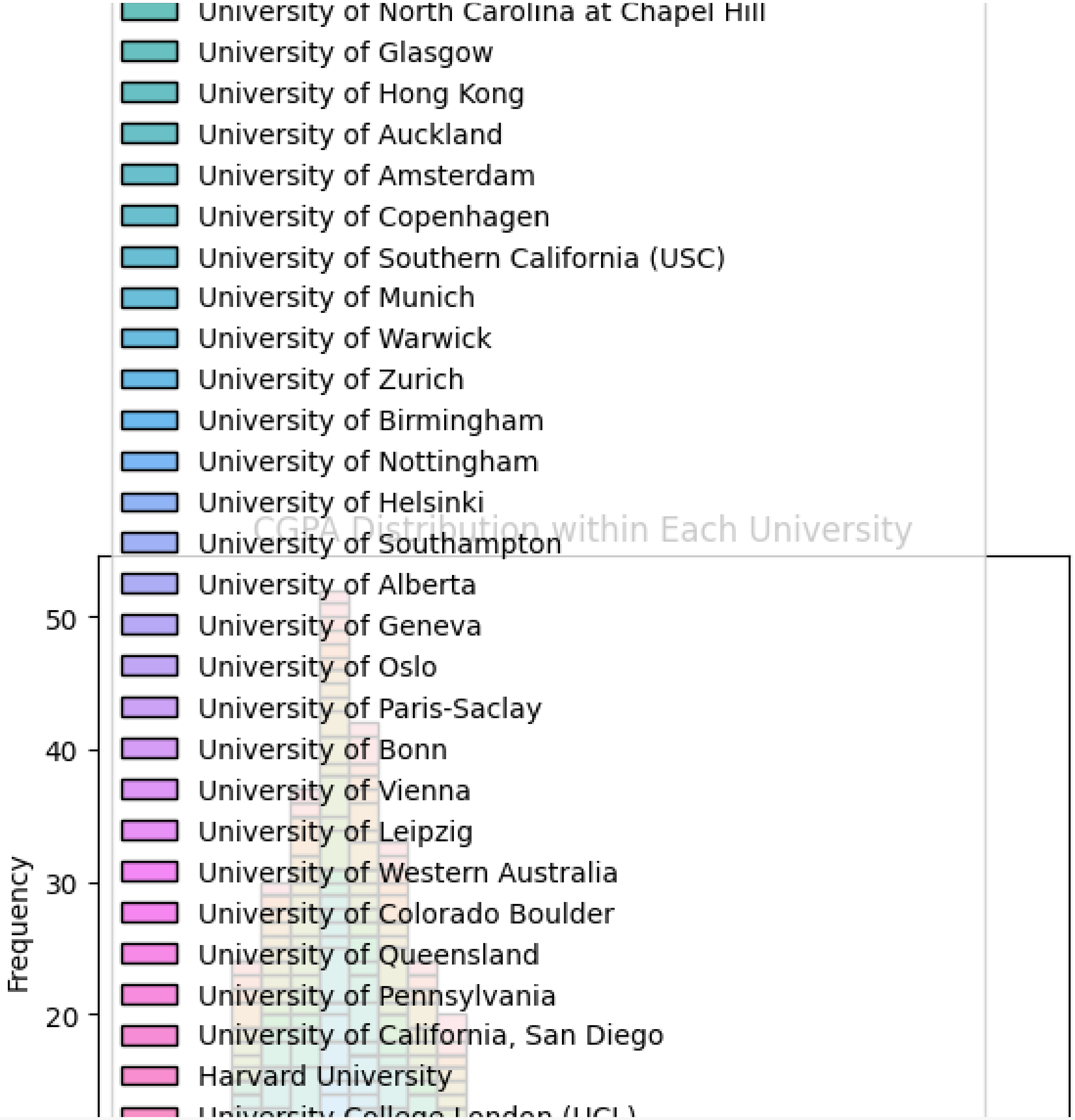
```
sbs.heatmap(correlation, annot=True, cmap='coolwarm')
plt.title('Correlation Heatmap: CGPA vs. Name Length')
plt.show()
#too low correlation.
```



