ECE213: Digital Electronics
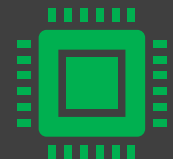
Ajmer Singh

9988921373

ajmer.17381@lpu.co.in
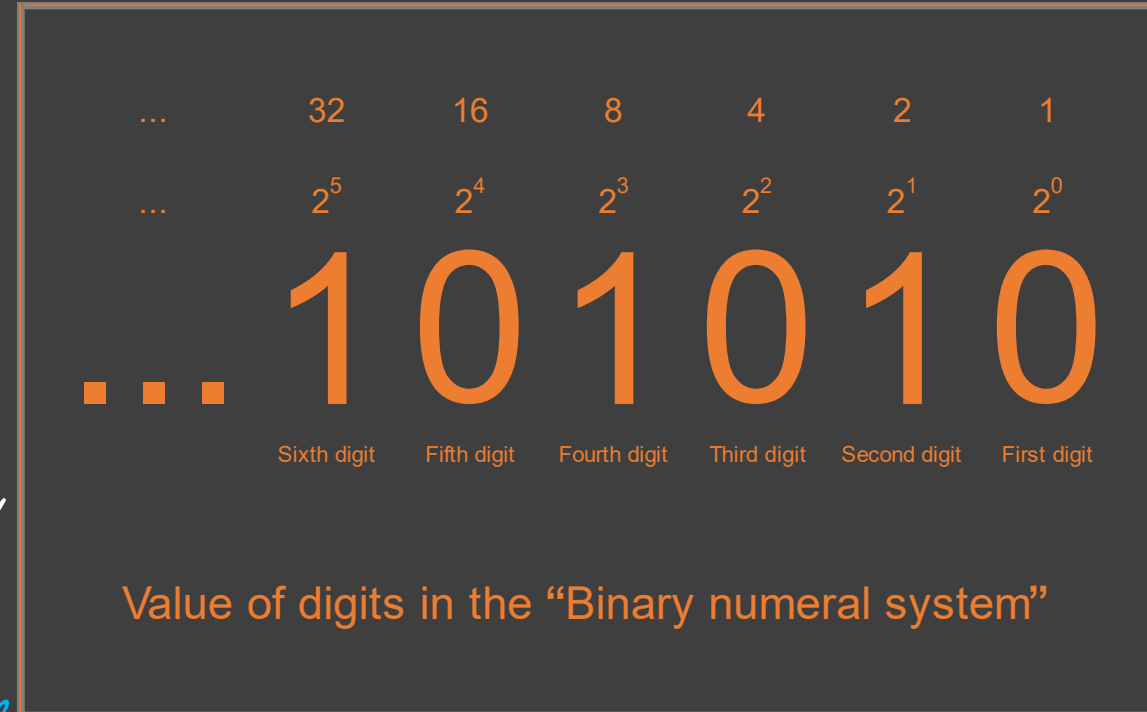
Unit 1

Number Systems : Digital Systems, Data representation and coding, Logic circuits, Implementation of digital systems, Number Systems, Codes- Positional number system, Binary number system, Methods of base conversions, Binary arithmetic, Representation of signed numbers, Fixed numbers, Binary coded decimal codes, Gray codes, Error detection code, Parity check codes, octal number system, Hexadecimal number system, Error correction code, Hamming code, Octal arithmetic, Hexadecimal arithmetic, Floating point numbers

...	32	16	8	4	2	1
...	2^5	2^4	2^3	2^2	2^1	2^0

... 1 0 1 0 1 0

| Sixth digit | Fifth digit | Fourth digit | Third digit | Second digit | First digit |

Value of digits in the "Binary numeral system"

Number Systems

Error detection code – Parity check codes

Data	Even Parity Code	Odd Parity Code
000	0 000	1 000
001	1 001	0 001
010	1 010	0 010
011	0 011	1 011
100	1 100	0 100
101	0 101	1 101
110	0 110	1 110
111	1 111	0 111

Algo : C

odd

If no. of ones in
C are (even)

Append '0'

else

Append '1'

end

Number Systems

Error detection code - Parity check codes

Block Parity (Even)

Px

Rx

Correct the detected error. By changing the bit.

Number Systems

Error detection code – Parity check codes

Ex   Identify the even parity code

A) $1 1 0 1 1 1 0$ odd $\longrightarrow$ Total no. of one's should be

B) $1 1 0 1 0 0$ odd   even

C) $1 1 0 1 0 1$ even   ✓

D) $1 1 1 0 1 0 1$ odd

Number Systems

Error detection code – Hamming code

★ what should be the size of hamming code.

$$\boxed{2^n - 1}$$

	P	l	D
Ex ✗ $n=1$		1	0
Costly ✓ $n=2$		3	①
# $\boxed{n=3}$		7	4
$n=4$		15	11
$n=5$		31	
		⋮	⋮

\# How many parity bits.

Ans. n

\# How many data bits

Ans $2^n - 1 - n = d$

Number Systems

Error detection code - Hamming code

⭐ 7-bit format of Hamming code

1 2 3 4 5 6 7

[🟨] parity bit position.

