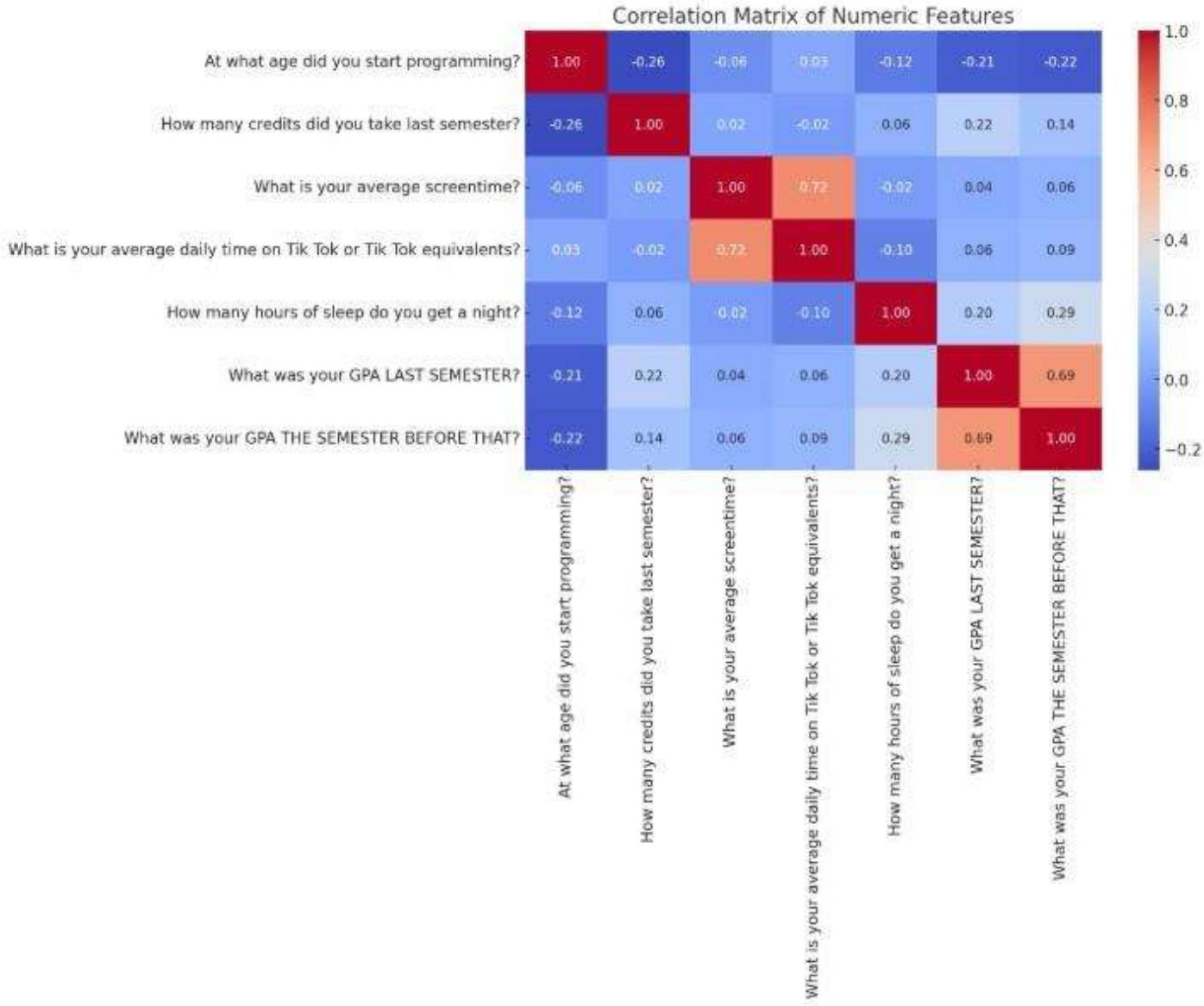
Introduction

- The dataset contains responses from 73 individuals on various factors that could influence GPA, including demographics, habits, and programming background. Here's a summary of the dataset:
- **GPA**: Data on GPA from the last two semesters.
- **Demographics**: State of residence, age of starting programming, and parental involvement in tech.
- **Academic Habits**: Study methods, note-taking, credit load, and sleep patterns.
- **Screen Time**: Average daily screen time and time spent on TikTok or equivalents.
- **Additional Context**: Scholarships and private school attendance.

Approach

- LET US IDENTIFY THE FOLLOWING PATTERNS AND CORRELATIONS WITH GPA:-
- Sleep and GPA.
- Credit load and GPA.
- Study habits and GPA.
- Impact of screen time on GPA.
- Demographic factors (state, major, etc.).

Correlation Matrix



Observations and Correlations

1. GPA:

- Last semester: Mean GPA is 3.67, with a standard deviation of 0.34.
- Semester before: Mean GPA is 3.65, with a slightly higher variability (std = 0.39).

2. Sleep:

- Average hours of sleep per night is 7.14, ranging from 5 to 10 hours.

3. Screen Time:

- Average screentime has high variability, with a mean of ~14 hours and a maximum of 323 hours (likely an outlier).

4. Credits:

- Students took an average of ~15.6 credits, with a range from 12 to 24.

