BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI (RAJ.)

Second Semester 2017-18 CS F111 Computer Programming

LABORATORY SESSION #3

(Number Systems)

Last week in the lectures, you have learned about number systems and representation of data inside a computer. In this week's lab, you will do some study and solve some exercises to solidify your understanding. As part of question #3, you'd have to log into the *Prithvi* server.

But first, as a quick refresher, read the first four sections of the tutorial provided at this link:
https://www3.ntu.edu.sg/home/ehchua/programming/java/DataRepresentation.html

1. Convert each of the following three decimal numbers in binary using (a) 1's complement form, and (b) 2's complement form using minimum number of bits and 16-bit representation: (i) –95 (ii) 64 (iii) –64

You can check your answers by using these web-based calculators:
http://www.convertforfree.com/ones-complement-calculator/
http://www.convertforfree.com/twos-complement-calculator/

Now try converting to sign magnitude form. Just notice how different the representations can be!

2. As you know, the IEEE-754 is a standard for representing floating point numbers.

(a) Compute the 32-bit binary representation of –16.375. You may verify your answer here:
https://www.h-schmidt.net/FloatConverter/IEEE754.html
Is it matching with yours?

(b) Now play around with the tool a bit. You can check on the individual bits of exponent and mantissa to find out what the underlying numbers could be. In particular, write down what entities are being represented when:

(i) All bits of the biased exponent and mantissa are off:

(ii) All bits of the biased exponent are on, but none of the mantissa are:

(iii) All bits of the exponent on, and some bits of the mantissa are on:

3. A bit pattern stored in computer memory is interpreted differently depending on the context. Consider the 32 bits abbreviated by the hexadecimal notation 0xC0000000. (Hint: Expand the 8-digit hexa notation into 32-bits binary notation before proceeding.)

a. If this 32-bit entity represented an unsigned integer, what value would it represent?

b. Now, if this 32-bit entity represented a signed integer in 1's complement form, what value would it represent? Work it out in your lab notebook to arrive at the answer.

c. Instead, if this 32-bit entity represented a signed integer in 2's complement form, what value would it stand for? Write down all steps in your calculations.

d. Finally, if these 32 bits represented a floating-point number (that used the IEEE-754 format), what value is stored at the memory location? Show the steps.

Now copy the executable file `/home/share/verify_repr` into your current directory and then run it by typing the following command at the dollar prompt: `./verify_repr`

Are the answers matching?