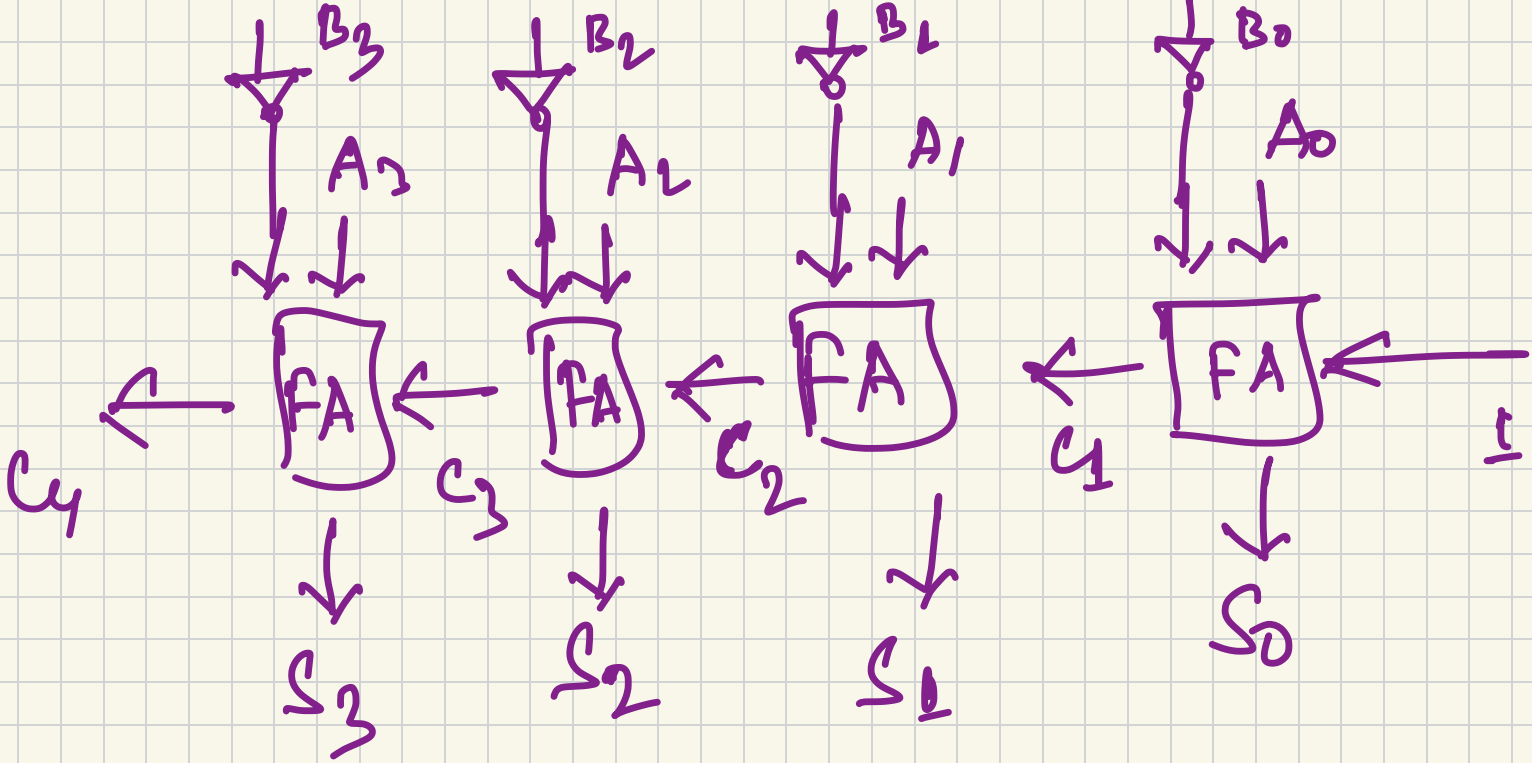
ACOL215 (Oct. 7th)

