



جامعة كلكامش  
الكلية التقنية الهندسية

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Lecture 2

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## Arithmetic Operations

### 1-Addition

The following tables illustrate the rules of addition in Binary, Octal and hexadecimal.

Case	A	+	B	Sum	Carry
1	0	+	0	0	0
2	0	+	1	1	0
3	1	+	0	1	0
4	1	+	1	0	1

Figure 1 Binary addition rules.

**Example:** Add  $(0011010)_2$  to  $(0001100)_2$ ?

**Answer:**

$$\begin{array}{r} \phantom{0}11 \quad \leftarrow \text{Carry} \\ 0011010 \\ + 0001100 \\ \hline 0100110 \end{array}$$

**Example:** Find the result of  $(11010.1101)_2 + (111101.111)_2$ ?

**Answer:**

$$\begin{array}{r}
 1111111 \quad \leftarrow \text{Carry} \\
 011010.1101 \\
 + 111101.1110 \\
 \hline
 1011000.1011
 \end{array}$$

## 2-Subtraction

### Binary Subtraction

**Subtraction and Borrow**, these two words will be used very frequently for the binary subtraction. There are four rules of binary subtraction.

Case	A	-	B	Subtract	Borrow
1	0	-	0	0	0
2	1	-	0	1	0
3	1	-	1	0	0
4	0	-	1	0	1

Figure2 Binary subtraction rules



### 3-Multiplication

In this section we will discuss the multiplication rules only in binary numbers.

Binary multiplication is similar to decimal multiplication. It is simpler than decimal multiplication because only 0s and 1s are involved. There are four rules of binary multiplication.

Case	A	x	B	Multiplication
1	0	x	0	0
2	0	x	1	0
3	1	x	0	0
4	1	x	1	1

**Figure 3** Binary multiplication rules

**Example:** Find the results of  $(10011)_2 \times (0101)_2$ ?

**Answer:**

$$\begin{array}{r} 10011 \\ 0101 \times \\ \hline 10011 \\ 00000 \\ 1001100 \\ 0000000 \\ \hline 01011111 \end{array}$$

**Example:** Find the results of  $(100.111)_2 \times (010.11)_2$ ?

**Answer:**

$$\begin{array}{r}
 100.111 \\
 010.11 \\
 \hline
 100111 \\
 1001110 \\
 0000000 \\
 100111000 \\
 000000000 \\
 \hline
 01101.01101
 \end{array}$$

#### 4- Division

Binary division is similar to decimal division. It is called as the long division procedure.

**Example:** Find the results of  $(11011)_2 \div (11)_2$ ?

**Answer:**

$$\begin{array}{r}
 1001 \\
 11 \overline{) 11011} \\
 \underline{- 11} \phantom{00} \\
 00 \phantom{00} \\
 \underline{- 00} \phantom{00} \\
 01 \phantom{00} \\
 \underline{- 00} \phantom{00} \\
 11 \phantom{00} \\
 \underline{- 11} \\
 00
 \end{array}$$

**Example:** Find the results of  $(101011.10)_2 \div (110)_2$ ?

**Answer:**

$$\begin{array}{r} 110 \overline{) 101011.10} \\ \underline{110} \phantom{000000} \\ 1001 \phantom{000000} \\ \underline{110} \phantom{000000} \\ 0111 \phantom{000000} \\ \underline{110} \phantom{000000} \\ 0011 \phantom{000000} \\ \underline{000} \phantom{000000} \\ 110 \phantom{000000} \\ \underline{110} \phantom{000000} \\ 000 \phantom{000000} \end{array}$$

The diagram shows a long division in binary. The divisor is 110 and the dividend is 101011.10. The quotient is 111.01. Blue arrows indicate the alignment of the divisor under the dividend at each step. A dashed blue line is under the first '1' of the dividend, and solid blue lines are under the '110' of the divisor at each step.