University of Windsor
Faculty of Science
School of Computer Science

COMP-2650
Computer Architecture I: Digital Design
Winter 2022

Lec#	Date	Title	Due Date	Grade Release Date
Lec02	Week 02	**Number Systems**	Feb. 02, 2022, Wednesday 4 AM EDT	Feb. 07, 2022

The objectives of the lecture (weekly) assignments are to practice on topics covered in the lectures as well as improving the student's critical thinking and problem-solving skills in ad hoc topics that are closely related but not covered in the lectures. Lecture assignments also help students with research skills, including the ability to access, retrieve, and evaluate information (information literacy).

Lecture Assignments Deliverables

You should answer 2 of the below questions based on your preference using an editor like MS Word, Notepad, and the likes or pen in papers. In the latter case, you have to write and scan the papers clearly and merge them into a single file. In the end, you have to submit all your answers in one single pdf file `lec02_UWinID.pdf` containing the question ids for the answer. *Please note that if your answers cannot be read, you will lose marks.* Please follow the naming convention as you lose marks otherwise. Instead of `UWinID`, use your own UWindsor account name, e.g., mine is hfani@uwindsor.ca, so my submission would be: `lec02_hfani.pdf`

Lecture Assignments
(select only 2 questions based on your preference)

1. Convert the following numbers to the required bases. Show the steps and the error in conversion with 6 fraction positions compared to when using 15 fraction positions.

   a. $(140.23)_5 \simeq (?)_2$
   b. $(F.6A)_{16} \simeq (?)_7$

2. Determine the base of the numbers in each case for the following operations to be correct.

   a. $14 / 2 = 5$
   b. $56 / 4 = 15$

3. A binary number $(N)_2$ can be converted to any radix number system $r = 2^n$ by partitioning the binary number into groups of n digits each, starting from the binary point to the left for the integer part and to the right for the fraction part. For instance,

   $(10\ 10\ 11\ .\ 11\ 11\ 00)_2 = (223.330)_{4=2^2}$
   $(101\ 011\ .\ 111\ 100)_2 = (53.74)_{8=2^3}$

   Prove it for $r = 4 = 2^2$.

4. Conversion from the radix number system $r = 2^n$ to binary system can be done by reversing the preceding procedure in the assignment (3). For instance, each octal ($r=2^3$) digit is converted to its 3-digit binary equivalent. Similarly, each hexadecimal ($r = 2^4$) digit is converted to its 4-digit binary equivalent. E.g.,

   $(53.74)_8 = (101\ 011\ .\ 111\ 100)_2$
   $(F3.A1)_{16} = (1111\ 0011\ .1010\ 0001)_2$

   Convert the following numbers to binary by the procedure explained:

   a. $(5F.A2)_{16}$
   b. $(213.32)_4$

5. Obtain the 1's and 2's complements of the following binary numbers by showing the steps:

   a. 10010000
   b. 00000000
   c. 11111111

6. Find the 8's and the 9's complement of the following base-9 numbers by showing the steps:

   a. 25,478,036
   b. 00,000,000

7. Given the magnitude of two numbers 01001 and 101, do the following arithmetic in signed-magnitude and signed-2's-complement form by showing the steps.

   a. $(+01001) + (+101)$
   b. $(-01001) - (+101)$

8. Given m is the number of positions for fraction part of a number in radix-r, prove that the maximum fraction number is equal to $(1 - \frac{1}{r^m})_{10}$ in the decimal system. For instance, given $m=3$, and $r=4$, the maximum fraction number is $(0.333)_4$, which is equal to $(1 - \frac{1}{4^3})_{10} = (0.984375)_{10}$.