Section 1

Introduction to Digital Systems
Number Systems
(Chapter 1)

Digital Systems

- What are they?
- Why study Digital Systems?

Popular Number Systems

- Binary (base 2)
  - Two possible values per digit
- Decimal (base 10)
  - Ten possible values per digit
- Hexadecimal (base 16)
  - Sixteen possible values per digit

Binary

- A digit has a value of 0 or 1.
- A natural fit for digital circuits
- Use multiple digits to represent a number larger than 1.

Bits, Bytes, and Prefixes

- A bit is a single digit
- A byte is a group of 8 bits
- Kilo-Byte – 2^{10} is the closest power of 2 to 1000. Just a little larger
- Mega-Byte – 2^{20}
- KB, MB, GB in digital systems are often used to represent size of RAM or size of address space. Devices that are based on a Power of 2.
- Disk drives use the standard meaning of KB, MB, etc. A disk drive is not a device based on the power of 2.

Binary to Decimal Conversion

- Multiply each bit by the weight of its position
- $1101_2 = 1*2^3 + 1*2^2 + 0*2^1 + 1*2^0 = 13_{10}$

Binary to Hexadecimal

- One hexadecimal digit is equivalent to 4 binary bits.
- A hexadecimal digit can have a value of 0 through 9 or A through F.
- Use the binary to hexadecimal table.
- Group binary number into groups of 4.
- Convert each group of 4 into a hexadecimal digit

General Radix Conversion

- 1. Divide number by new radix.
- 2. Record the remainder.
- 3. Multiply the remainder by the new radix.
- 4. Record the multiplied remainder as the next most significant digit.
- 5. If quotient of divided number is 0 you are done else use the quotient as the number and go to step 1.

Popular Codes

- ASCII (American Standard Code for Information Interchange) – Used to represent letters and symbols.
- Gray Code – A binary sequence where only one bit in the word changes as the value is incremented by 1.
- Binary Coded Decimal – A 4-bit word is used to represent a decimal number. Extra possible values for the 4-bit number are invalid.

Microprocessors Vs. Digital Circuits

- Microprocessors
  - A software solution
  - Slower, larger circuit, more power
- Digital Circuits
  - Faster, smaller circuit, less power
- Combination of both
  - Best of both