

# Digital Design

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## **Binary Codes**

# Codes

- Codes are the **symbolic representation of discrete information**, which may be presented in the form of numbers, letters or physical quantities.
- The symbols used for **binary digits** are **0** and **1** which are arranged according to the specified rule to make it as information.
- These codes are formed for **communication** information using digital computers.



# Codes Classification

- Binary Codes are broadly classified into five groups
  1. **Weighted Binary Codes**  
(Eg. 8421 , 2421 and BCD codes)
  2. **Non-Weighted Binary Codes**  
(Eg. Excess-3 and Grey Codes)
  3. **Error Detecting Codes**  
(Eg. Even-Parity code, Odd-Parity code, Check sums)
  4. **Error Correcting Codes**  
(Eg. Hamming code)
  5. **Alphanumeric codes**  
(Eg. ASCII codes)

# Weighted Binary Codes

- These codes obey the **Positional Weighting Principles**.
- Each number represents a specific weight.
- The bits are multiplied with indicated weights, the sum gives the decimal equivalent number
- Eg: 8421, 2421 and BCD codes

# Weighted Binary Codes : 8421 and 2421 codes

Weights



8	4	2	1	Decimal Equivalent
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

2	4	2	1	Decimal Equivalent
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
1	0	1	1	5
1	1	0	0	6
1	1	0	1	7
1	1	1	0	8
1	1	1	1	9

# Weighted Binary Codes : BCD Codes

- Binary Coded Decimals (BCD): Uses Binary number to specify decimal equivalent
- Uses four bits case for each decimal value

8	4	2	1	Decimal Equivalent
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

8	4	2	1	8	4	2	1	Decimal Equivalent
0	0	0	1	0	0	0	0	10
0	0	0	1	0	0	0	1	11
0	0	0	1	0	0	1	0	12
0	0	0	1	0	0	1	1	13
0	0	0	1	0	1	0	0	14
0	0	0	1	0	1	0	1	15
0	0	0	1	0	1	1	0	16
0	0	0	1	0	1	1	1	17
0	0	0	1	1	0	0	0	18
0	0	0	1	1	0	0	1	19

# Non-Weighted Binary Codes

- These codes not obey any **Positional Weighting Principles**.
- Each number is not assigned a fixed value.
- They obey a special rule hat an encoder decides
- **Eg.: Excess-3 and Grey Codes**

# Non-Weighted Binary Codes : Excess-3

- It is obtained by adding “3” to a decimal number. Its binary gives the exact code.
- It also uses **four bits** format as that of BCD codes

BCD				XS-3				DE
0	0	0	0	0	0	1	1	0
0	0	0	1	0	1	0	0	1
0	0	1	0	0	1	0	1	2
0	0	1	1	0	1	1	0	3
0	1	0	0	0	1	1	1	4
0	1	0	1	1	0	0	0	5
0	1	1	0	1	0	0	1	6
0	1	1	1	1	0	1	0	7
1	0	0	0	1	0	1	1	8
1	0	0	1	1	1	0	0	9

10 and 11 in XS-3

0	1	0	0	0	0	1	1	10
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0	1	0	0	0	1	0	0	11
---	---	---	---	---	---	---	---	----

# Non-Weighted Binary Codes : Gray Code

- Are also called **MINIMUM CHANGE CODES**
- In these codes only one bit in code group changes when moving from one step to next

Binary				Gray Codes				DE
0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1	1
0	0	1	0	0	0	1	1	2
0	0	1	1	0	0	1	0	3
0	1	0	0	0	1	1	0	4
0	1	0	1	0	1	1	1	5
0	1	1	0	0	1	0	1	6
0	1	1	1	0	1	0	0	7
1	0	0	0	1	1	0	0	8
1	0	0	1	1	1	0	1	9

Also Called Unit Distant Codes

Used in Analog to Digital Converters

Mirror Image Codes

# Shortcuts



# Binary to Gray Code Conversion and Vice-versa

- Will do in lectures after completion of XOR FUNCTION Implementation

# Random Examples

**Thank You**