Chapter 4: Arithmetic

Draft Notes

- ❑ Truncation occurs in unchecked binary adding and subtracting.
- ❑ Bit shifting is a fast way to multiply and divide binary numbers in powers of two (2).
- ❑ Overflow occurs when the calculated result will not fit in the destination storage unit.
- ❑ Show calculations for two's compliment signed integers. Have exercises for such.
- ❑ More details on floating point.

Required Knowledge

- ❑ Basic mathematics, Algebra helpful.
- ❑ Familiarity with the parts of a computer and how they work as explained in Chapter 1: Computers and Programming.
- ❑ Familiarity with binary and hexadecimal numbering systems, as explained in Chapter 2: Numbering Systems.
- ❑ Familiarity with binary-based systems Floating-Point, Fixed-Point, and BCD as explained in Chapter 3: Digital Storage.

Introduction

Various numbering systems and encodings based on binary can be used to represent numeric amounts. There is however, one more facet of this to explore. How are calculations performed between these various systems? This chapter attempts to explain that and give you an insightful look into the brain of a computer. Feel free to skip this chapter if you want to avoid the pain of dealing with more numbers and mathematics! While the previous chapters required minimal brainwork, this one will test and stress you.

IEC 559 Floats

This section explains the IEC 559 binary formats for floating-point values in both sizes: 32-bits and 64-bits.

Hex Arithmetic

Being the median between decimal, which you should already know, and binary, which you should be starting to understand, I'll begin by explaining basic arithmetic with hex.

Binary Arithmetic

This focuses on the arithmetic of binary *integers*.

Floating-Point Arithmetic

Situations requiring manual calculations of floating-point, specifically the IEEE 742 types, are rare, but are provided here anyway.

Fixed-Point Arithmetic

You may manually calculate out fixed-point arithmetic more than floating-point, but it will still be rare.

BCD Arithmetic

The arithmetic involved in BCD numbers is the same as that with decimal because each digit in BCD represents a decimal digit.

Summary

Tired?