Information and Communication Technology

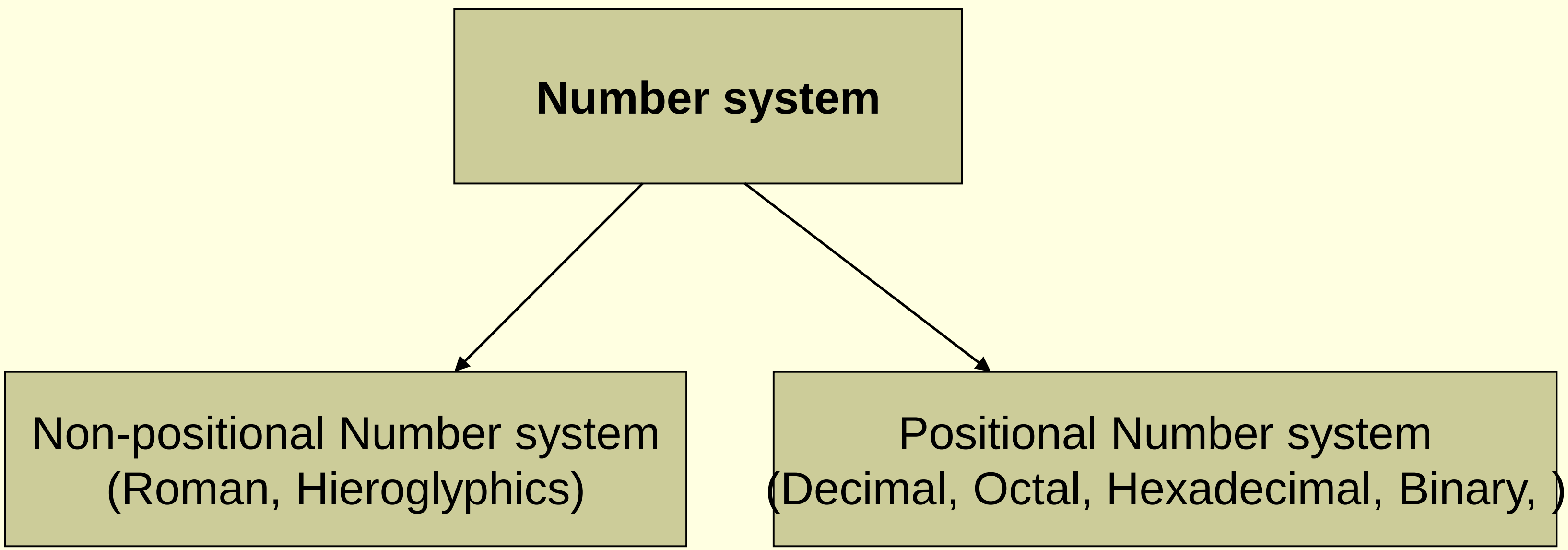
Class XI-XII

Chapter-3

Number system

Number system

- A number system is a method for counting, expressing and calculating numbers.



Non-positional number system

- **Non-positional number system** is a numeral system where the position of a digit does not affect its value. Each symbol has a fixed value

- **Example:**
- Roman number system.
- Hieroglyphics (number system of ancient Egypt)

Positional number system

- **Positional number system** is a numeral system where the position of a digit determines its value, depending on the base of the system.

- **Example:**
  - Binary
  - Octal
  - Decimal
  - Hexadecimal

- 326

MSD LSD

- LSD = Least Significant Digit
- MSD = Most Significant Digit

- LSB = Least Significant Bit
- MSB = Most Significant Bit

- $(9114)_{10}$
- What is 4 of this number ?
- Ans: LSB

- What is 9 of this number ?
- Ans: MSB

Base of number system

- **Base** of a number is defined as the **total** number of digits (basic symbols) used in that number system.

