



المحاضرة السادسة في مادة تقنيات وتركيب الحاسوب

Lecture 6

م.د. محمد سامي محمد

2021-2020

المرحلة الاولى

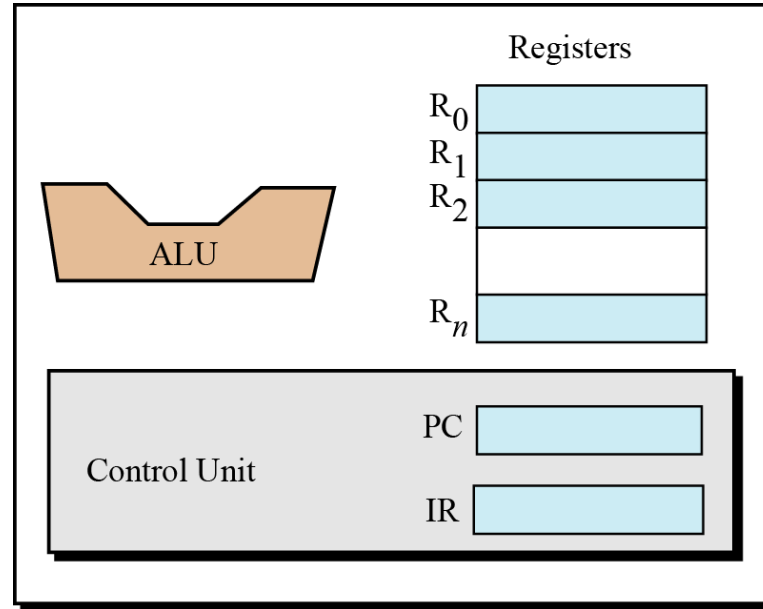


CENTRAL PROCESSING UNIT



- The central processing unit (CPU) performs operations on data. In most architectures it has three parts: an arithmetic logic unit (ALU), a control unit and a set of registers, fast storage locations.

CENTRAL PROCESSING UNIT



Central Processing Unit (CPU)

The arithmetic logic unit (ALU)

The central processing unit (CPU) performs operations on data.

In most architectures it has three parts: an arithmetic logic unit (ALU), a control unit and a set of registers, fast storage locations.



Registers



Registers are fast stand-alone storage locations that hold data temporarily. Multiple registers are needed to facilitate the operation of the CPU.

- ❑ Data registers
- ❑ Instruction register
- ❑ Program counter

The control unit

The third part of any CPU is the control unit.

The control unit controls the operation of each subsystem. Controlling is achieved through signals sent from the control unit to other subsystems.



Data Representation

Number system



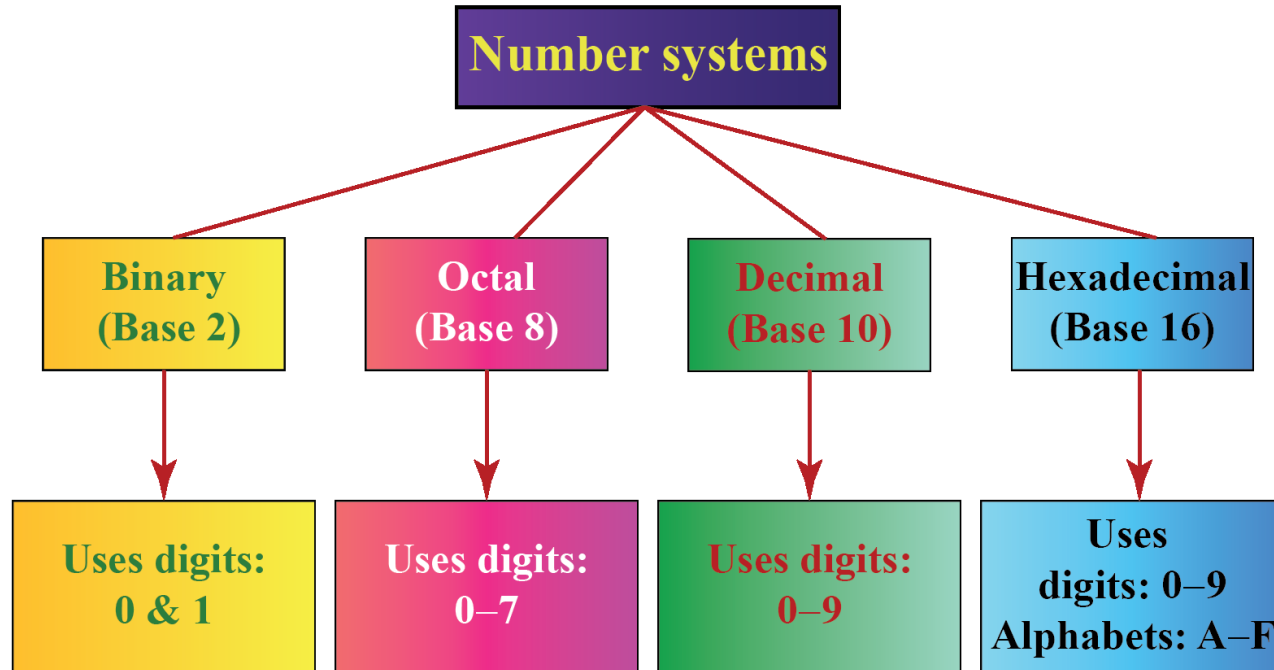
Number systems are the technique to represent numbers in the computer system architecture, every value that you are saving or getting into/from computer memory has a defined number system.

