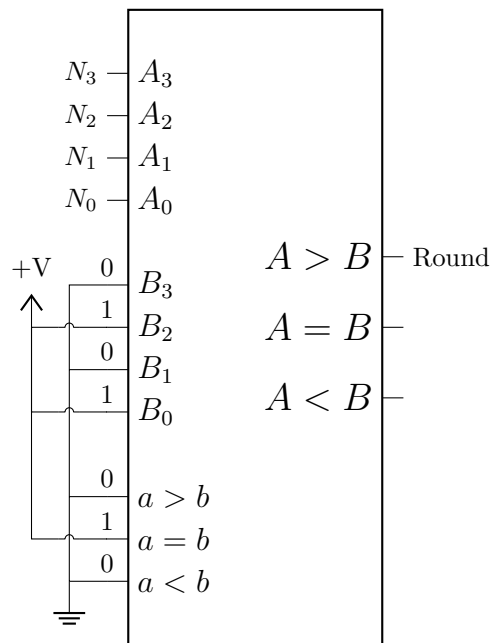# ECE 2300
# Digital Logic Design

# Homework 6

Choi Tim Antony Yung

April 7, 2020

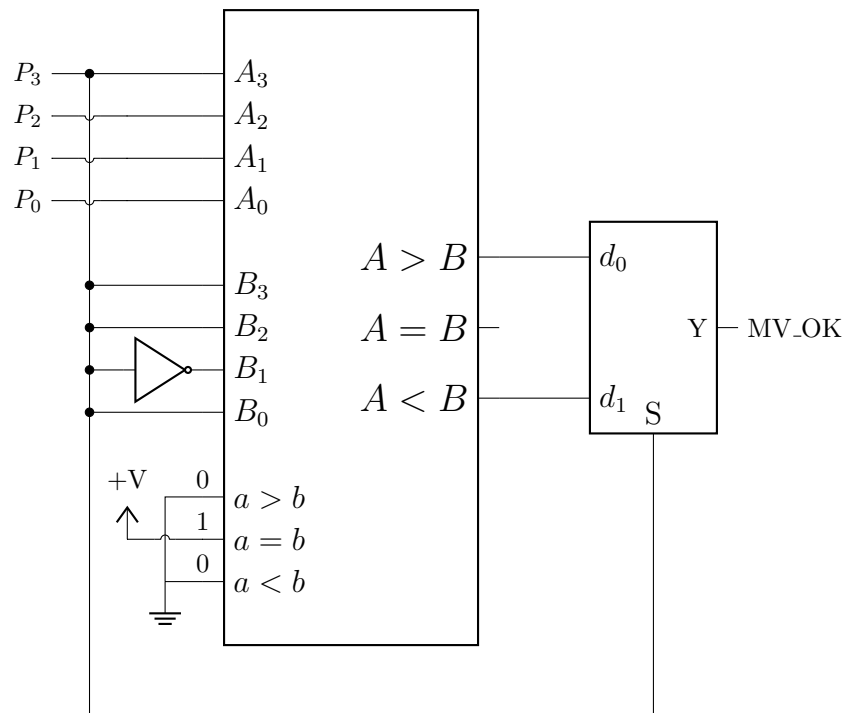# 1 Using a magnitude comparator, generate a logic one "Round" signal (to rounda number up by one) if the base 12 input, $N = N_3, N_2, N_1, N_0$, is six or higher. Let N connect to the comparator's A input.

$$Round = N > 5 = (N_3 N_2 N_1 N_0)_2 > (0101)_2$$

**2** **A simple mechanism moves between positions $P = (0000)_2$ and $P = (1111)_2$. Using a magnitude comparator, generate an enable signal, MV_OK,that is one if the position, P, is 12 or lower or if it is three or higher.**

| $P_3$ | | Thre | shold | | Relationship |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | P valid if greater than threshold |
| 1 | 1 | 1 | 0 | 1 | P valid if less than threshold |
| | $P_3$ | $P_3$ | $\overline{P_3}$ | $P_3$ | |

