CONTENTS

1.0 PROBLEM ANALYSIS

The following is the problem stipulated in the assignment:

“

Write a program that calculates your CGPA (as in your hand book). Maximum number of semesters for each student is only 10 semesters (5 years). Number of courses for each semester varies but not more than 6 courses can be registered per semester. Student only know the grades and units for each course taken. Students' academic achievement for registered courses will be graded as follows:

Alphabetic Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Grade Points	4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0

Figure 1

The achievement of students in any semester is based on Grade Point Average (GPA) achieved from all the registered courses in a particular semester. GPA is the indicator to determine the academic performance of students in any semester. CGPA is the Cumulative Grade Point Average accumulated by a student from one semester to another during the years of study. The formula to compute GPA and CGPA is as follows:

$$\text{Grade Point Average} = \frac{\sum_{i=1}^{n} U_i M_i}{\sum_{i=1}^{n} U_i}$$

where:

n = Number of courses taken

Ui = Course units for course i

Mi = Grade point for course i

”

1.1 Inputs

Fixed Input	
Input	Variable
Grade Point	double gradePoint

User Input	
Input	Variable
Grade Point	int courseNo
Number of courses	int semesterNo
Units for the course	int units
Grade for the course	string grade

1.2 Constraints

Throughout the question problem, there are several constraints. These constraints have been identified as two main categories namely; **defined** constraints that are based on what is defined by the question problem. and **logical** constraints that can logically be inferred as constraints through reasoning how things are in the real world. The following is the list of constraints according these categories:

i) Defined constraints

1) Number of semesters cannot be more than 10.
2) Number of courses per semester cannot be more than 6.
3) The grade can only be according what is referred from the table of available grades provided by the student handbook. (Figure 1, page 3)

ii) Logical constraints

1) All numbers inputted cannot be negative.
2) The number of semesters and courses must be at least 1.

1.3 Processes

The following are a list of processes involved to execute the program:

i) Input Validation

The process of verifying that the input entered by the user meets the all constraints of the program. Validation is also to make sure the program appropriately deals with unexpected inputs such as a character being inputted when the program requests for an integer.

ii) Summations

This process involves usage of a loop to add a newly inputted variable to the already existing sum. This method is used for summation aspects of the formula as opposed to an actual summation formula because this method allows for the user to define the maximum number of semesters and courses and only input the grades and units required according the number of semesters/courses defined by the user.

a) This process is used for "the sum of total GP" and "sum of units" so that it can be used later for calculation of GPA. The process involves using a while loop where the loop is repeated for each course. Here are the formula for all summations that will be involved later with the GPA calculation:

- Sum of Units = Sum of all previous courses units + units of the current course
- Total GP = Grade Point of current course * units of current course
- Sum of total GP = Sum of all previous courses total GP + current total GP course

b) The while loop is also used for summation of accumulated GPA and accumulated units. These summations will be used for calculation of CGPA:

- Accumulated GPA = Sum of all previous semesters sum of total GP + current total GP
- Accumulated units = Sum of all previous semesters sum of units + current sum of units

iii) Calculations

a) GPA = Sum of total GP / Sum of units

b) CGPA = Accumulated GPA / Accumulated units

1.1 Outputs

Output	Variable
Welcoming messages and instructions	-
Grade Point Average (GPA)	double gpa
Cumulative Grade Point Average (CGPA)	double cgpa
Remarks regarding CGPA	-

2.0 ALGORITHM

Pseudo-Code

START
1. Declare all variables (fixed and user input, calculation and loop control, output)
2. Print the welcoming message “Your personal CGPA calculator!”, table of available grades (refer Figure 1 on page 3) and message requesting for number of semesters to be inputted
3. Prompt number of semesters
4. Assign number of semesters as 0 so the loop is entered
5. WHILE number of semesters is not more than or equal to 1 nor less than or equal to 10
   5.1 Get number of semesters
   5.2 IF user’s input failed THEN
      5.2.1 Clear the input stream
      5.2.2 Ignore the input stream
      5.2.3 Print error message “ERROR: The number of semesters must be a number!”
      5.2.4 Print “Please enter again”
   5.3 ELSE IF number of semesters is less than or equal to 0 THEN
      5.3.1 Print error message “ERROR: The number of semesters must be at least 1!”
      5.3.2 Print “Please enter again”
      END IF
   5.4 IF number of semesters is more than 10 THEN
      5.4.1 Print error message “ERROR: 10 is the maximum number of semesters possible!”
      5.4.2 Print “Please enter again”
      END IF
   END WHILE
6. Initialise loop control variable for semester input loop as 1
7. Initialise accumulated GPA and accumulated units as 0
8. WHILE semester loop control variable is less than or equal to number of semesters
   8.1 Print “semester” and “semester loop control variable”
   8.2 Prompt number of courses
   8.3 Assign number of courses as 0
   8.4 WHILE number of courses is not more than or equal to 1 nor less than or equal to 6
      8.4.1 Get number of courses
      8.4.2 IF user’s input failed THEN
         8.4.2.1 Clear the input stream
         8.4.2.2 Ignore the input stream
         8.4.2.3 Print error message “ERROR: The number of courses must be a number!”
         8.4.2.4 Print “Please enter again”
      8.4.3 ELSE IF number of courses is less than or equal to 0 THEN
         8.4.3.1 Print error message “ERROR: The number of courses must be at least 1!”
         8.4.3.2 Print “Please enter again”
            END IF
      8.4.4 IF number of courses is more than 6 THEN
         8.4.4.1 Print error message “ERROR: 6 is the maximum number of courses possible!”
         8.4.4.2 Print “Please enter again”
            END IF
      END WHILE