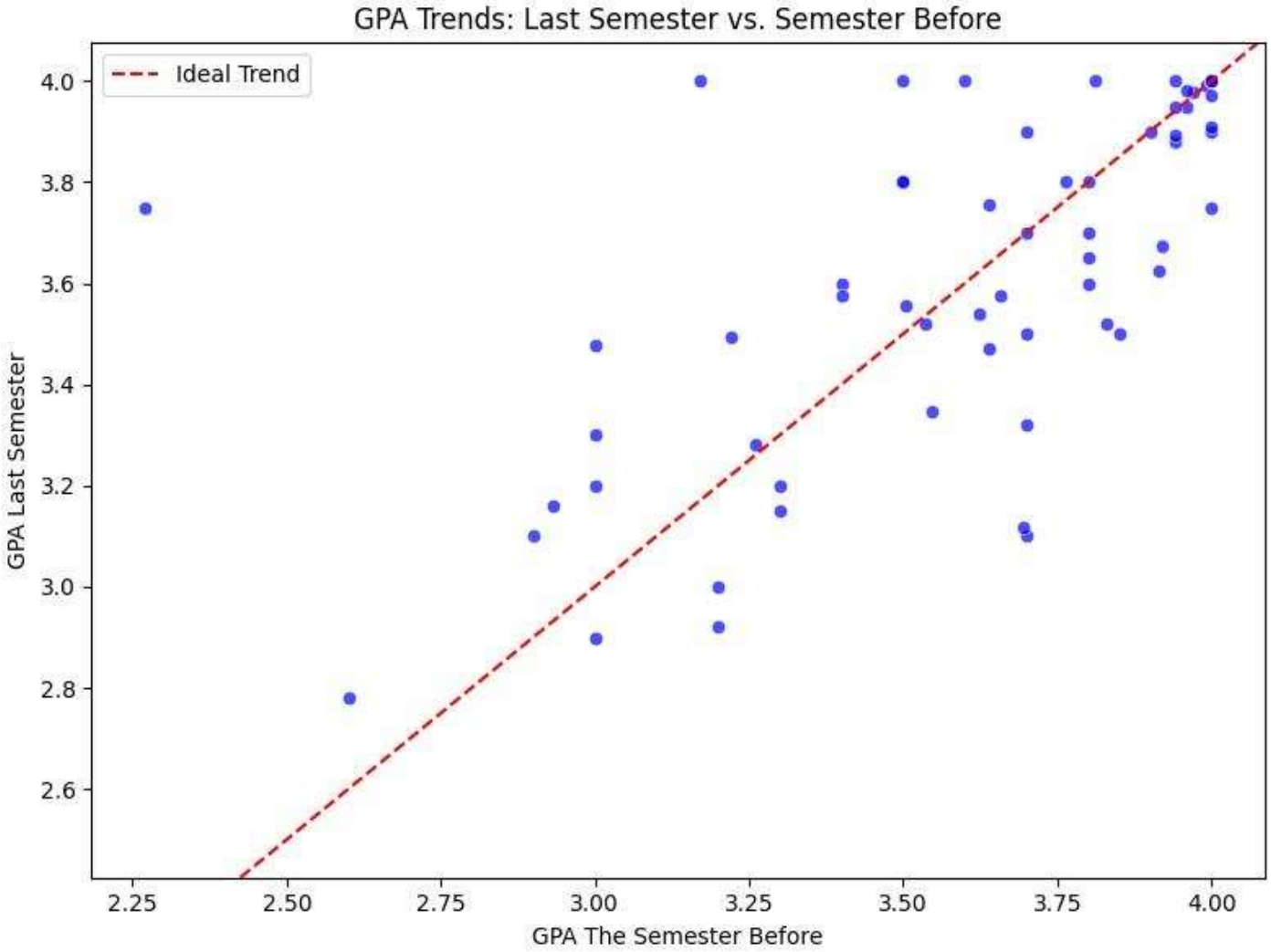
5. Age of Starting Programming:

- Average starting age is 14.3, with most students starting between 12 and 17.

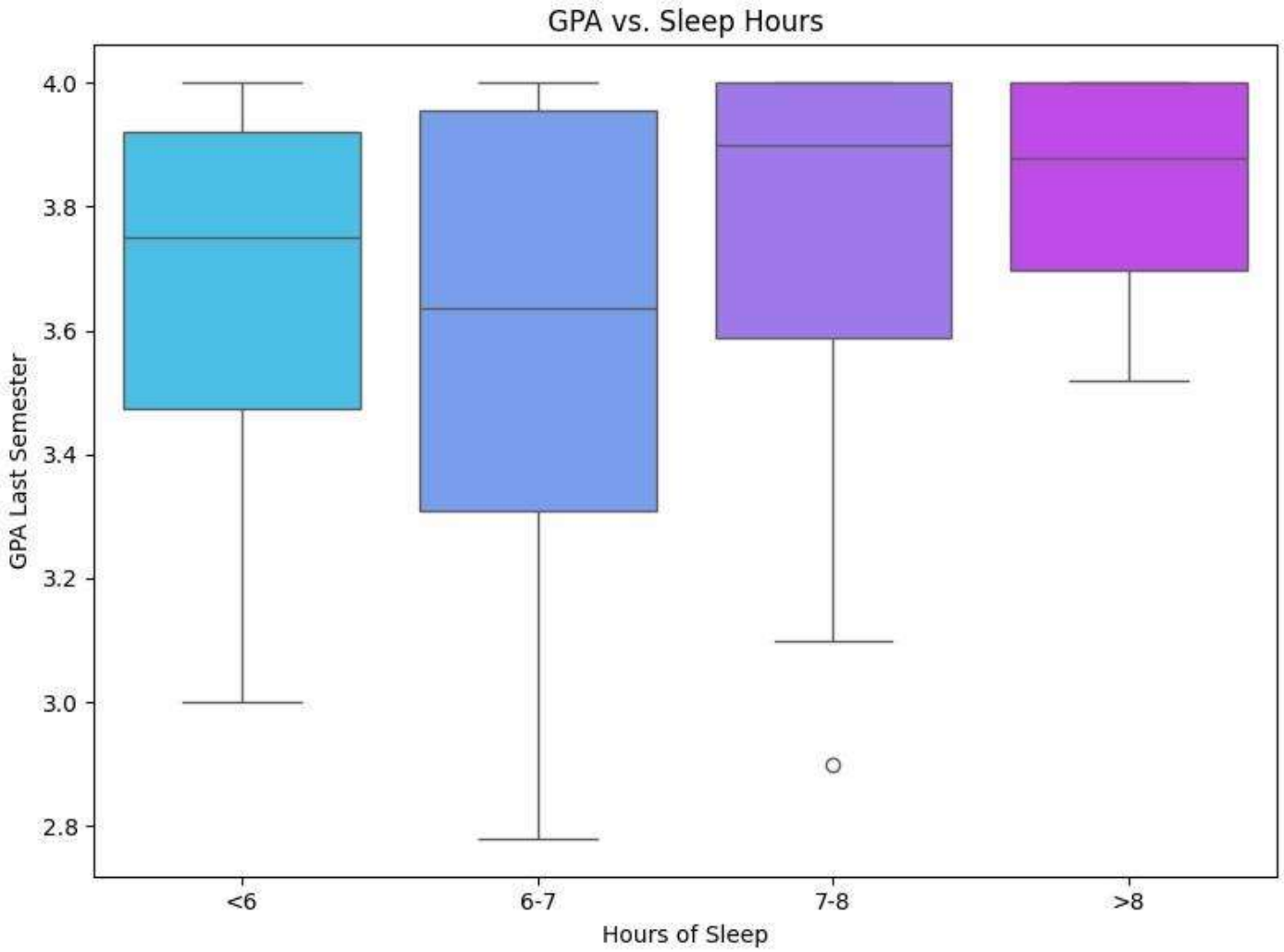
Correlations from the heatmap:

