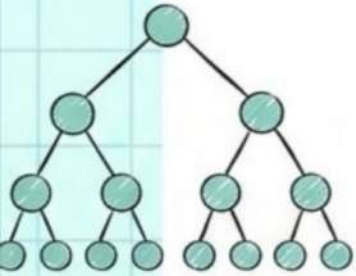
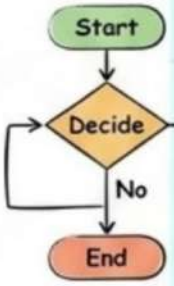
```
function computeSum(a, b) {
   return a + b;
}
```





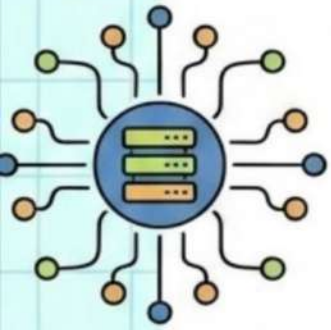


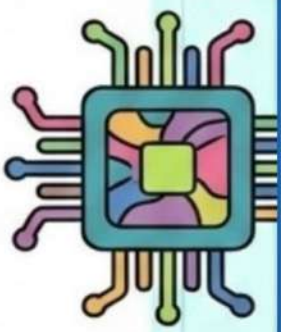
Eng. Hozifa Alqady

41098980

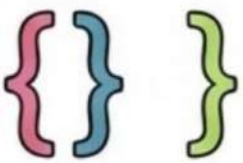
** CE 212 **



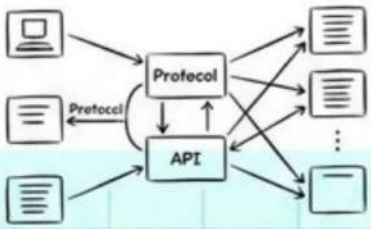










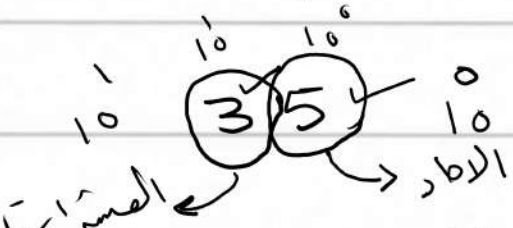






Numbers

- **Decimal**: 0 → 9
- **Binary**: 0 – 1
- **Octal**: 0 → 7
- **Hexa Decimal**: 0 → 15 (0 → 9, A, B ... F)



$3 \times 10^1 + 5 \times 10^0$

$30 + 5$

Binary

MSB 0 1 1 0 → LSB

0 1 1 0 bit

$0110 = 6$

$2^3\ 2^2\ 2^1\ 2^0$

$= 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= 0 + 4 + 2 + 0 = 6$

35 ⇒ Binary

$32 \Rightarrow 2^5$

$2 \Rightarrow 2^1$

$1 \Rightarrow 2^0$

1 0 0 0 1 1

$2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0$

تقلوبه العشان طول

⇒ 100011

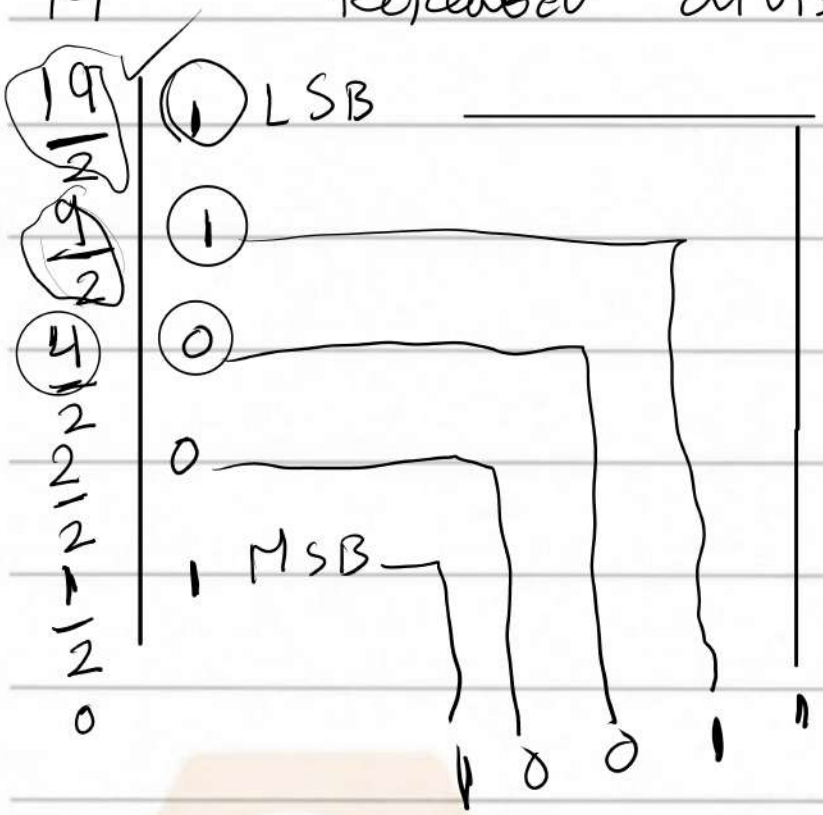
Decimal	Binary	octal	Hexa decimal
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	X	8
9	1001	X	9
10	1010	X	A
11	1011	X	B
12	1100	X	C
13	1101	X	D
14	1110	X	E
15	1111	X	F