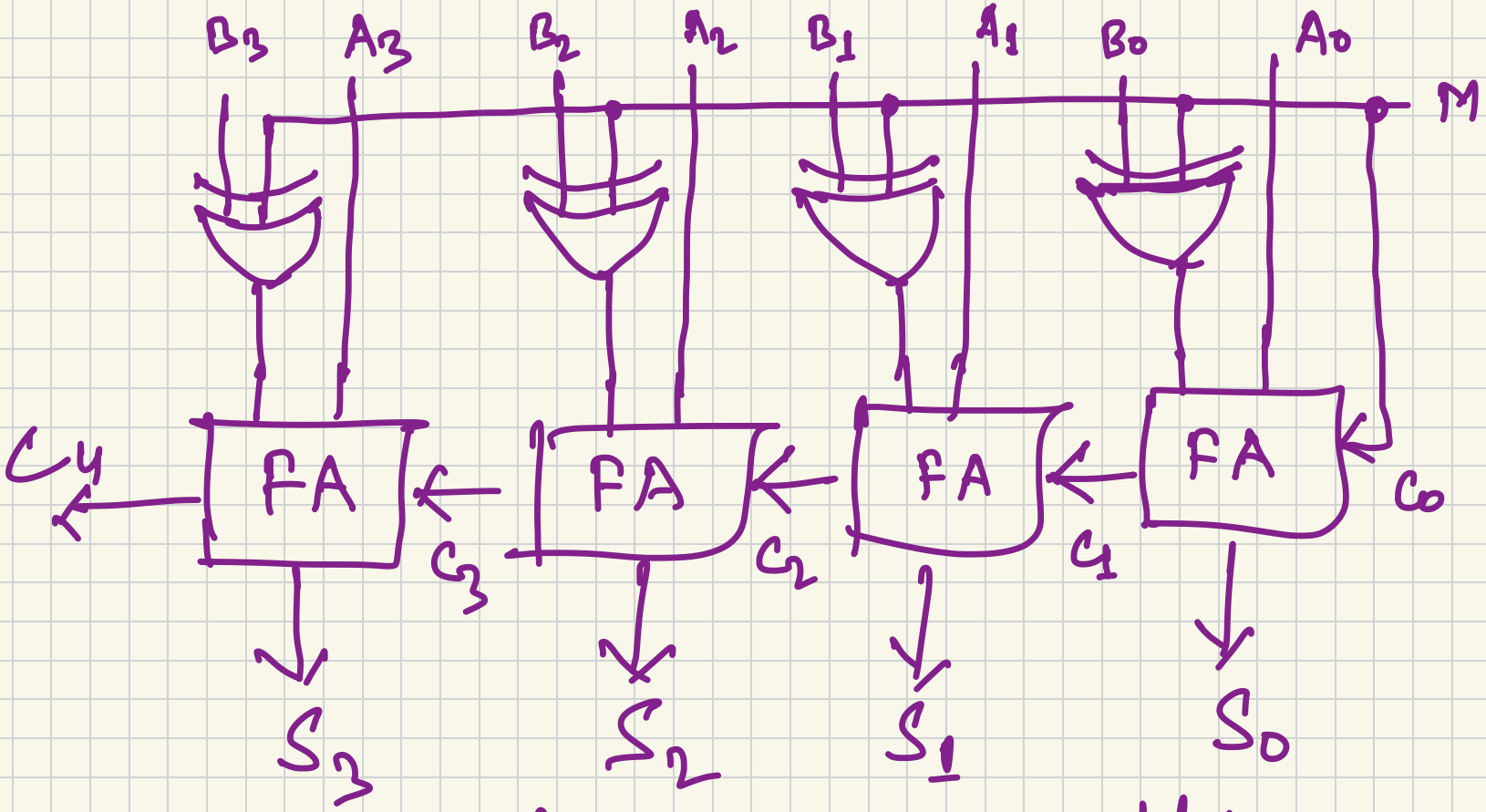
Binary Subtractor

A - B

add: A, 2's complement of B

A, 1's complement of B, 1


B3
A3
B2
A2
B1
A1
B0
A0
FA
FA
FA
FA
C4
C3
C2
C1
1
S3
S2
S1
S0



If M = 0 ← adder

M = 1 ← subtractor

Overflow

When two unsigned numbers are added, an overflow is detected from the end carry out of the most significant digit.

For signed numbers

→ left most bit represents the sign

→ negative numbers are in 2's complement form.

When two signed numbers are added, the sign bit is treated as a part of the number and the end carry does not indicate an overflow.

