

Lecture 3

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Binary Addition

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 10 \text{ (which is } 0 \text{ carry } 1)$$

$$0011010 + 001100 = 00100110$$

$$\begin{array}{r} 11 \\ \text{carry} \end{array}$$

$$0011010 = 26_{10}$$

$$+ 0001100 = 12_{10}$$

$$0100110 = 38_{10}$$

$$(10010)_2 + (1001)_2 = ?$$

Binary Subtraction

A	-	B	Subtract	Borrow
0	-	0	0	0
1	-	0	1	0
1	-	1	0	0
0	-	1	1	1

MINUEND
- SUBTRAHEND

$$\begin{array}{r} 1 \\ - 0 \\ \hline 1 \end{array} \quad \begin{array}{r} 11 \\ - 10 \\ \hline 1 \end{array} \quad \begin{array}{r} 1011 \\ - 10 \\ \hline 1001 \end{array}$$

$$\begin{array}{r} 110 \\ - 101 \\ \hline \end{array}$$

$$\begin{array}{r} 1\cancel{1}0\cancel{0}^{010} \\ - 101 \\ \hline \end{array}$$

$$\begin{array}{r} 1\cancel{1}0\cancel{0}^{010} \\ - 101 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 1\cancel{1}0\cancel{0}^{010} \\ - 101 \\ \hline 001 \end{array}$$

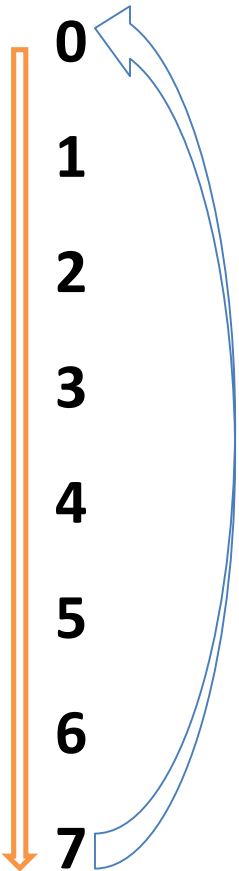
$$\begin{array}{r} 1\cancel{1}0\cancel{0}0\cancel{0}^{0101010} \\ - 111 \\ \hline 10001 \end{array}$$

Octal Addition

eight digits, 0,1,2,3,4,5,6,7

Count in forward direction (0-7)
After each cycle update carry 1

After 7 10, 11.....



$$456_8 + 123_8 = 601_8$$

$$\begin{array}{r} 11 \text{ carry} \\ 456 = 302_{10} \\ + 123 = 83_{10} \\ \hline 601 = 385_{10} \end{array}$$

Practice Questions

$$(376)_8 + (521)_8 = ?$$

$$(224)_8 + (631)_8 = ?$$

$$(453)_8 + (721)_8 = ?$$

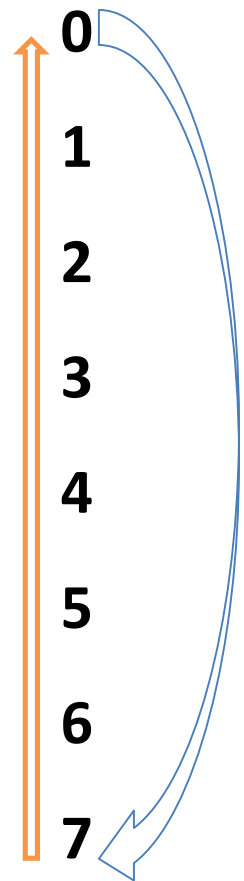
Octal Subtraction

Count in backward direction (7-0)
After each cycle update carry - 1

Example:

$$456_8 - 173_8 = 333_8$$

	8	borrow
³ 4 5 6	= 302 ₁₀	
- 1 7 3	= 123 ₁₀	
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2 6 3	= 179 ₁₀	



Practice Questions

$$(343)_8 - (252)_8 = ?$$

$$(704)_8 - (203)_8 = ?$$

Hexadecimal Addition

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F

10 digits and 6 letters, 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.

A = 10, B = 11, C = 12, D = 13, E = 14, F = 15.

After F 10,11.....

Count in forward direction (0-F)

After each cycle update carry 1

$$(A)H + (B)H = 15$$

$$4A6_{16} + 1B3_{16} = 659_{16}$$

$$\begin{array}{r} 1 \quad \text{carry} \\ 4A6 \end{array}$$

$$= 1190_{10}$$

$$+ 1B3 = 435_{10}$$

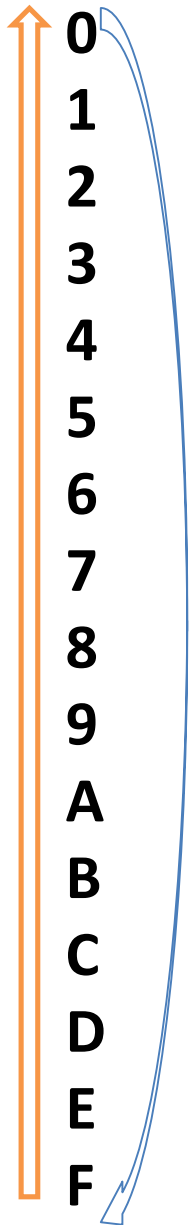
$$659 = 1625_{10}$$

Practice Questions

$$\begin{array}{r} 2AC6 \\ + \quad 92B5 \\ \hline \end{array}$$

$$(F57A)_{16} + (C85E)_{16} = ?$$

Hexadecimal Subtraction



Count in backward direction (F-0)
After each cycle update carry - 1

$$4A6_{16} - 1B3_{16} = 2F3_{16}$$

	16	borrow
³ 4 A 6	= 1190 ₁₀	
- 1 B 3	= 435 ₁₀	
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2 F 3	= 755 ₁₀	

Practice Questions

$$(234C)_{16} - (A127)_{16} = ?$$