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19 Repeated division القسمة المتكررة



19 = 10011

45/2 LSB 1
22/2 0
11/2 1
5/2 1
2/2 0
1/2 1 MSB
0

Decimal → Binary

45 = 1 0 1 1 0 1

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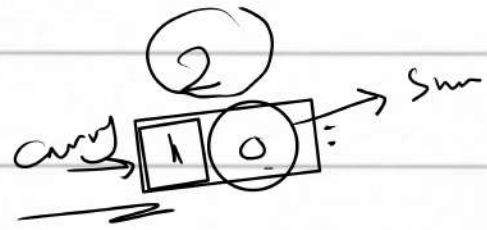
arithmetic operations

Add $0+0=0$

$0+1=1$

$1+0=1$

$1+1=0 \rightarrow 1$ (Sum → Carry)



3

11

7 | | |

3 | |

10 | 0 | 1 | 0

1 1 1

0 1 +

1 0 0

Subtraction

$0-0=0$

$1-0=1$

$1-1=0$

$0-1=1$ (diff) 1 (borrow)

0 1 0

0 | | |

0 1 0

11

10

01

11

01

10

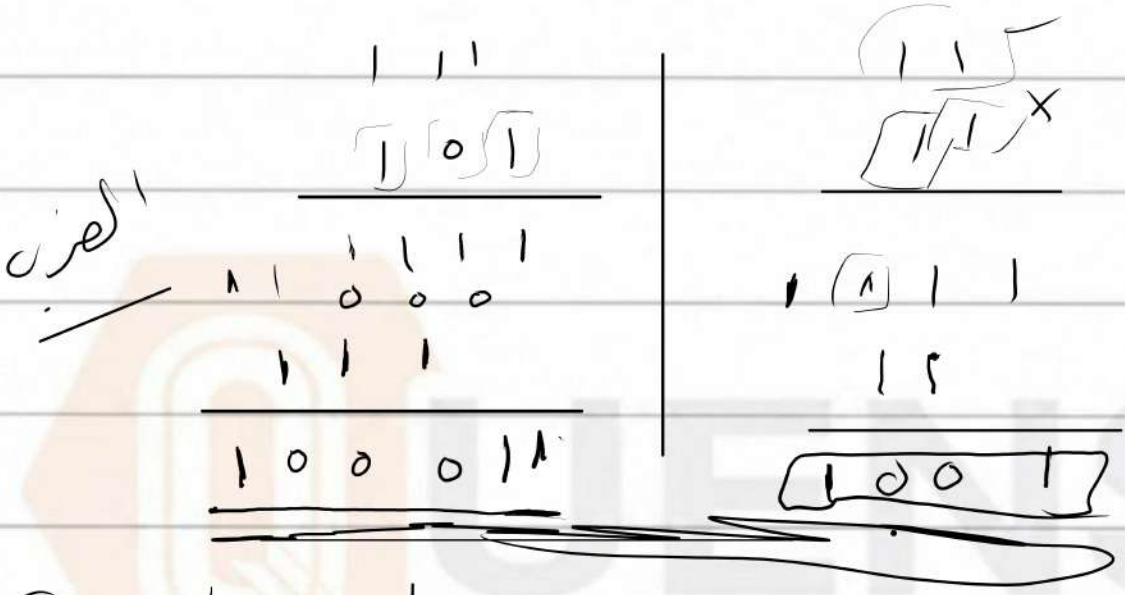
Multiplication

$0 \times 0 = 0$

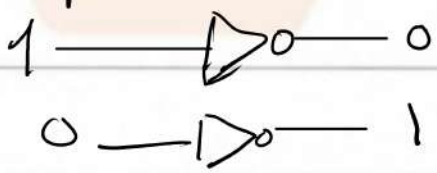
$0 \times 1 = 0$

$1 \times 0 = 0$

$1 \times 1 = 1$



Complements



1's Complement

0 1 1 1 0 0

1 0 0 0 1 1

2's Complement $\Rightarrow$ 1's + 1

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2's

0 11 | 0 0

1 00 0 1 1 1's

1 +

2's 1 00 1 0 0

Signed number

8 bits

sign magnitude

0 0011001 (25)

1 0011001 -25

1's Complement

00011001

1 1100 110 1's

2's Complement

00011 001 (-25)