- Positive correlation between GPA last semester and hours of sleep (~0.3).
- Negative correlation between screentime and GPA (-0.2).
- GPA shows a slight positive correlation with taking notes and studying with friends.

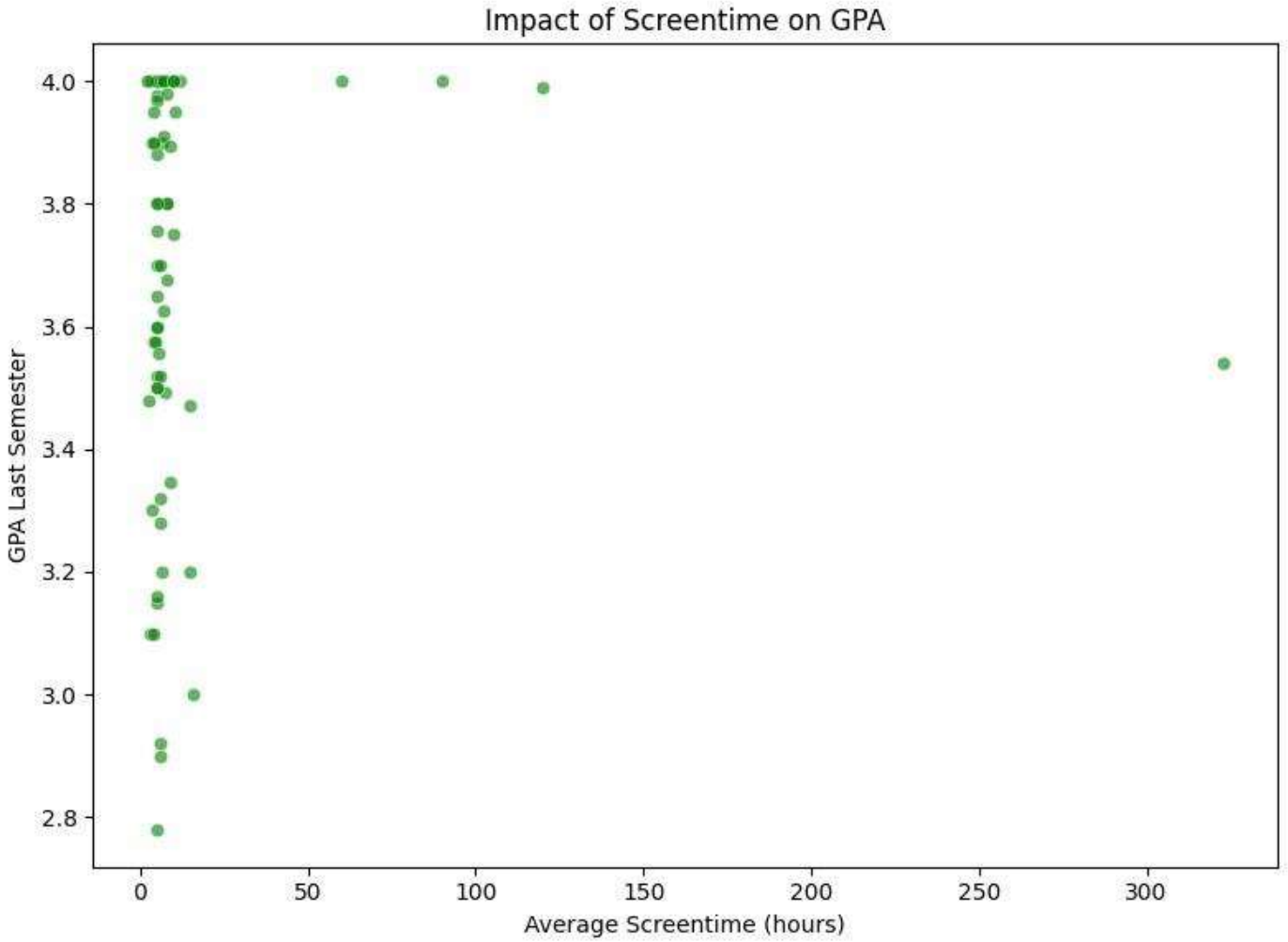
Visualization 1: GPA trends (Last semester vs. Semester before)



