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Assignment 1

Aim: Understanding the process of calculating SPI(Semester Performance Index) and CPI(Cumulative performance index). Design the algorithm and develop the program for the same.

Semester Performance Index (SPI):
Semester Performance Index (SPI) The performance of a student in a semester is indicated by a number called Semester Performance Index, SPI. The SPI is the weighted average of the grade points obtained in all the courses registered by the student during the semester. For example, if a student appears for five courses (Theory/labs/Projects/ etc.) in a semester with credits c1, c2, c3, c4 and c5 and her/his grade points in these courses are g1, g2, g3, g4 and g5 respectively, then her/his SPI is equal to:
SPI=Total_Sum / Total_Credits and Print or return the calculated SPI.

Steps:

1.Input

- Get the number of subjects from the user.
- For each subject, gather the following information:
  - Credit Points (CP)
  - Grade Points (GP)

2. Process

- Initialize Total_Sum to 0 and Total_Credits to 0.
- For each subject:
  - Calculate the product of CP and GP and add it to Total_Sum.
  - Add the CP of the subject to Total_Credits.

3. Check

- If Total_Credits is equal to 0, print an error message indicating that division by zero is not allowed.

4. Output

- Calculate the SPI using the formula:

  SPI=Total_Sum / Total_Credits and Print or return the calculated SPI.

Example Calculation:

Suppose you have taken the following courses in a semester:

1. **Course 1:**
    - Grade: AA (10.0 grade points)
    - Credit Points: 3
    - Quality Points: 10.0 × 3 = 30.0
2. **Course 2:**
    - Grade: AB (9.0 grade points)
    - Credit Points: 4
    - Quality Points: 9.0 × 4 = 36.0
3. **Course 3:**
    - Grade: CC (6.0 grade points)
    - Credit Points: 3
    - Quality Points: 6.0 × 3 = 18.0
4. **Course 4:**
    - Grade: BB (8.0 grade points)
    - Credit Points: 2
    - Quality Points: 8.0 × 2 = 16.0

Step-by-Step Calculation:

- **Total Quality Points:** 30.0 (Course 1) + 36.0 (Course 2) + 18.0 (Course 3) + 16.0 (Course 4) = 100.0
- **Total Credit Points:** 3 (Course 1) + 4 (Course 2) + 3 (Course 3) + 2 (Course 4) = 12
- **SPI:** SPI = 100.0 / 12 = 8.33

So, the SPI for this semester would be 8.33

Algorithm for SPI:

1. **Input:**
    - Number of subjects.
    - List of subjects, each containing:
        - Credit Points (CP)
        - Grade Points (GP)
2. **Process:**

- Calculate the total sum of the product of credit points and grade points for all subjects: Total_Sum = Σ (CP * GP).
- Calculate the total credit points: Total_Credits = Σ (CP).

3. **Check:**
   - If Total_Credits == 0, print an error message to avoid division by zero.
4. **Output:**
   - Compute SPI using the formula: SPI = Total_Sum / Total_Credits.
   - Print or return SPI.

Pseudocode:

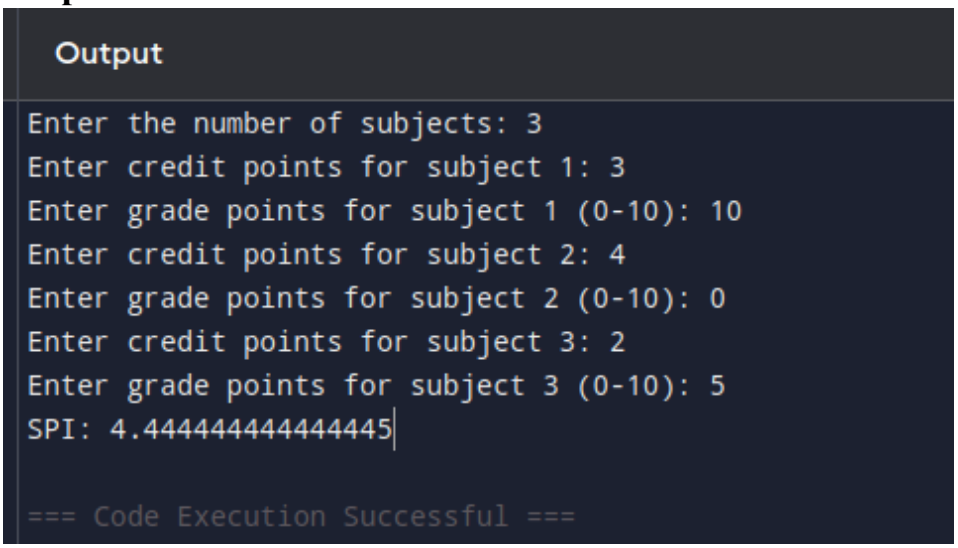
```
FUNCTION calculate_spi(cp_list, gp_list):
    SET total_sum = 0
    SET total_credits = 0

    FOR EACH (CP, GP) IN zip(cp_list, gp_list):
        total_sum = total_sum + (CP * GP)
        total_credits = total_credits + CP

    IF total_credits == 0 THEN
        RETURN "Error: Total credits cannot be zero"
    ENDIF

    SET SPI = total_sum / total_credits
    RETURN SPI
END FUNCTION
```