111 00 110

1

2's comp (-25) 111 00111

sign magnitude

سالب → 1 00101 01

6 5 4 3 2 1 0

2 2 2 2 2 2 2

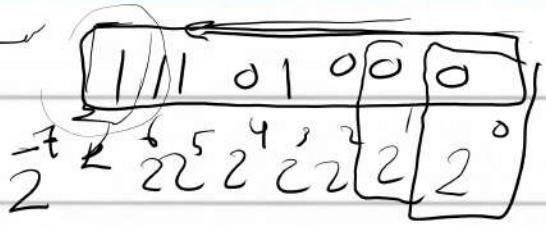
$0\times2^6 + 0\times2^5 + 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0$

$= 0 + 0 + 16 + 0 + 4 + 0 + 1 = -21$

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- مثال



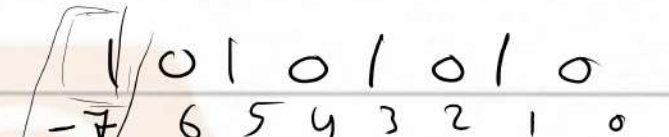
بس 1 ده +1

$1*2^{-7} + 1*2^6 + 1*2^5 + 0*2^4 + 1*2^3 + 0*2^2 + 0*2^1 + 0*2^0 =$

$-128 + 64 + 32 + 0 + 8 + 0 + 0 + 1 = -23$

2's Complement → Decimal

نفس الطريقة بس مش هنضيف 1 في الآخر



$-2^7*1 + 0*2^6 + 1*2^5 + 0*2^4 + 1*2^3 + 0*2^2 + 1*2^1 + 0*2^0$

$-128 + 0 + 32 + 0 + 8 + 0 + 2 + 0 = -86$

* Range signed integer



$Range = From(-2^{n-1}) \text{ to } (2^{n-1} - 1)$

$Range = From(-2^{8-1}) \text{ to } (2^{8-1} - 1)$

$= From(-2^7) \text{ to } (2^7 - 1)$

$From(-128) \text{ to } (127)$

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Addition – 2's Complement

الحسبة عادي

```
  00000111
+ 00000100
----------
  00001011
```

$15 + -(6) = 9$

```
carry  0 0 0 0 0 1 1 1 1 +15
       1 1 1 1 1 0 1 0 -6
      ---------------
     1 0 0 0 0 1 0 0 1 → 9
     ↑
  discard
```

$16 + (-24) = -8$

```
  00010000  16
+ 11101000  -24
------------
  11111000  ✓ 8 2's complement
```

نبالي

2's complement = 8

```
  11111000
  00000111  1's
          +
  --------
  00001000  ⇒ 8
```

$(-5) + (-9) = -14$

```
  11111011
+ 11110111
----------
1 11101010
↑
discard
```

2's -14

```
  11110010
```


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Subtraction

$9 - 5 = 4$

$9 + (-5) = 4$

$9 + (-5) = 4$

8 بت

00001000 (-) 00000011 = difference

minuend — subtrahend

$8 - 3 = 5$

$8 + (-3) = 5$

أصل ± (عكس بالسالب)

00000011 3

1111 1100 -3

1

11111101 -3

2's

8

00001000

+

11111101 -3

1 00001010 = 5

dis

minuend − (subtrahend)

minuend + 2's complement

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Hexadecimal.

0 ⟶ 9, A, B, C, D, E F

Binary

Hexa

1000 0111 1011 0011 ← Binary

↓ ↓ ↓ ↓

8 7 B 3 ← Hexa

$87B3_{16}$

AA7C ← Hexa

Binary

1010 0111 1100

A 7 C

$_{16}$

Hexadecimal to decimal

$E5_{16} \Rightarrow ??_{10}$

E 5

16^1 16^0

$E * 16^1 + 5 * 16^0$

14

$14 * 16 + 5 * 1 = 229$

Decimal to Hexa

650 / 16	40.652	$0.652 * 16 = 10 \Rightarrow A$
40 / 16	2.5	$0.5 * 16 = 8 \Rightarrow 8$
2 / 16	0.125	$0.125 * 16 = 2 \Rightarrow 2$
0		

$28A_{16}$

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Octal system $0 \rightarrow 7$

octal to Decimal

$237_8 = ??_{10}$

2 3 7

$8^2\ 8^1\ 8^0$ $\Rightarrow 2*8^2 + 3*8^1 + 7*8^0$

$= 128 + 24 + 7 = 159_{10}$

Decimal to octal

$\frac{359}{8}$	44.875	$0.875 * 8 = 7$ LSB
$\frac{44}{8}$	5.5	$0.5 * 8 = 4$
$\frac{5}{8}$	0.625	$0.625 * 8 = 5$ MSB
0		

octal 547_8

octal 547_8

to

Binary 101100111

Binary & octal

111 110 011 $= 763_8$

7 6 3

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BCD → Binary Coded decimal

0 ⟶ 9

0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9

35

00110101 BCD

170 BCD = ??

0001 0111 0000 BCD → 170

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