- **Example:**
- There are 10 digits in decimal number system
  - i.e. 0,1,2,3,4,5,6,7,8,9
- So **base** of decimal number system is **10**

- **The important factors in calculating the value of a positional number system are:**

- The base
- The position of each digit
- The value of the number

Different number systems & their base

Number system	Used Symbols	Base	Example
Binary	0 and 1	**2**	$(1010101)_2$
Octal	0,1,2,3,4,5,6,7	**8**	$(5071)_8$
Decimal	0,1,2,3,4,5,6,7,8,9	**10**	$(8193)_{10}$
Hexadecimal	0,1,2,3,4,5,6,7,8,9, A,B,C,D,E,F	**16**	$(3A7C)_{16}$

Explain

- 3 base number system.
- N based number system

- bit 0/1

- Byte= 00000000
- 11111111
- 10101010

- 3 base number system:
- Total 3 basic symbols is used in 3 base number system that is 0,1 and 2.
- Example:
- $(21)_3$

- N base number system:

- Total N basic symbols is used in N base number system that is 0,1,2,3………N-1

- Example:
- $(216)_N$

Why Binary number system is used in Computer?

it is easy to make computer understand 2 states(0 and 1)

- Only 2 symbols used in Binary number system
- That is: 0 and 1
- 0= Absent of electricity
- 1= present of electricity

- The decimal number system is not suitable for computers because it has 10 different digits (0 to 9).
- To use decimal, a computer would need to handle 10 different levels of electricity, which is very difficult and unreliable.

Rule#1

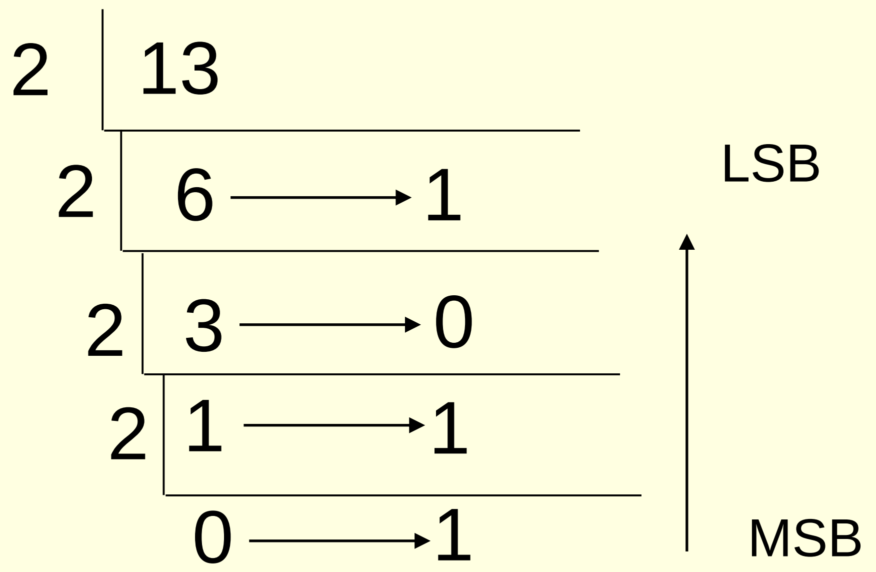
Decimal → Binary

Decimal → Octal

Decimal → Hexadecimal

Decimal → Binary

- $(13)_{10}=(\ ?\ )_2$



Ans: $(13)_{10}=(\ 1101)_2$

Decimal	→	Binary

- $(17)_{10} = (\ ?\ )_2$

2	17	
2	8	→ 1
2	4	→ 0
2	2	→ 0
2	1	→ 0
	0	→ 1

Ans: $(17)_{10} = (10001)_2$

2) $(133.0625)_{10}=(\ ?\ )_2$

2	133	
2	66 →	1
2	33 →	0
2	16 →	1
2	8 →	0
2	4 →	0
2	2 →	0
2	1 →	0
	0 →	1

$(133)_{10}=(10000101)_2$

$(0.0625)_{10}=(?)_2$

	.0625 × 2
0	.125 × 2
0	.25 × 2
0	.5 × 2
1	0

$(.0625)_{10}=(.0001)_2$

Ans: $(133.0625)_{10}=(10000101.0001)_2$

3) $(173.46)_{10}=(\ ?\ )_2$

2	173	
2	86	1
2	43	0
2	21	1
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