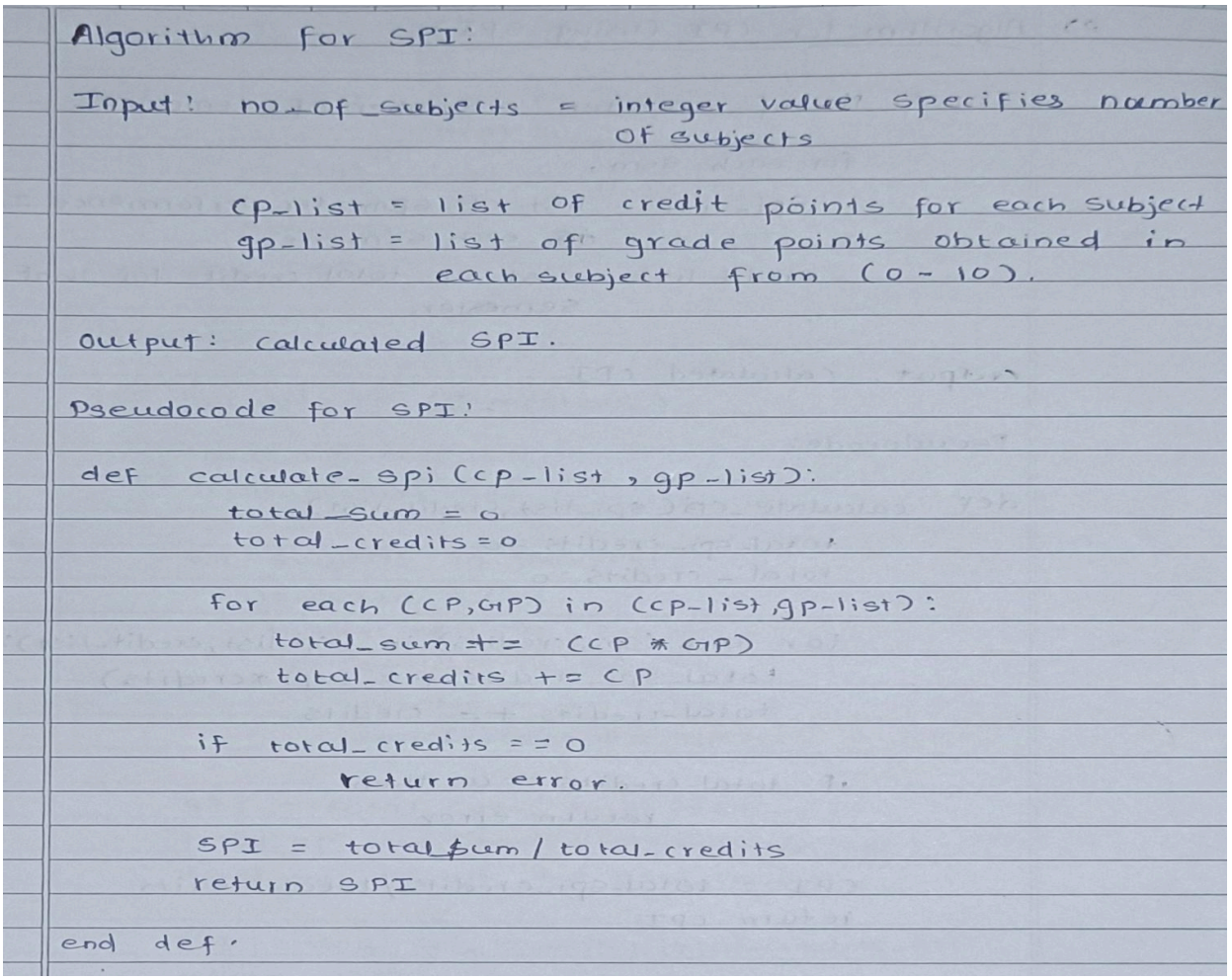
Program:

```
# Function to calculate SPI
def calculate_spi(cp_list, gp_list):
    total_sum = 0
    total_credits = 0

    # Calculate total sum and total credits
    for CP, GP in zip(cp_list, gp_list):
        total_sum += CP * GP
        total_credits += CP

    # Check for division by zero
    if total_credits == 0:
        return "Error: Total credits cannot be zero"

    # Calculate SPI
```

```
    SPI = total_sum / total_credits
    return SPI

# Main program
def main():
    cp_list = []
    gp_list = []
    num_subjects = int(input("Enter the number of subjects: "))

    # Get user input for CP and GP for each subject
    for i in range(num_subjects):
        CP = int(input(f"Enter credit points for subject {i + 1}: "))
        GP = int(input(f"Enter grade points for subject {i + 1} (0-10): "))
        cp_list.append(CP)
        gp_list.append(GP)

    # Call the function with CP and GP lists
    spi = calculate_spi(cp_list, gp_list)
    print(f"SPI: {spi}")

if __name__ == "__main__":
    main()
```

