Final Exam (April 28, 2015)

Materials:

Topics A to F:
http://www.eecs.yorku.ca/course_archive/2014-15/W/1520R/Topics.html

Textbook: Ch. 1, 2, 3, 4, 5, 10, 11.1, 11.2, 12.3, 15.1, 15.2, 15.3, 16.1, 16.2

Glade Manual: Ch. 1 - 9

Review on Number Systems

1. To convert from a decimal number (Base 10) to other bases

Step 1: Always divide the decimal number by the new base, write down the quotient and the reminder

Step 2: Divide the quotient by the new base, write down the new quotient and the new reminder

Step 3: Keep repeating step 2 until quotient is 0

2. To convert from Binary to Octal

Step 1: group bits into threes, right to left

Step 2: convert each such group to an octal digit

Ex: what is the Octal representation of 1011010010 ?

Ans: 001 011 010 010 ⇐ Base 2

1 3 2 2 ⇐ Base 8 (Octal representation)

Review on Number Systems

3. To convert from binary to Hexadecimal

Step 1: group bits into fours, right to left
Step 2: convert each such group to a hexadecimal digit

Ex: what is the Hexadecimal representation of 1011010010 ?

Ans:

0010	1101	0010	⇐	Base 2
2	D	2	⇐	Base 16 (Hexadecimal representation)

Review on Number Systems

4. To convert from Octal to Binary

convert each octal digit to a three-bit binary representation

Ex: what is the Binary representation of 745 (Octal) ?

Ans: 7 4 5 ← Base 8 (Octal representation)

111 100 101 ← Base 2

Hence, 745 in octal is 111100101 in binary

5. To convert from Hexadecimal to Binary

convert each Hexadecimal digit to a four-bit binary representation

Ex: what is the Binary representation of 745 (Hexadecimal) ?

Ans: 745 in hexadecimal is 011101000101 in binary

Review on Number Systems

6. To convert from Octal to Hexadecimal

Convert Octal to Binary first and then convert from Binary to Hexadecimal

Ex: Convert 53 (Octal) to Hexadecimal

Ans: 5 3 ⬅ Base 8 (Octal representation)

101 011 ⬅ Base 2

Group the binary digits in groups of 4:

0010 1011 ⬅ Base 2

2 B ⬅ Base 16 (Hexadecimal representation)

Hence, 53 in octal is equivalent to 2B in hexadecimal

Review on Number Systems

7. To convert from Hexadecimal to Octal

Convert Hexadecimal to Binary first and then convert from Binary to Octal

Ex: Convert 53 (Hexadecimal) to Octal

Ans: 5 3 ← Base 16 (Hexadecimal representation)

0101 0011 ← Base 2

Group the binary digits in groups of 3:

001 010 011 ← Base 2

1 2 3 ← Base 8 (Decimal representation)

Hence, 53 in hexadecimal is equivalent to 123 in octal

Review on Number Systems

8. To convert from any bases to decimal (base 10)

Use the following equation (n = number of digits, B = original base, d_i = digit in the i^{th} position in the number) :

$$d_n*B^{n-1} + d_{n-1}*B^{n-2} + \ldots + d_2*B^1 + d_1$$

Ex: Convert 53 (Hexadecimal) to decimal

Ans: $5*16^1 + 3*16^0 = 80 + 3 = 83$

Ex: Convert 53 (Octal) to decimal

Ans: $5*8^1 + 3*8^0 = 40 + 3 = 43$

Review on Number Systems

Show how the pattern 10111000 translates using each of the following interpretations

Two's complement:

8-bit normalized floating point:

Review on Number Systems

Two's complement: invert all the bits and add 1 to find the original magnitude of the decimal number

```
  10111000

  01000111   ⇐ Inverted bits
+        1   ⇐ Add 1
----------
  01001000
```

01001000 corresponds to decimal 72

Hence, 10111000 corresponds to decimal -72

Review on Number Systems

Floating point: 8-bit floating-point format is 1 bit for sign, 3 bits for exponent, 4 bits for mantissa

1 011 1000

Sign bit — exponent — mantissa

011 in decimal is 3, have to subtract 4 based on excess-4 notation, so 3 - 4 = -1

Hence, the format is: -0.1000×2^{-1}

-0.01000×2^{0} ← Shift the radix point to the left so that the format is expressed in terms of 2^{0}

$= -0.01$ ← Still in base 2

Hence, -0.01 in base 2 is -1/4 or -0.25 in decimal