Computer Fundamental

Computer Codes / Character Encoding / Character Representation

- Binary Number = 0 & 1
- Binary Code = Character (A-Z, 0-9,symbols-@#$%^&*,…., Emoji 😊👌😎😃(●’◡’●),language-Hindi, Gujrati,urdu,Chinese,……)
- Most computers do not represent characters as pure binary numbers.
- They use a coded version of true binary to represent alphabets, digits, and special symbols($,%,#,*,&,!,…..) as well as decimal numbers.
- Character coding is standardized so that data can be transferred between different computers.
- Codes used are: - BCD, ASCII, EBCDIC, Gray Code, Excess-3 code

(ये Characters = Digits,symbols,letter,Emoji,any language {hindi,Chinese,urdu,…..} को binary{0,1} में बदलता हैं)

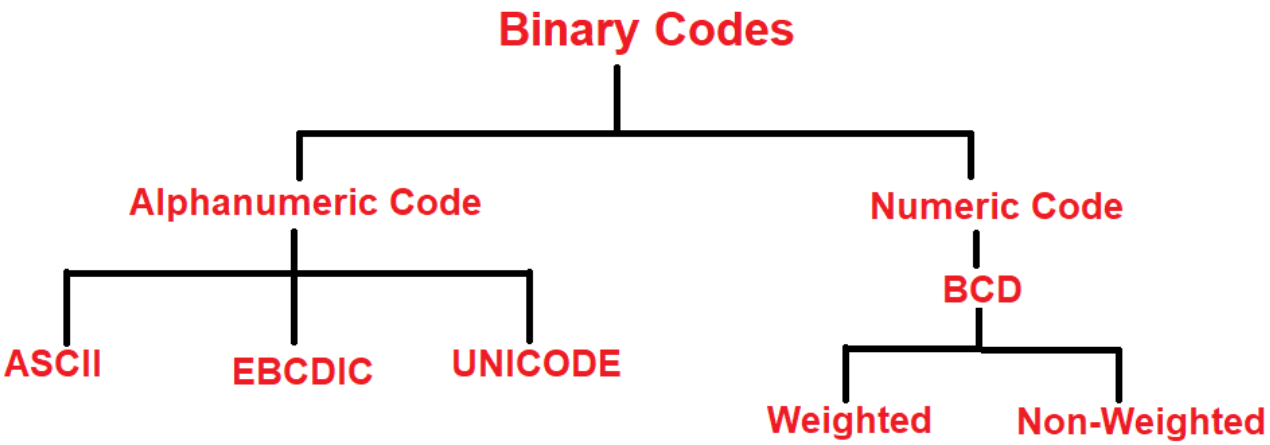
Q. What is Binary Code ?

→ It is the symbolic representation of discrete information which may be represented in the form of numeric, alphabets, Emoji & special characters.

- A binary code is a group of n-bits that can represent distinct/Specific symbols.

➢ Advantages of Binary Code

- Binary codes are suitable for the computer applications.
- Binary codes are suitable for the digital communications.
- Binary codes make the analysis and designing of digital circuits if we use the binary codes.
- Since only 0 & 1 are being used, implementation becomes easy.



➢ Numeric Code /BCD Two parts

1. Weighted Codes

2. Non-Weighted Codes

1. Weighted Codes :- A weighted code is a binary code in which each bit has a fixed positional weight. (हर digit का एक "weight/Value" होता हैं)

- These weights help to represent decimal digits (0-9) in binary form.
- E.g – 8421 (BCD),2421 Code, 5211 Code

✓ Use of Weighted codes

i. Electronic Calculators (all Calculators internally BCD use)
ii. Digital Clocks/Watches (BCD value show in LED/LCD)
iii. Digital Meters

iv. Digital systems/Digital Circuits (7-segment displays, keypad input system,…)
v. Microcontrollers/ Embedded system
vi. Banking & Financial calculators