Output:





Algorithm for SPI:

Input: no_of_subjects = integer value specifies number of subjects

cp_list = list of credit points for each subject
gp_list = list of grade points obtained in each subject from (0 - 10).

Output: calculated SPI.

Pseudocode for SPI:

```
def calculate_spi(cp_list, gp_list):
    total_sum = 0
    total_credits = 0

    for each (CP, GP) in (cp_list, gp_list):
        total_sum += (CP * GP)
        total_credits += CP

    if total_credits == 0
        return error.

    SPI = total_sum / total_credits
    return SPI

end def.
```

Cumulative Performance Index (CPI):

Cumulative Performance Index (CPI) An up to date assessment of the overall performance of a student from the time she/he entered the Institute is obtained by calculating a number called the Cumulative Performance Index, CPI, in a manner similar to the calculation of SPI. The CPI therefore considers all the courses registered by the student, towards the minimum requirement of the degree she/he has enrolled for, since she/he entered the Institute. The CPI is calculated at the end of every semester to two decimal places and is indicated in semester grade reports. A CPI of 6.75 or above will be considered as equivalent to First Class (60%).

Steps for the CPI Algorithm

1. **Input**
    - list of SPI values for each semester.
    - list of total credit points for each semester.
2. **Process**
    - Initialize Total_SPI_Credits to 0 and Total_Credits_All to 0.

    - For each semester:
        - Calculate the product of the SPI and the corresponding total credit points.
        - Add this product to Total_SPI_Credits.
        - Add the total credit points for the semester to Total_Credits_All.
3. **Check**
    - If Total_Credits_All is equal to 0, print an error message indicating that division by zero is not allowed.
4. **Output**
    - If Total_Credits_All is not zero, calculate the CPI using the formula:

      CPI=Total_Credits_All / Total_SPI_CreditsPrint or return the calculated CPI.

Example:

Assume the following data across three semesters:

Semester 1:

- Course 1: AA (10.0), 3 credits → 30.0 quality points
- Course 2: AB (9.0), 4 credits → 36.0 quality points

Semester 2:

- Course 1: BB (8.0), 3 credits → 24.0 quality points
- Course 2: AB(9.0), 3 credits → 27.0 quality points

Semester 3:

- Course 1: AA (10.0), 3 credits → 30.0 quality points
- Course 2: BB (8.0), 4 credits → 32.0 quality points

Step-by-Step Calculation:

- **Total Quality Points:** (30.0 + 36.0) + (24.0 + 27.0) + (30.0 + 32.0) = 179.0
- **Total Credit Hours:** (3 + 4) + (3 + 3) + (3 + 4) = 20
- **CPI:** 179.0 / 20 = 8.95

So, the CPI is 8.95.

Algorithm for CPI (Using SPI):

1. **Input:**
    - **Number of semesters.**
    - For each semester, input:
        - Semester Performance Index (SPI).

- Total credits for that semester.