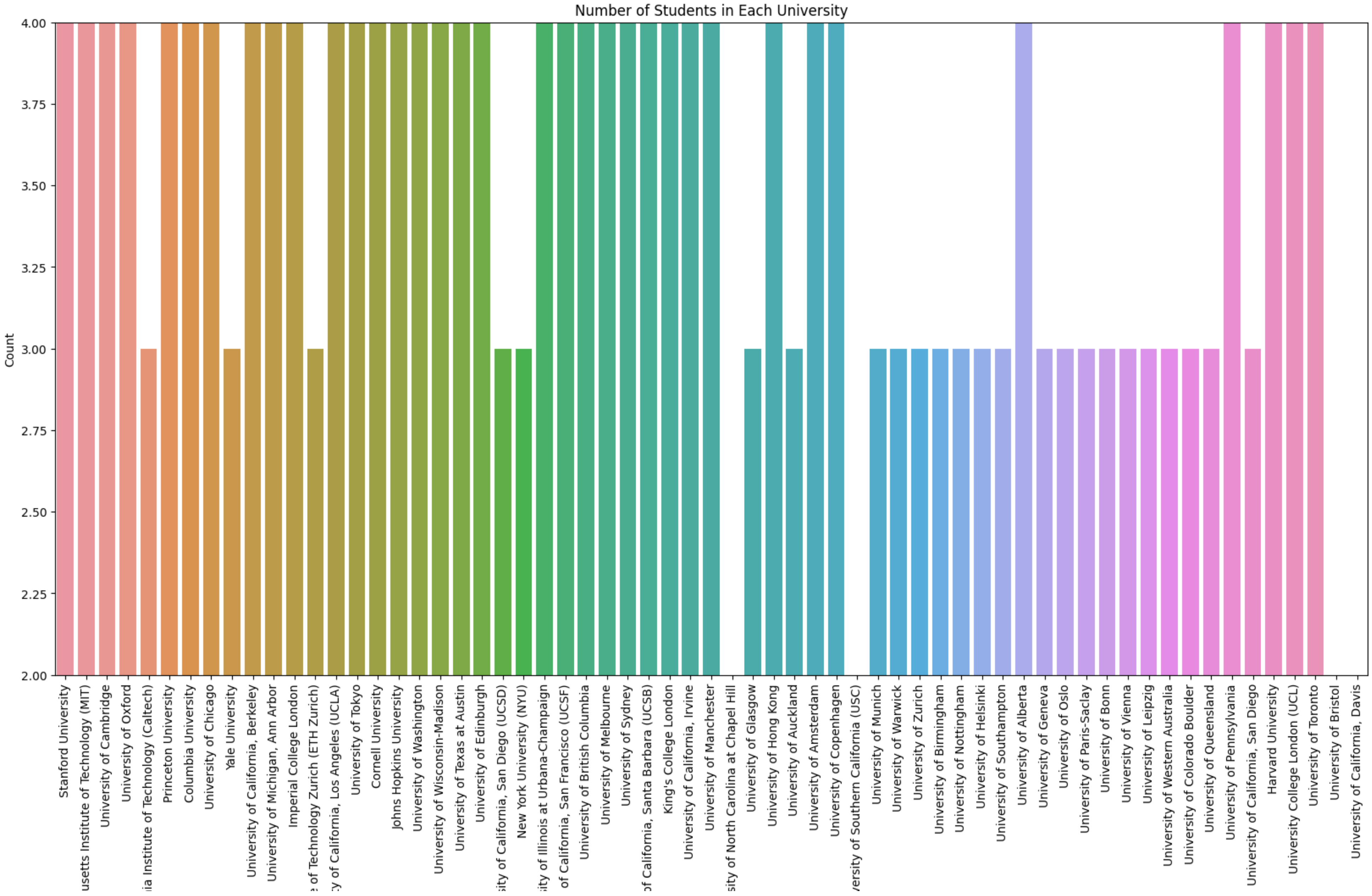
How does the CGPA vary across different universities?

```
sbs.histplot(data=file, x='Student_CGPA', hue='University_Name', multiple='stack')
plt.xlabel('CGPA')
plt.ylabel('Frequency')
plt.title('CGPA Distribution within Each University')
plt.show()
```


University_Name
Stanford University
Massachusetts Institute of Technology (MIT)
University of Cambridge
University of Oxford
California Institute of Technology (Caltech)
Princeton University
Columbia University
University of Chicago
Yale University
University of California, Berkeley
University of Michigan, Ann Arbor
Imperial College London
Swiss Federal Institute of Technology Zurich (ETH Zurich)
University of California, Los Angeles (UCLA)
University of Tokyo
Cornell University
Johns Hopkins University
University of Washington
University of Wisconsin-Madison
University of Texas at Austin
University of Edinburgh
University of California, San Diego (UCSD)
New York University (NYU)
University of Illinois at Urbana-Champaign
University of California, San Francisco (UCSF)
University of British Columbia
University of Melbourne
University of Sydney
University of California, Santa Barbara (UCSB)
King's College London
University of California, Irvine
University of Manchester



```
fig , ax = plt.subplots(figsize = (20,10))
sbs.countplot(data=file, x='University_Name',ax=ax)
plt.xlabel('University')
plt.ylabel('Count')
plt.title('Number of Students in Each University')
plt.xticks(rotation=90)
plt.ylim(2.0,4.0)
plt.show()
```

