Contents

Contributors:

- Daniel Fitz (Sanchez)

0.1 Assessment

- Online Quizzes (10% = Best 10 $\times$ 1%)
  Due Mondays at 8am
- Mid-semester exam (10% or 20%)
  Saturday (centrally scheduled - sometime week 5 to 7)
  Multiple-choice, open-book
- Prac Exam (Pass/Fail)
  Held during Monday/Wednesday Learning Lab sessions in week 6
  You must pass in order to pass the course
- Project (20%)
  Develop a microcontroller program
- Final Exam (50% or 60%)
  Short answer, problem solving, open-book

Chapter 1

Lecture Notes

1.1 Bits, Bytes and Binary

1.1.1 Structured Computer Organization

Level 5: Problem-oriented language level
Level 4: Assembly language level
Level 3: Operating system machine level
Level 2: Instruction set architecture level
Level 1: Microarchitecture level
Level 0: Digital Logic level

1.1.2 Unsigned Number in Binary

Each bit position has a value $\rightarrow$ 2^n (starting at zero). Add all values of the positions together and that's unsigned value.

1.1.3 Converting Decimal to Binary

- Method 1
  rewrite n as sum of powers of 2 (by repeatedly subtracting largest power of 2 not greater than n)
  Assemble binary number from 1's in bit positions corresponding to those powers of 2, 0's elsewhere
- Method 2
  Divide n by 2
  Remainder of division (0 or 1) is next bit
  Repeat with n = quotient

Note 1: Example

Convert 53 to binary

$$\frac{53}{2} = 26 \text{ rem } 1 \Rightarrow 1$$
$$\frac{26}{2} = 13 \text{ rem } 0 \Rightarrow 0$$
$$\frac{13}{2} = 6 \text{ rem } 1 \Rightarrow 1$$
$$\frac{6}{2} = 3 \text{ rem } 0 \Rightarrow 0$$
$$\frac{3}{2} = 1 \text{ rem } 1 \Rightarrow 1$$
$$\frac{1}{2} = 1 \text{ rem } 1 \Rightarrow 1$$

$\therefore 53 \equiv 0b110101$

1.1.4 Least and Most Significant Bits

Most Significant Bit (MSB): Bit that's worth the most, the left-most bit
Least Significant Bit (LSB): Bit that's worth the least, the right-most bit

Note 2: Radices

- **Radix:** number system base
- A radix-k number system
  k different symbols to represent digits 0 to $k-1$
  Value of each digit is (from the right) $k^0, k^1, k^2, k^3, \ldots$
- Often convenient to deal with
  Octal (radix-8) - Symbols: 0, 1, 2, 3, 4, 5, 6, 7
  One octal digit corresponds to 3 bits
  Hexadecimal (radix-16) - Symbols: 0, 1, 2, 3, 4, 5, 6, 7, 7, 8, 9, A, B, C, D, E, F
  One hexadecimal digit corresponds to 4 bits (useful)

Note 3: Radix Identification

- Hexadecimal
  Leading 0x (C, Atmel AVR)
  Trailing h (Some assembly languages)
  Leading $ (Atmel AVR Assembly)
- Octal
  Leading 0 (C, Atmel AVR)
  Trailing q (Some assembly languages)
  Leading @ (Some assembly languages)
- Binary
  Leading 0b (Atmel AVR Assembly, Some C)
  Trailing b (Some assembly languages)
  Leading % (some assembly languages)