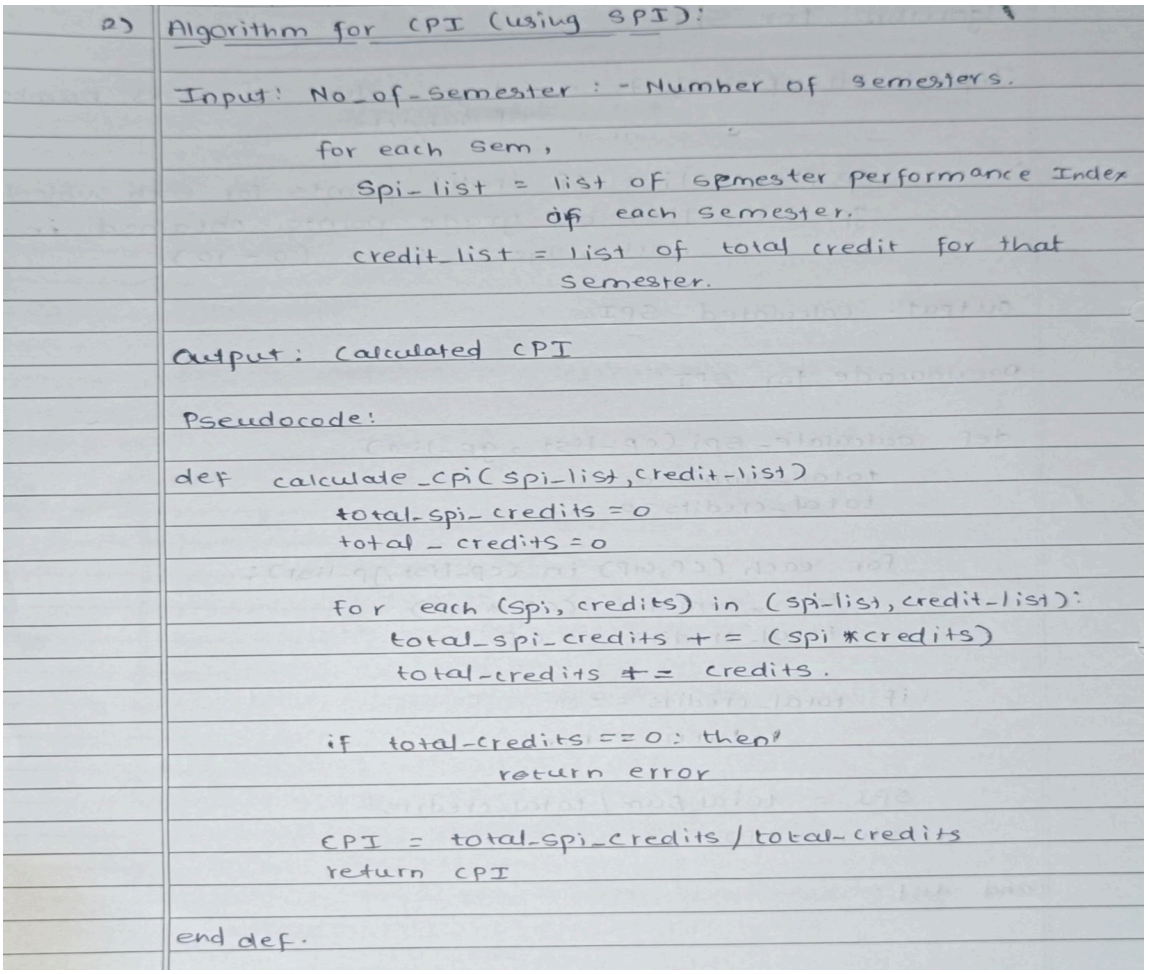
2. **Process:**
   - Calculate the sum of the product of SPI and total credits for all semesters: Total_SPI_Credits = Σ (SPI * Total Credits).
   - Calculate the total credit points for all semesters: Total_Credits_All = Σ (Total Credits).
3. **Check:**
   - If Total_Credits_All == 0, print an error message to avoid division by zero.
4. **Output:**
   - Compute CPI using the formula: CPI = Total_SPI_Credits / Total_Credits_All.
   - Print or return CPI.

Pseudocode:

Input:

List of SPI values, List of total credits for each semester

```
FUNCTION calculate_cpi(spi_list, credit_list)
    SET total_spi_credits = 0
    SET total_credits = 0

    FOR EACH (spi, credits) IN zip(spi_list, credit_list) DO
        total_spi_credits = total_spi_credits + (spi * credits)
        total_credits = total_credits + credits

    IF total_credits == 0 THEN
        RETURN "Error: Total credits cannot be zero"
    END IF
    SET CPI = total_spi_credits / total_credits
    RETURN CPI
END FUNCTION
```