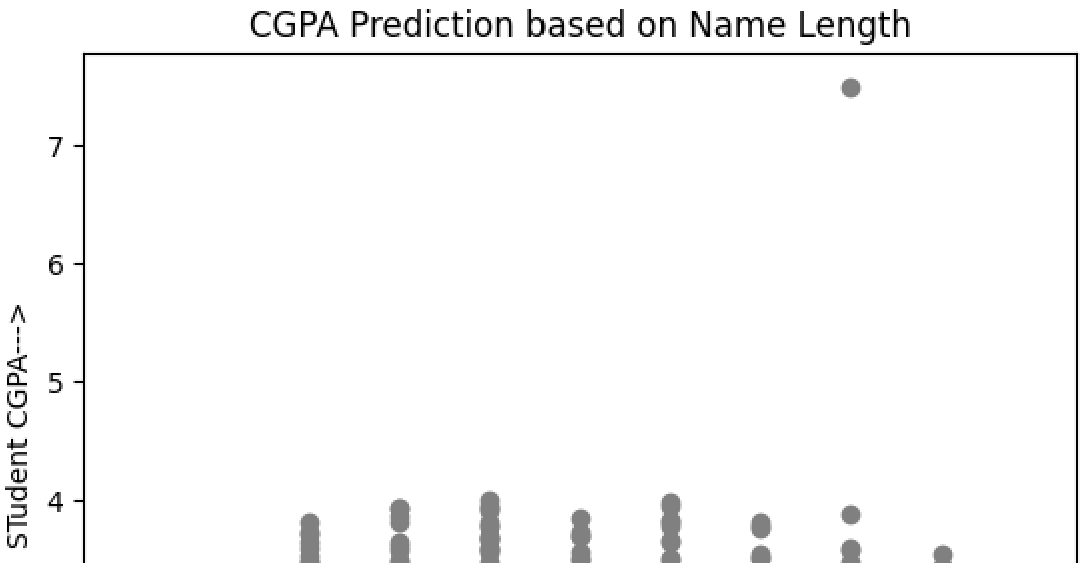


Can we predict a student's CGPA based on the length of their name using linear regression?

The correlation 0.05:

it indicates a very weak positive correlation.A correlation value of 0.06 suggests that there is a very minimum linear relationship between the CGPA and the name length.

```
X = file['Name_Length'].values.reshape(-1, 1)
y = file['Student_CGPA'].values
model = LinearRegression()
model.fit(X, y)
predicted_cgpa = model.predict(X)
plt.scatter(X, y, color='grey', label='Actual Data')
plt.plot(X, predicted_cgpa, color='red', linewidth=2, label='Regression Line')
plt.xlabel('Student Name Length--->')
plt.ylabel('STudent CGPA--->')
plt.title('CGPA Prediction based on Name Length')
plt.show()
mse = mean_squared_error(y, predicted_cgpa)
print("Mean Squared Error:",mse)
```



Which university has the highest number of students with a CGPA above a certain threshold?

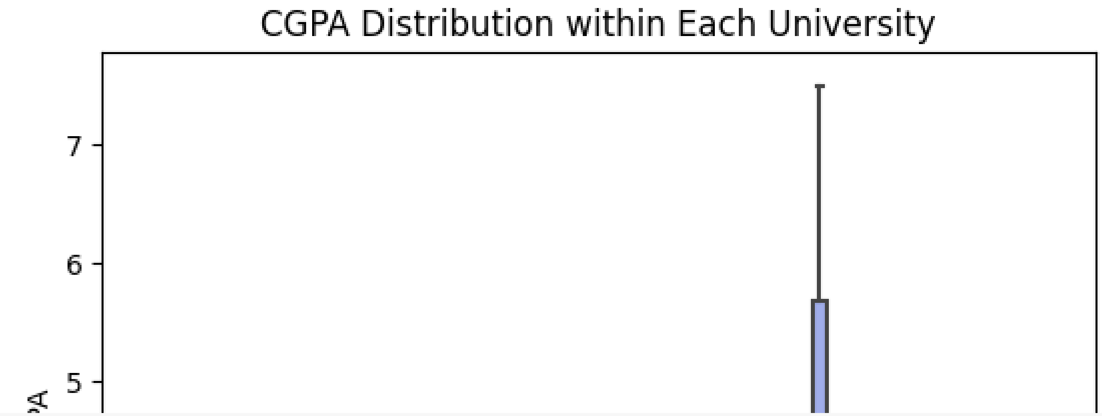
```
threshold = 3.00
filtered_data = file[file.Student_CGPA > threshold]
university_counts = filtered_data.groupby('University_Name').size()
university_with_highest_count = university_counts.idxmax()
print("The university with the highest number of students above the CGPA 3.0 threshold =",university_with_highest_count)
```

```
The university with the highest number of students above the CGPA 3.0 threshold = King's College London
```

Can we identify any outliers in the CGPA distribution within each university?

```
sbs.boxplot(x='University_Name', y='Student_CGPA', data=file)
plt.xticks(rotation=90)
plt.xlabel('University')
plt.ylabel('CGPA')
plt.title('CGPA Distribution within Each University')
```

```
Text(0.5, 1.0, 'CGPA Distribution within Each University')
```



```
def remove_outliers(data, threshold=3):
    z_scores = stats.zscore(data)  # Calculate z-scores
    filtered_data = data[abs(z_scores) <= threshold]  # Filter data based on threshold
    cleaned_data = data[data.isin(filtered_data).all(axis=1)]  # Remove rows containing outliers
    return cleaned_data
cleaned_data = remove_outliers(file[['Student_CGPA']])
```

Can we cluster students based on their CGPA using k-means clustering?