[🟪] data bit positions

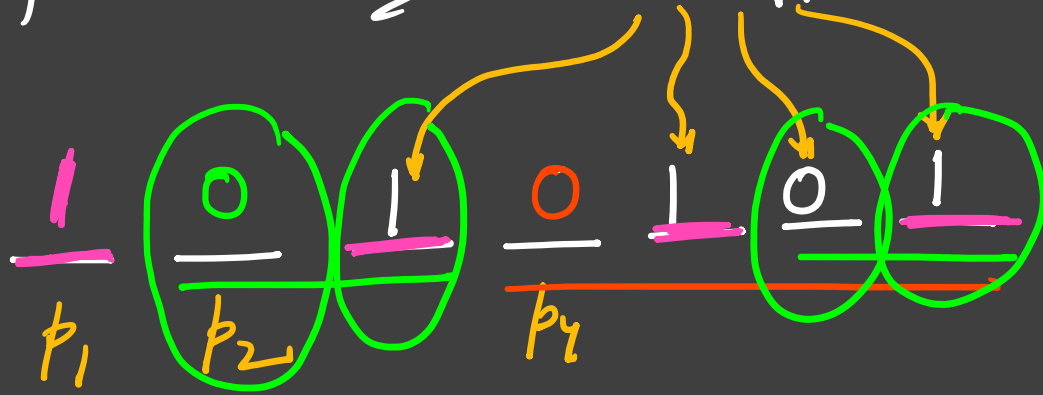| Total	p	d
7	[3]	4

poly.

2^0 2^1 2^2 2^3 2^4 2^5 -----

This will tell you the possits of parity bits.

1   2   4

Number Systems

Error detection code - Hamming code

Ex Write the 7-bit hamig code for data $D = 1101.$

Even

$$\underset{P_1}{1} \quad \underset{P_2}{0} \quad 1 \quad \underset{P_4}{0} \quad 1 \quad 0 \quad 1$$

$\Rightarrow P_1 \, (\, 1, 3, 5, 7\,)$

$\Rightarrow P_2 \, (\, 2, 3, 6, 7\,)$

$\Rightarrow P_4 \, (\, 4, 5, 6, 7\,)$

The 7-bit even parity hamig code for Data $D = 1101$ is

$C = 1010101$

* Type of Parity

(i) Even

(ii) odd.

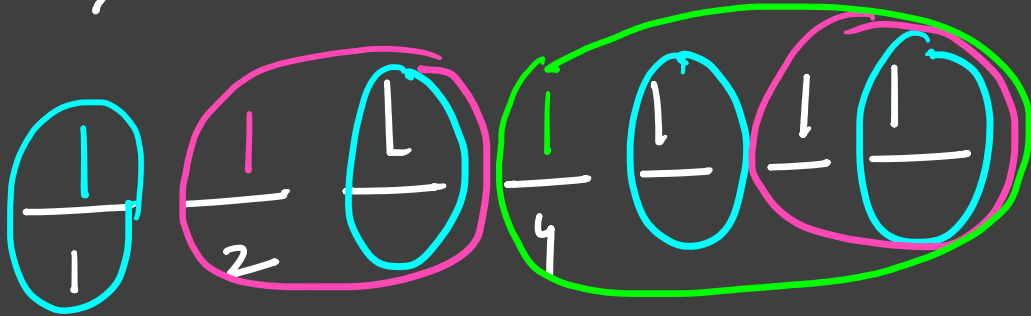Q: How we get to know that which bit possit are responsible for which parity bit

A:

P_4	P_2	P_1	
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Number Systems

Error detection code - Hamming code

Eve

$D = 1111$

$$\frac{1}{1} \quad \frac{1}{2} \quad \frac{1}{4} \quad \frac{1}{4}$$

$C = 11111111$

Ex

$D = 1001$

$$\frac{0}{} \quad \frac{0}{} \quad \frac{1}{} \quad \frac{1}{} \quad \frac{0}{} \quad \frac{0}{} \quad \frac{1}{}$$

Ex   odd parity hamming code

$D = 1111$

$$\frac{0}{} \quad \frac{0}{} \quad \frac{1}{} \quad \frac{0}{} \quad \frac{1}{} \quad \frac{1}{} \quad \frac{1}{}$$

Ex   odd parity hamming code

$D = 1001$

$$\frac{1}{} \quad \frac{1}{} \quad \frac{1}{} \quad \frac{0}{} \quad \frac{0}{} \quad \frac{0}{} \quad \frac{1}{}$$

Number Systems

Error detection code - Hamming code

☆ Left to Right
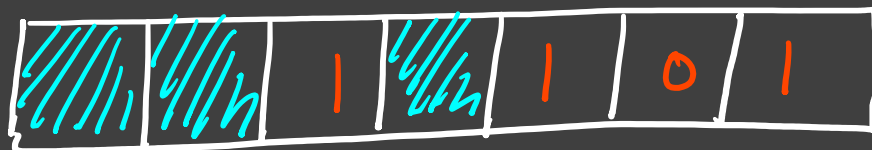
		1		1	0	1
1	2	3	4	5	6	7

P_1 P_2 P_4

☆ Right to left
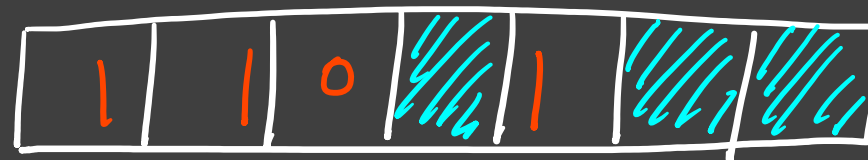
$D = 1101$

1	1	0		1		
7	6	5	4	3	2	1

P_4 P_2 P_1

Even

(A) 1 0 1 0 1 0 1

odd

(B) 0 1 1 1 1 0 1

(C) 1 1 0 0 1 1 0

(D) 1 1 0 1 1 0 1

Error detection code - Hamming code

D	R→L even	R→L odd	L→R Even	L→R odd
0 000				
0 001				
0 010				
0 011				
0 100				
0 101				
0 110				
0 111				
1 000				
1 001				
1 010				
1 011				
1 100				
1 101				