2. Non-Weighted Codes

- These codes do not have fixed positional weights.
- No Fixed value(weight) is assigned to each bit.
- E.g –Gray Code, Excess-3(XS-3)

❖ BCD (Binary coded decimal)

- 4 bit (1 Nibble) represent all digit in binary form
- Four digit binary code
- In BCD we can use the binary number from = 0000-1001 only
- Which are the decimal equivalent from 0-9 respectively.
- BCD is weighted Code .

$$63_{10} = (0110\ 0011)_{BCD}$$
$$869_{10} = (1000\ 0110\ 1001)_{BCD}$$
$$4728_{10} = (0100\ 0111\ 0010\ 1000)_{BCD}$$
Decimal — BCD

  - Convert Decimal to BCD
  - Convert Binary to BCD
  - Convert BCD to Decimal
  - Convert BCD to Binary (BCD to Decimal and again Decimal to Binary)

➢ Excess 3 Code / xs-3

- Excess भी BCD की तरह 4 bit लेता हैं |
- Excess-3 code is a non-weighted code.
- It is a self-complementary binary coded decimal(BCD) code of 9's complement.
- Excess-3 codes are unweighted and can be obtained by adding 3 to each decimal digit.

- The codes 0000 and 1111 are not used for any digit which is an advantage for memory organization as these codes can cause fault in transmission line.

➢ Use of Excess-3 code

✓ Older Digital calculators
✓ Digital clocks/Counters
✓ Error detection systems
✓ BCD arithmetic systems
✓ Complement based substraction circuits

Excess-3 Code

Decimal	*BCD*	*Excess-3*
0	0000	0011
1	0001	0100
2	0010	0101
3	0011	0110
4	0100	0111
5	0101	1000
6	0110	1001
7	0111	1010
8	1000	1011
9	1001	1100

❖ Convert BCD to Excess-3 Code

- Step1 - पहले decimal निकालें
- Step2 - प्राप्त decimal में प्रत्येक अंक में जितना excess बोल रहा हैं उतना जोड़ से, यहाँ 3 हैं तो 3 जोड़ दें |
- Step 3 - जोड़ने पर जो प्राप्त होगा वो decimal ही होगा |
- Step4 - उस decimal को Excess में convert कर दो वो मेरा ans होगा

Q1. $(01000110)_{BCD} = (\quad)_{xs\text{-}3}$

Sol^n = (01000110) → 46

(01000110) → (4+3)(6+3)

(01000110) → 79 (convert Excess)

(01000110) → (0111 1001)

