CS 238 - ASSEMBLY LANGUAGE FOR ENGINEERS

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Grading Policy

- Office Hours
- Text Book
- Assignments
- Exams
- Grades

Pre-Requisites

- Numbering system.
- Fundamental knowledge about programming languages.
- Computer Hardware.
- Digital Logic.
- Creativity (Think outside the box)
- Common sense

There are 10 types of people in this world; those who understand binary and other who doesn't.

Chapter 1

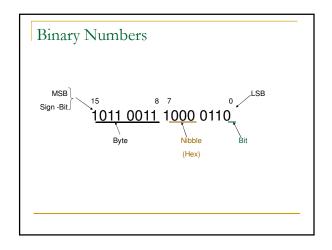
Data Representation

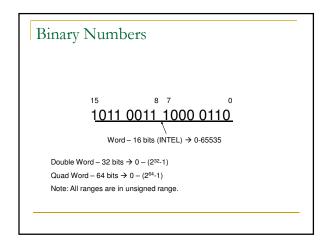
CS238 – Assembly Language Programming Amarnath Jasti

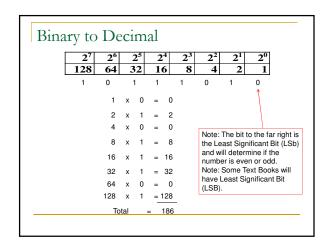
Review

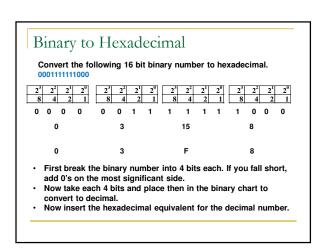
- Why assembly is needed?
- Computer system
- Assembly Language definition:
 - Machine specific programming language with a one-to-one correspondence between the statements and the computers native machine language and is specific to the processor or processor family
 - Note: Instructions in assembly are designed to match a computers machine instruction set and hardware architecture.

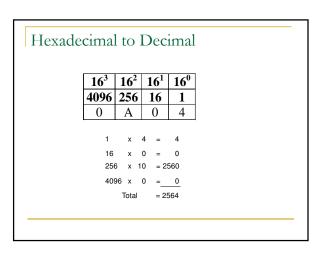
Base Index Decimal - 10 - 0 1 2 3 4 5 6 7 8 9 Binary - 2 - 0 1 Octal - 8 - 0 1 2 3 4 5 6 7 Hexadecimal - 16 - 0 1 2 3 4 5 6 7 8 9 A B C D E F











Number Types

- Signed (MSB= 0 '+'ve, MSB= 1- '-'ve)
- Unsigned
- Conversions
 - Unsigned Decimal to Binary and vice-versa
 - Unsigned Decimal to Hex and vice-versa
 - □ Signed Decimal to Binary and vice-versa
 - Signed Decimal to Hex and vice-versa

Unsigned Integers

- Represents positive integers only
- Example: ASCII character codes
- Not necessary to indicate a sign, so all 8 or 16 bits can be used for the magnitude:
 - \Box 1 byte = 8 bits = 2^8 = 256 (0 to 255)
 - \Box 2 bytes = 16 bits = 2^{16} = 65,536 (0 to 65,535)
 - $4 bytes = 32 bits = 2^{32}$
 - = 4,294,967,296 (0 to 4,294,967,295)

Signed Integers

- Represents positive and negative integers
- MSB (Most Significant Bit leftmost bit) used to indicate sign
 - \bigcirc 0 = positive, 1 = negative
- One less bit is used for the magnitude, with one extra negative value
 - \Box 1 byte = 8-1 bits = 2^7 (-128 to +127)
 - \Box 2 bytes = 16-1 bits = 2^{15} (-32,768 to +32,767)
 - a 4 bytes = 32-1 bits = 2^{31} (-2,147,483,648 to +2,147,483,647)

1's & 2's Complement

- 1's complement form
 - □ Formed by reversing (complementing) each bit
- 2's complement form
 - □ Formed by adding 1 to 1's complement
 - Negative numbers are stored this way
 - Additive inverse of a number
 - Computer never has to subtract
 - A B = A + (-B)

Decimal Conversion

- Unsigned Integers
 - Convert binary directly to decimal form
- Signed Integers
 - □ If MSB = 0, convert directly to decimal
 - □ If MSB = 1, convert to 2's complement form (reverse the bits & add 1), then to decimal form

2's compliment (Signed Decimal Conversion)

- 01001101₂ = 77₁₀
 - □ The most significant bit is 0, so it's a positive value.
- What is the binary value of -77₁₀?
- To convert to -77 in two's-complement notation,
 - Consider the absolute value
 - One's Compliment: Inverse the bits; 0 becomes 1, and 1 becomes 0
- Add 1 to the result.
- Result is the equivalent binary value of signed integer.
- Absolute Value → |-77| = 77 = 0100 1101
- One's Compliment → 1011 0010
- Adding 1 \rightarrow 1011 0010 + 1 = **1011 0011** = -77₁₀

Binary Addition and Subtraction

- Addition: 1 + 1 = 10, 0 + 1 = 1
- Subtraction
 - Smaller number from a larger number
 - Determine 2's compliment of the smaller number
 - Add 2's compliment to the larger number
 Discard the final carry
 - Larger number from a smaller number
 - Determine the 2's compliment of the larger number
 - Add the 2's compliment to the smaller number.
 - There is no carry from the left most column. The result is in 2's compliment, and is negative.
 - Change the sign and take the 2's compliment to get the result.

 - Ex: 9-13 = -4
 1101 -> 0011; 0011 + 1001 = 1100 = [0100] Abs value.

Binary Coded Decimal - BCD

- BCD represents each of the digits of an unsigned decimal as the 4-bit binary equivalents.
- Unpacked BCD: Contains only one decimal digit per byte.
- Packed BCD: packs two decimal digits into a single byte.
- Ex: 8 0000 1000, 0000 1000
- 10 − 0000 0001 0000 0000, 0001 0000

Reading assignment

- Section 1.3
- Section 1.4
- External Links posted on Blackboard.