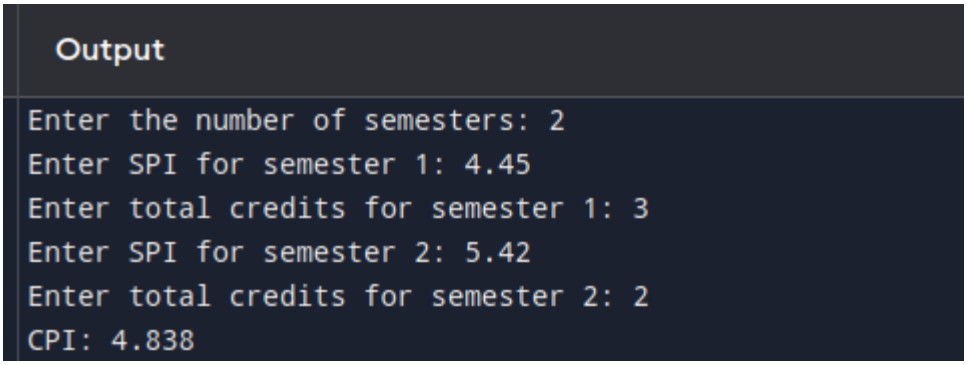


Program:

```
# Function to calculate CPI
def calculate_cpi(spi_list, credit_list):
    total_spi_credits = 0
    total_credits = 0

    for spi, credits in zip(spi_list, credit_list):
        total_spi_credits += spi * credits
        total_credits += credits

    if total_credits == 0:
        return "Error: Total credits cannot be zero"

    CPI = total_spi_credits / total_credits
```

```
    return CPI

# Main program
def main():
    spi_list = []
    credit_list = []
    num_semesters = int(input("Enter the number of semesters: "))

    for i in range(num_semesters):
        spi = float(input(f"Enter SPI for semester {i + 1}: "))
        credits = int(input(f"Enter total credits for semester {i + 1}: "))
        spi_list.append(spi)
        credit_list.append(credits)

    cpi = calculate_cpi(spi_list, credit_list)
    print(f"CPI: {cpi}")

# Run the program
if __name__ == "__main__":
    main()
```

Output:



Algorithm for CPI (Using Grades):

1. **Input:**
    - For each semester:
        - List of subjects with their Credit Points (CP) and Grade Points (GP).
2. **Process:**
    - For each semester:
        - Calculate SPI using the formula: SPI = Σ (CP * GP) / Σ (CP).
    - Calculate the CPI using the SPI values and total credits for each semester as done in the previous CPI algorithm.
3. **Check:**
    - If total credits for any semester or across all semesters is zero, print an error message to avoid division by zero.
4. **Output:**
    - Print or return the CPI.

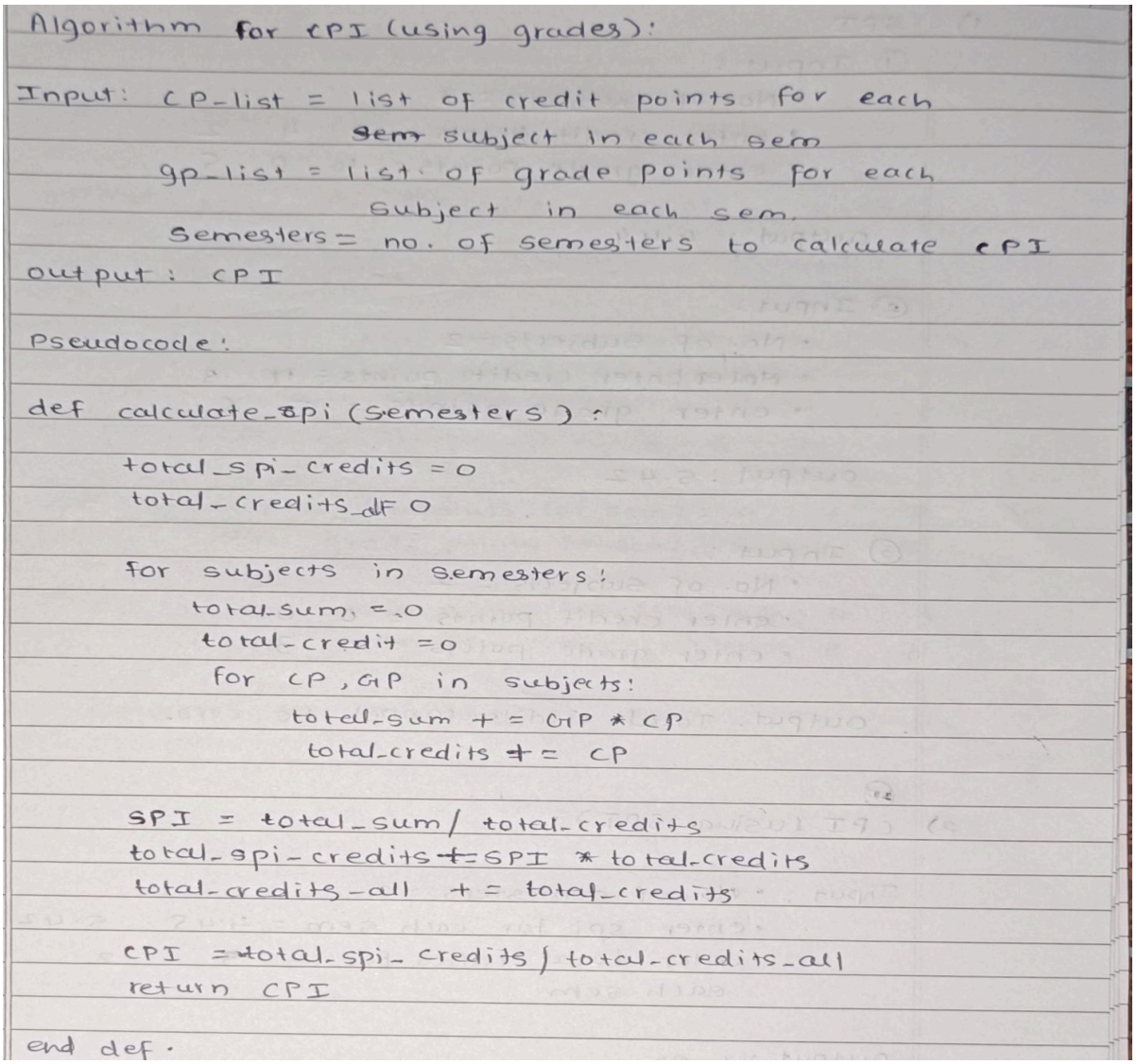
Pseudocode:

```
Input: List of semesters, each containing subjects (CP, GP)

Total_SPI_Credits = 0

Total_Credits_All = 0


For each semester:

    Total_Sum = 0

    Total_Credits = 0

    For each subject in the semester:

        Total_Sum += CP * GP

        Total_Credits += CP

    SPI = Total_Sum / Total_Credits

    Total_SPI_Credits += SPI * Total_Credits

    Total_Credits_All += Total_Credits


If Total_Credits_All == 0:

    Print "Error: Total credits cannot be zero"
```