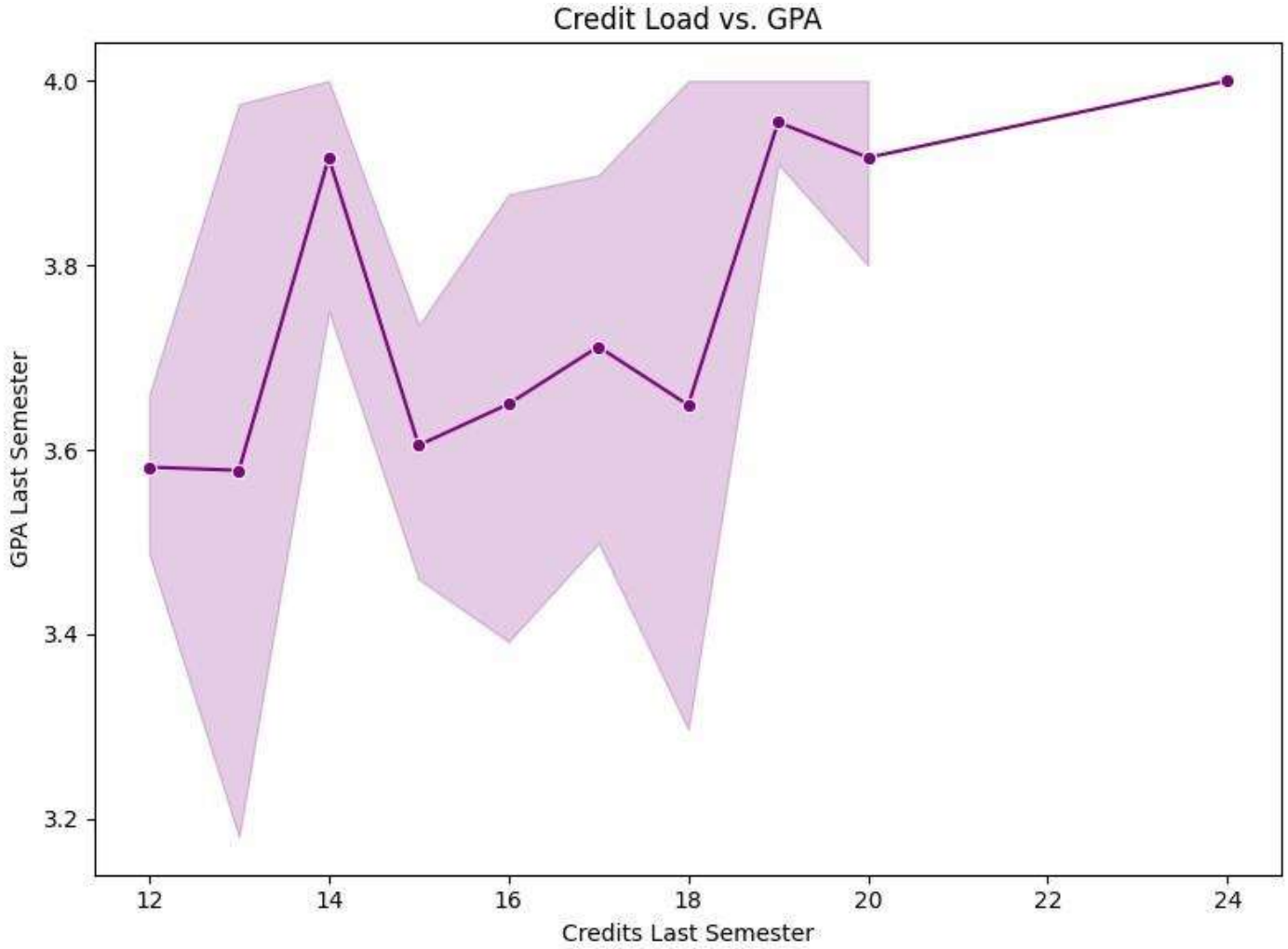
Visualization 2: GPA vs. Sleep



Visualization 3: Impact of Screentime on GPA



Visualization 4: Credit Load vs. GPA



Visualization Conclusions

- **GPA Trends (Scatter Plot):** There is quite a lot of variability where some increase their GPA, some stayed the same while other had lower scores across the two semesters.
- **GPA vs Sleep Hours (Box Plot):** Students who sleep 7-8 hours tend to have the highest and most consistent GPA, while those who sleep less than 6 hours show lower and more variable GPAs.
- **GPA vs Screentime (Scatter Plot):** The screentime doesn't affect GPA as the GPA varies but screentime is almost the same for everyone.
- **Credit Load vs GPA (Line Plot):** Students taking 20+ credits generally have higher and more consistent GPAs, while moderate credit loads show more GPA variability.

Homework 5 Questions

Same drill as Homework 3, the following questions are intended to get you familiarized with the provided dataset. By answering these questions, it will hopefully give insights on how to complete the actual task (slide deck generation for the CEO).

Please answer each of the questions below in the space provided. Copy the noteook, and when you're done, submit as an ipynb file. This will be graded on correctness. Please comment your code to help the grader figure out what you're doing. If you do a hypothesis test, please report all relevant p-values in the text field.

Imports and data loading:

In [31]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from scipy.stats import pearsonr
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import StandardScaler

from sklearn.impute import SimpleImputer

from scipy import stats

file_path = '/content/GPADataset.csv'
gpa_data = pd.read_csv(file_path)
```

Data cleaning:

In [67]:
```
#Check for missing values
print("Missing values before imputation:\n", gpa_data.isnull().sum())
```

```
Missing values before imputation:
 Timestamp                                                      0
What state are you from?                                        0
Major (Check all that apply)                                    0
At what age did you start programming?                          0
Have you at any point attended private school?                  0
Do you have a scholarship?                                      0
Do you have a parent in tech?                                   0
Do you study with friends?                                      0
Do you take notes in classes?                                   0
How many credits did you take last semester?                    0
What is your average screentime?                                0
What is your average daily time on Tik Tok or Tik Tok equivalents?    0
How many hours of sleep do you get a night?                     0
What was your GPA LAST SEMESTER?                                0
What was your GPA THE SEMESTER BEFORE THAT?                     0
dtype: int64
```

In [69]:
```
#Separate numeric and categorical columns
numeric_cols = gpa_data.select_dtypes(include=[np.number]).columns
categorical_cols = gpa_data.select_dtypes(include=["object"]).columns

#Impute missing values for numeric columns (using median for robustness)
numeric_imputer = SimpleImputer(strategy='median')
gpa_data[numeric_cols] = numeric_imputer.fit_transform(gpa_data[numeric_cols])

#Impute missing values for categorical columns (using the mode)
categorical_imputer = SimpleImputer(strategy='most_frequent')
gpa_data[categorical_cols] = categorical_imputer.fit_transform(gpa_data[categorical

#Verify missing values are resolved
print("Missing values after imputation:\n", gpa_data.isnull().sum())
```