8.5 Initialise loop control variable for course input loop as 1
8.6 Initialise sum of units as 0
8.7 Initialise sum of total GP as 0
8.8 WHILE course loop control variable is less than or equal to number of courses
8.8.1 Print "* Course" and "course loop control variable"
8.8.2 Prompt grade
8.8.3 Assign grade as "X" so that the loop is entered
8.8.4 WHILE grade is not a grade in the table of available grades (Figure 1, page 3)
8.8.4.1 Get grade
8.8.4.2 IF grade is not a grade in the table of available grades THEN
8.8.4.2.1 Print error message "ERROR: Invalid grade input! Please refer to table for valid grade inputs. (must be in CAPS)."
8.8.4.2.2 Print "Please enter again"
END IF
END WHILE
8.8.5 Prompt units
8.8.6 Get units
8.8.7 IF grade is A
8.8.7.1 Assign grade point as 4.00
8.8.8 ELSE IF grade is A-
8.8.8.1 Assign grade point as 3.67
8.8.9 ELSE IF grade is B+
8.8.9.1 Assign grade point as 3.33
8.8.10 ELSE IF grade is B
8.8.10.1 Assign grade point as 3.00
8.8.11 ELSE IF grade is B-
8.8.11.1 Assign grade point as 2.67
8.8.12 ELSE IF grade is C+
8.8.12.1 Assign grade point as 2.33
8.8.13 ELSE IF grade is C
8.8.13.1 Assign grade point as 2.00
8.8.14 ELSE IF grade is C-
8.8.14.1 Assign grade point as 1.67
8.8.15 ELSE IF grade is D+
8.8.15.1 Assign grade point as 1.33
8.8.16 ELSE IF grade is D
8.8.16.1 Assign grade point as 1.00
8.8.17 ELSE IF grade is D-
8.8.17.1 Assign grade point as 0.67
8.8.18 ELSE IF grade is F
8.8.18.1 Assign grade point as 0
END IF
8.8.19 Print the grade point
8.8.20 Calculate sum of units: sum of units = sum of units + units
8.8.21 Calculate total GP: total GP = grade point * units
8.8.22 Print total GP
8.8.23 Print sum of units
8.8.24 Calculate sum of total GP: sum of total GP = sum of total GP + total GP
8.8.25 Increment course loop control variable by one
END WHILE

8.9 Calculate grade point average (GPA): GPA = sum of total GP / sum of units
8.10 Print sum of total GP
8.11 Print sum of units
8.12 Print sum of total GP
8.13 Print GPA
8.14 Calculate Accumulated Units: Accumulated units = Accumulated + Sum of units units
8.15 Calculate Accumulate GPA: Accumulated GPA = Accumulated + Sum of GPA total GP
END WHILE
9. Calculate CGPA: CGPA = Accumulated GPA / Accumulated units
10. Print Accumulated GPA, accumulated units and CGPA
11. IF 3.75 is less than or equal to CGPA and CGPA is less than or equal to 4.00
11.1 Print "Excellent"
12. ELSE IF 3.25 is less than or equal to CGPA and CGPA is less than or equal to 3.74
12.1 Print "Very Good"
13. ELSE IF 2.75 is less than or equal to CGPA and CGPA is less than or equal to 3.24
13.1 Print "Good"
14. ELSE IF 2.25 is less than or equal to CGPA and CGPA is less than or equal to 2.74
14.1 Print "Work Smart"
15. ELSE IF CGPA is less than or equal to 2.24
15.1 Print "Work Very Hard and Work Smart"

END

3.0 DESK CHECK

The program algorithm with line number labelled:

Line No.	Step
1	Declare all variables (fixed and user input, calculation and loop control, output)
2	Print the welcoming message "Your personal CGPA calculator!", table of available grades (refer Figure 1 on page 3) and message requesting for number of semesters to be inputted
3	Prompt number of semesters
4	Assign number of semesters as 0 so the loop is entered
5	WHILE number of semesters is not more than or equal to 1 nor less than or equal to 10
6	Get number of semesters
7	IF user's input failed THEN
8	Clear the input stream
9	Ignore the input stream
10	Print error message "ERROR: The number of semesters must be a number!"
11	Print "Please enter again"
12	ELSE IF number of semesters is less than or equal to 0 THEN
13	Print error message "ERROR: The number of semesters must be at least 1!"
14	Print "Please enter again"
15	END IF
16	IF number of semesters is more than 10 THEN
17	Print error message "ERROR: 10 is the maximum number of semesters possible!"
18	Print "Please enter again"
19	END IF
20	END WHILE
21	Initialise loop control variable for semester input loop as 1
22	Initialise accumulated GPA and accumulated units as 0
23	WHILE semester loop control variable is less than or equal to number of semesters
24	Print "semester" and "semester loop control variable"
25	Prompt number of courses
26	Assign number of courses as 0

```
WHILE number of courses is not more than or equal to 1 nor less than or equal to 6
        Get number of courses
        IF user's input failed THEN
                Ignore the input stream
                Clear the input stream
                Print error message "ERROR: The number of courses must be a number!"
                Print "Please enter again"
        ELSE IF number of courses is less than or equal to 0 THEN
                Print error message "ERROR: The number of courses must be at least 1!"
                Print "Please enter again”
        END IF
        IF number of courses is more than 6 THEN
                Print error message "ERROR: 6 is the maximum number of courses possible!"
                Print "Please enter again"
        END IF
END WHILE
Initialise loop control variable for course input loop as 1
Initialise sum of units as 0
Initialise sum of total GP as 0
WHILE course loop control variable is less than or equal to number of courses
        Print "* Course" and "course loop control variable"
        Prompt grade
        Assign grade as "X" so that the loop is entered
        WHILE grade is not a grade in the table of available grades (Figure 1, page 3)
                Get grade
                IF grade is not a grade in the table of available grades THEN
                Print error message "ERROR: Invalid grade input! Please refer to table for valid grade inputs. (must be in CAPS)."
                        Print "Please enter again"
                END IF
        END WHILE
        Prompt units
        Get units
        IF grade is A
                Assign grade point as 4.00
        ELSE IF grade is A-
```

```
62                  Assign grade point as 3.67
63              ELSE IF grade is B+
64                  Assign grade point as 3.33
65              ELSE IF grade is B
66                  Assign grade point as 3.00
67              ELSE IF grade is B-
68                  Assign grade point as 2.67
69              ELSE IF grade is C+
70                  Assign grade point as 2.33
71              ELSE IF grade is C
72                  Assign grade point as 2.00
73              ELSE IF grade is C-
74                  Assign grade point as 1.67
75              ELSE IF grade is D+
76                  Assign grade point as 1.33
77              ELSE IF grade is D
78                  Assign grade point as 1.00
79              ELSE IF grade is D-
80                  Assign grade point as 0.67
81              ELSE IF grade is F
82                  Assign grade point as 0
83              END IF
84              Print the grade point
85              Calculate sum of units: sum of units = sum of units + units
86              Calculate total GP: total GP = grade point * units
87              Print total GP
88              Print sum of units
89              Calculate sum of total GP: sum of total GP = sum of total GP + total GP
90              Increment course loop control variable by one
91          END WHILE
92          Calculate grade point average (GPA): GPA = sum of total GP / sum of units
93          Print sum of total GP
94          Print sum of units
95          Print sum of total GP
96          Print GPA
```

```
97          Calculate Accumulated Units: Accumulated units = Accumulated units + Sum of units
98          Calculate Accumulate GPA: Accumulated GPA = Accumulated GPA + Sum of total GP
99      END WHILE
100     Calculate CGPA: CGPA = Accumulated GPA / Accumulated units
101     Print Accumulated GPA, accumulated units and CGPA
102     IF 3.75 is less than or equal to CGPA and CGPA is less than or equal to 4.00
103         Print "Excellent"
104     ELSE IF 3.25 is less than or equal to CGPA and CGPA is less than or equal to 3.74
105         Print "Very Good”
106     ELSE IF 2.75 is less than or equal to CGPA and CGPA is less than or equal to 3.24
107         Print "Good"
108     ELSE IF 2.25 is less than or equal to CGPA and CGPA is less than or equal to 2.74
109         Print "Work Smart"
110     ELSE IF CGPA is less than or equal to 2.24
111         Print "Work Very Hard and Work Smart"
```

Desk Check 1:

All inputs are valid but the number of semesters and courses are 2 to respectively to test the logic of these loops.

Inputs: semesterNo = 2, courseNo = 2, grade = B, units = 4, grade A, units = 5, courseNo = 2, grade = D, units = 3, grade = C+, units = 4

Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput
1																
2																
3																
4											0					
5															(!(1<=semesterNo) && !(semesterNo<=10)) ? is T	
6											2					semesterNo ? 2
7															cin.fail ? is F	
8																
9																
10																
11																
12															!(semesterNo <= 0) ? is F	
13																
14																
15																
16															!(6 <= semesterNo) ? is F	
17																
18																
19																
20																
5															(!(1<=semesterNo) && !(semesterNo<=10)) ? is F	
21				1												
22	0	0														
23															counterSem<=semesterNo ? is T	
24																
25																
26						0										
27															(!(1<=courseNo) && !(courseNo<=6)) ? is T	
28						2										courseNo ? 2
29															cin.fail ? is F	
30																
31																
32																
33																
34															!(courseNo <= 0) ? is F	
35																
36																
37																
38															!(6 <= courseNo) ? is F	
39																
Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput

40																
41																
42																
27															(!(1<=courseNo) && !(courseNo<=6)) ? is F	
43					1											
44												0				
45													0			
46															counterCourse<=courseNo ? is T	
47								“X”								
48																
49																
50															grade == !(grade available in table) ? is T	
51								“B”								grade ? B
52															grade == !(grade available in table) ? is F	
53																
54																
55																
56																
50															grade == !(grade available in table) ? is F	
57																
58														4		units ? 4
59															grade == “A” ? is F	
60																
61															grade == “A-” ? is F	
62																
63															grade == “B+” ? is F	
64																
65															grade == “B” is T	
66									3.00							
67																
68																
69																
70																
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
84																gradePoint = 3.00
85												0 + 4 = 4				
86										3.00 * 4 = 12.00						
Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput

87																gradePointUnits = 12.00
88																sumUnits = 4
89													0 + 12.00 = 12.00			
90						1 + 1 = 2										
46															counterCourse<=courseNo ? is T	
47								“X”								
48																
49																
50															grade == !(grade available in table) ? is T	
51								“A”								grade ? A
52															grade == !(grade available in table) ? is F	
53																
54																
55																
56																
50															grade == !(grade available in table) ? is F	
57																
58														5		units ? 5
59															grade == “A” ? is T	
60									4.00							
61																
62																
63																
64																
65																
66																
67																
68																
69																
70																
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
84																gradePoint = 4.00
85												4 + 5 = 9				
86										4.00 * 5 = 20.00						
87																gradePointUnits = 20.00
88																sumUnits = 9
89													12.00 + 20.00 = 32.00			
Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput
90						2 + 1 = 3										