$P_3$ — $A_3$

$P_2$ — $A_2$

$P_1$ — $A_1$

$P_0$ — $A_0$

$B_3$

$B_2$    $A > B$ — $d_0$

$A = B$    Y — MV_OK

$B_1$

$B_0$    $A < B$ — $d_1$   S

+V    0   $a > b$

1   $a = b$

0   $a < b$

**3.a** Design a magnitude comparator to compare two 4-bit two's complement numbers, **X** and **Y**.
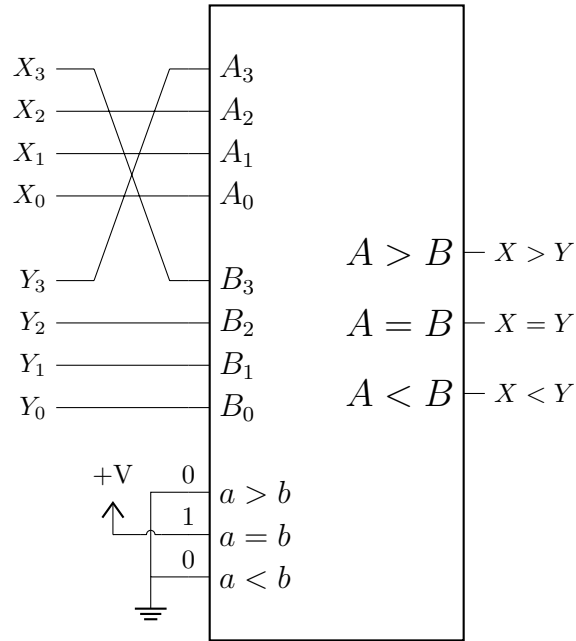


**3.b** Complete the following chartgiving the outputs for the corresponding inputs (the leftmost X and Y bits are the MSBs). Indicate whether the output is correct (i.e."OK") and give the true relationship of thesignedinputs.

| X (in) signed | | | | Y (in) signed | | | | A unsigned | | | | B unsigned | | | | $X > Y$ | $X = Y$ | $X < Y$ | OK (Signed Result) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | OK ($-4 < +5$) |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | OK ($-6 > -7$) |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | OK ($-8 < +5$) |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | OK ($-3 = -3$) |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | OK ($+3 > -5$) |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | OK ($-3 > -4$) |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | OK ($+7 > +5$) |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | OK ($+3 < +4$) |

## 4 Using magnitude comparators, create a circuit to compare two 8-bit unsigned numbers, X and Y. Let X connect to the comparator A inputs.



4
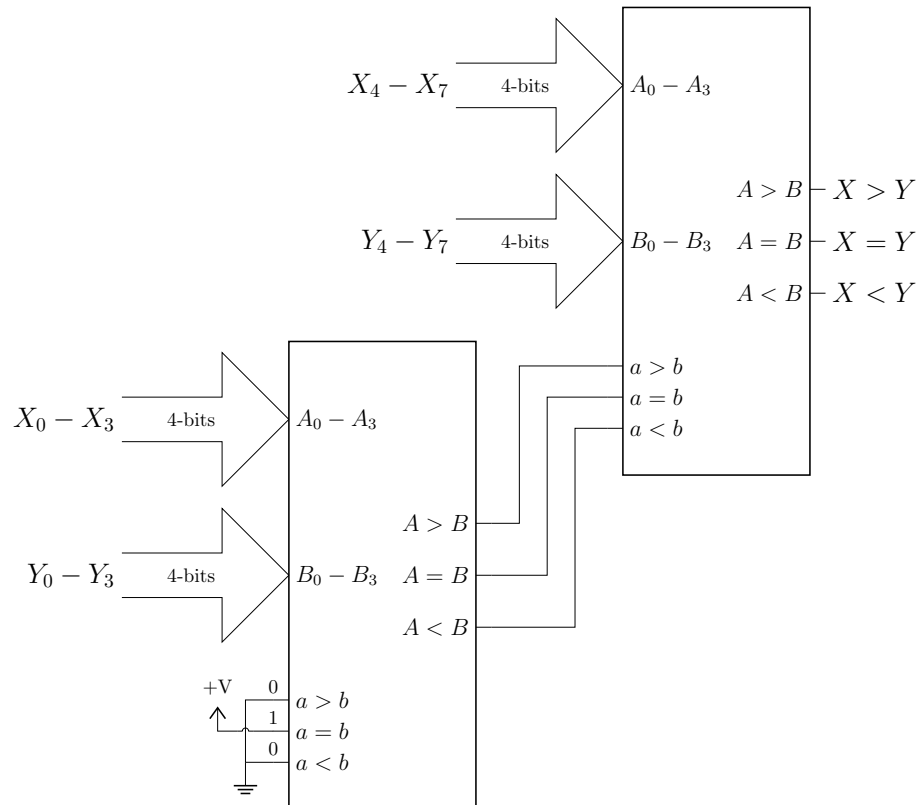
## 5   Using two 2:1 muxes and a magnitude comparator, design a circuit to compare 4-bit inputs X and Y as unsigned numbers when S=0 or as two's complement numbers when S=1.

$X_3$ $Y_3$

| $d_0$ |
| $d_1$   Y |
| S |

$X_2$ — $A_3$
$X_1$ — $A_2$
$X_0$ — $A_1$
$A_0$

| $d_0$ |
| $d_1$   Y |
| S |

$Y_2$ — $B_3$
$Y_1$ — $B_2$
$Y_0$ — $B_1$
$B_0$

$A > B$ — $X > Y$

$A = B$ — $X = Y$

$A < B$ — $X < Y$

+V     0   $a > b$
        1   $a = b$
        0   $a < b$