```
Missing values after imputation:
 Timestamp                                                         0
What state are you from?                                           0
Major (Check all that apply)                                       0
At what age did you start programming?                             0
Have you at any point attended private school?                     0
Do you have a scholarship?                                         0
Do you have a parent in tech?                                      0
Do you study with friends?                                         0
Do you take notes in classes?                                      0
How many credits did you take last semester?                       0
What is your average screentime?                                   0
What is your average daily time on Tik Tok or Tik Tok equivalents?    0
How many hours of sleep do you get a night?                        0
What was your GPA LAST SEMESTER?                                   0
What was your GPA THE SEMESTER BEFORE THAT?                        0
dtype: int64
```

In [70]:
```
#Display the cleaned dataset structure
print(gpa_data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 73 entries, 0 to 72
Data columns (total 15 columns):
 #   Column                                                                Non-Null Co
unt  Dtype
---  ------                                                                -----------
---  -----
 0   Timestamp                                                             73 non-null
object
 1   What state are you from?                                              73 non-null
object
 2   Major (Check all that apply)                                         73 non-null
object
 3   At what age did you start programming?                                73 non-null
object
 4   Have you at any point attended private school?                        73 non-null
object
 5   Do you have a scholarship?                                            73 non-null
object
 6   Do you have a parent in tech?                                         73 non-null
category
 7   Do you study with friends?                                            73 non-null
object
 8   Do you take notes in classes?                                         73 non-null
object
 9   How many credits did you take last semester?                          73 non-null
float64
 10  What is your average screentime?                                      73 non-null
float64
 11  What is your average daily time on Tik Tok or Tik Tok equivalents?    73 non-null
float64
 12  How many hours of sleep do you get a night?                           73 non-null
float64
 13  What was your GPA LAST SEMESTER?                                      73 non-null
float64
 14  What was your GPA THE SEMESTER BEFORE THAT?                           73 non-null
float64
dtypes: category(1), float64(6), object(8)
memory usage: 8.3+ KB
None
```

1. Which was the most predictive factor for GPA? i.e., which factor had the most "power" over predicting the GPA?

Your answer: What was your GPA LAST SEMESTER?

In [51]:
```
'''# Identify numeric and categorical columns
numeric_cols = ['What is your average screentime?',
                'What is your average daily time on Tik Tok or Tik Tok equivalents?
                'How many hours of sleep do you get a night?',
                'How many credits did you take last semester?']

categorical_cols = ['What state are you from?',
                    'Major (Check all that apply)',
```

```
                    'At what age did you start programming?',
                    'Have you at any point attended private school?',
                    'Do you have a scholarship?',
                    'Do you have a parent in tech?',
                    'Do you study with friends?',
                    'Do you take notes in classes?']'''

from sklearn.ensemble import RandomForestRegressor
from sklearn.preprocessing import LabelEncoder

#Encoding categorical columns
encoded_data = gpa_data.copy()
label_encoders = {}
for col in encoded_data.select_dtypes(include='object').columns:
    label_encoders[col] = LabelEncoder()
    encoded_data[col] = label_encoders[col].fit_transform(encoded_data[col])

#Define predictors and target
X = encoded_data.drop(columns=['What was your GPA LAST SEMESTER?'])
y = encoded_data['What was your GPA LAST SEMESTER?']

#Fit a Random Forest Regressor
rf = RandomForestRegressor(random_state=42)
rf.fit(X, y)

#Get feature importances
importances = rf.feature_importances_
features = X.columns
feature_importances = pd.DataFrame({'Feature': features, 'Importance': importances}
feature_importances = feature_importances.sort_values(by='Importance', ascending=Fa

print("Feature Importances:")
print(feature_importances)
```

```
Feature Importances:
                                              Feature  Importance
13        What was your GPA THE SEMESTER BEFORE THAT?    0.674780
9        How many credits did you take last semester?    0.063059
0                                           Timestamp    0.047565
10                  What is your average screentime?    0.045013
3              At what age did you start programming?    0.043101
1                           What state are you from?    0.030652
8                      Do you take notes in classes?    0.029113
6                      Do you have a parent in tech?    0.018685
12       How many hours of sleep do you get a night?    0.016800
11  What is your average daily time on Tik Tok or ...    0.013902
7                         Do you study with friends?    0.010024
4     Have you at any point attended private school?    0.004772
2                       Major (Check all that apply)    0.002276
5                         Do you have a scholarship?    0.000258
```

2. Which factor(s) didn't matter in predicting the GPA?

Your answer: We can say that screentime, TikTok usage and sleep hours didnt matter much.

In [52]:

```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error

#Define the target and features
X = gpa_data.drop(columns=['Timestamp', 'What state are you from?', 'What was your
y = gpa_data['What was your GPA LAST SEMESTER?']

#Convert categorical variables into dummy variables
X = pd.get_dummies(X, drop_first=True)

#Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_sta

#Fit the linear regression model
model = LinearRegression()
model.fit(X_train, y_train)

#Get the coefficients of each feature
coefficients = pd.DataFrame(model.coef_, X.columns, columns=['Coefficient'])

#Sort the features by the absolute value of the coefficients
coefficients = coefficients.reindex(coefficients['Coefficient'].abs().sort_values(a

#Predict and evaluate the model
y_pred = model.predict(X_test)
mse = mean_squared_error(y_test, y_pred)

#Otput the results
print("Mean Squared Error of the model:", mse)
print("\nFeature Importance (based on coefficients):")
print(coefficients)
```