$(173)_{10}=(10101101)_2$

$(.46)_{10}=(?)_2$

	.46 x 2
0	.92 x 2
1	.84 x 2
1	.68 x 2
1	.36 x 2
0	.72 x 2
1	.44

$(\mathbf{.46})_{10}=(.011101\ldots\ldots)_2$

Ans: $(173.46)_{10}=(10101101.011101\ldots\ldots)_2$

Decimal → Octal

- 1) $(71)_{10}=(?\ )_8$

$$
\begin{array}{l|l}
8 & 71 \\
\hline
8 & 8 \rightarrow 7 \\
\hline
8 & 1 \rightarrow 0 \\
\hline
 & 0 \rightarrow 1
\end{array}
$$

Ans: $(71)_{10}=(\ 107)_8$

2) $(295.03125)_{10}=(\ ?\ )_8$

8	295	
8	36	→ 7
8	4	→ 4
	0	→ 4

$(295)_{10}=(447)_8$

$(.03125)_{10} = (?)_8$

	.03125
	x 8
0	. 25
	x 8
2	0

$(.\ 03125)_{10} = (.02)_8$

Ans: $(295.03125)_{10} = (447.02)_8$

Decimal to Octal

- $(367.23)_{10} = (\ ? \ )_8$

- $(557.165605\ldots\ldots\ldots\ldots\ldots)_8$

Decimal → Hexadecimal

- 1) $(251)_{10} = (\ ?\ )_{16}$

16	251	
16	15 →	11(B)
	0 →	15(F)

Ans: $(251)_{10} = (\ FB)_{16}$

2) $(411.015625)_{10} = (\ ?\ )_{16}$

16	411	
16	25	→ 11(B)
16	1	→ 9
	0	→ 1

$(411)_{10} = (19B)_{16}$

$(.015625)_{10}=(?)_{16}$

	.015625
	x 16
0	.25
	x 16
4	0

$(.015625)_{10}=(.04)_{16}$

Ans: $(411.015625)_{10}=(19B.04)_{16}$

3) $(555.23)_{10}=(\ ?\ )_{16}$

16	555		
16	34	$\longrightarrow$	11(B)
16	2	$\longrightarrow$	2
	0	$\longrightarrow$	2