46															counterCourse<=courseNo ? is F	
91																
92							32.00 / 9 = 3.56									
93	Print sum of total GP															SumGradePointUnits = 32.00
94	Print sum of units															sumUnits = 9
95																
96	Print GPA															gpa = 3.56
97		0 + 9														
98	0 + 32.00															
23															counterSem<=semesterNo ? is T	
24																
25																
26						0										
27															(!(1<=courseNo) && !(courseNo<=6)) ? is T	
28						2										courseNo ? 2
29															cin.fail ? is F	
30																
31																
32																
33																
34															!(courseNo <= 0) ? is F	
35																
36																
37																
38															!(6 <= courseNo) ? is F	
39																
40																
41																
42																
27															(!(1<=courseNo) && !(courseNo<=6)) ? is F	
43					1											
44												0				
45													0			
46															counterCourse<=courseNo ? is T	
47								“X”								
48																
49																
50															grade == !(grade available in table) ? is T	
51								“D”								grade ? D
52															grade == !(grade available in table) ? is F	
53																
54																
55																
Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput
56																
50															grade == !(grade available in table) ? is F	

57																
58														4		units ? 3
59															grade == “A” ? is F	
60																
61															grade == “A-” ? is F	
62																
63															grade == “B+” ? is F	
64																
65															grade == “B” is F	
66																
67															grade == “B-” is F	
68																
69															grade == “C+” is F	
70																
71															grade == “C” is F	
72																
73															grade == “C-” is F	
74																
75															grade == “D+” is F	
76																
77															grade == “D” is T	
78										1.00						
79																
80																
81																
82																
83																
84																gradePoint = 1.00
85													0 + 3 = 3			
86											1.00 * 3 = 3.00					
87																gradePointUnits = 3.00
88																sumUnits = 3
89														0 + 3.00 = 3.00		
90						1 + 1 = 2										
46															counterCourse<=courseNo ? is T	
47								“X”								
48																
49																
50															grade == !(grade available in table) ? is T	
51								“C+”								grade ? A
52															grade == !(grade available in table) ? is F	
53																
54																
55																
56																
50															grade == !(grade available in table) ? is F	
57																
58														5		units ? 5
Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput
59															grade == “A” ? is F	
60																
61															grade == “A-” ? is F	
62																
63															grade == “B+” ? is F	

64																
65															grade == “B” is F	
66																
67															grade == “B-” is F	
68																
69															grade == “C+” is T	
70									2.33							
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
84																gradePoint = 2.33
85												3 + 4 = 7				
86										2.33 * 4 = 9.32						
87																gradePointUnits = 9.32
88																sumUnits = 7
89													3.00 + 9.32 = 12.32			
90						2 + 1 = 3										
46															counterCourse<=courseNo ? is F	
23															counterSem<=semesterNo ? is F	
91																
92							12.32 / 7 = 1.76									
93																SumGradePointUnits = 12.32
94																sumUnits = 7
95																
96																gpa = 1.76
97		9 + 7 = 16														
98	32.00 + 12.32 = 44.32															
99																
100			44.32 / 16 = 2.77													
101																
102															(3.75<=cgpa && cgpa<=4.00) ? is F	
103																
104															(3.25<=cgpa && cgpa<=3.74) ? is F	
105																
106															(2.75<=cgpa && cgpa<=3.24) ? is T	
107																“Good”
108																
109																

110																
111																

Desk Check 2:

All inputs are invalid at first but then corrected according the error message. (input validation is not needed for units)

Inputs: semesterNo = a, semesterNo 1, courseNo = 7, courseNo 1, grade = 1, grade A, units = 4

Line No.	accumulatedgpa	accumulatedUnits	cgpa	counterSem	counterCourse	courseNo	gpa	grade	gradepoint	gradePointUnits	semesterNo	sumUnits	sumGradePointUnits	units	Conditions	Input/Ouput
1																
2																
3																
4											0					
5															(!(1<=semesterNo) && !(semesterNo<=10)) ? is T	
6																semesterNo ? a
7															cin.fail ? is T	
8																
9																
10																“Error message”
11																“Prompt for new input”
12															!(semesterNo <= 0) ? is F	
13																
14																
15																
16															!(6 <= semesterNo) ? is F	
17																
18																
19																
20																
5															(!(1<=semesterNo) && !(semesterNo<=10)) ? is T	
6																semesterNo ? 1
7															cin.fail ? is F	
8																
9																
10																
11																
12															? is F	
13																
14																
15																
16															? is F	
17																
18																
19																
20																
21				1												
22	0	0														
23															counterSem<=semesterNo ? is T	
24																
25																
26						0										
27															(!(1<=courseNo)	

															&& !(courseNo<=6)) ? is T	
28						7										courseNo ? 7
29															cin.fail ? is F	
30																
31																
32																
33																
34															!(courseNo <= 0) ? is F	
35																
36																
37																
38															!(6 <= courseNo) ? is T	
39																
40																
41																“Error message”
42																“Prompt for new input”
27															(!(1<=courseNo) && !(courseNo<=6)) ? is T	
28						1										courseNo ? 1
29															cin.fail ? is F	
30																
31																
32																
33																
34															!(courseNo <= 0) ? is F	
35																
36																
37																
38															!(6 <= courseNo) ? is F	
39																
40																
41																
42																
43					1											
44												0				
45													0			
46															counterCourse<=courseNo ? is T	
47								“X”								
48																
49																
50															grade == !(grade available in table) ? is T	
51								“1”								grade ? 1
52															grade == !(grade available in table) ? is T	
53																
54																
55																Error message
56																Prompt user for new input
50															grade == !(grade available in table) ? is F	
57																
58														4		units ? 4
59															grade == “A” ? is T	
60									4.00							
61																

