

LAB #4

Purpose:

The purpose of this lab is to learn to apply the selection control structures in writing a C program to solve a given problem.

Before the lab:

1. Read your notes concerning logical expressions, the if and switch statements.

During the lab:

PART I: PROGRAMMING EXERCISES

Exercise #1:

- a. Using Geany, write a C program that prompts and asks the user for two assignment marks (a1 and a2) and two test marks (t1 and t2). All four variables are integer variables and are in % (out of 100). Your program should display the four marks properly labeled to check if the input has been successful.
- b. Next, calculate and display the average of the four marks.
- c. The program should continue to add on to what you have written by using an if statement to assign the letter 'A' to a char variable named "grade" if the average is greater than or equal to 80. The program should print out the grade as a single letter using %c to output the variable "grade". Repeat running your program with different input data, and be sure to input the marks so that at least one trial case gives an 'A'. Afterwards change the output (printf) statement so that a "label" is produced. Recall that this is so that when looking at the screen you will know what the number you see is meant to represent. (eg: "The grade is A", as opposed to just 'A'.)
- d. The program should then expand this into an if/else statement to assign the letter 'A' to a char variable named grade if the average is greater than or equal to 80, or 'B' if the average is less than 80. Test this with the marks 80 85 75 85 and then run the program again with marks 75 65 70 75.
- e. The program should then use an if statement inside the else branch to additionally separate out the averages less than 80. If the average is less than 80 (all marks in this else part will be) the inner if statement will assign the grade as 'B' if the average is greater than or equal to 70 and 'C' if the average is less than 70. This time, create your own sets of four marks to test that the program separates the 'B' and 'C' grades.
- f. Continue the use of if statements in the else sections as you create them to separate grades into 'C' vs 'D' ('C' is greater than or equal to 60, but of course still less than 70; 'D' is for marks less than 60 but more than or equal to 50; and 'F' if the mark is less than 50. Again, check this with several of your own sets of four marks.
- g. Modify and Check your program with example grades so that the output looks like this:

Enter Assignments Grades: 80 70

Enter Test Grades: 60 70

The average is: 70%

The letter grade is: B

Make sure the averages and letter grades are correct for every set of grades and have your program checked by the TA.

Exercise #2:

- a. Modify the program written for Exercise #1 to add the following rule: "If either test mark t1 or t2 is less than 50, change the grade to an 'F'.". now check your program with this set of data: 80 60 45 80. It should be an 'F' with the new rule.

Exercise #3:

- a. Using Geany, ask the user for a warship class by a letter ('S', 'C', 'D', 'F' and 'A'). Use a switch statement to display the warship class name (S for Submarine, C for Cruiser, D for Destroyer, F for Frigate and A for Aircraft Carrier). Display a message that the ship is unknown if the user enters any other letter. (Note: accept also the lowercase version of the letters)

Exercise #4:

- a. The National Earthquake Information Centre has asked you to write a program implementing the following decision table to characterize an earthquake based on its Richter scale number.

Richter scale number (n)	Characterization
$n > 5.0$	Little or no damage
$5.0 \leq n < 5.5$	Some damage
$5.5 \leq n < 6.5$	Serious damage: Walls may crack or fall
$6.5 \leq n < 7.5$	Disaster: Houses and buildings may collapse
$n \geq 7.5$	Catastrophe: Most buildings destroyed

Could you do this program with a switch statement. If not, what is the reason?

Exercise #5:

- a. Without a computer evaluate the following expression: $1 \ \&\& \ (30 \% 10 \geq 0) \ \&\& \ (30 \% 10 \leq 3)$
- b. Is either set of parentheses required?
- c. Write the complement of the expression using the NOT operator.
- d. Write the complement of the expression using the DeMorgan Theorem.

PART II: DISCOVERY ACTIVITIES

- i. Using your text book, or an Internet search (do not ask friends or TA) or simply by experimenting with Quincy, explain in a few sentences the differences between the = and == operators and why **if (x = 0)** is always false.

PART III: LAB REPORT SUBMISSION

1. Submit the .c files for programming exercises 1 to 5.
2. Submit the text file containing the answer to the discovery question.
3. Submit on D2L/Brightspace under Lab #4. Submissions are due at the end of the lab session. You must submit your work before leaving the lab.

After the lab:

1. Review the steps you took to perform the various operations in the lab.

Homework:

- On paper (no computer needed), do the following programming (write the code by hand as you would on a test or an exam).

8. Write a program that interacts with the user like this:

```
(1) Carbon monoxide
(2) Hydrocarbons
(3) Nitrogen oxides
(4) Nonmethane hydrocarbons
Enter pollutant number>> 2
Enter number of grams emitted per mile>> 0.35
Enter odometer reading>> 40112
Emissions exceed permitted level of 0.31 grams/mile.
```

Use the table of emissions limits below to determine the appropriate message.¹

	First 50,000 Miles	Second 50,000 Miles
carbon monoxide	3.4 grams/mile	4.2 grams/mile
hydrocarbons	0.31 grams/mile	0.39 grams/mile
nitrogen oxides	0.4 grams/mile	0.5 grams/mile
nonmethane hydrocarbons	0.25 grams/mile	0.31 grams/mile

- Show your homework to your lab assistant at the **beginning of next week's lab**.
- If you wish, you may try your solution with the computer to see if you got the correct solution (no need to show the computer version).

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