$(555)_{10}=(22B)_{16}$

$(.23)_{10}=(?)_{16}$

	.23 x 16
3	.68 x 16
(A)10	.88 x 16
(E)14	.08 x 16
1	.28 x 16
4	.48 x 16
7	.68

$(.23)_{10}=(.3AE147\ldots\ldots)_{16}$

Ans: $(555.23)_{10}=(22B.\ 3AE147\ldots\ldots)_{16}$

Rule#2

Binary → Decimal

Octal → Decimal

Hexadecimal → Decimal

Binary → Decimal

- $(101)_2 = (\ ?\ )_{10}$

- 1 0 1

$2^0 \times 1 = 1$

$2^1 \times 0 = 0$

$2^2 \times 1 = 4$

5

- **Ans:** $(101)_2 = (\ 5\ )_{10}$

$(10101.101)_2=(\ ?\ )_{10}$

- 1 0 1 0 1 . 1 0 1

$2^{-3} \times 1 = 0.125$

$2^{-2} \times 0 = 0$

$2^{-1} \times 1 = 0.5$

$2^{0} \times 1 = 1$

$2^{1} \times 0 = 0$

$2^{2} \times 1 = 4$

$2^{3} \times 0 = 0$

$2^{4} \times 1 = 16$

21.625

Octal → Decimal

- $(507)_8 = (\ ?\ )_{10}$

- 5 0 7

$8^0 \times 7 = 7$

$8^1 \times 0 = 0$

$8^2 \times 5 = 320$

327

Ans: $(507)_8 = (327)_{10}$

$(7432.106)_8 = (\ ?\ )_{10}$

7 4 3 2 . 1 0 6

$8^{-3} \times 6 = 0.0117$

$8^{-2} \times 0 = 0$

$8^{-1} \times 1 = 0.125$

$8^{0} \times 2 = 2$

$8^{1} \times 3 = 24$

$8^{2} \times 4 = 256$

$8^{3} \times 7 = 3584$

3866.1367

Hexadecimal → Decimal

- $(A2C)_{16} = (\ ?\ )_{10}$

- A 2 C

$16^0 \times 12 = 12$

$16^1 \times 2 = 32$

$16^2 \times 10 = 2560$

2604

- **Ans:** $(A2C)_{16} = (2604)_{10}$

$(C3B.D6)_{16}=(\ ?\ )_{10}$

C 3 B . D 6

$16^{-2} \times 6=0.0234$

$16^{-1} \times 13=0.8125$

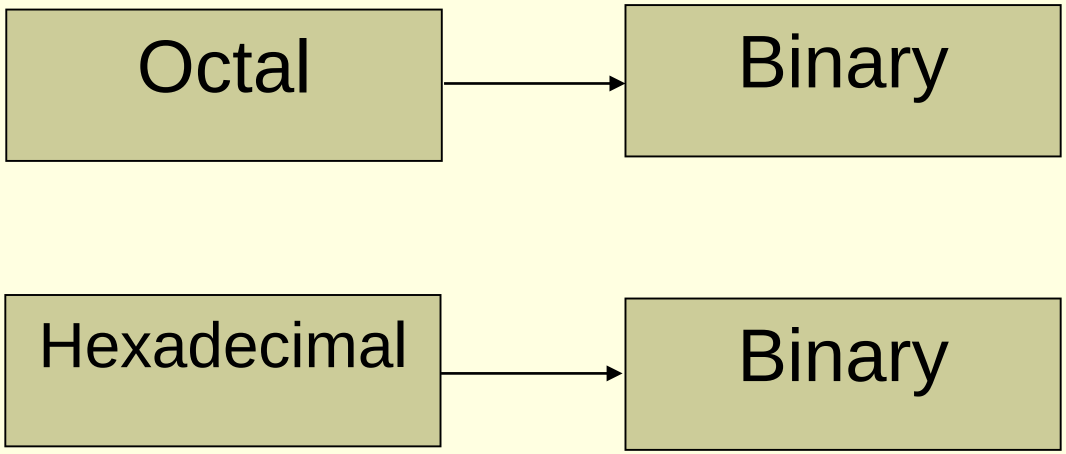
$16^{0} \times 11=11$

$16^{1} \times 3= 48$

$16^{2} \times 12=3072$

3131.8359

Rule#3



Octal → Binary

- $(6734)_8=(?)_2$

4	2	1

- 6 7 3 4

110 111 011 100

Ans: $(110111011100)_2$

1 0 5 . 2 4

001 000 101 . 010 100

Ans: $(001\ 000\ 101.010\ 100)_2$

Hexa → Binary

- $(6F3E)_{16}=(?)_2$

  - 6 F 3 E

0110 1111 0011 1110

Ans: $(0110111100111110)_2$

B 0 C . 1 9

1011 0000 1100 . 0001 1001

Ans: 1011 0000 1100.0001 1001

Rule#4

Binary → Octal

Binary → Hexadecimal

Binary → Octal

- 11101

4	2	1

- $\underbrace{011}_{3}\ \underbrace{101}_{5}$

Ans:
$(11101)_2 = (35)_8$

4	2	1

- 1011001

- $\underline{001}\ \underline{011}\ \underline{001}$

  1 3 1

- Ans: $(131)_8$

- 1110111.10001

4	2	1

- $\underbrace{001}_{1}\ \underbrace{110}_{6}\ \underbrace{111}_{7}.\ \underbrace{100}_{4}\ \underbrace{010}_{2}$