Else:

CPI = Total_SPI_Credits / Total_Credits_All

Print "CPI:", CPI



Algorithm for CPI (using grades):

Input: CP_list = list of credit points for each subject in each sem
GP_list = list of grade points for each subject in each sem.
Semesters = no. of semesters to calculate CPI

output: CPI

Pseudocode:

```
def calculate_spi(Semesters):
    total_spi_credits = 0
    total_credits_all = 0

    for subjects in Semesters:
        total_sum = 0
        total_credit = 0
        for CP, GP in subjects:
            total_sum += GP * CP
            total_credits += CP

    SPI = total_sum / total_credits
    total_spi_credits += SPI * total_credits
    total_credits_all += total_credits

    CPI = total_spi_credits / total_credits_all
    return CPI

end def.
```

Program:

```
def calculate_cpi_using_grades():
    # Initialize variables to store total SPI weighted credits and total credits
    total_spi_credits = 0
    total_credits_all = 0

    # Input the number of semesters
    num_semesters = int(input("Enter the number of semesters: "))
```

```
    # Loop through each semester
    for semester in range(num_semesters):
    print(f"Enter details for Semester {semester + 1}:")

    # Input the number of subjects in this semester
    num_subjects = int(input("Enter the number of subjects: "))

    total_sum = 0
    total_credits = 0

    # Input details for each subject
    for subject in range(num_subjects):
    # Take input for credits and grade points (GP) for each subject
    credits = int(input(f"  Enter credits for subject {subject + 1}: "))
    grade_point = float(input(f"  Enter grade point (GP) for subject {subject + 1}:
"))

    # Calculate the weighted sum of credits and grade points
    total_sum += credits * grade_point
    total_credits += credits

    # Check if total credits for the semester is zero to avoid division by zero
    if total_credits == 0:
    print("Error: Total credits cannot be zero for a semester.")
    return

    # Calculate SPI for the semester
    SPI = total_sum / total_credits
```