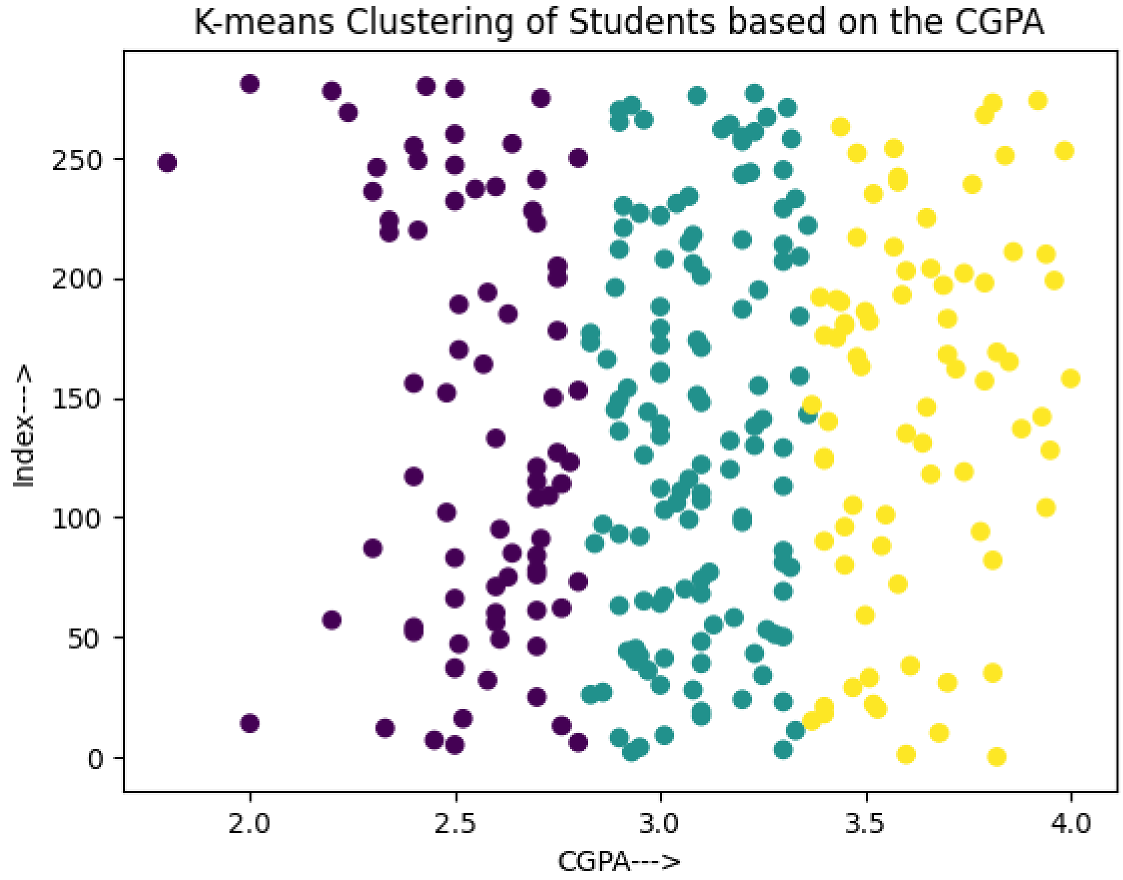
k-Mean clustering after removing outliers from Student_CGPA:

```
from sklearn.preprocessing import LabelEncoder

# Encode student names as numeric labels
label_encoder = LabelEncoder()
encoded_names = label_encoder.fit_transform(file['Student_Name'])
X = cleaned_data.values.reshape(-1, 1)
k = 3
kmeans = KMeans(n_clusters=k, random_state=42)
kmeans.fit(X)
```

```
labels = kmeans.labels_
plt.scatter(X, range(len(cleaned_data.values)), c=labels, cmap='viridis')
plt.xlabel('CGPA--->')
plt.ylabel('Index--->')
plt.title('K-means Clustering of Students based on the CGPA')
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will chang
  warnings.warn(
```


K-means Clustering of Students based on the CGPA

k_mean clustering when we have outliers in student CGPA:

```
X = file.Student_CGPA.values.reshape(-1, 1)
k = 3
kmeans = KMeans(n_clusters=k, random_state=42)
kmeans.fit(X)
labels = kmeans.labels_
plt.scatter(file['Student_CGPA'], [0]* len(file), c=labels, cmap='viridis')
plt.xlabel('CGPA')
plt.title('K-means Clustering of Students based on CGPA')
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will chang
```