Ans: $(167.42)_8$

Binary → Hexa

111100

8	4	2	1

$\underbrace{0011}_{3}\ \underbrace{1100}_{12(C)}$

Ans: $(3C)_{16}$

8	4	2	1

- 1111101
- $\underbrace{0111}_{7}\ \underbrace{1101}_{13(D)}$
- Ans: 7D

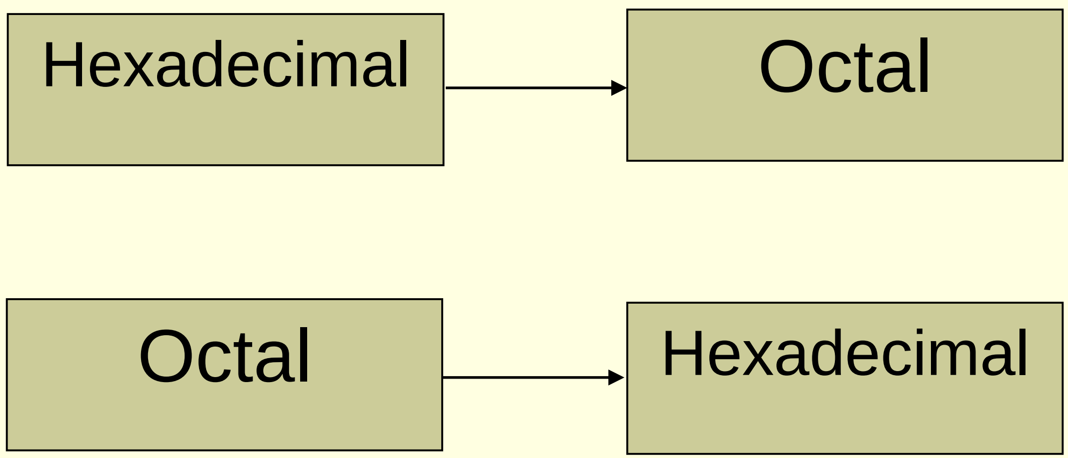
Binary → Hexa

1 1 1 1 1 0 1.1 1 1 1 1 1 1

$$\underbrace{0111}_{7}\ \underbrace{1101}_{13(D)}.\ \underbrace{1111}_{15(F)}\ \underbrace{1110}_{14(E)}$$

Ans: 7D.FE

Rule#5



Hexa → Octal

- $AB.CD = (\ ?\ )_8$

- A B . C D

- 1010 1011. 1100 1101

- 010 101 011. 110 011 010
- 2 5 3 . 6 3 2

Octal → Hexa

- $(67.56)_8=(\ ?\ )_{16}$

6 7 . 5 6

110 111 . 101 110

$$\underbrace{0011}_{3}\ \underbrace{0111}_{7}\ .\ \underbrace{1011}_{11(B)}\ \underbrace{1000}_{8}$$

Ans: 37.B8

Rules of Binary Addition

0	0	1	1
0	1	1	1
			1
C=0 S=0	C=0 S=1	C=1 S=0	C=1 S=1

Add $(11011)_2$ and $(1101)_2$

$$\begin{array}{r} 11011 \\ 1101 \\ \hline 101000 \end{array}$$

Ans: $(101000)_2$

Add $(101010)_2$ and $(111011)_2$

$$
\begin{array}{r}
101010 \\
111011 \\
\hline
1100101
\end{array}
$$

Ans: 1100101

Add $(101.11)_2$ and $(1111.1011)_2$

$$
\begin{array}{r}
101.11 \\
1111.1011 \\
\hline
10101.0111
\end{array}
$$

Ans:10101.0111

$$
\begin{array}{r}
1011.1011 \\
111.101 \\
\hline
10011.0101
\end{array}
$$

Explain

- 6+5+3=1110

- 1+7=10

Add 2 Octal numbers

16

15

33

Quotient added

Remainder here

OCTAL ADDITION

- 6 7 5
- 4 7 7

1 3 7 4

- 5 4 3 7
- 7 0 6 3

- 1 4 5 2 2

Hexa addition

- A D 8 3 F 2 1
- 0 5 7 E B 8 7

- B 3 0 2 A A 8

- A C 5 A 9
- E D 6 9 4

1 9 9 C 3 D

Rules of Binary Subtraction

0	1	1	0
0	1	0	1
			1
0	0	1	1

Borrow

Subtract $(111)_2$ from $(1011)_2$

$$\begin{array}{r} 1\,0\,1\,1 \\ 1\,1\,1 \\ \hline 1\,0\,0 \end{array}$$

Ans: 100

Subtract $(111)_2$ from $(1101)_2$

$$\begin{array}{r} 1\,1\,0\,1 \\ 1\,1\,1 \\ \hline 1\,1\,0 \end{array}$$

Ans: 110

Subtract (101110) from (1011011)

```
  1 0 1 1 0 1 1
    1 0 1 1 1 0
-----------------
0  1 0 1 1 0 1
```

