SPI (Semester Performance Index):

1. Grade Points (GP): Each course is assigned a certain number of credits, and students receive grades for each course. Each grade has a corresponding grade point.

2. SPI Calculation:

   - SPI = (Σ (Credit of each course * Grade Point of the course)) / (Total credits for the semester)

CPI (Cumulative Performance Index):

1. CPI Calculation:

   - CPI = (Σ (SPI of each semester)) / (Total no of semesters)

Algorithm for SPI and CPI Calculation

1. Input:

   - `n`: Number of courses in the current semester.
   - `credits[]`: Array containing credits for each course.
   - `grades[]`: Array containing grade points for each course.
   - `m`: Number of previous semesters.
   - `total_previous_credits`: Total credits completed in previous semesters.
   - `total_previous_points`: Total grade points accumulated in previous semesters.

2. Output:

   - SPI for the current semester.
   - CPI up to the current semester.

3. Steps:

   1. Initialize `total_credits_current_sem` to 0 and `total_points_current_sem` to 0.
   2. For each course `i` from 1 to `n`:
      - Multiply `credits[i]` with `grades[i]` and add to `total_points_current_sem`.
      - Add `credits[i]` to `total_credits_current_sem`.
   3. Calculate SPI:
      - `SPI = total_points_current_sem / total_credits_current_sem`
   4. Calculate cumulative credits and points:

- `cumulative_credits = total_previous_credits + total_credits_current_sem`
- `cumulative_points = total_previous_points + total_points_current_sem`

5. Calculate CPI:
   - `CPI = cumulative_points / cumulative_credits`
6. Return `SPI` and `CPI`.

Sample Input and Output (Test Cases)

Positive Test Cases:

1. Test Case 1:
   - Credits: [4, 3, 3, 2]
   - Grades: [10, 9, 8, 7]
   - Previous Credits: 20
   - Previous Points: 160
   - Output:
     - SPI: 8.8
     - CPI: 8.4

2. Test Case 2:
   - Credits: [3, 3, 3]
   - Grades: [9, 8, 7]
   - Previous Credits: 18
   - Previous Points: 144
   - Output:
     - SPI: 8.0
     - CPI: 8.0

Negative Test Cases:

3. Test Case 3:
   - Credits: [4, 3, 2]
   - Grades: [5, 6, 4]
   - Previous Credits: 20

- Previous Points: 130
- Output:
  - SPI: 5.222
  - CPI: 6.2

4. Test Case 4:
   - Credits: [3, 2, 1]
   - Grades: [3, 4, 5]
   - Previous Credits: 22
   - Previous Points: 132
   - Output:
     - SPI: 3.75
     - CPI: 5.571

5. Test Case 5:
   - Credits: [2, 3, 2]
   - Grades: [2, 3, 4]
   - Previous Credits: 21
   - Previous Points: 105
   - Output:
     - SPI: 2.778
     - CPI: 4.312

Program to Calculate SPI and CPI

```
def calculate_spi_cpi(credits, grades, total_previous_credits, total_previous_points):
    total_credits_current_sem = sum(credits)
    total_points_current_sem = sum(c * g for c, g in zip(credits, grades))

    spi = total_points_current_sem / total_credits_current_sem
```

```
    cumulative_credits = total_previous_credits + total_credits_current_sem
    cumulative_points = total_previous_points + total_points_current_sem

    cpi = cumulative_points / cumulative_credits

    return spi, cpi

# Test Cases
test_cases = [
    ([4, 3, 3, 2], [10, 9, 8, 7], 20, 160),
    ([3, 3, 3], [9, 8, 7], 18, 144),
    ([4, 3, 2], [5, 6, 4], 20, 130),
    ([3, 2, 1], [3, 4, 5], 22, 132),
    ([2, 3, 2], [2, 3, 4], 21, 105),
]

for i, (credits, grades, prev_credits, prev_points) in enumerate(test_cases):
    spi, cpi = calculate_spi_cpi(credits, grades, prev_credits, prev_points)
    print(f"Test Case {i+1}: SPI = {spi:.3f}, CPI = {cpi:.3f}")
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Users\sarak\OneDrive\Desktop\Sarakshi\Python course> python -u "c:\Users\sarak\OneDrive\Desktop\Sarakshi\Python course\spi&cpi.py"
Test Case 1: SPI = 8.750, CPI = 8.281
Test Case 2: SPI = 8.000, CPI = 8.000
Test Case 3: SPI = 5.111, CPI = 6.069
Test Case 4: SPI = 3.667, CPI = 5.500
Test Case 5: SPI = 3.000, CPI = 4.500
PS C:\Users\sarak\OneDrive\Desktop\Sarakshi\Python course>
```

Conclusion

The algorithm and the implemented program successfully calculate the SPI and CPI based on the provided inputs. The program has been tested with a mix of positive and negative test cases, demonstrating its effectiveness in handling various scenarios.

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