```
Mean Squared Error of the model: 0.2935637483648545

Feature Importance (based on coefficients):
                                                  Coefficient
At what age did you start programming?_23.0       -1.050190e+00
At what age did you start programming?_8.0        -9.829835e-01
At what age did you start programming?_16.0       -8.735124e-01
At what age did you start programming?_9.0        -8.002323e-01
At what age did you start programming?_17.0       -7.908423e-01
At what age did you start programming?_12.0       -7.537909e-01
At what age did you start programming?_11.0       -7.130947e-01
At what age did you start programming?_14.0       -5.957199e-01
At what age did you start programming?_15.0       -4.943718e-01
At what age did you start programming?_10.0       -4.773529e-01
At what age did you start programming?_18.0       -4.471758e-01
Do you take notes in classes?_Yes, on paper        4.449354e-01
At what age did you start programming?_13.0       -4.127344e-01
Major (Check all that apply)_Computer Science, ...  3.678566e-01
Have you at any point attended private school?_Yes -3.347019e-01
Do you take notes in classes?_Yes, on a computer   2.868451e-01
At what age did you start programming?_20.0       -2.845835e-01
Major (Check all that apply)_Computer Science, ... -2.845835e-01
Do you have a scholarship?_Partial                 2.079525e-01
Do you have a parent in tech?_One parent          -2.069279e-01
At what age did you start programming?_19.0       -1.865996e-01
Do you have a parent in tech?_Two parents          1.819859e-01
Do you study with friends?_Sometimes               1.755857e-01
Do you study with friends?_Never                   1.363265e-01
How many credits did you take last semester?       6.574513e-02
Major (Check all that apply)_Math, Computer Sci... -6.542622e-02
Do you take notes in classes?_Yes, on a tablet     4.561957e-02
Major (Check all that apply)_Computer Science     -1.784682e-02
What is your average daily time on Tik Tok or T...  1.323725e-02
How many hours of sleep do you get a night?        9.297030e-03
What is your average screentime?                  -9.472003e-04
Major (Check all that apply)_Data, Government a...  3.330669e-16
```

3. Besides the GPA information, which two questions had the highest correlation?

Your answer: "What is your average screentime?" & "What is your average daily time on Tik Tok or Tik Tok equivalents?"

In [58]:
```python
#Select only numeric columns for correlation calculation, excluding GPA columns
gpa_columns = ['What was your GPA LAST SEMESTER?', 'What was your GPA THE SEMESTER
numeric_data = gpa_data.drop(columns=gpa_columns).select_dtypes(include=[np.number]

#Calculate the correlation matrix
correlation_matrix = numeric_data.corr()

#Display the correlation matrix
print(correlation_matrix)
```

```
                                                    How many credits did you take la
st semester?  \
How many credits did you take last semester?
1.000000
What is your average screentime?
0.019508
What is your average daily time on Tik Tok or T...
-0.028567
How many hours of sleep do you get a night?
0.059845

                                                    What is your average screentime?
\
How many credits did you take last semester?                                0.019508
What is your average screentime?                                           1.000000
What is your average daily time on Tik Tok or T...                         0.723634
How many hours of sleep do you get a night?                               -0.010591

                                                    What is your average daily time
on Tik Tok or Tik Tok equivalents?  \
How many credits did you take last semester?
-0.028567
What is your average screentime?
0.723634
What is your average daily time on Tik Tok or T...
1.000000
How many hours of sleep do you get a night?
-0.100172

                                                    How many hours of sleep do you g
et a night?
How many credits did you take last semester?
0.059845
What is your average screentime?
-0.010591
What is your average daily time on Tik Tok or T...
-0.100172
How many hours of sleep do you get a night?
1.000000
```

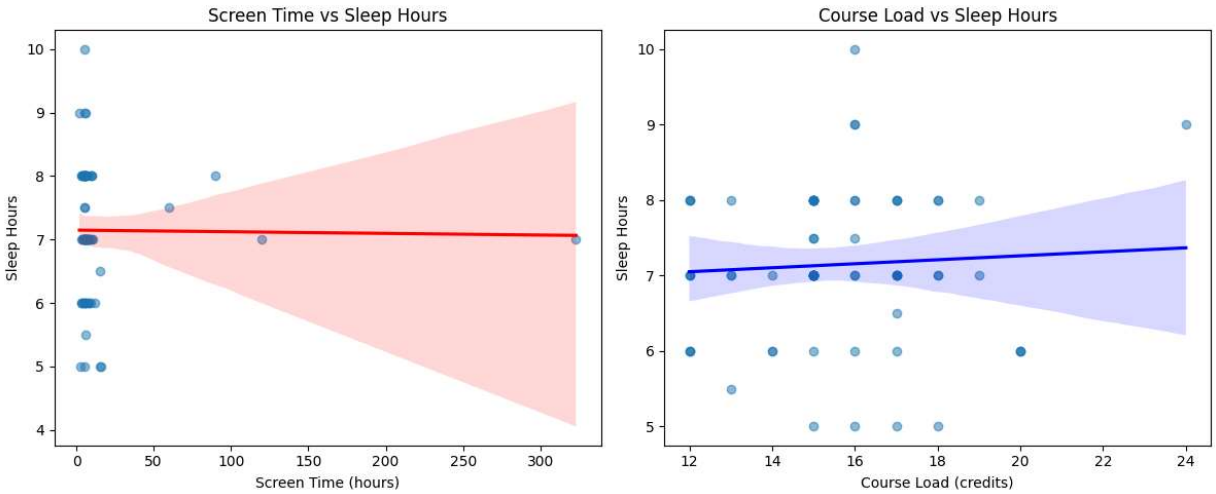
4. Which one had more impact on students' quality of sleep, the amount of screen time or course load?

Your answer: Course load has a greater impact on students' quality of sleep. (but only marginally more. Looking at the big picture, niether have much impact on the quality of sleep)

In [39]:
```python
#Select relevant columns
screen_time = gpa_data['What is your average screentime?']
course_load = gpa_data['How many credits did you take last semester?']
sleep_hours = gpa_data['How many hours of sleep do you get a night?']

#Calculate correlation
correlation_screen_time = screen_time.corr(sleep_hours)
```

```
correlation_course_load = course_load.corr(sleep_hours)

print(f"Correlation between screen time and sleep hours: {correlation_screen_time}"
print(f"Correlation between course load and sleep hours: {correlation_course_load}"

#Linear Regression: Screen time impact on sleep
X_screen_time = screen_time.values.reshape(-1, 1)
regressor_screen_time = LinearRegression()
regressor_screen_time.fit(X_screen_time, sleep_hours)
screen_time_coefficient = regressor_screen_time.coef_[0]

#Linear Regression: Course load impact on sleep
X_course_load = course_load.values.reshape(-1, 1)
regressor_course_load = LinearRegression()
regressor_course_load.fit(X_course_load, sleep_hours)
course_load_coefficient = regressor_course_load.coef_[0]

print(f"Screen time coefficient impact on sleep: {screen_time_coefficient}")
print(f"Course load coefficient impact on sleep: {course_load_coefficient}")