Note that an overflow cannot occur after an addition if one number is positive and the other is negative.

Consider

$+70$ 01000110

$+80$ 01010000

01 → last two carries

10010110

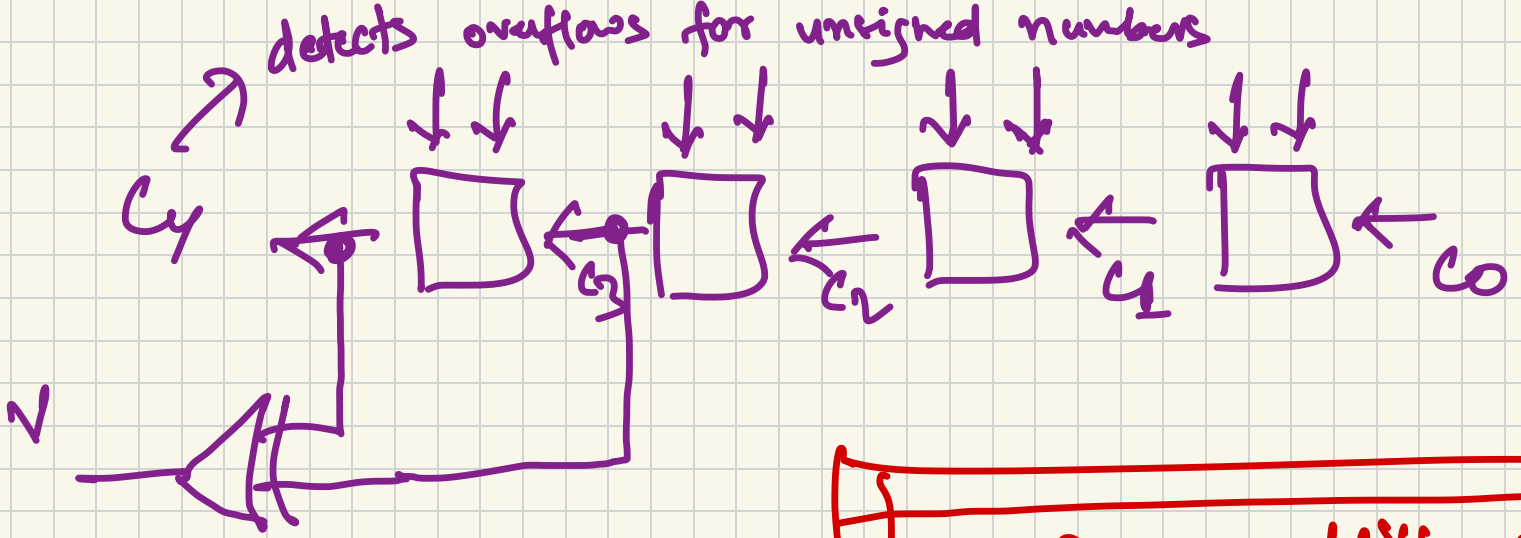
a negative number!

-70 10111010

-80 10110000

01101010

a positive number!



BCD addition (sect. 1.7)