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76																
77																
78																
79																
80																
81																
82																
83																
84																gradePoint = 4.00
85												0 + 4 = 4				
86										4.00 * 4 = 16.00						
87																gradePointUnits = 16.00
88																sumUnits = 4
89													0 + 16.00 = 16.00			
90						1 + 1 = 2										
91																
92							16.00 / 4 = 4.00									
93																SumGradePointUnits = 32.00
94																sumUnits = 9
95																
96																gpa = 3.56
97		0 + 4														
98	0 + 16.00															
23															counterSem<=semesterNo ? is F	
99																
100			16.00 / 4 = 4.00													
101																
102															(3.75<=cgpa && cgpa<=4.00) ? is T	
103																“Excellent”
104																
105																
106																
107																
108																
109																
110																
111																

4.0 SOURCE CODE

```
//**************************************************************************
// This program calculates your CGPA and GPA per semester and determines
// which group you are in (excellent, very good, etc.) based on your
// grades for each course in each semester.
//**************************************************************************

#include <iostream>
#include <iomanip> //Header file to allow functions to manipulate output decimal places.
using namespace std;

int main()
{
//Declare and initialise variables...
//Fixed inputs:
double gradePoint;

//User inputs:
int courseNo, semesterNo, units;
string grade;

//Calculation variables:
int counterSem, counterCourse; //loop control variables for semester and course input loops
int sumUnits, accumulatedUnits;
double gradePointUnits, accumulatedgpa, sumGradePointUnits;

//Outputs:
double cgpa, gpa;

cout<<fixed<<showpoint<<setprecision(2); //set output correct to 2 decimal places.

cout<<"=============================================================================================="<<endl;
cout<<"==                    Your personal CGPA calculator!                    =="<<endl;
cout<<"=============================================================================================="<<endl;
cout<<endl;
cout<<" Table of Available Grades:"<<endl<<endl;
cout<<"**********************************************************************************"<<endl;
cout<<"**  A   | A- | B+ | B  | B- | C+ | C  | C- | D+ | D  | D- | F  **"<<endl;
```

```
cout<<"** 4.00 | 3.67 | 3.33 | 3.00 | 2.67 | 2.33 | 2.00 | 1.67 | 1.33 | 1.00 | 0.67 | 0.00 **"<<endl;
cout<<"*********************************************************************************************"<<endl;
cout<<endl;
cout<<" Please input without any spaces..."<<endl<<endl;
cout<<" Number of semesters: ";

semesterNo = 0; //This statement is needed to ensure the validation loop is entered.
while(!(1<=semesterNo) || !(semesterNo<=10)) //Input validation loop for number of semesters.
{
        cin>>semesterNo;
   if(cin.fail()) //Validation for wrong data types being entered into integer data type.
   {
        cin.clear();
        cin.ignore(100, '\n');
        cout<<" ERROR: The number of semesters must be a number!"<<endl;
    cout<<" Please enter again: ";
       } else if(semesterNo<=0) //Validation for negative numbers and the number zero.
    {
            cout<<" ERROR: The number of courses must be at least 1!"<<endl;
            cout<<" Please enter again: ";
    }
   if(semesterNo>10) //Validation for numbers larger than 10 since the question stipulates that maximum number of semesters is 10.
   {
    cout<<" ERROR: 10 is the maximum number of semesters possible!"<<endl;
    cout<<" Please enter again: ";
   }
}

counterSem = 1;
accumulatedgpa = 0;
accumulatedUnits = 0;
while(counterSem<=semesterNo) //"Number of courses" input loop that loops for how many semesters there are.
{
    cout<<endl;
    cout<<"==================== Semester "<<counterSem<<" ====================="<<endl<<endl;
    cout<<" Number of courses for semester "<<counterSem<<": "; //Each semester can have different number of courses taken.

    courseNo = 0; //This statement is needed to ensure the validation loop is entered.
        while(!(1<=courseNo) || !(courseNo<=6)) //Input validation loop for number of courses.
```