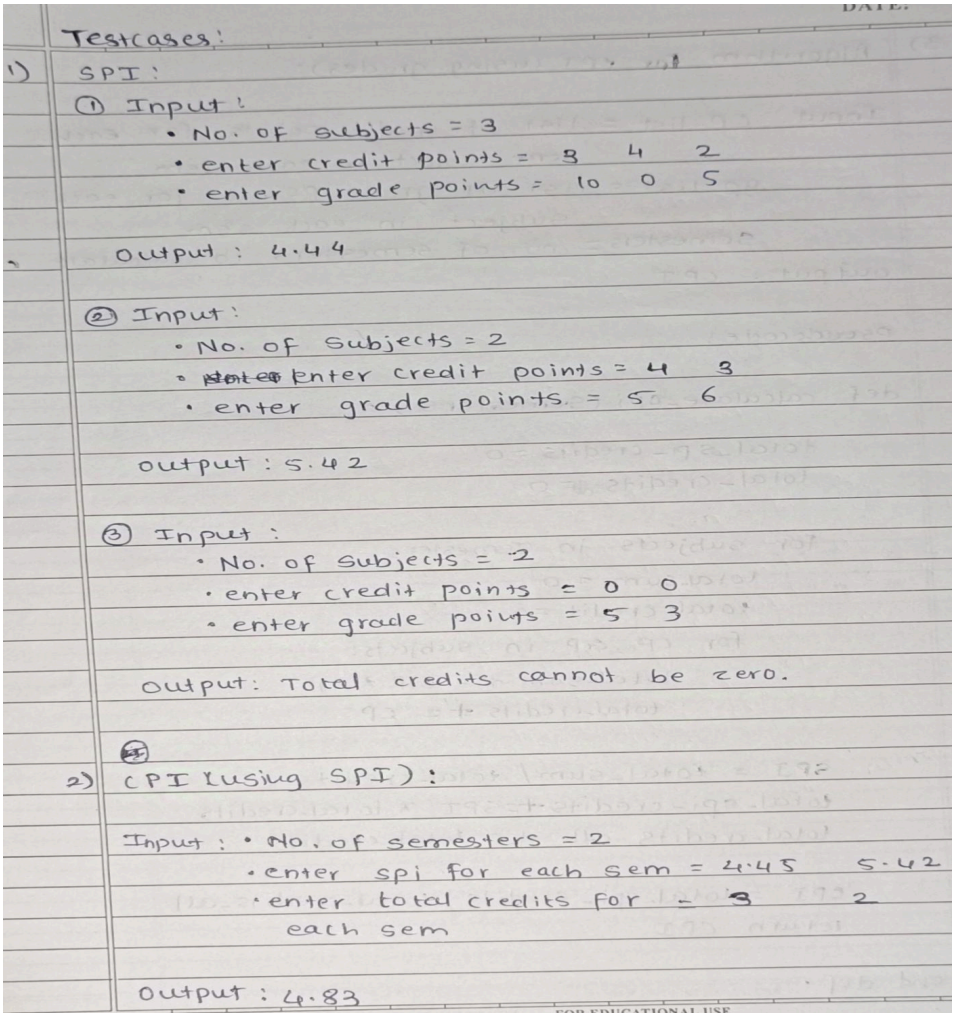
```
        total_spi_credits += SPI * total_credits
        total_credits_all += total_credits

        # Check if total credits across all semesters is zero to avoid division by zero
        if total_credits_all == 0:
        print("Error: Total credits cannot be zero across all semesters.")
        return

        # Calculate the CPI
        CPI = total_spi_credits / total_credits_all
        return CPI
# Calculate the CPI using user input
cpi = calculate_cpi_using_grades()
if cpi is not None:
        print(f"Your CPI is: {cpi:.2f}")
```

Output:

Output

```
Enter the number of semesters: 3
Enter details for Semester 1:
Enter the number of subjects: 3
  Enter credits for subject 1: 3
  Enter grade point (GP) for subject 1: 4
  Enter credits for subject 2: 4
  Enter grade point (GP) for subject 2: 7
  Enter credits for subject 3: 2
  Enter grade point (GP) for subject 3: 9
Enter details for Semester 2:
Enter the number of subjects: 3
  Enter credits for subject 1: 4
  Enter grade point (GP) for subject 1: 6
  Enter credits for subject 2: 4
  Enter grade point (GP) for subject 2: 7
  Enter credits for subject 3: 7
  Enter grade point (GP) for subject 3: 5
Enter details for Semester 3:
Enter the number of subjects: 3
  Enter credits for subject 1: 3
  Enter grade point (GP) for subject 1: 9
  Enter credits for subject 2: 4
  Enter grade point (GP) for subject 2: 8
  Enter credits for subject 3: 3
  Enter grade point (GP) for subject 3: 7
Your CPI is: 6.62
```

Test Cases:



Testcases:

1) SPI:

① Input:
- No. of subjects = 3
- enter credit points = 3 4 2
- enter grade points = 10 0 5