$(01000110)_{BCD}$ → $(01111001)_{xs\text{-}3}$ Solve

Q2. $(100001011001)_{BCD} = (101110001100)_{xs-3}$

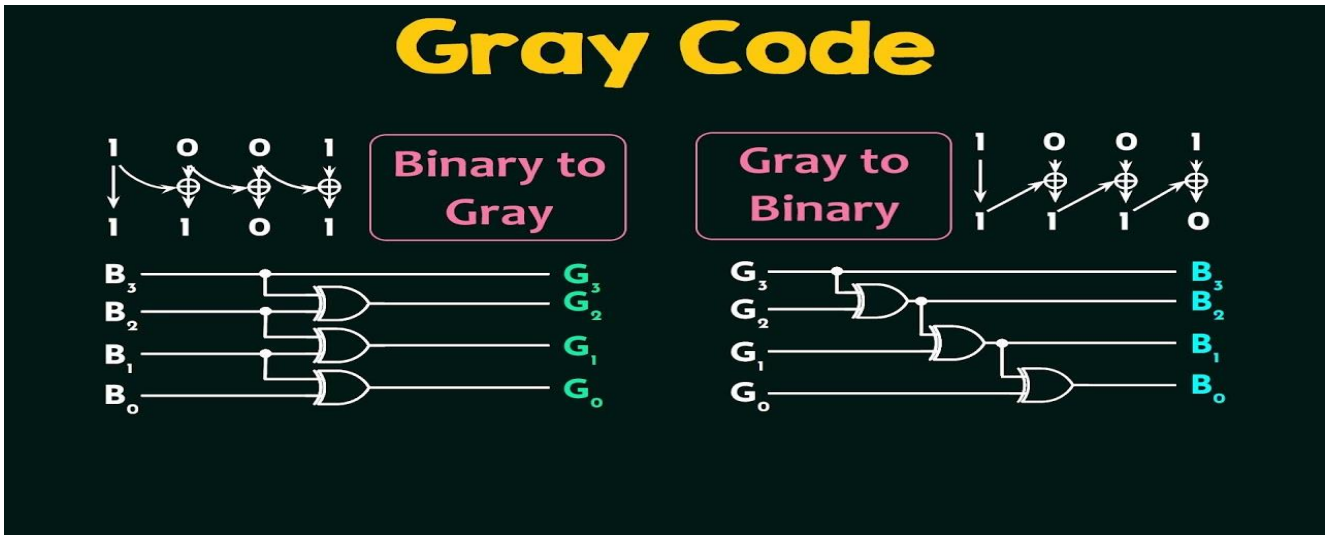
Q3. $(3)_{10} = (0110)_{xs-3}$

Q4. $(25)_{10} = (01011000)_{xs-3}$

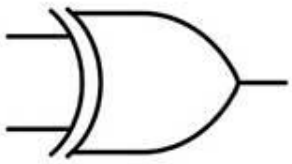
❖ Gray Code

- It is also called as = unit distance code.
- Unit code means = successive code words differ only one bit.
- Used to facilitate = Error correction in digital communications.
- This code was invented by = Frank Gray in 1953.

❖ Convert Binary code into Gray Code



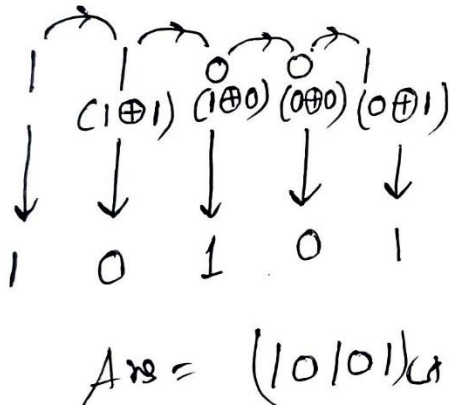
XOR



A	B	Output
0	0	0
1	0	1
0	1	1
1	1	0

Q. Convert $(11001)_B = (?)_G$

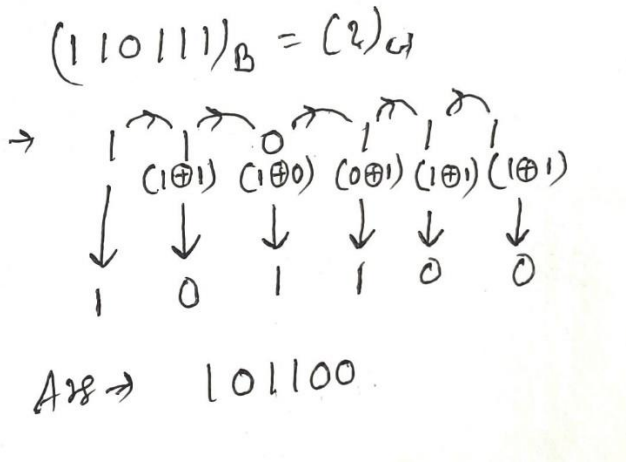
→



Step 1 → पहला digit को as it is लिख देंगे
Step 2 → जोड़े (1st digit को 2nd digit से)
(2nd digit को 3rd " ")
(3rd " को 4th " ")