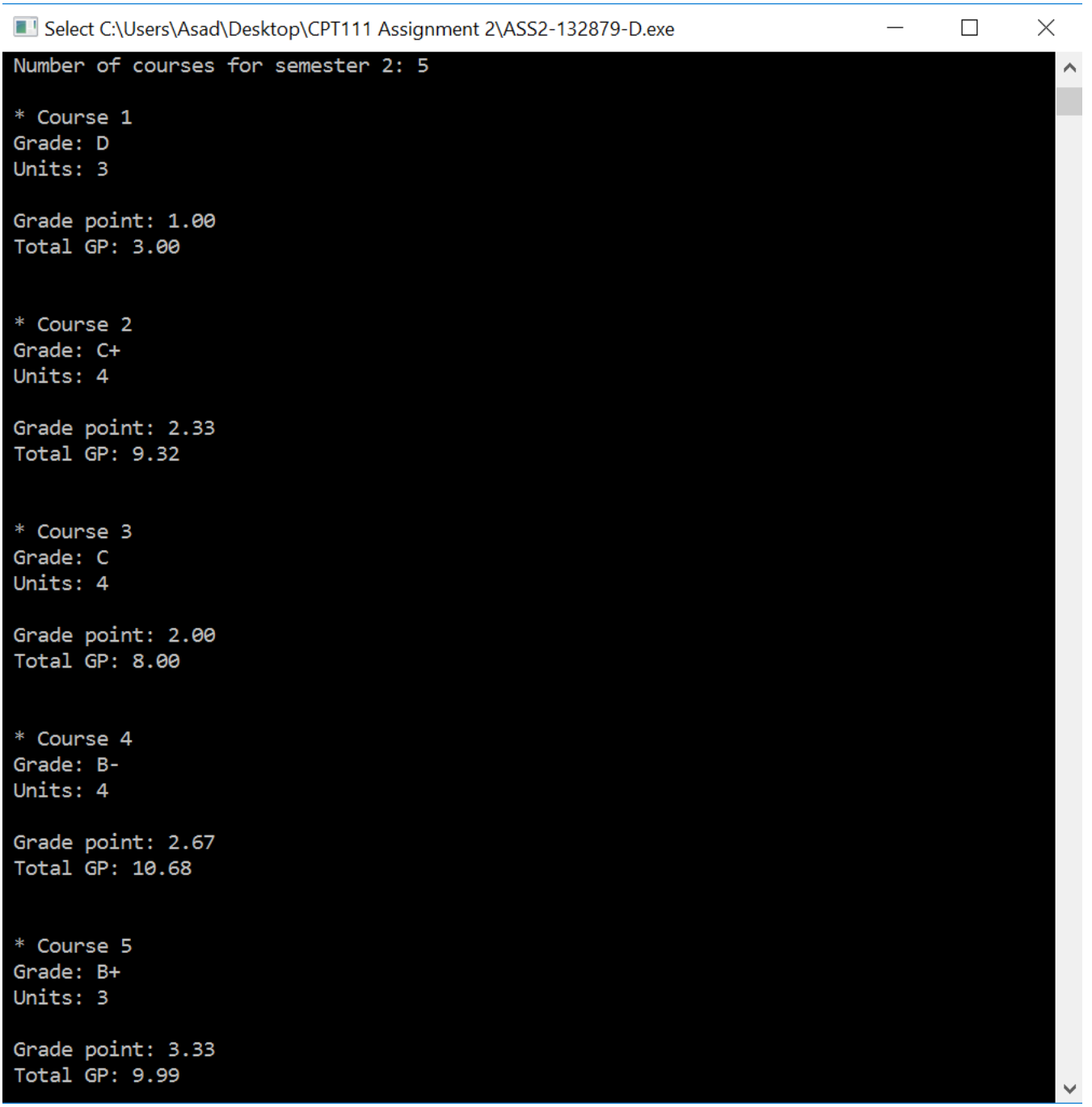
```
{
        cin>>courseNo;
 if(cin.fail())
 {
        cin.clear();
        cin.ignore(100, '\n');
        cout<<" ERROR: The number of courses must be a number!"<<endl;
 cout<<" Please enter again: ";
        } else if(courseNo<=0)
  {
            cout<<" ERROR: The number of courses must be at least 1!"<<endl;
            cout<<" Please enter again: ";
  }
 if(courseNo>6)
 {
  cout<<" ERROR: 6 is the maximum number of courses possible!"<<endl;
  cout<<" Please enter again: ";
 }
}


    counterCourse = 1; //It's important to reset this to one before a course loop is started for a new semester because semester 2 onwards will restart from course 1.
    sumUnits = 0;
    sumGradePointUnits = 0; //The sum units and sum of product of grade point and units will be reused for each semester's courses so it must be reset to zero for every semester
    while(counterCourse<=courseNo) //"Course's grade and units" input loop that loops for how many courses there are for each semester.
        {
     cout<<endl;
            cout<<" * Course "<<counterCourse<<endl;
     cout<<" Grade: ";

     //Input validation loop for grade (only accepts grades that are mentioned in the table of available grades):

     grade = "X"; //This statement is needed to ensure the loop is entered.
     while(!(grade == "A" || grade == "A-" || grade == "B+" || grade == "B" || grade == "B-" || grade == "C+" ||
            grade == "C" || grade == "C-" || grade == "D+" || grade == "D" || grade == "D-" || grade == "F"))
     {
        cin>>grade;

        if (!(grade == "A" || grade == "A-" || grade == "B+" || grade == "B" || grade == "B-" || grade == "C+" ||
```