What is the average CGPA for each cluster identified in the previous question?

| |

Here we Have 3 clusters and 3 different averages to thier respective clusters:

| |

```
cleaned_data['Cluster'] = labels[:len(cleaned_data)]
avg_cgpa_by_cluster = cleaned_data.groupby('Cluster')['Student_CGPA'].mean()
print(avg_cgpa_by_cluster)
```

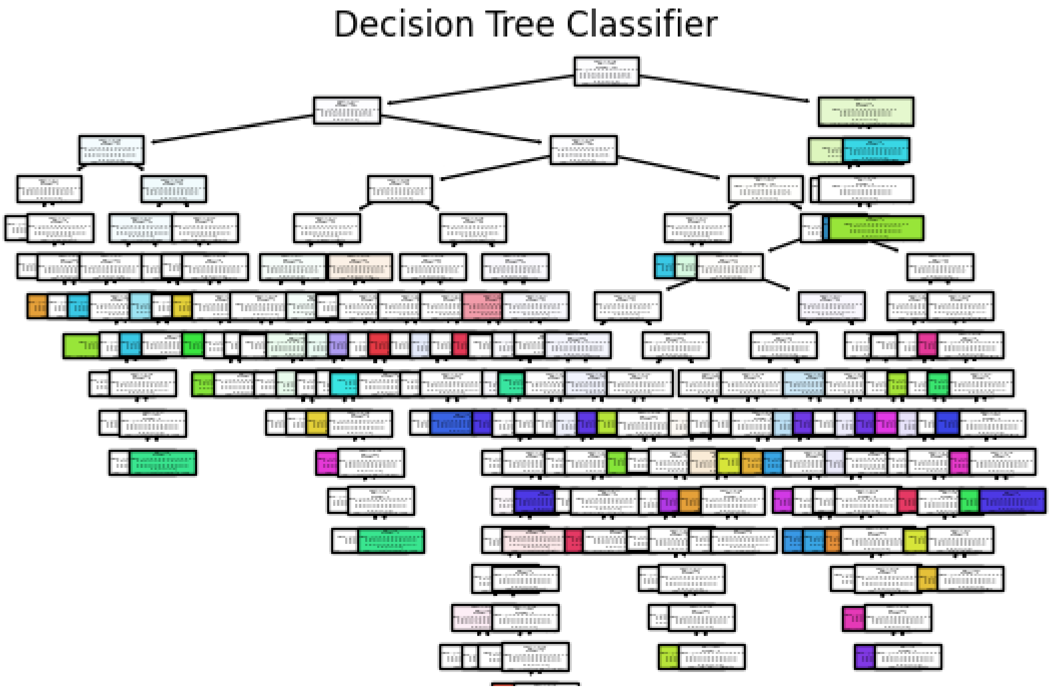
```
Cluster
0    3.176575
1    3.020117
2    2.940000
Name: Student_CGPA, dtype: float64
```

| |

Can we classify students into universities based on their CGPA using a decision tree?

| |

```
X = file[['Student_CGPA']]
y = file[['University_Name']]
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.15, random_state=42)
D_T_C_Object = DecisionTreeClassifier()
D_T_C_Object.fit(X_train, y_train)
y_pred = D_T_C_Object.predict(X_test)
plot_tree(D_T_C_Object, feature_names=['CGPA'], class_names=D_T_C_Object.classes_, filled=True)
plt.title('Decision Tree Classifier')
plt.show()
```



How accurate is the decision tree model in predicting the university?

```
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:" ,accuracy)
```

```
Accuracy: 0.0
```

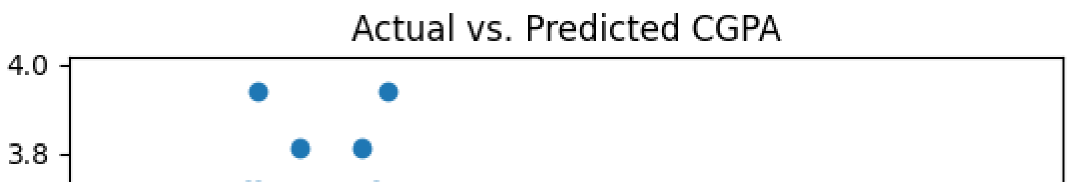
What is the overall average CGPA across all universities?

```
print("Overall Average CGPA Acroos All Universities",cleaned_data.Student_CGPA.mean())
```

```
Overall Average CGPA Acroos All Universities 3.0902943262411346
```

