

CS 135 Fall 2010. Team Assignment 1.

Discuss these questions in your team, and come with your observations/answers to class.

Ques.1: Number conversions.

- (a) Convert the binary number 01010101 to decimal.
- (b) Convert the decimal number 27 to an 8-bit unsigned binary representation.
- (c) Convert the 8-bit 2's complement binary number 11001110 to decimal.
- (d) Convert the decimal number -87 to an 8-bit 2's complement binary representation.
- (e) Convert the decimal number -87 to an 8-bit signed magnitude binary representation.
- (f) Convert the 8-bit unsigned binary number 11011101 to hexadecimal.
- (g) Convert the unsigned hexadecimal number 37 to unsigned 8-bit binary.
- (h) What is the result of adding 87 and 98 when they are represented in 8-bit 2's complement (and the result should also be in 8-bit 2's complement).

Ques.2: Consider the following 'shortcut' to computing the 2's complement of a number. Starting from the right, copy over the bits until and including the first 1. Flip/complement all bits to the left of the rightmost 1. Why does this work?

Ques. 3: Can you define the overflow conditions, when adding two 2's complement numbers, only in terms of the carry-in and carry-out of the sign bit ?

Ques.4: Base-k representation.

The Innovative Brain Manufacturing corporation (IBMC) has entered the computer industry and wishes to specialize in high cost low performance systems. Their innovation is based on the idea of implementing the entire CPU in Trinary (base 3) logic elements.

Their decision is based on some theoretical arguments in favor of the trinary system. In principle, the most efficient implementation should occur for base "e" (2.718281). However IBMC research could not figure out how to implement a base "e" AND gate, so they chose the closest integer (3) instead.

- (a) Consider the product, rw , where r is the radix and w is an arbitrary wordlength. Given a fixed $K=rw$, can we provide a mathematical proof that the size of the largest number capable of being represented is maximized for $r=e$?
- (b) Is the trinary system best in this regard (i.e., when $K=rw$ is fixed) when compared with other radices between 2 and 6 ?
- (c) How can we define the logic functions OR and AND in the trinary system ?

Ques.5: Floating Point.

- (a) Give an example of a number that has a 32-bit floating point representation (as in Figure 2.2 in the textbook) and cannot be represented as a 32-bit 2's complement integer. Explain why this number cannot be represented as an integer.
- (b) Give an example of a number that can be represented as a 32-bit 2's complement integer but cannot be represented exactly as a 32-bit floating point. Explain why this number cannot be represented as a floating point.