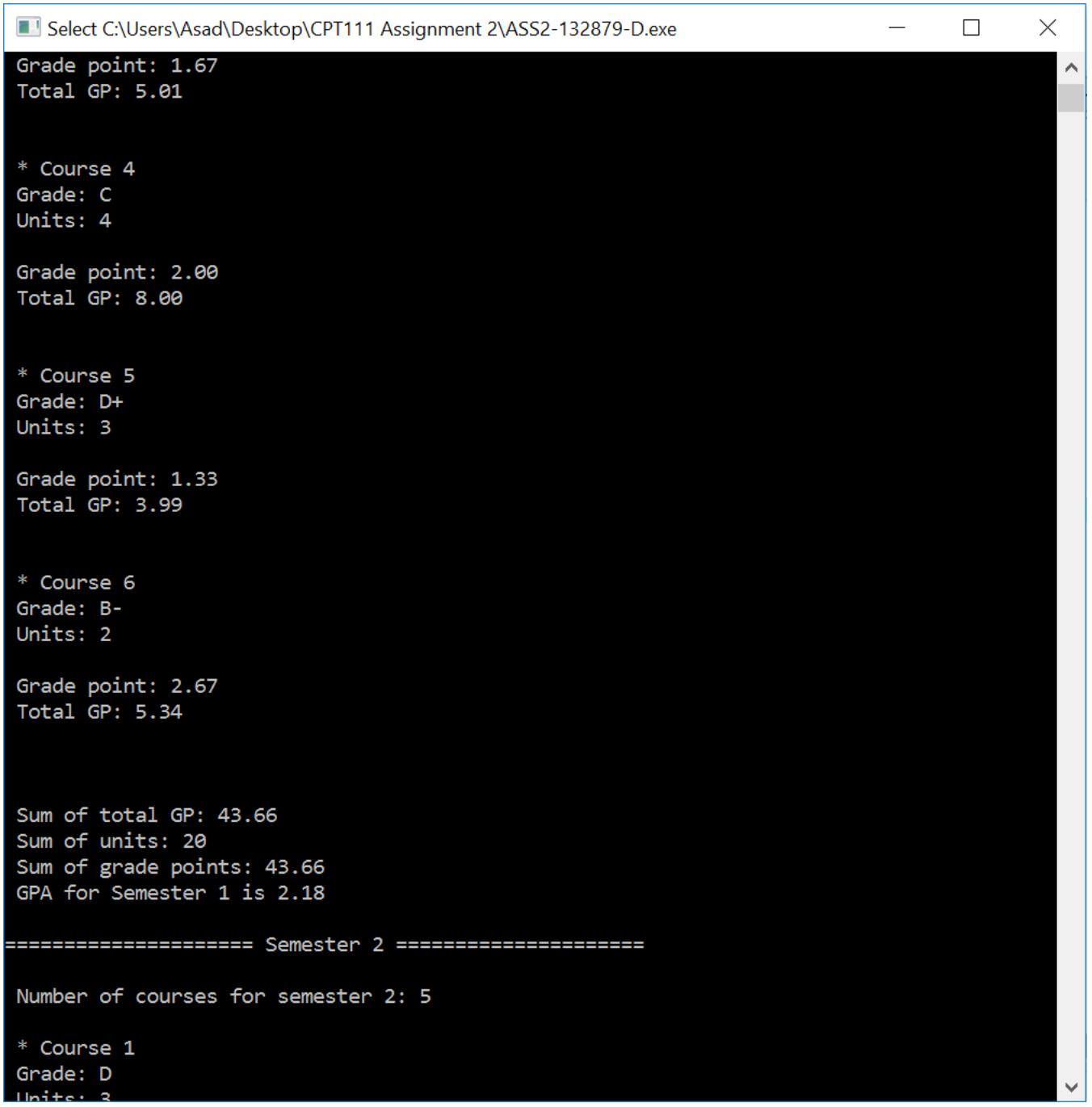
```
                    grade == "C" || grade == "C-" || grade == "D+" || grade == "D" || grade == "D-" || grade == "F"))
            {
             cout<<" ERROR: Invalid grade input! Please refer to table for valid grade inputs. (must be in CAPS)"<<endl;
             cout<<" Please enter again: ";
            }
}

                    cout<<" Units: ";
units = 0; //This statement is needed to ensure the loop is entered.
while(!(1<=units)) //Input validation loop for units.
      {
                    cin>>units;
   if(cin.fail())
   {
              cin.clear();
              cin.ignore(100, '\n');
              cout<<" ERROR: The units must be a number!"<<endl;
     cout<<" Please enter again: ";
            } else if(units<=0)
     {
               cout<<" ERROR: The units must be at least 1!"<<endl;
               cout<<" Please enter again: ";
     }
         }


//Assign grade point according to grade that has been inputted:

   if(grade == "A")
    gradePoint = 4.00;
    else if(grade == "A-")
     gradePoint = 3.67;
     else if (grade == "B+")
      gradePoint = 3.33;
      else if (grade == "B")
       gradePoint = 3.00;
       else if (grade == "B-")
        gradePoint = 2.67;
        else if (grade == "C+")
```

