Binary and C Intro Assignment (Learning)

CSCI 389: Computer Systems

Spring 2022

This assignment is an opportunity to test your understanding of binary and C and receive feedback. Point values are assigned so that you can differentiate between large and small mistakes, but this assignment does not affect your grade.

Due Date: Wednesday, February 2nd at 10:00 am.

1. (12 points) **Converting Bases.** Convert the following numbers to the specified base.

   (a) (2 points) Convert 209_{10} to binary.

   (b) (2 points) Convert 192_{10} to hexadecimal.

   (c) (2 points) Convert 10110001_2 to decimal.

   (d) (2 points) Convert 1001101_2 to hexadecimal.

   (e) (2 points) Convert $D3A7_{16}$ to decimal.

   (f) (2 points) Convert $83EF_{16}$ to binary.

   A. The smallest base 2 number that fits in is 128 which is 2^7. $209 - 128 = 81$, the next fitting power of two is 64 which is 2^6. $81 - 64 = 17$, the next power of 2 is 16 which is 2^4. The last power of two is 1 which is 2^0,

   The resulting number is: 11010001

   B. The first digit is $\lfloor 192/16 \rfloor = 12 = C$ and the second digit is $192\%16 = 0$. Therefore the hex digit is $C0$

   C. $2^0 + 2^4 + 2^5 + 2^7 = 209$

   D. Digits can be grouped together in groups of 4. The last four buts 1101 is 13 and the remaining three 100 represent 4. So in hex the number is $4D$

   E. $7(16^0) + 10(16^1) + 3(16^2) + 13(16^3) = 54183$

   F. $15(16^0) + 14(16^1) + 3(16^2) + 8(16^3) = 33775$

2. (4 points) **Binary Addition.** Show how to add 10001111_2 and 01100101_2 using binary arithmetic.

   This is a series of half adds, and if there happens to be three then in addition to the carry the digit is also set to true.

   ```
         1   1   1   1
     1 0 0 0 1 1 1 1   Addend
   + 0 1 1 0 0 1 0 1   Augend
     1 1 1 1 0 1 0 0   Sum
   ```

   Credits to

   11110100

3. (4 points) **Binary Multiplication.** Show how to multiply 100110 and 11001 using binary arithmetic.

4. (4 points) **Latency and Bandwidth.** Create the truth table for the following circuit:
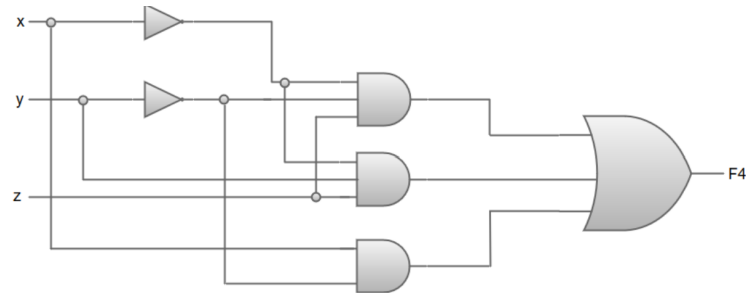
x	y	z	$output$
1	1	1	0
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	1
0	1	0	0
0	0	1	1
0	0	0	0

5. (16 points) **C.** Write C code that generates a list of random integers and computes the mean (as a real number). Your program should take as input two parameters, the length of the list, and a seed to generate the random numbers. It should print out the list of integers and the calculated mean. Submit your code, as well as the makefile you used to compile it.