Digital System Design

Module 1 - NUMBER SYSTEM

18.08.2020

Arithmetic Operations - Binary Addition

Augend	Addend	Carry	Sum
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Binary Addition

An Example: $(1010)_2 + (1100)_2$

Carry		1	0	0	0
augend		1	0	1	0
addend	+	1	1	0	0
Sum	1	0	1	1	0

Another example: $(101101)_2 + (110111)_2$

Carry	1	1	1	1	1	1	
augend		1	0	1	1	0	1
addend	+	1	1	0	1	1	1
Sum	1	1	0	0	1	0	0

Binary Subtraction

minuend	subtrahend	difference	borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Binary Subtraction

borrow				1			
borrow		0	0	10	10	0	0
minuend		1	1	0	0	1	0
subtrahend	-	1	0	0	1	0	0
difference		0	0	1	1	1	0

Binary Multiplication

Multiplicand	Multiplier	Product
0	0	0
0	1	0
1	0	0
1	1	1

Binary Multiplication

Multiplicand			1	0	1	0	1	1		
Multiplier					×	1	0	1		
			1	0	1	0	1	1		
		0	0	0	0	0	0			
	1	0	1	0	1	1				
	1	1	0	1	0	1	1	1		

$$
\begin{array}{rcccccccc}
 & 1 & 0 & 1 & 0 & 1 & 1 & & \\
101 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 1 \\
 & -1 & 0 & 1 & & & & & \\
\hline
 & 0 & 0 & 1 & 1 & & & & \\
 & & 0 & 0 & 0 & & & & \\
\hline
 & & 0 & 1 & 1 & 0 & & & \\
 & & & -1 & 0 & 1 & & & \\
\hline
 & & & 0 & 0 & 1 & 1 & & \\
 & & & & 0 & 0 & 0 & & \\
\hline
 & & & & 0 & 1 & 1 & 1 & \\
 & & & & & -1 & 0 & 1 & \\
\hline
 & & & & & 0 & 1 & 0 & 1 \\
 & & & & & & -1 & 0 & 1 \\
\hline
 & & & & & & 0 & 0 & 0 \\
\hline\hline
\end{array}
$$

Hexadecimal Addition

Carry		1	1	0	
augend		4	A	2	5
addend	+	8	9	E	3
Sum		D	4	0	8

Octal Addition

Carry	1	0	1		
augend		6	2	5	0
addend	+	5	1	3	4
Sum	1	3	4	0	4

Test Time