- 100100
- 111111

- 100101

- 1 1 . 0 1
- 1 0 . 1 1

0 0 . 1 0

- 1 0 0 . 0 1
- 1 1 . 1 1

0 1 0 . 1 0

Subtract (1011.110) from (11011.001)

```
 1 1 0 1 1 . 0 0 1
   1 0 1 1 . 1 1 0
-------------------
 0 1 1 1 1 . 0 1 1
```

- 1 0 1 0 1. 1 1 1

  1 0 0 1. 1 0 1

  1 1 0 0 .0 1

Add $(+13)_{10}$ and $(-7)_{10}$ by 2's complement method using 8 bit register

+13= 00001101

+7= 00000111

+7=0 0 0 0 0 1 1 1

1 1 1 1 1 0 0 0 (1's complement)

+1

-7= 1 1 1 1 1 0 0 1 (2's complement)

$$
\begin{array}{r}
+13 = 0\ 0\ 0\ 0\ 1\ 1\ 0\ 1 \\
-7 = 1\ 1\ 1\ 1\ 1\ 0\ 0\ 1 \\
\hline
+6 = 1\ \ 0\ 0\ 0\ 0\ 0\ 1\ 1\ 0
\end{array}
$$

Carry bit

sign bit

Ans $(+6)_{10}$ or $(0\ 0\ 0\ 0\ 0\ 1\ 1\ 0)_2$

Add $(+17)_{10}$ and $(-23)_{10}$ by 2's complement method using 8 bit register

17 = 0 0 0 1 0 0 0 1

23 = 0 0 0 1 0 1 1 1

1 1 1 0 1 0 0 0 (1's complement)

1

-23 = 1 1 1 0 1 0 0 1 (2's complement)

17 = 0 0 0 1 0 0 0 1

-23 = 1 1 1 0 1 0 0 1

-6 = 1 1 1 1 1 0 1 0

Ans: -6 or 1 1 1 1 1 0 1 0

$(-12)_{10}$ and $(-7)_{10}$

+12 = 0 0 0 0 1 1 0 0

= 1 1 1 1 0 0 1 1 (1's complement)

+ 1

-12 = 1 1 1 1 0 1 0 0 (2's complement)

+7 = 0 0 0 0 0 1 1 1

= 1 1 1 1 1 0 0 0 (1's complement)

+ 1

-7= 1 1 1 1 1 0 0 1 (2's complement)

-7= 1 1 1 1 1 0 0 1

-12 = 1 1 1 1 0 1 0 0

-19 =1 1 1 1 0 1 1 0 1

Carry

Ans: -19 or 1 1 1 0 1 1 0 1

Add $(-12)_{10}$ and $(-5)_{10}$ by 2's complement method using 8 bit register

- +12= 00001100

  = 11110011 (1's complement)

  +1

-12 = 11110100

+5 = 00000101

= 11111010 (2's complement)

+1

-5 =11111011

- -12 =   11110100
- -5   =   11111011

- -17= 1 11101111

Carry Bit

- Ans: 11101111

Subtract $(9)_{10}$ from $(13)_{10}$ by 2's complement using addition method

- (+13) – (+9)
- (+13) + (-9)
- +13= 00001101
- +9=00001001

11110110 (1's Complement)

+1

-9 =11110 111 (2's Complement)

- +13= 0 0 0 0 1 1 0 1
- -9 = 1 1 1 1 0 1 1 1
- 4 =1 0 0 0 0 0 1 0 0

Carry Bit

- Ans: 4 = 0 0 0 0 0 1 0 0

Determine difference $(77)_8$ And $(A2)_{16}$ in addition method

- A2= 1 0 1 0 0 0 1 0
- 77= 0 0 1 1 1 1 1 1
- 1 1 0 0 0 0 0 0 (1's complement)
- +1
- 1 1 0 0 0 0 0 1 (2's complement)

- A2= 1 0 1 0 0 0 1 0
- 1 1 0 0 0 0 0 1
- 1 0 1 1 0 0 0 1 1

Carry
Bit

Subtract (-17) from (-23) by 2's complement using 8 bit register

- (-23)- (-17)
- (-23)+ (+17)
- 23= 0 0 0 1 0 1 1 1
- = 1 1 1 0 1 0 0 0 (1's Complement)
- +1

- = 1 1 1 0 1 0 0 1(2's Complement)

