

605.204 - Computer Organization

Module 1: Assignment 1

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Brief Introduction

This assignment involves the representation and manipulation of binary numbers within a computer.

Problem 1

1. From section 2.10 of "Introduction to Assembly Language: From Soup to Nuts: ARM Edition (Kann)", complete exercises 1(a, d, e, f), 2 (b, e), 4(a, b, c, d; assume 16 bit numbers), 5(a, b, c, e), 6(a, b, c, d), 7(a, b), 9. This material is not graded, and simply for practice, You will be quizzed on this material later.

The problems were completed as specified.

Problem 2

2. Give the binary fixed point representation in 16 bits with 4 bits fractional part for the following numbers:

a. $5.75 = 2^2 + 2^0 + 2^{-1} + 2^{-2} = 101.11 = \mathbf{0000000001011100}$

b. $13.875 = 2^3 + 2^2 + 2^0 + 2^{-1} + 2^{-2} + 2^{-3} = 1101.111 = \mathbf{0000000011011110}$

c. $21.375 = 2^4 + 2^2 + 2^0 + 2^{-2} + 2^{-3} = 10101.011 = \mathbf{0000000101010110}$

Problem 3

For the following 16 bit fixed point binary numbers with 4 bit fractional part below, give the decimal value:

a. $0000000011011011 = 1101.1011 = 2^3 + 2^2 + 2^0 + 2^{-1} + 2^{-3} + 2^{-4} = 8 + 4 + 1 + 0.5 + 0.125 + 0.0625 = \mathbf{13.6875}$

b. $0000000101000110 = 10100.011 = 2^4 + 2^2 + 2^{-2} + 2^{-3} = 16 + 4 + 0.25 + 0.125 = \mathbf{20.375}$

Problem 4

Choose 2 of the following 4 functions, and implement those two programs in the language of your choice. These programs will be graded. Be sure to properly comment them with your name and purpose of the program as a preamble to the file, what functions are present in the file (refer to the numbers 1-4 below) , document all functions, and observe proper rules for naming of variables and indentation in the language of your choice. You should implement each of these as a function in your program, and call them from a main function in your program.

- A program to implement the `toUpper` and `toLower`. To implement these functions, you must use the bitwise AND (`&`) and OR (`|`) operators. Using addition and subtraction is not acceptable for this assignment.*
- Write a program to take a string representing a binary number, and write out the number in hex.*
- Write a program to take an integer and write its value out in hex. You cannot use string formatting, but must mask 4 bits at a time and find the value in a table (array) of hex values.*
- Implement a program that converts an ASCII string of characters to an integer value. You may NOT use any standard libraries to convert the string to integer. You may use libraries for tasks like retrieving each number from the string, etc.*

I chose to implement each of the four functions listed above using C++11.

My resulting code can be found at <https://github.com/nhinke/computer-organization-repo/tree/master/module01>, and can be cloned (along with pre-built binaries

in a *bin/* folder) and viewed using the following commands:

```
git clone https://github.com/nhinke/computer-organization-repo.git
cd computer-organization-repo/module01/
```

The pre-built binaries can then be run using the following commands:

```
cd bin/
./problem4a
./problem4b
./problem4c
./problem4d
```

Note that each of the pre-built binaries will print out an example input-output sequence to the active terminal.