Computer architecture supports following number systems.

- Binary number system
- Octal number system
- Decimal number system
- Hexadecimal (hex) number system

Data Representation

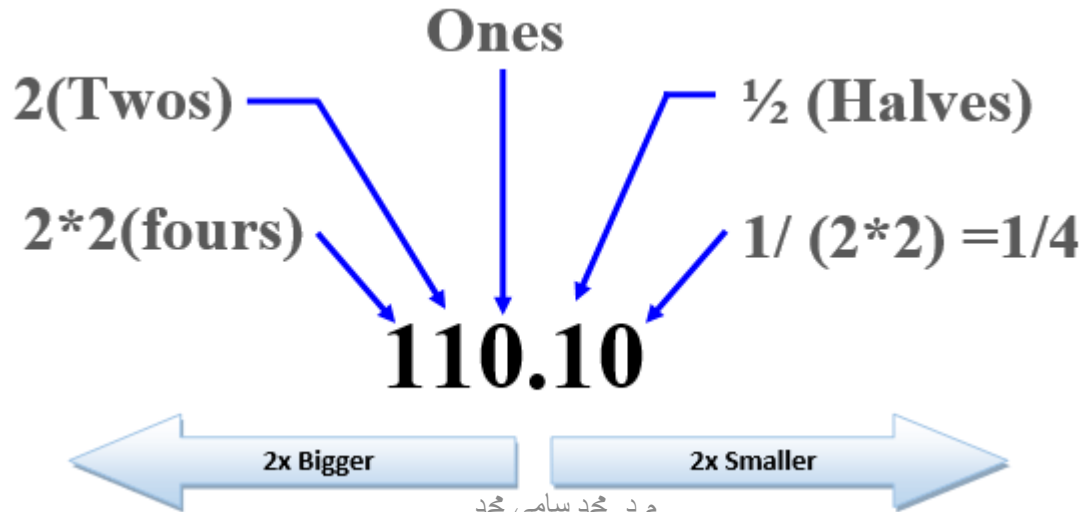
Number system



BINARY NUMBER SYSTEM



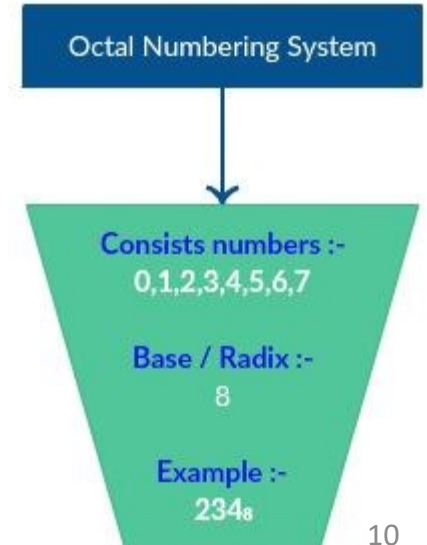
A Binary number system has only two digits that are 0 and 1. Every number (value) represents with 0 and 1 in this number system. The base of binary number system is 2, because it has only two digits



OCTAL NUMBER SYSTEM



Octal number system has only eight (8) digits from 0 to 7. Every number (value) represents with 0,1,2,3,4,5,6 and 7 in this number system. The base of octal number system is 8, because it has only 8 digits



DECIMAL NUMBER SYSTEM



Decimal number system has only ten (10) digits from 0 to 9. Every number (value) represents with 0,1,2,3,4,5,6, 7,8 and 9 in this number system. The base of decimal number system is 10, because it has only 10 digits

Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Decimal point	Tenths	Hundredths	Thousandth	Ten-Thousandth	Hundred-Thousandth	Millionths
Whole part							•	Decimal part					

م.د. محمد سامي محمد

HEXADECIMAL NUMBER SYSTEM



A Hexadecimal number system has sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number (value) represents with 0,1,2,3,4,5,6, 7,8,9,A,B,C,D,E and F in this number system. The base of hexadecimal number system is 16, because it has 16 alphanumeric values. Here A is 10, B is 11, C is 12, D is 14, E is 15 and F is 16.

