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Design and Analysis of Algorithms Lab

Laboratory 1 – Calculation of SPI and CPI

Algorithm:

SPI Algorithm:

```
SPI(credits, grades)
//Computes SPI of a Semester
//Input: Two arrays credits and grades, denoting the credits and the grade obtained respectively in each course
//Output: SPI
Algorithm:
    total = 0
    n = length(credits)
    for i = 0 to n-1
        total = total + credits[i]*grades[i]
    spi = total/sum(credits)
    return spi
```

CPI Algorithm:

```
CPI(spi, credits)
//Computes CPI across 8 semesters
//Input: Two arrays spi and credits, denoting the spi obtained and total credits of each semester
//Output: CPI
Algorithm:
    total = 0
    n = length(credits)
    for i = 0 to n-1
        total = total + spi[i]*credits[i]
    cpi = total/sum(credits)
    return cpi
```

Testcases:

1. SPI Testcases:

Credits (array)	Grades (array)
[3,3,2,3,2]	[10,9,6,7,8]
[3,4,3,1,2]	[10,6,5,8,5]
[2,3,4,-2,1]	[5,7,5,10,9]
[3,4,2,1]	[10,4,5,6,3]
[1,2,3,3,2]	[2,3,4,5,7]

2. CPI Testcases:

SPI (array)	Credits (array)
[9.21,9.32,8.15,8.65,8.88,8.92,8.71,9.00]	[22, 22, 23, 22, 24, 22, 23, 22]
[9.44,9.28,9.45,8.73,9.36,8.84,8.72,9.49]	[22, 22, 24, 22, 23, 22, 23, 24]
[8.58, 8.56, 9.37, 9.27, 9.45, 8.53, 8.58]	[22, 24, 22, 22, 22, 22, 24, 23]
[9.3,8.93,9.12,8.97,9.03,9.36,8.64,9.04]	[23, 23, 22, 24, 24, 22, -23, 24]

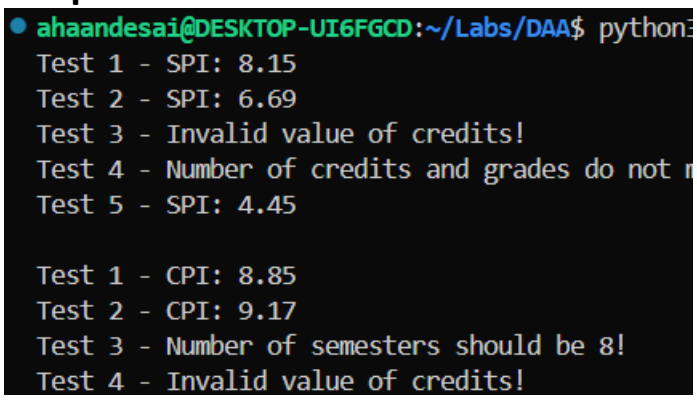
Program:

```
#ALgorithms
def spi(credits, grades):
    #SPI is weighted mean of credits and grades
    if len(credits) != len(grades) or len(credits) == 0:
        print("Number of credits and grades do not match!")

    elif any([grade<0 or grade>10 for grade in grades]):
        #Checks if any grade is not between 0 and 10 - Invalid grade
        print("Invalid value of grades!")

    elif any([credit<0 or credit>4 for credit in credits]):
        #Checks if any credit is not between 0 and 4 - Invalid credit
        print("Invalid value of credits!")

    else:
        total = 0
        n = len(credits)
        for i in range(n):
            total += credits[i]*grades[i]
        return total/sum(credits)

def cpi(spi, credits):
    #CPI is weighted mean of spi and credits
    if (len(credits) != len(spi)):
        print("Number of credits and SPIs do not match!")

    elif (len(credits) < 1 or len(credits) > 8) or (len(spi) < 1 or len(spi) > 8):
        print("Invalid number of credits or SPIs!")

    elif any([credit<0 for credit in credits]):
        #Checks if any credit is negative - Invalid credit
        print("Invalid value of credits!")

    elif any([spi<0 or spi>10 for spi in spi]):
        #Checks if any SPI is not between 0 and 10 - Invalid SPI
        print("Invalid value of SPI!")

    else:
        total  = 0
        for i in range(8):
            total += spi[i]*credits[i]
        return total/sum(credits)
```

```
#SPI Tests
def spi_tests():
    credits_tests = [[3,3,2,3,2],
                     [3,4,3,1,2],
                     [2,3,4,-2,1],
                     [3,4,2,1] ,
                     [1,2,3,3,2]]
    grades_tests = [[10,9,6,7,8],
                    [10,6,5,8,5],
                    [5,7,5,10,9],
                    [10,4,5,6,3],
                    [2,3,4,5,7]]

    n = len(credits_tests)
    for i in range(n):
        print(f'Test {i+1} - ', end="")
        try:
            print(f"SPI: {round(spi(credits_tests[i], grades_tests[i]),2)}")
        except:
            #Error message will be printed by the function
            continue
    print()        #prints a newline


#CPI Tests
def cpi_tests():
    spi_tests = [
                [9.21,9.32,8.15,8.65,8.88,8.92,8.71,9.00],
                [9.44, 9.28, 9.45, 8.73, 9.36, 8.84, 8.72, 9.49],
                [8.58, 8.56, 9.37, 9.27, 9.45, 8.53, 8.58],
                [9.3, 8.93, 9.12, 8.97, 9.03, 9.36, 8.64, 9.04]
               ]

    semester_credits_tests = [
                            [22, 22, 23, 22, 24, 22, 23, 22],
                            [22, 22, 24, 22, 23, 22, 23, 24],
                            [22, 24, 22, 22, 22, 22, 24, 23],
                            [23, 23, 22, 24, 24, 22, -23, 24]
                           ]

    for i in range(len(spi_tests)):
```

```
        print(f"Test {i+1} - ", end="")
        try:
            print(f"CPI: {round(cpi(spi_tests[i], semester_credits_tests[i]),2)}")
        except:
            #Error message will be printed by the function
            continue

#Run the tests
spi_tests()
cpi_tests()
```

Output:



Conclusion: We have studied the algorithm to calculate SPI and CPI of a student.