- -23= 1 1 1 0 1 0 0 1
- +17=0 0 0 1 0 0 0 1
- -6   =1 1 1 1 1 0 1 0

- Ans: -6   =1 1 1 1 1 0 1 0

Subtract (-12) from (+15) by 2's complement using 8 bit register

- (+15) - (- 12)
- =(+15) + (+12)

Binary subtraction by 2's Complement

- Subtract $(1101)_2$ from $(11101)_2$ by 2's Complement

$$
\begin{array}{r l}
0\,0\,0\,0\,1\,1\,0\,1 & \\
1\,1\,1\,1\,0\,0\,1\,0 & \text{(1's complementation)} \\
1 & \\
\hline
1\,1\,1\,1\,0\,0\,1\,1 & \text{(2's complementation)}
\end{array}
$$

0 0 0 1 1 1 0 1

1 1 1 1 0 0 1 1

$\boxed{1}$ 0 0 0 1 0 0 0 0

Carry bit

Ans: 0 0 0 1 0 0 0 0

Subtract $(110)_2$ from $(1110)_2$ by 2's complement using 8 bit register

- 1110= 0 0 0 0 1 1 1 0

- 1 1 0 = 0 0 0 0 0 1 1 0

  1 1 1 1 1 0 0 1

  ---

  1 1 1 1 1 1 1 1

Advantage of 2's Complement

- Simple circuit and works faster
- less expensive mechanism
- Use same circuit for converting positive to negative and vise versa
- Use same circuit for both addition and subtraction

Explain

- 2’s complement methods makes digital circuit simple.
- Only sign of a number is changed by 2’s complement

Stem:

- Professor of ICT was teaching number system in class. He asked Imran about his marks in half-yearly and yearly examinations. Imran informed him that he scored $\mathbf{(37)_8}$ in half yearly and **3F** in final exam.
- C) Convert Imran's half yearly marks in hexadecimal
- D) is Imran marks in final exam greater than $\mathbf{(72)_{10}}$ or not? What are the difference between them?

JB 2019

- Rumi and Jhumi scored $(72)_{10}$ and $(72)_{8}$ in test examination. Their roll in class is $(37)_{8}$ and $(3A)_{16}$

- c) convert their roll in traditional number system. *$(31)_{10}$, $(58)_{10}$*
- D) is it possible to find difference of their marks by addition ?

- ICT teacher was teaching Number system in class (XI). But he asked the Roll number of a student by being annoyed at his inattentiveness. The student replied **$(31)_{10}$** . Then on being asked by the teacher about the roll number of his previous class, he replied **$(15)_{10}$.** Then the teacher told him that his bad result was due to his inattentiveness.
- (c) Express the roll number of the student of running class in Binary number system.
- (d) Evaluate the change in their result of the student in the Stimuli finding out the difference of the roll number of the two classes only through addition.

Become of natural disaster in 2016 the farmers suffered a lot of damage:

Farmer	crop	Area Damaged
Mr. Ali	Potato	$(42)_{10}$ Hector
Mr. Jamil	Rice	$(253)_8$ Hector
Mr. Hasib	Tomato	$(E3)_{16}$ Hector
Mr. Jalil	Carrot	$(110)_2$ Hector

- c) Subtract land of Mr. Jalil from land of Mr. Ali in 2’s complement system.
- d) Between Mr. Jamil and Mr. Hasib who become looser?

- Ages of Sumi, Sumi's father and mother are $(10)_{16}$, $(100)_8$ and $(2F)_{16}$ years respectively.
- (c) Convert the age of Sumi's mother into octal.
- (d) How many times is the age of Sumi's father than that of Sumi? Analyze.

- Roni gets idea about different number system in his ICT class, According to this idea, the age of his sister is $(110101)_2$ and the age of his brother is $(53)_8$. Roni and his brother purchase two school bags of the same brand and model by $(207)_{16}$ and $(510)_{10}$ Tk. accordingly from different stalls.
- (c) Find out the difference between the ages of Roni's brother and sister from the stem using addition system.
- (d) Find out the price of their school bags in octal-system and give your opinions.

- ‘X’, ‘Y’ and ‘Z’ are 3 friends. They went Bazar . X purchased books of Tk $(110110)_2$, Y purchased books of $(36)_8$ and Z purchased tk A9.

