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# Lecture 11

# **Subtractor and Multiplier**

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### **Unsigned Number and Signed Number**

- Unsigned numbers are all positive number.
- Unsigned numbers cannot express a negative number.
- Signed number can express both positive and negative numbers.
  - MSB (Most Significant Bit) is a sign bit.
  - If sign bit is 0, the number is a positive number.
  - If sign bit is 1, it is a negative number.

Unsigned Numbers	Signed Numbers	
0101 (+5 <sub>10</sub> )	0XX	(+)
110 (+6 <sub>10</sub> )	1XXX	(-)
	1XXXXX	(-)

## **Arithmetic Operations Using Two's Complement**

• We can Ignore the sign during operations just like they are unsigned numbers.



• Because A-B = A + (-B), we can use addition for subtraction instead.

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#### **Subtractors**

Use ripple carry adder to make a subtractor.

 $X_3X_2X_1X_0 - Y_3Y_2Y_1Y_0 = X_3X_2X_1X_0 + (-Y_3Y_2Y_1Y_0)$ 



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### **Adder-Subtractor Circuit**

The difference of adder and subtractor is if we apply an input as it is or its two's complement.



# **Multiplier**





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