CSE 351 Section 1 – Number Bases and Working in C [Solutions]

Hi there and welcome to section! ☺

Numerals

A *numeral* is a symbolic representation of a number. For the purposes of this class, we will define a numeral as a sequence of digits (symbols).

Binary	Decimal	Hex
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

Number Bases

If we have an n-digit numeral $d_{n-1}d_{n-2} \ldots d_0$ in base b, then the value of that numeral is $\sum_{i=0}^{n-1} \boldsymbol{d_i\, b^i}$, which is just fancy notation to say that instead of a 10's or 100's place we have a b's or b^2's place.

The most common bases we will use in this class are 2, 10, and 16, which are called binary, decimal, and hexadecimal (or hex), respectively. In base b, each digit d_i can only be one of b fixed symbols (0-1 for binary, 0-9 for decimal, etc.).

The table on the right shows the equivalent numerals for the numbers 0 through 15 in these three major number bases. We differentiate between these bases by using the prefix '`0b`' for binary and '`0x`' for hexadecimal.

Exercises:

1. Complete the table below by converting the numbers into the other two common bases. You may leave the "Decimal" column unsimplified.

Binary	Decimal	Hexadecimal
0b10010011	$2^7 + 2^4 + 2^1 + 2^0 = 147$	0x93
0b10110	$1\times16^1 + 6\times16^0 = 22$	0x16
0b111111	63	0x3F
0b100100	$2^5 + 2^2 = 36$	0x24
0b110000110000	$12\times16^2 + 3\times16^1 = 3120$	0xC30
0b0	0	0x0
0b101110101101	$11\times16^2 + 10\times16^1 + 13\times16^0 = 2989$	0xBAD
0b110110101	437	0x1B5

Setting Up Your System

You have four options for your working environment:

1) CSE Labs: Log in locally to one of the *Linux* machines in CSE 002, 003, or 006 (must have a CSE account)
2) Remote access: Log in remotely to `attu.cs.washington.edu` (CSE account)
3) Install the CSE VM: https://www.cs.washington.edu/lab/software/linuxhomevm
4) Personal computer: Must be running a Linux distribution (e.g. Ubuntu, Fedora, CentOS)

You will need the following tools for the rest of the course, so make sure you know how to access/use them (already installed on `attu` and the VM) and start to get familiar with them:

- Text Editor (personal preference)
  - Try many, pick one! Some tutorials can be found on the course website.
  - Command-line: `nano`, `vim`, `emacs`
  - Graphical: `gedit`, `emacs`
- GNU Compiler Collection (`gcc`)
  - Example: `gcc -Wall -g -std=c99 -o execName sourceCode.c`
    - `-W` sets warnings
    - `-g` turns on debugging symbols
    - `-std` sets what version of C we are using
    - `-o` sets the name of the resulting executable
- GNU Project Debugger (`gdb`)
  - Command-line debugger that we will use heavily later in the course

Code Examples:

1) Download `HelloWorld.c` from the class webpage:
```
$ wget https://courses.cs.washington.edu/courses/cse351/19sp/sections/01/code/HelloWorld.c
```
2) Open the file in your favorite text editor and read the comments
3) Compile the file to the executable `hello`: `$ gcc -o hello HelloWorld.c`
4) Run the program: `$ ./hello`

5) Download calculator.c from the class webpage:
```
$ wget https://courses.cs.washington.edu/courses/cse351/19sp/sections/01/code/calculator.c
```
6) Read through the code in a text editor, then compile and run the program
7) Example usage: `$ ./calculator 4 5 +`

printf

Used to print to the console. Unfortunately, you can't concatenate String variables like you can in Java.

You provide a format string as the first argument, which includes placeholders to print out variables:

- `%d` for signed int, `%u` for unsigned int, `%f` for float, `%s` for "string", `%x` for hexadecimal, `%p` for pointer
- Examples:
  - `printf("I am %d years old", 20)` prints "I am 20 years old"
  - `printf("My name is %s", "Alfian")` prints "My name is Alfian"
  - `printf("%d in hex is %x", 2827, 2827)` prints "2827 in hex is 0xb0b"