Q. Convert $(110111)_B = (?)_G$

→



Q.Gray code of decimal 3 is → ans 0010

→ $(3)_{10} = (?)_G$ → decimal to binary and again Binary to decimal

Q. Gray code of decimal 15 is → ans 1000

Q. Gray code of decimal 18 is → ans 11011

❖ Convert Gray Code into Binary Code

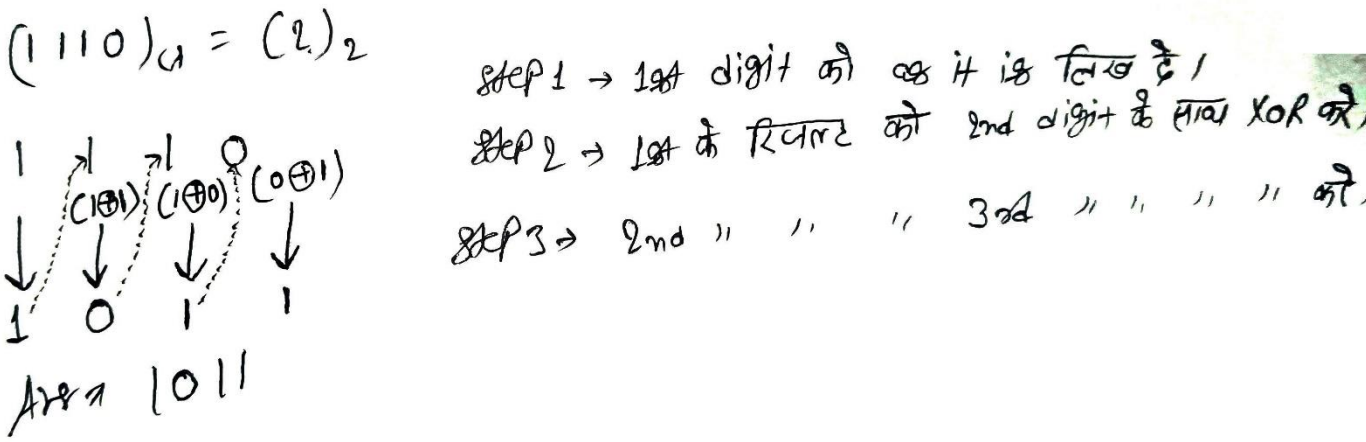
Step1 : Record the MSB (Most significant Bit) as it is

Step2 : Add MSB to the next bit of Gray Code.

Step3 : Record the sum & neglect the carry = (XOR)

Step4 : Repeat the process

Example → Convert $(1110)_G$ to Binary $(?)_2$



Q. Convert $(111101)_G = (?)_B$

Ans – 101001

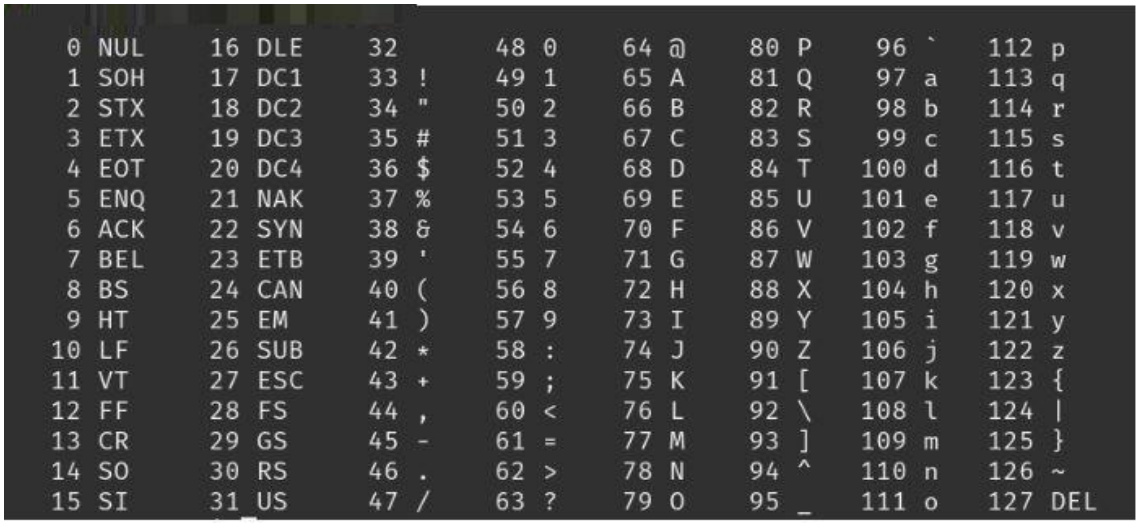
❖ ASCII (American Standard Code for Information Interchange)