Can we build a regression model to predict a student's CGPA based on their university?

```
X = file[['University_Name']]
y = file['Student_CGPA']
X_encoded = pd.get_dummies(X, drop_first=True)#actually I have used y=file.University_Name from previous cell.See Decision Tree Regre
X_train, X_test, y_train, y_test = train_test_split(X_encoded, y, test_size=0.40, random_state=42)
regression_model = LinearRegression()
regression_model.fit(X_train, y_train)
y_pred = regression_model.predict(X_test)
plt.scatter(y_test, y_pred)
plt.xlabel('Actual CGPA')
plt.ylabel('Predicted CGPA')
plt.title('Actual vs. Predicted CGPA')
plt.show()
```



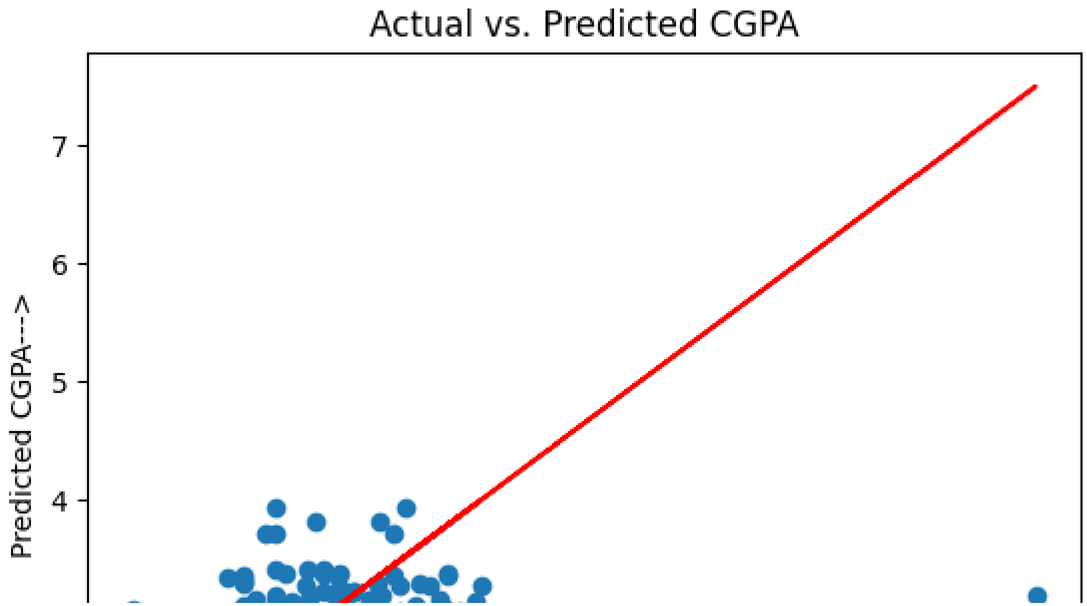
How well does the regression model perform in predicting the CGPA?

```
MSE = mean_squared_error(y_test, y_pred)
print("Mean Squared Error:(MSE)=", mse)
R_Squared=r2_score(y_test, y_pred)
print("R_Squared=",R_Squared)
#Lower MSE indicates better model performance.
#The model is not good in explaining the variation of student CGPA.
```

```
Mean Squared Error:(MSE)= 0.2582738201179288
R_Squared= -0.4110867213854772
```

Linear Regression Model:

```
plt.scatter(y_test, y_pred)
plt.plot(y_test,y_test, color='red')
plt.xlabel('Actual CGPA--->')
plt.ylabel('Predicted CGPA--->')
plt.title('Actual vs. Predicted CGPA')
plt.show()
```