Draw a circuit for BCD addition. chapter 4

Binary Multiplication

$B_1 \quad B_0$

$A_1 \quad A_0$

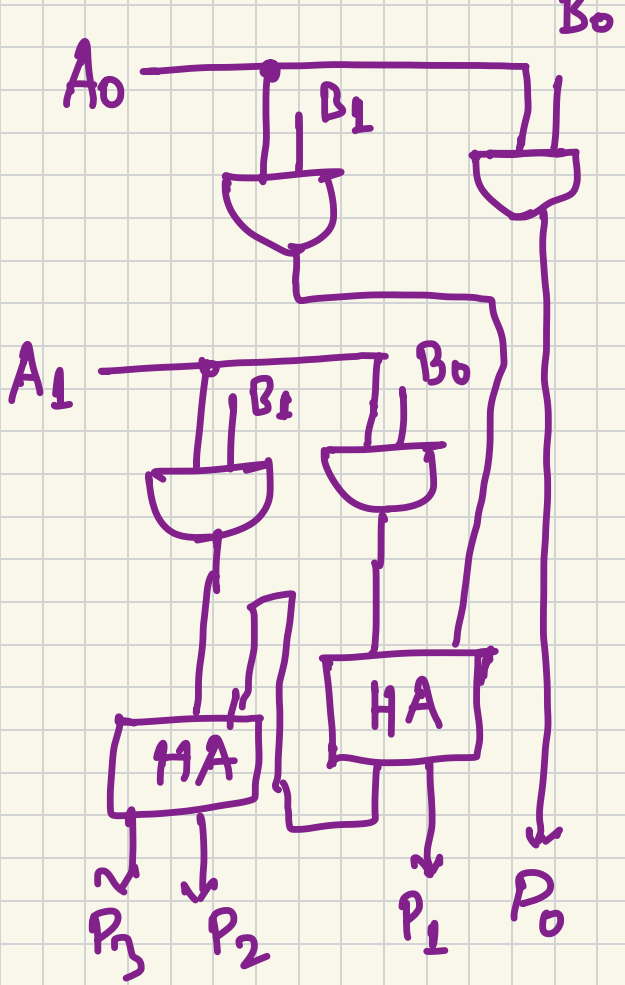
$A_0B_1 \quad A_0B_0$

$A_1B_1 \quad A_1B_0$

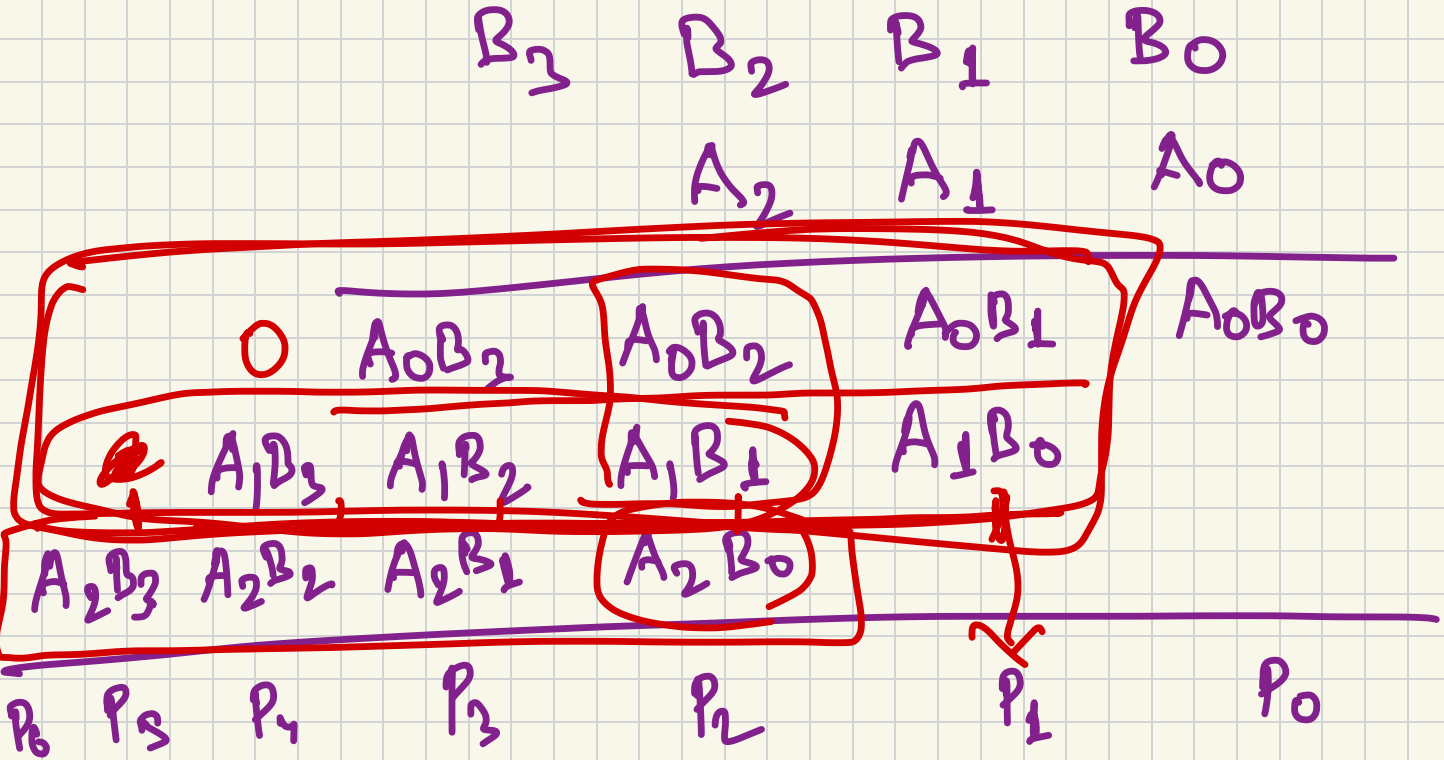
$A_0B_1 \quad A_0B_0$

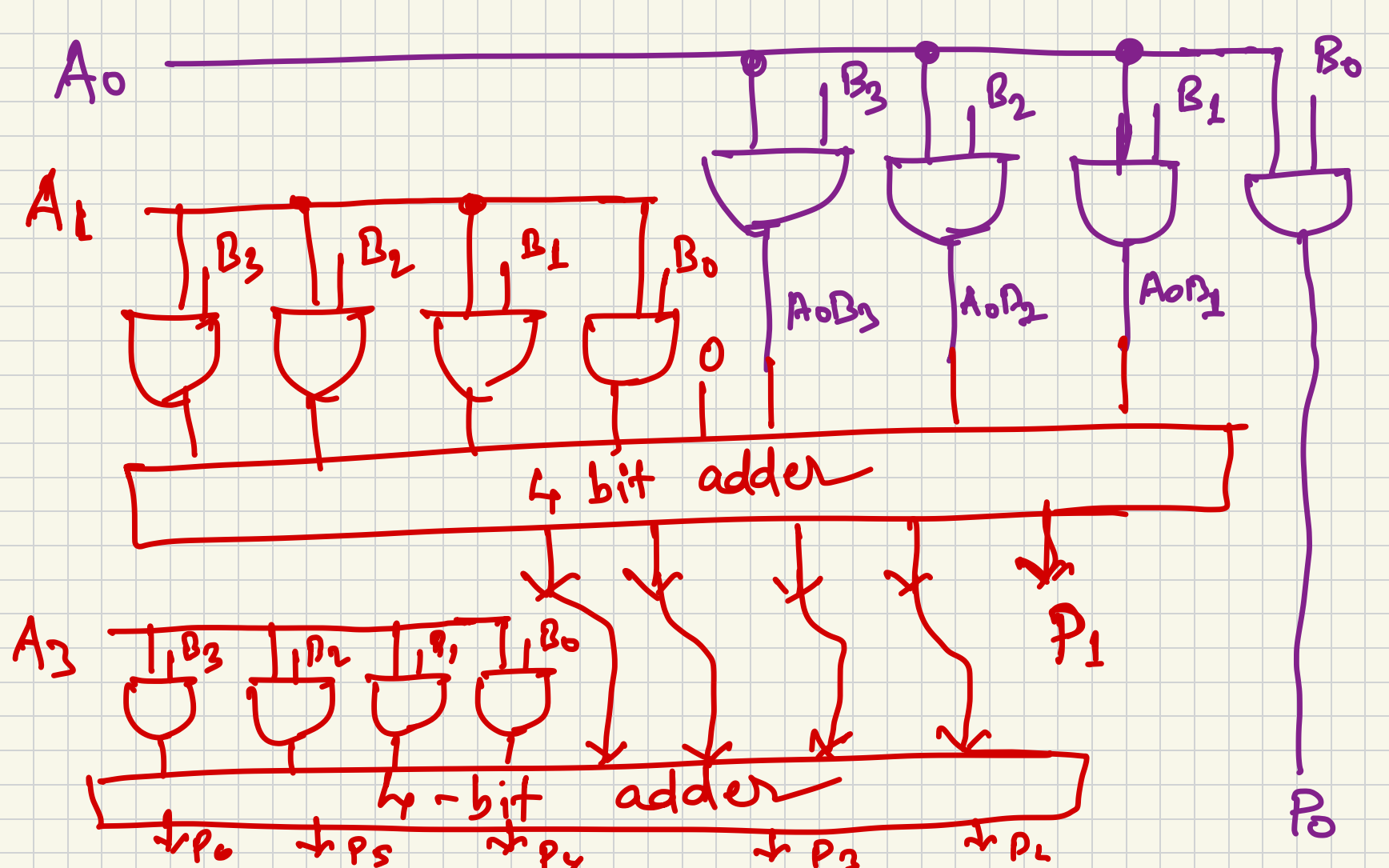
$A_1B_1 + A_1B_0$

$P_3 \quad P_2 \quad P_1 \quad P_0$