#Visualizations
plt.figure(figsize=(12, 5))

#Plot 1: Screen time vs sleep
plt.subplot(1, 2, 1)
sns.regplot(x=screen_time, y=sleep_hours, scatter_kws={'alpha':0.5}, line_kws={"col
plt.title('Screen Time vs Sleep Hours')
plt.xlabel('Screen Time (hours)')
plt.ylabel('Sleep Hours')

#Plot 2: Course load vs sleep
plt.subplot(1, 2, 2)
sns.regplot(x=course_load, y=sleep_hours, scatter_kws={'alpha':0.5}, line_kws={"col
plt.title('Course Load vs Sleep Hours')
plt.xlabel('Course Load (credits)')
plt.ylabel('Sleep Hours')

plt.tight_layout()
plt.show()

#Final conclusion based on coefficients
if abs(screen_time_coefficient) > abs(course_load_coefficient):
    print("\nCONCLUSION:\nScreen time has a greater impact on students' quality of
else:
    print("\nCONCLUSION:\nCourse load has a greater impact on students' quality of
```

```
Correlation between screen time and sleep hours: -0.010590639827294506
Correlation between course load and sleep hours: 0.0598451726130494
Screen time coefficient impact on sleep: -0.00025797667027177145
Course load coefficient impact on sleep: 0.026383138878434315
```



CONCLUSION:
Course load has a greater impact on students' quality of sleep.

5. Does having a parent (or more) in tech have impact on the starting age for programming?

Your answer: Having a parent in tech does not have a significant impact on the starting age for programming.

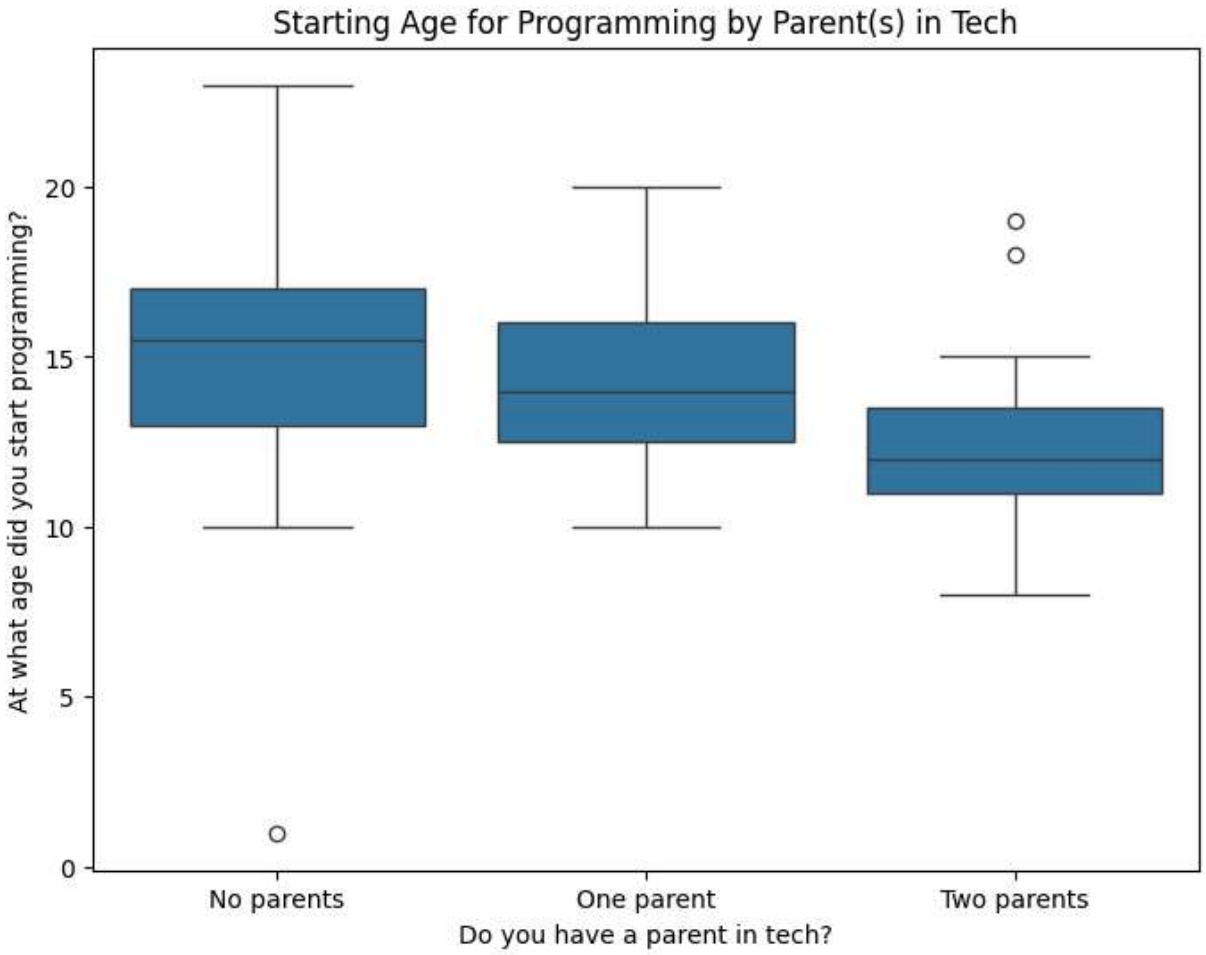
The correlation between having a parent in tech and the starting age for programming is -0.245, so it does not indicate a strong linear relationship.

The ANOVA test shows that the difference in the starting age for programming between students with one parent in tech, two parents in tech, or no parents in tech is **NOT significant.**

In [59]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats

#Convert 'Do you have a parent in tech?' to a categorical variable if it's not alre
gpa_data['Do you have a parent in tech?'] = gpa_data['Do you have a parent in tech?

#Calculate correlation if possible (though not ideal for categorical vs continuous)
correlation = gpa_data['At what age did you start programming?'].corr(gpa_data['Do
print(f"Correlation between having a parent in tech and starting age for programmin

#ANOVA test to see if there's a significant difference in starting age for programm
anova_result = stats.f_oneway(
    gpa_data[gpa_data['Do you have a parent in tech?'] == 'One parent']['At what ag
    gpa_data[gpa_data['Do you have a parent in tech?'] == 'Two parents']['At what a
)

print(f"ANOVA result: {anova_result}")

#Visualization to see if there's any difference
plt.figure(figsize=(8, 6))
```

```
sns.boxplot(x='Do you have a parent in tech?', y='At what age did you start program
plt.title('Starting Age for Programming by Parent(s) in Tech')
plt.show()
```

```
Correlation between having a parent in tech and starting age for programming: -0.245
0434502821818
ANOVA result: F_onewayResult(statistic=2.916476326780966, pvalue=0.0970719529260449)
```



6. Assume that the students who gave response to this survey have a consistent studying habit. Based on that assumption, does studying with friends help with grades? What about note taking?