Actual vs. Predicted CGPA

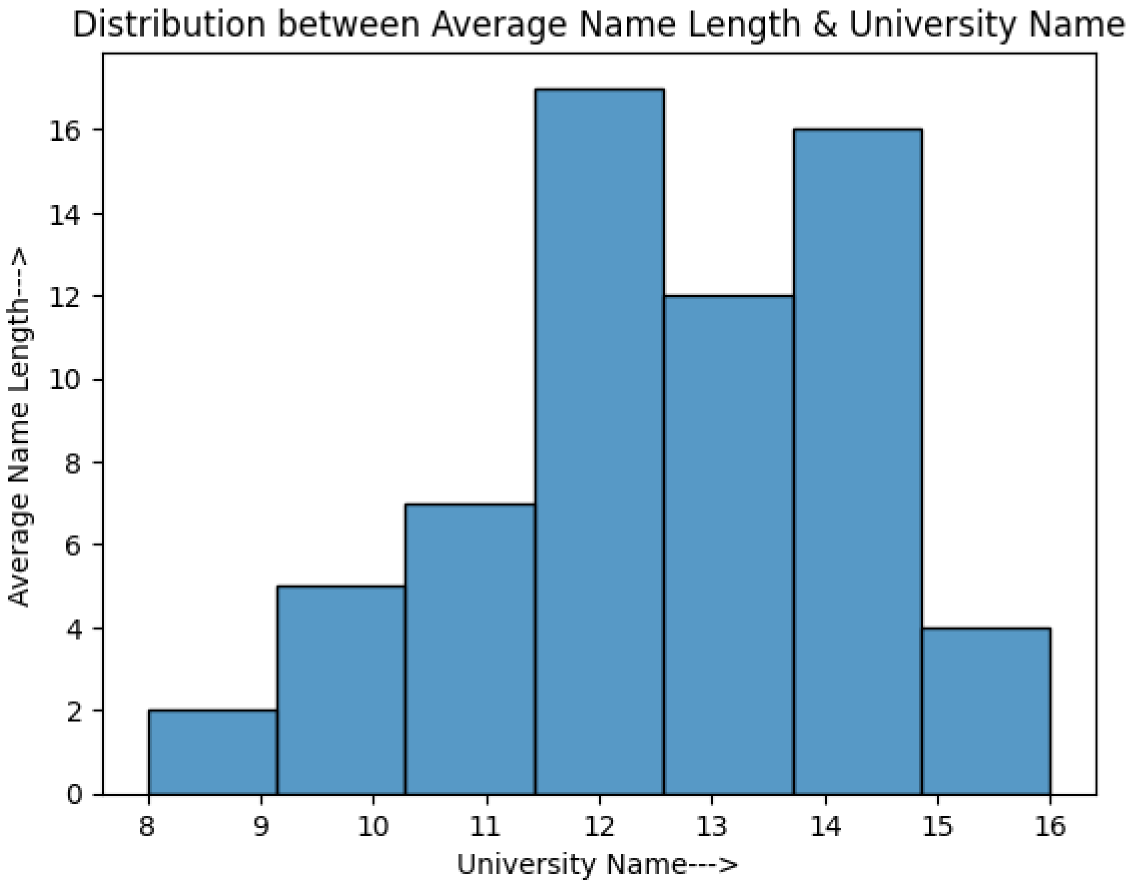
Are there any missing or erroneous values in the CGPA column?

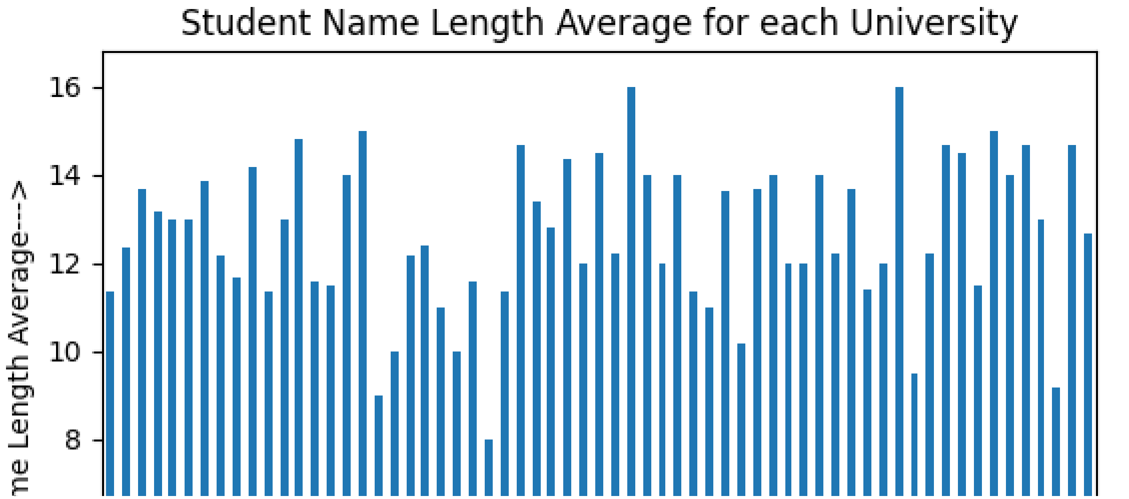
Answer:

Yes, there were many missing values (NaN), but I have already cleared them by dropping the NaN values and removing duplicate values as well.

Can we detect any relationships between the length of the student's name and their university using association rules?

```
name_length_avg = file.groupby('University_Name')['Name_Length'].mean()
sbs.histplot(name_length_avg)
plt.xlabel('University Name--->')
plt.ylabel('Average Name Length--->')
plt.ylabel('Average Name Length--->')
plt.title('Distribution between Average Name Length & University Name')
plt.show()
name_length_avg.plot(kind='bar')
plt.xlabel('University Names---->')
plt.ylabel(' Student Name Length Average--->')
plt.title('Student Name Length Average for each University')
plt.show()
```


Distribution between Average Name Length & University Name
Average Name Length--->
University Name--->
0
2
4
6
8
10
12
14
16
8
9
10
11
12
13
14
15
16


Student Name Length Average for each University
me Length Average--->
8
10
12
14
16