- Between X and Y who spent more money?
- (110110)   (011 110)
- What are the total price of X, Y and Z’s book in Octal ? (375)

Stem:

- ICT teacher said each of the three students to write one positional number each. Students wrote $(1010110)_2$,$(77)_8$ and $(1C)_{16}$.
- Subtract third number form 2^{nd} number using 2's complement method.
- According to the stern, whether the addition of first and third number is the largest or the smallest from second number? Analyze.

Stem:

- Monthly Telephone bill of Mr. Zaman Tk$(705.75)_{10}$. While going to purchage a laptop for Mobin, saw that RAM(3FF) and $(1247)_8$ Is written on 1^{st} and 2^{nd} laptop.

C) Convert telephone bill in to Hexadecimal

D) Which laptop is better?

110101010101010010100010
100101111000001000100101
010101010101001011100011
010001010010101110001001
010101010000111110101010
010101010101010100100011

Code

Code

- The computer code is a way of representing each character using only 0 and 1
- The letter, number and special characters that we input into computer are stored using computer code

BCD

- Binary Coded Decimal
- Represent each decimal digit by 4 bit binary digit

$(792)_{10} = (\ ?\ )_{BCD}$

7 9 2

0111 1001 0010

Difference between BCD code and Binary Number System

BCD	Binary Number
1. BCD code used to represent each decimal digit into 4 bit binary	1. It is a Number system that use only 0 and 1 called Binary Number system
2. Need more bit to represent any decimal number	2. Need less number bit to represent any decimal number
3. Example: $(13)_{10}=(0001\ 0011)_{BCD}$	3. Example: $(13)_{10}=(1101)_2$
4) BCD can be converted from only Decimal number	4) Can be converted from any number system

Alphanumeric code

- EBCDIC
- ASCII
- Unicode

EBCDIC

Extended Binary Coded Decimal Interchange Code

is an 8-bit character encoding

Can represent 2^8 or 256 character uniquely

- **EBCDIC created by** IBM company for using letter, symbols in their computers.

- In the year 1963 and 1964, computer input method was very old. In this method, input had to be given by making holes in the paper card.

- So when making EBCDIC, it was also considered to make holes in the paper.

Alphanumeric code

- Use alphabet, numbers and symbols
- a- z, A-Z, 0-9, @#$%^&*()
- Examples:
  - ASCII
  - Unicode

ASCII

- **American Standard Code for Information Interchange**
- This is an alphanumeric code of 7 bits. As it is 7 bits, it can express a total of 128 symbols
- A = 65= 100 0001

Partial chart of ASCII code

Character	Decimal equivalence value	ASCII
A	65	0100 0001
B	66	0100 0010
C	67	0100 0011
D	68	0100 0100

Partial chart of ASCII code

Character	Decimal equivalence value	ASCII
a	97	0110 0001
b	98	0110 0010
c	99	0110 0011
d	100	0110 0100

ASCII

- Initially a teleprinter was created to be used and later to integrate computers.

- Teleprinter- Device for transmitting telegraph messages as they are keyed, and for printing messages received.

- The first 32 codes are used for mechanical control, the remaining 96 codes are lowercase English letters (a-z), uppercase English letters (A-Z), numbers (0-9), punctuation marks (; /, ?:), Mathematical symbols (+, -,%) etc.

- The 8-bit ASCII is currently used by adding the eighth bit to the 8-bit ASCII
- A = 65= 0100 0001
-

Unicode

- 16 bit code
- Can identify 2^{16}= 65536 character uniquely
- character from all language become possible to identify (Chinese, Japanese, Greek etc.)
- Emoji are also included in Unicode

- 0000 0000 0000 0000
- To
- 1111 1111 1111 1111
-
-

- First version of Unicode(1.0.0) published in 1991. At that time it was possible to allow 24 languages in Unicode

- In 2020, 13^{th} version of Unicode is published. Its become possible to allow 154 languages in Unicode.

- There are several ways to process Unicode bites:

- UTF-8
- UTF-16

- UTF-Unicode Transformation Format

UTF-8(for website only)

- Although UFT-8 is 8 bit, only necessary bits will take place while being used.
- **Explain**
- All language of the world become possible to be coded