Hexadecimal Weighting

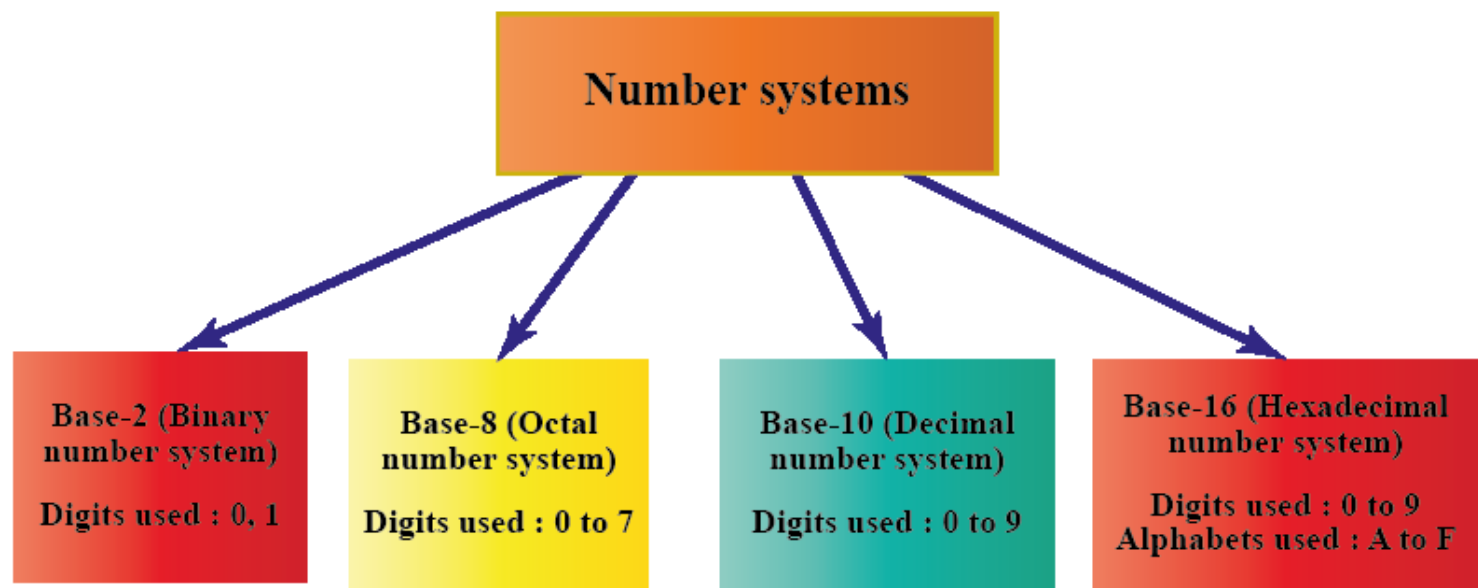
16^3 16^2 16^1 16^0

5C8A₁₆

م.د. محمد سامي محمد

Data Representation

Number system



CONVERSIONS-DECIMAL TO OTHER



1. DECIMAL TO BINARY

To convert Number system from Decimal Number System to Any Other Base is quite easy; you have to follow just two steps:

- A) Divide the Number (Decimal Number) by the base of target base system (in which you want to convert the number: Binary (2), octal (8) and Hexadecimal (16)).
- B) Write the remainder from step 1 as a Least Signification Bit (LSB) to Step last as a Most Significant Bit (MSB).

CONVERSIONS-DECIMAL TO OTHER



1. DECIMAL TO BINARY

Decimal to Binary Conversion		Result
Decimal Number is : $(12345)_{10}$		
2	12345	1 LSB
2	6172	0
2	3086	0
2	1543	1
2	771	1
2	385	1
2	192	0
2	96	0
2	48	0
2	24	0
2	12	0
2	6	0
2	3	1
	1	1 MSB
		Binary Number is $(11000000111001)_2$

CONVERSIONS-DECIMAL TO OTHER



2. DECIMAL TO OCTAL

Decimal to Octal Conversion		Result	
Decimal Number is : $(12345)_{10}$		Octal Number is $(30071)_8$	
8	12345		1 LSB
8	1543		7
8	192		0
8	24		0
	3		3 MSB

