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CE6305-501

Homework1

1. Let there be two inter-stage signals,  and . Let each signal to indicate the carry,  by the following truth table.

|  |  |  |
| --- | --- | --- |
|  |  |  |
| 0 | 0 | 0 |
| 0 | 1 | -1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 ( or don’t care) |

The truth table is given as the following:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| 1 | 1 | 1 | -1 | 1 |
| 1 | 1 | 0 | -1 | 0 |
| 1 | 1 | -1 | 0 | 1 |
| 1 | 0 | 1 | -1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | -1 | 0 | 0 |
| 0 | 1 | 1 | -1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | -1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | -1 | 1 | 1 |

2. Proof by Case,

First case: when the number is non-negative(equivalently, when the sign bit  is 0).

By definition, the value of positive 2’s complement number is given by



Checking to see if  is equivalent to . Since ,

 becomes



Also,

 becomes



Thus  when 

Second case: when the number is negative (equivalently, when the sign bit  is 1)

By definition, the value of negative 2’s complement number is given by

.

Since ,  becomes,



Also,  becomes,



Thus  when .

Since  covers both cases, which are exhausts all numbers represented in 2’s complement,  does represents the value of a number in 2’s complement.

3. When , which is of k-bit 2’s complement number, is to be extended into 2k bits,

1) leave the lowest k-1 bits () as-is

2) pad upper k+1 according to bit k-1 ().

a) if then pad all upper bits () to 0

b) if then pad all upper bits () to 1

4. With bits, we can represent up to  numbers. If we need to balance the negative and positive ranges as much as we can, we should have  numbers for both positive and negative numbers. So we want to have the lowest value possible to be  and the highest . For easy conversion of values to representation and vice versa, we set the bias ***B* to be *2k-1*** so that the lowest value possible can be represented by bits of 0. For arithmetic operations, we have to apply trick here.

a) for addition:

Let X and Y be the bias representation of numbers and x and y be the actual values. Then the real values for each number are X-*B*, Y-*B*, respectively. However, whereas what we need is

,

has value of .

So, we need to subtract an extra  so .

b) for negation:

Let X be the bias representation of a number and x be the actual value (). If negation is to be required, we need 

Since negating X will only give us , we need to add 2 more bias value B. So,

