Lab 1 Number Systems

I. Lab Environment

- Need a cardkey to access the lab and the building. The cardkey can be purchased from the bookstore for a non-refundable $10 fee or from a friend. Email engrcard@engr.uvic.ca for cardkey related problems by sending your student number and the card number.
- Use your netlink ID and password to log in. Email itsupport@csc.uvic.ca if you have difficulties to log on to the machines or to print documents in the labs.
- ECS 249 is the only lab with the hardware and software provided for this course. Suggest you start your assignments early.
- **"H"** drive is your network space in the CSC file server. Store all your work in H drive and keep a back up copy using other portable devices (such as a flash memory). Files stored in the C drive might be erased over night.
- For printing, once you send your printing job, use the printers outside the lab. There are two printers: one on the 2nd floor, and another one on the 3rd floor, in the study areas. Log in using your netlink ID and password, if you have credit on your One-Card, you can release your work. Otherwise, you need to add credit to your student card.

II. Number Systems

In the computer system, we need to know how many bits (storage space) are used. For example, let's count the number of students in the lab. In decimal number system, we just need two digits. In binary number system, how many bits do we need? Let's do counting up in decimal, binary and hexadecimal. Here is the conversion table:

Decimal (2 digits)	Binary (5 bits)	Hexadecimal (2 digits)
0	0b**00000**	0x**00**
1	0b**00001**	0x**01**
2	0b**00010**	0x**02**
3	0b**00011**	0x**03**
4	0b**00100**	0x**04**
5	0b**00101**	0x**05**
6	0b**00110**	0x**06**
7	0b**00111**	0x**07**
8	0b**01000**	0x**08**
9	0b**01001**	0x**09**
10	0b**01010**	0x0**A**
11	0b**01011**	0x0**B**
12	0b**01100**	0x0**C**
13	0b**01101**	0x0**D**
14	0b**01110**	0x0**E**
15	0b**01111**	0x0**F**
16	0b10000	0x10
17	0b10001	0x11
18	0b10010	0x12
19	0b10011	0x13
20	0b10100	0x14

III. Exercises

1. What is the minimum number of bits used for our lab? Why?
2. How many different values can be represented by 6 bits?
3. There are 56 students registered in CSC 230, what is the minimum number of bits needed to represent this number in binary (assume it is an unsigned number)?
4. Convert the following numbers assuming the binary and hexadecimal numbers are unsigend:
    a. 0b1001101 to decimal
    b. 63 to binary
    c. 27 to binary
    d. 323 to binary
    e. 1012 to binary
    f. 1012 to octal
    g. 0x1E to decimal:
    h. 0x1E to octal:
    i. 0x66 to decimal:
    j. 0x1F5 to decimal
    k. 0x1170 to decimal
    l. 39 to hexadecimal
    m. 51 to hexadecimal
    n. 158 to hexadecimal
    o. 1032 to hexadecimal

5. Convert negative integer numbers using 2's complement notation
    a. -63 to binary and then to Hex
    b. -45 to binary and then to Octal
    c. -13 to binary
    d. 0b101011 to decimal
    e. 0b10110 to decimal
    f. 0b001110 to decimal
    g. 0b110100 to decimal

6. What are the minimum and maximum values represented by a 4-bit binary number: a) as an unsigned number? b) as a 2's complement number? How about 8 bits, 16 bits, k bits?
7. What is the result of bit-wise AND operation of: 0b10110010 with 0b11110000?
8. What is the result of logical Shift-Left operation on 0b01011100? What will the result of logical Shift-right be? (For more information, refer to https://en.wikibooks.org/wiki/Microprocessor_Design/Shift_and_Rotate_Blocks)
9. What is the result when bit-wise XOR and mask of 0b11111111 are applied on byte 0b10110100?
10. What is the mask to be used if we want to clear bits 2, 3, 5 and 7 of a byte? For example, clear bit 3 means set the bit at position 2^3 to zero, if the binary number is 0b1001,1101, after clearing bit 3, the binary number will be 0b10010101. If the mask is 0b1111 01111, any binary number "AND" with the mask will set the bit 3 to zero and the bits at other positions will not be changed.