CptS 121 - Program Design and Development

Lab 13: Bit Manipulation

Assigned: Week of April 15, 2024
Due: At the end of the lab session

I. Learner Objectives:

At the conclusion of this programming assignment, participants should be able to:

- Utilize bit operations

II. Prerequisites:

Before starting this programming assignment, participants should be able to:

- Utilize output parameters and pointers in a C program
- Apply the dereference or indirection C operator
- Declare strings in C
- Apply library functions found in <string.h>
- Implement array notation or pointer arithmetic to manipulate strings
- Distinguish between character arrays and strings in C
- Pass arrays into functions
- Initialize arrays using an initializer list
- Construct loops to traverse through arrays

III. Overview & Requirements:

This lab, along with your TA, will help you navigate through applying bit operations.

Labs are held in a “closed” environment such that you may ask your TA questions. Please use your TAs knowledge to your advantage. You are required to move at the pace set forth by your TA. Please help other students in need when you are finished with a task. You may work in pairs if you wish. However, I encourage you to compose your own solution to each problem. Have a great time! Labs are a vital part to your education in CptS 121 so work diligently.

Tasks:

1. From Chapter 10 of Deitel and Deitel's *C How to Program* book. Write a program that right shifts an integer variable 4 bits. The program should print the integer in bits before and after the shift operation. Does your system place 0s or 1s in the vacated bits?

2. From Chapter 10 of Deitel and Deitel's *C How to Program* book. Left shifting an unsigned integer by 1 bit is equivalent to multiplying the value 2. Write a

function `power2()` that takes two integer arguments number and pow and calculates:

number * 2^{pow}

Use the shift operator to calculate the result. Print the values as integers and as bits.

3. From Chapter 10 of Deitel and Deitel's *C How to Program* book. The left-shift operator can be used to pack four character values into an unsigned integer variable. Write a program that inputs four characters from the keyboard and passes them to function `packCharacters()`. To pack four characters into an unsigned integer variable, assign the first character to the unsigned variable, shift the unsigned variable left by 8 bit positions and combine the unsigned variable with the second character using the bitwise inclusive OR operator. Continue to shift by 8 and OR until all characters have been packed into the 4-byte unsigned integer variable. The program should output the characters in their bit format before and after they are packed into the unsigned integer to prove that the characters are in fact packed correctly in the unsigned variable

IV. Submitting Labs:

- You are not required to submit your lab solutions. However, you should keep them in a folder that you may continue to access throughout the semester.

V. Grading Guidelines:

- This lab is worth 10 points. Your lab grade is assigned based on completeness and effort. To receive full credit for the lab you must show up on time, work in a team, complete two-thirds of the problems, and continue to work on the problems until the TA has dismissed you.