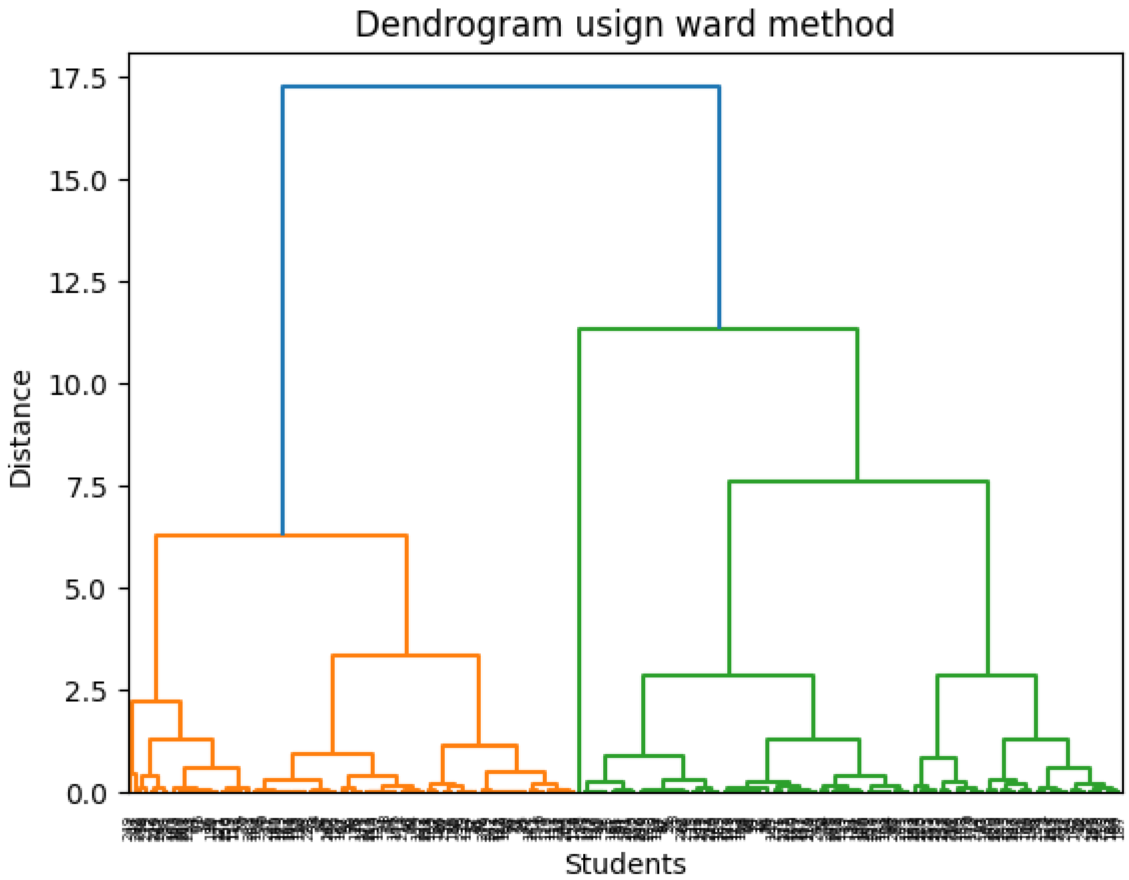
What is the range of CGPA scores for each university?

```
cgpa_range = file.groupby('University_Name')['Student_CGPA'].agg(['min', 'max'])
print("Range of CGPA for each University:\n",cgpa_range.head())
```

```
Range of CGPA for each University:
                                                 min   max
University_Name
California Institute of Technology (Caltech)  2.61  3.43
Columbia University                           2.70  3.59
Cornell University                            2.24  3.66
Harvard University                            2.00  3.50
Imperial College London                       2.70  3.79
```

Can we identify any clusters or groups of students based on the CGPA and university using hierarchical clustering?

```
features = ['Student_CGPA']
scaler = StandardScaler()
file_scaled = scaler.fit_transform(file[features])
clustering = AgglomerativeClustering(n_clusters=3)  # Specify the number of clusters
labels = clustering.fit_predict(file_scaled)
linkage_matrix = linkage(file_scaled, method='ward')  # Use 'ward' method for hierarchical clustering
dendrogram(linkage_matrix)
plt.title('Dendrogram usign ward method')
plt.xlabel('Students')
plt.ylabel('Distance')
plt.show()
```



Can we build a classification model to predict the university based on the CGPA and the length of the student's name?

```
X_train, X_test, y_train, y_test = train_test_split(file[['Student_CGPA', 'Name_Length']], file.University_Name, test_size=0.20, ran
model = LogisticRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (st
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

How accurate is the classification model in predicting the university?

```
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
#The model is not performing well bcz accuracy=1.7%(very low)
```

```
Accuracy: 0.017543859649122806
```

What is the correlation between the length of the student's name and the CGPA within each university?

```
correlation=file.Name_Length.corr(file.Student_CGPA)
print(correlation)
```

```
0.051329688243614446
```

●