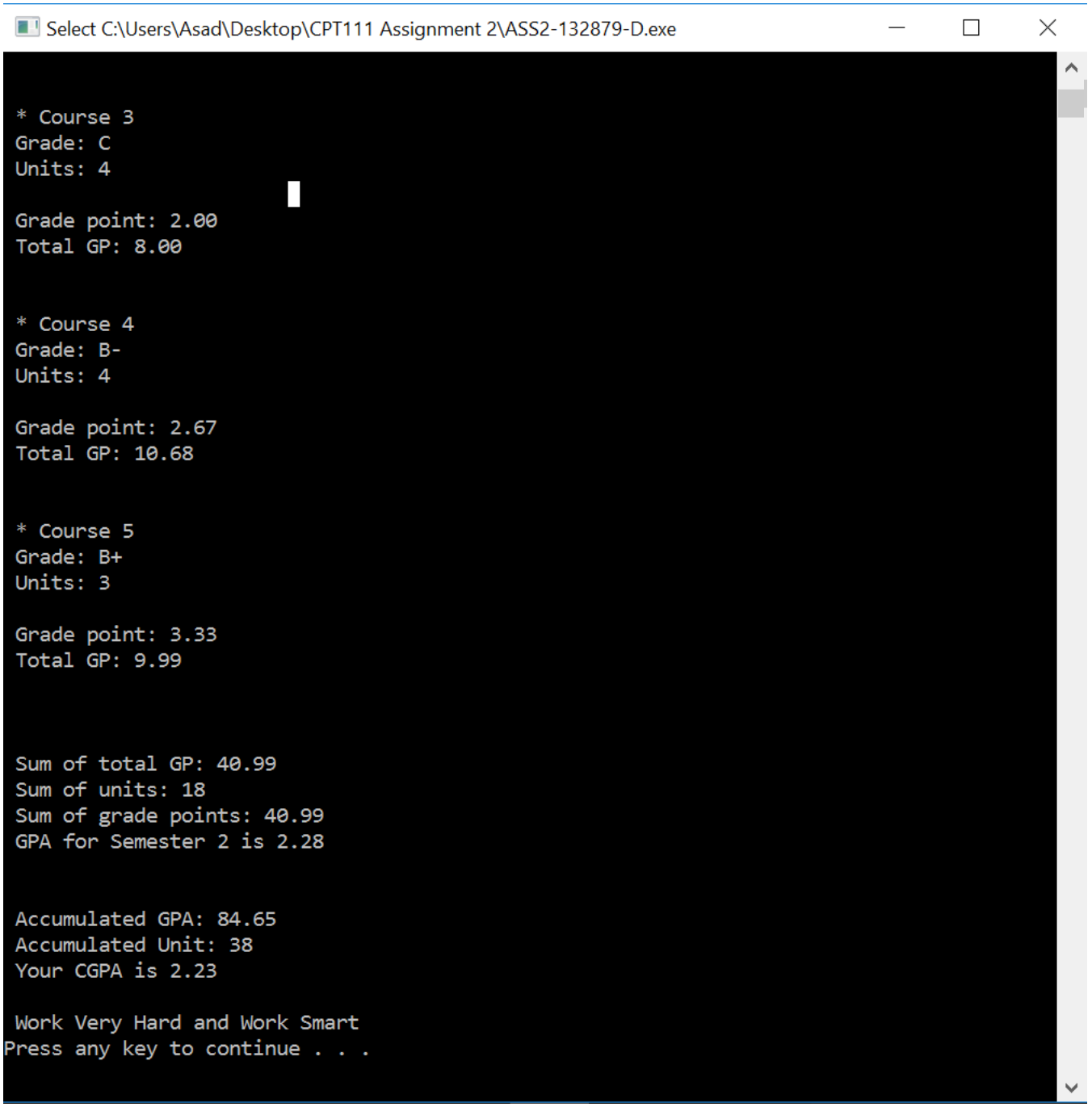
```
            gradePoint = 2.33;
            else if (grade == "C")
             gradePoint = 2.00;
             else if (grade == "C-")
              gradePoint = 1.67;
              else if (grade == "D+")
               gradePoint = 1.33;
               else if (grade == "D")
                gradePoint = 1.00;
                else if (grade == "D-")
                 gradePoint = 0.67;
                 else if (grade == "F")
                  gradePoint = 0;


        cout<<endl;
        cout<<" Grade point: "<<gradePoint<<endl;
        sumUnits += units; //Adds current course's units to the total of all previous course's units.
        gradePointUnits = gradePoint * units; //Product of grade points and units which must be summed for the formula of GPA and CGPA.
        cout<<" Total GP: "<<gradePointUnits<<endl; //Outputs the Total GP (which is the same as gradePointUnits) for user's convenience
to trace the calculations.
        sumGradePointUnits += gradePointUnits; //Adds current course's Total GP to the total of all previous course's units.
        cout<<endl;
        counterCourse++; //Increases course count by 1 so that the next course can begin being inputted.
                                }


    gpa = sumGradePointUnits/sumUnits;
    cout<<endl<<endl;
    cout<<" Sum of total GP: "<<sumGradePointUnits<<endl;
    cout<<" Sum of units: "<<sumUnits<<endl;
                cout<<" Sum of grade points: "<<sumGradePointUnits<<endl;
    cout<<" GPA for Semester "<<counterSem<<" is "<<gpa<<endl;
                accumulatedUnits += sumUnits;
    accumulatedgpa += sumGradePointUnits;
                counterSem++;
}


cgpa = accumulatedgpa/accumulatedUnits;
cout<<endl<<endl;
```

```
cout<<" Accumulated GPA: "<<accumulatedgpa<<endl;
cout<<" Accumulated Unit: "<<accumulatedUnits<<endl;
cout<<" Your CGPA is "<<cgpa<<endl<<endl;

//Remarks regarding CGPA:
if(3.75<=cgpa && cgpa<=4.00)
 cout<<" Excellent"<<endl;
 else if(3.25<=cgpa && cgpa<=3.74)
  cout<<" Very Good"<<endl;
  else if(2.75<=cgpa && cgpa<=3.24)
   cout<<" Good"<<endl;
   else if(2.25<=cgpa && cgpa<=2.74)
    cout<<" Work Smart"<<endl;
    else if(cgpa<=2.24)
     cout<<" Work Very Hard and Work Smart"<<endl;

system("pause");
return 0;
}
```

5.0 SAMPLE INPUT AND OUTPUT




Select C:\Users\Asad\Desktop\CPT111 Assignment 2\ASS2-132879-D.exe
Grade point: 1.67
Total GP: 5.01
* Course 4
Grade: C
Units: 4
Grade point: 2.00
Total GP: 8.00
* Course 5
Grade: D+
Units: 3
Grade point: 1.33
Total GP: 3.99
* Course 6
Grade: B-
Units: 2
Grade point: 2.67
Total GP: 5.34
Sum of total GP: 43.66
Sum of units: 20
Sum of grade points: 43.66
GPA for Semester 1 is 2.18
========== Semester 2 ==========
Number of courses for semester 2: 5
* Course 1
Grade: D


Select C:\Users\Asad\Desktop\CPT111 Assignment 2\ASS2-132879-D.exe
* Course 3
Grade: C
Units: 4
Grade point: 2.00
Total GP: 8.00
* Course 4
Grade: B-
Units: 4
Grade point: 2.67
Total GP: 10.68
* Course 5
Grade: B+
Units: 3
Grade point: 3.33
Total GP: 9.99
Sum of total GP: 40.99
Sum of units: 18
Sum of grade points: 40.99
GPA for Semester 2 is 2.28
Accumulated GPA: 84.65
Accumulated Unit: 38
Your CGPA is 2.23
Work Very Hard and Work Smart
Press any key to continue . . .