Lab Week 3 (Monday)

Binary, Octal, Hexa Conversions

Decimal Number system? 0 – 9 (the system we usually work with)
We are allowed numbers – 0 -> 9 with (1, 10's, 100's, 10000's place)
1234 = 1(1000) + 2(100) +3(10) + 4(1)

Here the way it works is we count up to say 9, once we hit 9, if we wish to go further, we increment to the left and reset 9 to 0.
9 -> 10 … just like 99 -> 100…

Binary Number system – 0 and 1 (2 base)

- 100, 11, 1, 101 (these are example numbers)

  Converting the above to decimal usually works in the following manner:
  _(2^n-1) + …. + _(2^0)

  For 100 -> n = 3
  1(2^2) + 0(2^1) + 0(2^0) = 4

  As Nathaniel said 11 = 3
  1(2^1) + 1(2^0) = 3

Octal Numbering system – 0 – 7 (8 base)

Our numbers look like -> 12436760, 11, 10, 27, ….

Hexadecimal Numbering system – Numbers and letters which give it up 16 characters (16 base)

a. 0 – 9 and A – F
   A = 10, B = 11, C = 12, D = 13, E = 14, F = 15
   Examples: A8F210, FFFFF1, D65EF

To differentiate between bases, we usually add a subscript

$(101)_2$ $(101)_8$ $(101)_{16}$ 101

Convert the following into decimal:

$(10101)_2$

1(2^4) + 0(2^3) + 1(2^2) + 0(2^1) + 1(2^0) = 16 + 0 + 4 + 0 + 1 = 21

$(3246)_8$

3(8^3) + 2(8^2) + 4(8^1) + 6(8^0) = 1702 (double check)

$(AD2)_{16}$

10(16^2) + 13(16^1) + 2(16^0) = 2560 + 208 + 2 = …

Converting from decimal to base x, here x can be any number

For example, in the binary case:

Convert 19 into binary:
Take this as long division. First step, divide 19 by 2 → 9 remainder 1
We carry our 9 down to the next division. Which yields → 4 remainder 1… We keep repeating this process until our remainder is our dividend.

2 | 19 → 9, R = 1
2 | 9 → 4, R = 1
2 | 4 → 2, R = 0
2 | 2 → 2, R = 0
2 | 1 → R = 1

Conversion comes in the following manner: READ THE REMAINDER FROM BOTTOM TO TOP
Can double check that $(10011)_2$ is = 19

1(2^4) + 0 (2^3) + 0 (2^2) + 1(2^1) + 1(2^0) = 16 + 2 + 1 = 19

Try this: 1293 into hexadecimal

16 | 1293 → 80, R = 13
16 | 80 → 5, R = 0
16 | 5 → 0, R = 5

We can check that our number in hexadecimal is $(50D)_{16}$

Convert 1204 to base 7:

7 | 1204 → 172, R = 0
7 | 172 → 24, R = 4
7 | 24 → 3, R = 3
7 | 3 → 0, R = 3

We can check that our 7 base is $(3340)_7$

To convert from binary to hexa or oct we will group our binary into 4 or 3 digits respectively

Convert $(110\ 110\ 101)_2$ into hexa and oct

0001 1011 0101 (convert each 4 pair into decimal) → 1 11 5 → $(1B5)_{16}$

110 110 101 (convert each 3 pair into decimal) → 6 6 5 → $(665)_8$

Converting from Hexadecimal or octa into binary:

For example $(ABC)_{16}$ to binary, then we would do the following:

A = 10 → 1010
B = 11 → 1011
C = 13 → 1100

Add them together from left to right: $(ABC)_{16}$ = $(1010\ 1011\ 1100)_2$

Convert $(123)_8$ to binary:

1 = 1 → 001
2 = 2 → 010
3 = 3 → 011
Add them together from left to right: $(123)_8$ = $(001\ 010\ 011)_2 = (1010011)_2$