Your answer: i) Students who study with friends and take notes on paper tend to have the highest GPAs, both last semester and the semester before, with consistent performance across note-taking methods and study habits.

ii) Paper note-taking, especially for frequent studiers, appears to have the most significant positive impact on GPA.

In [62]:
```
import pandas as pd

#Relevant columns in your dataset
relevant_columns = [
    "Do you study with friends?",
```

```
    "Do you take notes in classes?",
    "What was your GPA LAST SEMESTER?",
    "What was your GPA THE SEMESTER BEFORE THAT?"
]

#Clean the data: select relevant columns and drop rows with missing values
data_cleaned = gpa_data[relevant_columns].dropna()

#Convert GPA columns to numeric, handling any non-numeric values (they will be set
data_cleaned["What was your GPA LAST SEMESTER?"] = pd.to_numeric(
    data_cleaned["What was your GPA LAST SEMESTER?"], errors="coerce"
)
data_cleaned["What was your GPA THE SEMESTER BEFORE THAT?"] = pd.to_numeric(
    data_cleaned["What was your GPA THE SEMESTER BEFORE THAT?"], errors="coerce"
)

#Group data by "Do you study with friends?" and "Do you take notes in classes?", an
grouped_data = data_cleaned.groupby(
    ["Do you study with friends?", "Do you take notes in classes?"]
)[["What was your GPA LAST SEMESTER?", "What was your GPA THE SEMESTER BEFORE THAT?

#Print the results
print(grouped_data)
```

Do you study with friends?	Do you take notes in classes?	What was your GPA LAST SEMESTER?
Frequently	No	3.600000
	Yes, on a computer	3.635000
	Yes, on a tablet	3.350000
	Yes, on paper	3.895286
Never	No	3.738000
	Yes, on a computer	3.598500
	Yes, on a tablet	3.874500
	Yes, on paper	3.725500
Sometimes	No	3.625000
	Yes, on a computer	3.651500
	Yes, on a tablet	3.468083
	Yes, on paper	3.732600

Do you study with friends?	Do you take notes in classes?	What was your GPA THE SEMESTER BEFORE THAT?
Frequently	No	3.800000
	Yes, on a computer	3.725000
	Yes, on a tablet	3.500000
	Yes, on paper	3.641714
Never	No	3.650000
	Yes, on a computer	3.731500
	Yes, on a tablet	3.876500
	Yes, on paper	3.663667
Sometimes	No	3.566000
	Yes, on a computer	3.669000
	Yes, on a tablet	3.445917
	Yes, on paper	3.724800

In [66]:
```python
#Iterate through the grouped data by study habit (first level of grouping)
for study_habit, group in grouped_data.groupby(level=0):
    print(f"Study Habit: {study_habit}")

    #Iterate through the groups by note-taking habit (second level of grouping)
    for note_taking_habit, row in group.iterrows():
        #Extract relevant data
        last_gpa = row["What was your GPA LAST SEMESTER?"]
        before_gpa = row["What was your GPA THE SEMESTER BEFORE THAT?"]

        #Print the results for each combination of study habit and note-taking habi
        print(
            f"  Note Taking: {note_taking_habit}\n"
            f"    - Average GPA Last Semester: {last_gpa:.2f}\n"
            f"    - Average GPA Semester Before: {before_gpa:.2f}\n"
        )

    #Print a separator for clarity between different study habits
    print("-" * 50)
```

```
Study Habit: Frequently
  Note Taking: ('Frequently', 'No')
    - Average GPA Last Semester: 3.60
    - Average GPA Semester Before: 3.80

  Note Taking: ('Frequently', 'Yes, on a computer')
    - Average GPA Last Semester: 3.63
    - Average GPA Semester Before: 3.73

  Note Taking: ('Frequently', 'Yes, on a tablet')
    - Average GPA Last Semester: 3.35
    - Average GPA Semester Before: 3.50

  Note Taking: ('Frequently', 'Yes, on paper')
    - Average GPA Last Semester: 3.90
    - Average GPA Semester Before: 3.64

------------------------------------------------
Study Habit: Never
  Note Taking: ('Never', 'No')
    - Average GPA Last Semester: 3.74
    - Average GPA Semester Before: 3.65

  Note Taking: ('Never', 'Yes, on a computer')
    - Average GPA Last Semester: 3.60
    - Average GPA Semester Before: 3.73

  Note Taking: ('Never', 'Yes, on a tablet')
    - Average GPA Last Semester: 3.87
    - Average GPA Semester Before: 3.88

  Note Taking: ('Never', 'Yes, on paper')
    - Average GPA Last Semester: 3.73
    - Average GPA Semester Before: 3.66

------------------------------------------------
Study Habit: Sometimes
  Note Taking: ('Sometimes', 'No')
    - Average GPA Last Semester: 3.62
    - Average GPA Semester Before: 3.57

  Note Taking: ('Sometimes', 'Yes, on a computer')
    - Average GPA Last Semester: 3.65
    - Average GPA Semester Before: 3.67

  Note Taking: ('Sometimes', 'Yes, on a tablet')
    - Average GPA Last Semester: 3.47
    - Average GPA Semester Before: 3.45

  Note Taking: ('Sometimes', 'Yes, on paper')
    - Average GPA Last Semester: 3.73
    - Average GPA Semester Before: 3.72

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```