Name: Nilanshu Ranjan

Roll No: 231070035

Branch: Computer Engineering

DAA Assignment 1

Algorithm for SPI and CPI Calculation

Problem Statement:

Write a program that calculates the Semester Performance Index (SPI) and Cumulative Performance Index (CPI) for a student over multiple semesters. The program will collect the number of subjects, credits, and grades for each subject and use this data to compute the SPI for each semester and the CPI across all semesters.

Algorithm:

1. **Initialize Data Structures**:
    - Create vectors grades, credits, and spi to store the grades, credits, and SPI for each semester.
2. **Input Number of Semesters**:
    - Prompt the user to enter the number of semesters n.
3. **SPI Calculation for Each Semester**:
    - For each semester, execute the following steps:
        - Prompt the user to enter the number of subjects.
        - Initialize total_credit to 0.
        - For each subject:
            - Prompt the user to enter the credit and grade.
            - Append the credit and grade to the respective vectors.
            - Add the credit to total_credit.
        - Compute the SPI using the formula: SPI=summation(credits*grades)/summation(credits)
        - Append the calculated SPI to the spi vector.
        - Display the SPI for the semester.

4. **CPI Calculation**:
    - Compute the CPI using the formula: CPI=(sum of SPI)/n where n is the number of semesters.
    - Display the CPI.
5. **Main Function**:
    - Initialize vectors grades, credits, and spi.
    - Prompt the user to enter the number of semesters.
    - For each semester, call the SPI calculation function.
    - After all semesters, call the CPI calculation function to display the overall CPI.
    -

❖ Pseudo Code:

```
Function SPI_cal(credit, grade, spi)
    Print "Enter number of subjects:"
    Read n

    total_credit = 0
    For i from 0 to n-1
        Print "Enter credit and grade for subject " + i
        Read c, g
        Append g to grade
        Append c to credit
        total_credit = total_credit + c
    End For

    sum = 0
    For i from 0 to n-1
        sum = sum + grade[i] * credit[i]
    End For

    SPI = sum / total_credit
    Append SPI to spi
    Print "Your spi is: " + SPI
End Function

Function CPI_cal(spi)
    n = size of spi
    sum = 0
    For i from 0 to n-1
        sum = sum + spi[i]
    End For
```

```
    CPI = sum / n
    Print "Your cpi is: " + CPI
    Return CPI
End Function
```

❖ Code :

```
#incIude <bits/stdc++.h>
using namespace std;

void SPI_cal(vector<int>& credit, vector<int>& grade,
vector<int>& spi){
    cout<<"Enter number of subjects:"<<endl;
    int n, c, g;
    cin>>n;

    int total_credit = 0;
    for(int i = 0; i<n; i++){
        cout<<"Enter credit and grade for subject
"<<i<<endl;
        cin>> c >> g;
        grades.push_back(g);
        credit.push_back(c);
        total_credit += c;
    }

    int sum = 0;
    for(int i = 1; i <= n; i++){
        sum += grade[i]*credit[i];
    }

    float SPI= 1.0*sum/tot ered;
    spi.push_back(SPI);
    cout <<"Your spi is: "<< SPI <<endl;
}
```

```cpp
float CPI_cal(vector<int> spi){
    int n = spi.size();

    //calculation float tot spi=0; int tot cred=0;
    int sum = 0;
    for(int i = 0; i < n; i++){
        sum += spi[i];
    }

    //result
    float CPI=1.0*sum/n;
    cout <<"Your cpi is: "<<CPI<<endI;
    return CPI;
}


int main(){

    vector<int> grades;
    vector<int> credits;
    vector<int> spi;

    int n;
    cout << "enter number of semester: ";
    cin >> n;

    for (int i = 0; i<n; i++){
        SPI_cal(grades, credits, spi);
    }

    CPI_cal(spi);
    return 0;
}
```

❖ Input:

- Number of semesters: 2
- Semester 1: 3 subjects
    - Subject 1: 3 credits, grade 8
    - Subject 2: 4 credits, grade 7
    - Subject 3: 3 credits, grade 9
- Semester 2: 2 subjects
    - Subject 1: 4 credits, grade 6
    - Subject 2: 4 credits, grade 8

❖ Output:

- SPI for semester 1: 7.9
- SPI for semester 2: 7.0
- CPI: 7.45

Test Cases

Input

```
Enter number of semesters: 1
Enter number of subjects:
3
Enter credit and grade for subject 1:
3 10
Enter credit and grade for subject 2:
4 9
Enter credit and grade for subject 3:
2 8
```

Output

```
Your SPI is: 9.22
Your CPI is: 9.22
```

Input

```
Enter number of semesters: 2
Enter number of subjects:
3
Enter credit and grade for subject 1:
3 7
Enter credit and grade for subject 2:
4 8
Enter credit and grade for subject 3:
3 9
Enter number of subjects:
2
Enter credit and grade for subject 1:
4 6
Enter credit and grade for subject 2:
4 8
```

Output

```
Your SPI is: 7.91
Your SPI is: 7.00
Your CPI is: 7.45
```

Input

```
Enter number of semesters: 4
Enter number of subjects:
2
Enter credit and grade for subject 1:
4 5
Enter credit and grade for subject 2:
3 6
Enter number of subjects:
3
Enter credit and grade for subject 1:
```

```
2 7
Enter credit and grade for subject 2:
3 8
Enter credit and grade for subject 3:
4 9
Enter number of subjects:
4
Enter credit and grade for subject 1:
1 10
Enter credit and grade for subject 2:
2 9
Enter credit and grade for subject 3:
3 8
Enter credit and grade for subject 4:
4 7
Enter number of subjects:
3
Enter credit and grade for subject 1:
4 6
Enter credit and grade for subject 2:
3 5
Enter credit and grade for subject 3:
2 4
```

Output

```
Your SPI is: 5.57
Your SPI is: 8.00
Your SPI is: 8.16
Your SPI is: 5.33
Your CPI is: 6.76
```

Conclusion

The provided code effectively calculates the Semester Performance Index (SPI) and Cumulative Performance Index (CPI) for a student based on the grades and credits of subjects across multiple semesters. The process involves collecting the number of subjects, their corresponding credits, and grades for each semester, and then calculating the SPI for each semester and the overall CPI.

Key Takeaways:

1. SPI Calculation:
    - For each semester, the user inputs the number of subjects, followed by the credit and grade for each subject.
    - The SPI is calculated by taking the weighted sum of grades (grade multiplied by the corresponding credit) and dividing it by the total credits of the semester.
    - The SPI is stored in a vector for further use in CPI calculation.
2. CPI Calculation:
    - The CPI is calculated as the average of SPIs from all semesters.
    - This average provides a comprehensive measure of the student's academic performance over multiple semesters.
3. User Interaction:
    - The code is interactive and prompts the user to enter the necessary details for each subject and semester.
    - After calculating the SPI for each semester, it displays the SPI to the user.
    - Finally, after all semesters' SPIs are collected, it calculates and displays the CPI.
4. Edge Cases:
    - The code handles different numbers of subjects and credits for each semester.

- The calculation ensures that the grades and credits are accurately considered for SPI and CPI computation.