Exercise Draw the multiplier circuit for




A0
B3
B2
B1
B0
A1
B3
B2
B1
B0
0
A0B3
A0B2
A0B1
4 bit adder
P1
A3
B3
B2
B1
B0
4-bit adder
P0
P5
P4
P3
P2
P0

Magnitude Comparator

$\frac{A}{n}$ $\frac{B}{n}$

$A = B$ | $A > B$ | $A < B$

$A = B$

$A_3\ A_2\ A_1\ A_0$

$B_3\ B_2\ B_1\ B_0$

$A_3 = B_3$ and $A_2 = B_2$ and $A_1 = B_1$ and $A_0 = B_0$

$x_i = A_i B_i + A_i' B_i'$

$(A = B)$ $= \overline{x_3\ x_2\ x_1\ x_0}$

$A > B$

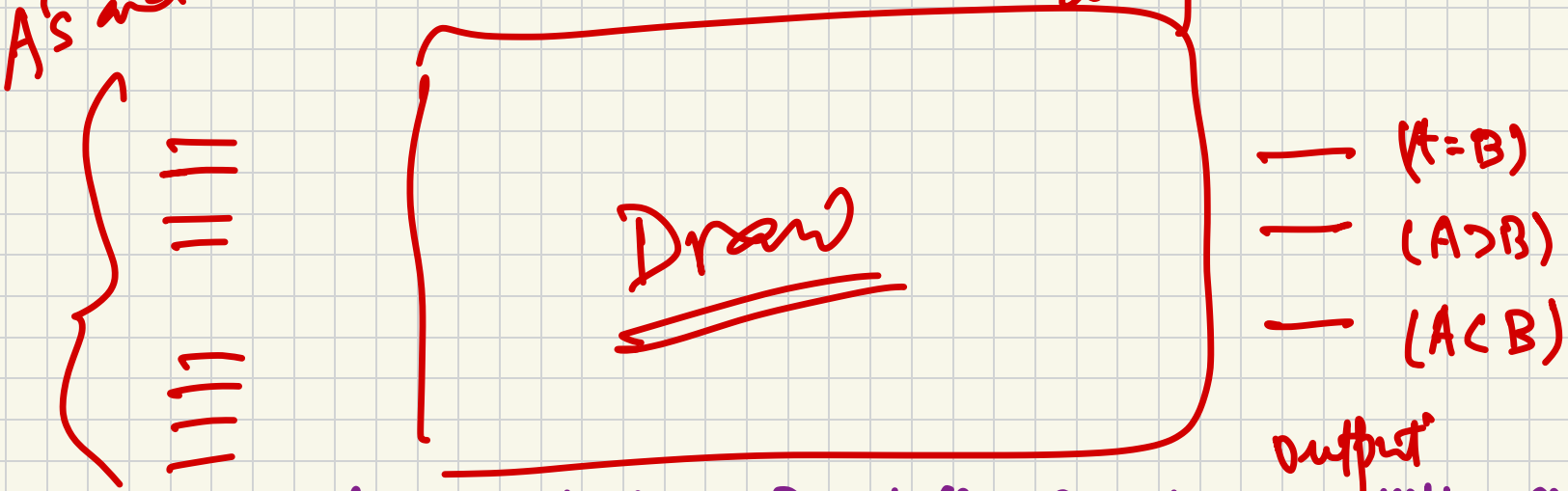
$$A_3 B_3' + x_3 A_2 B_2' + x_3 x_2 A_1 B_1' + x_3 x_2 x_1 A_0 B_0'$$

$A < B$

$$A_3' B_3 + x_3 A_2' B_2 + x_3 x_2 A_1' B_1 + x_3 x_2 x_1 A_0' B_0$$

Exercise

Draw the circuit for a 4-bit magnitude comparator.



Next lecture : Decoders, Encoders, Multiplexers