CONVERSIONS-DECIMAL TO OTHER



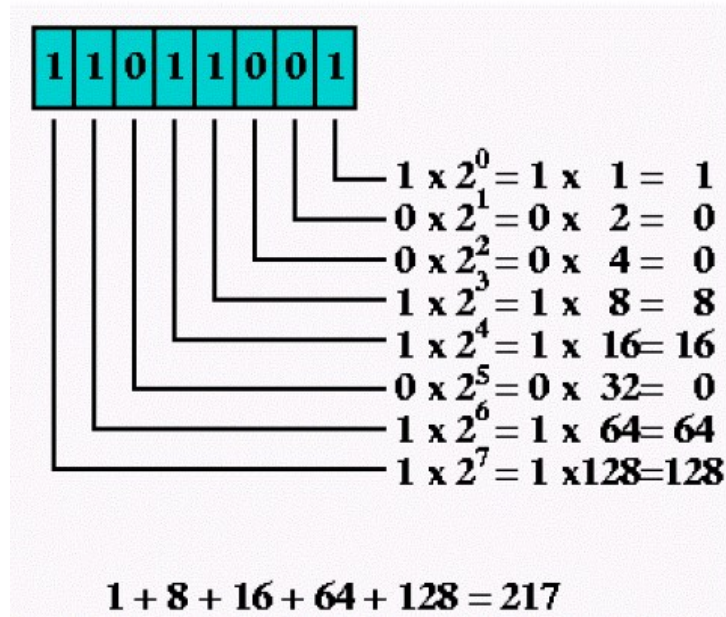
3. DECIMAL TO HEXADECIMAL

Decimal to Hexadecimal Conversion		Result												
<p>Example 1 Decimal Number is : $(12345)_{10}$</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>16</td><td>12345</td></tr> <tr><td>16</td><td>771</td></tr> <tr><td>16</td><td>48</td></tr> <tr><td>8</td><td>3</td></tr> </table> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>9</td></tr> <tr><td>3</td></tr> <tr><td>0</td></tr> <tr><td>3</td></tr> </table> <p>LSB MSB</p>		16	12345	16	771	16	48	8	3	9	3	0	3	Hexadecimal Number is $(3039)_{16}$
16	12345													
16	771													
16	48													
8	3													
9														
3														
0														
3														
<p>Example 2 Decimal Number is : $(725)_{10}$</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>16</td><td>725</td></tr> <tr><td>16</td><td>45</td></tr> <tr><td></td><td>2</td></tr> </table> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>5</td><td>5</td></tr> <tr><td>13</td><td>D</td></tr> <tr><td>2</td><td>2</td></tr> </table> <p>LSB MSB</p>		16	725	16	45		2	5	5	13	D	2	2	Hexadecimal Number is $(2D5)_{16}$ Convert 10, 11, 12, 13, 14, 15 to its equivalent... A, B, C, D, E, F
16	725													
16	45													
	2													
5	5													
13	D													
2	2													

CONVERSIONS-BINARY TO OTHER



1. BINARY TO DECIMAL



CONVERSIONS-BINARY TO OTHER



2. BINARY TO OCTAL

Binary: 11100101 =	11 100 101	
	011 100 101	Pad the most significant digits with zeros if necessary to complete a group of three.

CONVERSIONS-BINARY TO OTHER



3. BINARY TO HEXADECIMAL

Binary:	0000	0001	0010	0011	0100	0101	0110	0111
Hexadecimal:	0	1	2	3	4	5	6	7
Binary:	1000	1001	1010	1011	1100	1101	1110	1111
Hexadecimal:	8	9	A	B	C	D	E	F

Binary =	1110	0101	
Hexadecimal =	E	5	= E5 hex

CONVERSIONS-OCTAL TO OTHER



1. OCTAL TO BINARY

Octal:	0	1	2	3	4	5	6	7
Binary:	000	001	010	011	100	101	110	111

Octal =	3	4	5	
Binary =	011	100	101	= 011100101 binary

CONVERSIONS-OCTAL TO OTHER



2. OCTAL TO HEXADECIMAL

Octal =	3	4	5	
Binary =	011	100	101	= 011100101 binary

Binary =	1110	0101	
Hexadecimal =	E	5	= E5 hex

CONVERSIONS-OCTAL TO OTHER



3. OCTAL TO DECIMAL

$$345 \text{ octal} = (3 * 8^2) + (4 * 8^1) + (5 * 8^0) = (3 * 64) + (4 * 8) + (5 * 1) = 229 \text{ decimal}$$

CONVERSIONS-HEXADECIMAL TO OTHER



1. HEXADECIMAL TO BINARY

Hexadecimal =	A	2	D	E	
Binary =	1010	0010	1101	1110	= 1010001011011110 binary

CONVERSIONS-HEXADECIMAL TO OTHER



2. HEXADECIMAL TO OCTAL

Hexadecimal to Octal

$AC_{16} \rightarrow 254_8$

$1EF_{16} \rightarrow 757_8$

CONVERSIONS-HEXADECIMAL TO OTHER



3. HEXADECIMAL TO Decimal

Hexadecimal to Decimal

$$\boxed{23E}_{16} \longrightarrow \boxed{574}_{10}$$

↓ ↓ ↓ A → 10 C → 12
16² 16¹ 16⁰ B → 11 D → 13

$$\boxed{AB09}_{16} \longrightarrow \boxed{43875}_{10}$$

Number System

- Addition
- Subtraction
- Multiplication
- Division

