

Overflow Detector

Lab L04

Introduction

In order to obtain a correct answer when adding and subtracting, we must ensure that the result has a sufficient number of bits to accommodate the sum. If we start with two n-bit numbers, and the sum occupies n+1 bits, we say that an overflow occurs. Overflow is a problem in computers because the number of bits that hold a number is fixed, and a result that exceeds the number of bits cannot be accommodated. For this reason, computers detect and can signal the occurrence of an overflow.

With signed numbers, an overflow cannot occur for an addition if one number is positive and the other is negative: Adding a positive number to a negative number produces a result whose magnitude is equal to or smaller than the larger of the original numbers. An overflow may occur if the two numbers added are both positive or both negative. Example:

$$\begin{array}{r} 01000 \text{ (8)} \\ +01001 \text{ (9)} \\ \hline 10001 \text{ (-15)} \end{array} \qquad \begin{array}{r} 11000 \text{ (-8)} \\ +10111 \text{ (-9)} \\ \hline 01111 \text{ (+15)} \end{array}$$

An overflow condition can be detected by observing the carry into the sign bit position and the carry out of the sign bit position. If these two carries are not equal, an overflow has occurred.

Design

Add the required components to the circuit you implemented for lab 2 (the 4-bit 2's complement adder/subtractor circuit) to check for an **overflow**. One of the components you need to add is an overflow indicator **V**. If the add/subtract operation results in an overflow the indicator **V** becomes **1**, otherwise **v = 0**.

Submitting Results

1. Perform the following arithmetic operations using your adder - subtractor circuit and verify that the added overflow detector work fine:

$$(i) \mathbf{0011 + 0101} \qquad (ii) \mathbf{1101 + 1110} \qquad (iii) \mathbf{0111 + 1001}$$

2. All macros are to be submitted with your assignment. Please make sure that each macro includes your name, date and assignment number. Also that they are named correctly ie: LastnameF_L04x (Where Lastname is your last name, F is your first initial and x is a unique letter [a-z] that you used to distinguish each macro.

Reference

- M. Mano and C. Kime: "Logic and Computer Design Fundamentals", Prentice Hall Publisher, 2000, ISBN: 0-13-012468-0.