Output: 4.44

② Input:
- No. of Subjects = 2
- ~~Note~~ Enter credit points = 4 3
- enter grade points = 5 6

output: 5.42

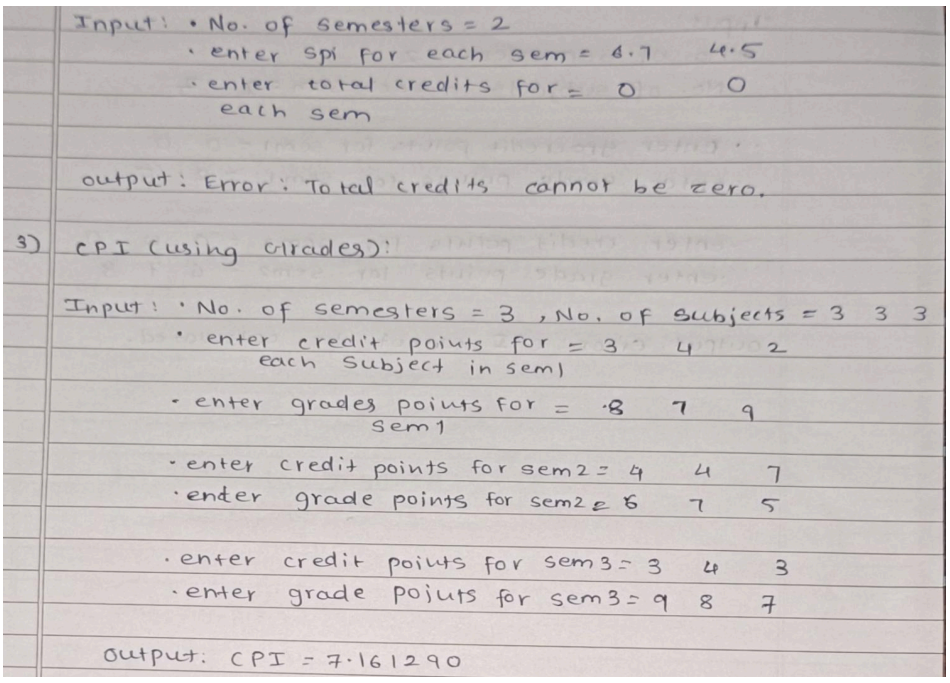
③ Input:
- No. of subjects = 2
- enter credit points = 0 0
- enter grade points = 5 3

Output: Total credits cannot be zero.

2) CPI (using SPI):

Input:
- No. of semesters = 2
- enter spi for each sem = 4.45 5.42
- enter total credits for each sem = 3 2

Output: 4.83



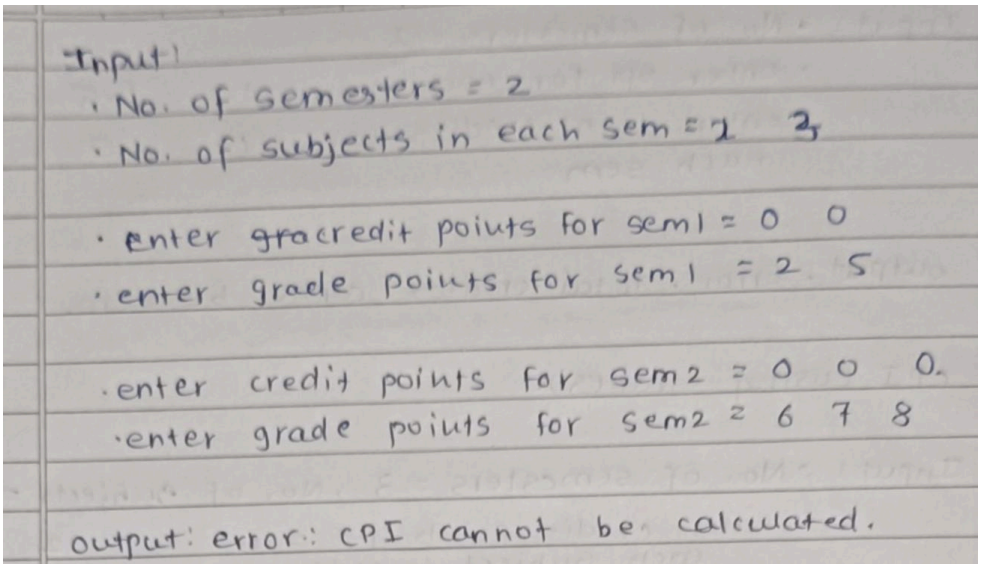
Input:
- No. of semesters = 2
- enter spi for each sem = 6.7 4.5
- enter total credits for each sem = 0 0

output: Error: Total credits cannot be zero.

3) CPI (using Grades):

Input:
- No. of semesters = 3, No. of subjects = 3 3 3
- enter credit points for each subject in sem1 = 3 4 2
- enter grades points for sem1 = 8 7 9
- enter credit points for sem2 = 4 4 7
- enter grade points for sem2 = 6 7 5
- enter credit points for sem3 = 3 4 3
- enter grade points for sem3 = 9 8 7

Output: CPI = 7.161290



Conclusion: In this experiment we learned to calculate SPI and CPI.