- This technic all country is a same code use for data/ information send/interchange together.

Two types of ASCII

i) ASCII-7 bit (Original) (store $2^7 = 128$ character)

ii) ASCII-8 bit/ Extended ASCII (store $2^8 = 256$ character)



0	NUL	16	DLE	32		48	0	64	@	80	P	96	`	112	p
1	SOH	17	DC1	33	!	49	1	65	A	81	Q	97	a	113	q
2	STX	18	DC2	34	"	50	2	66	B	82	R	98	b	114	r
3	ETX	19	DC3	35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	20	DC4	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	21	NAK	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK	22	SYN	38	&	54	6	70	F	86	V	102	f	118	v
7	BEL	23	ETB	39	'	55	7	71	G	87	W	103	g	119	w
8	BS	24	CAN	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	25	EM	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF	26	SUB	42	*	58	:	74	J	90	Z	106	j	122	z
11	VT	27	ESC	43	+	59	;	75	K	91	[	107	k	123	{
12	FF	28	FS	44	,	60	<	76	L	92	\	108	l	124	|
13	CR	29	GS	45	-	61	=	77	M	93	]	109	m	125	}
14	SO	30	RS	46	.	62	>	78	N	94	^	110	n	126	~
15	SI	31	US	47	/	63	?	79	O	95	_	111	o	127	DEL

➢ Use of ASCII

- Old Computer System / legacy computers
- Basic Text files(txt)
- Network Protocols
- ASCII art (image create by characters)
- Programming use escape code(\n,\t,..)

ANSI = American National Standards Institute

It is organization that develops standards for computers,programming language,files,character codes, networking and more.

❖ EBCDIC (Extended Binary coded Decimal Interchange Code)

- It is a character encoding systems used by IBM mainframes.
- Its 8 bits character represent. i.e. 2^8=256 character.
- Mainly used in IBM mainframes and large business computers.
- In ASCII and EBCDIC Character same but code different/ Different encoding.

Code/Character	**A**	**F**	**0 (zero)**	**3**
ASCII (Decimal)	65	70	48	51
ASCII (Binary)	01000001	01000110	00110000	00110011
EBCDIC (Decimal)	C1	C6	F0	F3
ASCII (Binary)	11000001	11000110	11110000	11110011

➢ Use of EBCDIC Code

- IBM mainframe computers
- Banking systems
- Legacy business applications that still use IBM mainframes
- Reading old punched card data

➢ Unicode (Universal character encoding)

- Unicode is a universal character encoding standard that assigns a unique number to every character in every language,including symbols, emojis and special characters.
- Size of Unicode is 8-32 bits / character (Modern systems)
- Supports all language in the world (English,hindi,Chinese,Gujrati, urdu,…..)
- Each character has a unique code point.
- E.g – UTF-8 (1-4 bytes per character)
  UTF-16 (2 or 4 bytes)
  UTF-32 (4 bytes per character)

Example of Unicode

Character: A

Unicode code point: U+0041

Character: ञ

Unicode code point: U+0905

Character: 😊

Unicode code point: U+1F60A

Character: π

Unicode code point: U+03C0

✓ Use of Unicode

- Web pages (HTML,CSS,JavaScript)
- Mobile apps

- Operating systems (Winodws, linux,MacOS)
- Messaging Apps (Whatsapp, telegram,…)
- Any system that needs multi-language support

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