Gray Code
Other Codes
Logic Families

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Gray Code

- It is sometimes convenient to use the Gray code to represent the digital data when it is converted from analog data
- The advantage of Gray code over straight binary number sequence is that only one bit in the code group changes when going from one number to the next

Gray Code

Decimal digit	Gray code
0	0000
1	0001
2	0011
3	0010
4	0110
5	0111
6	0101
7	0100

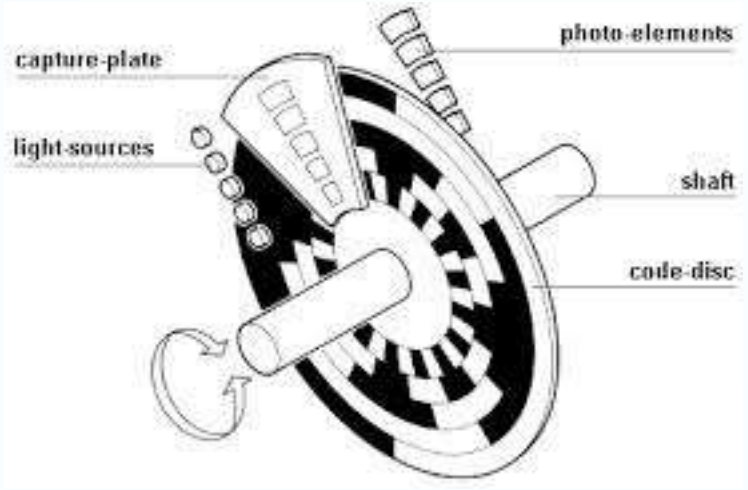
Decimal digit	Gray code
8	1100
9	1101
10	1111
11	1110
12	1010
13	1011
14	1001
15	1000

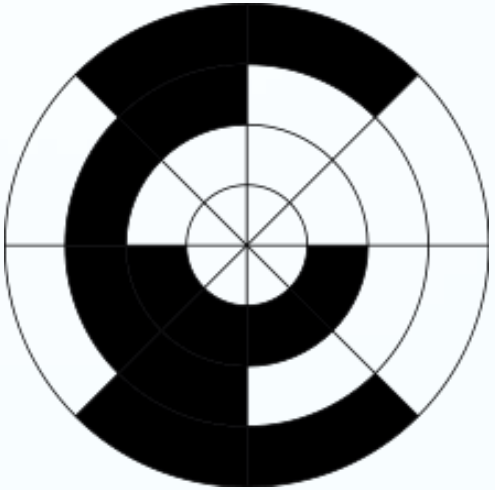
Gray Code Vs Binary Code

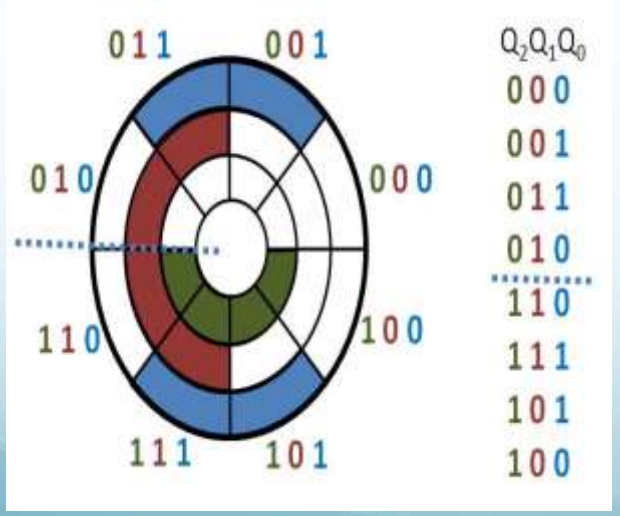
- Compare the number of bits changing when going from one number to the next:
  - In Gray code it is always 1 bit.

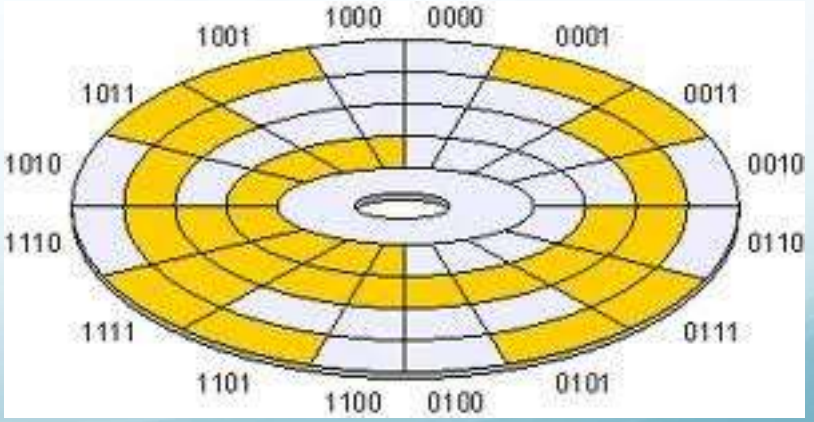
Binary Code	Bit Changes	Gray Code	Bit Changes
000		000	
	1		1
001		001	
	2		1
010		011	
	1		1
011		010	
	3		1
100		110	
	1		1
101		111	
	2		1
110		101	
	1		1
111		100	
	3		1
000		000	

Gray Code Application







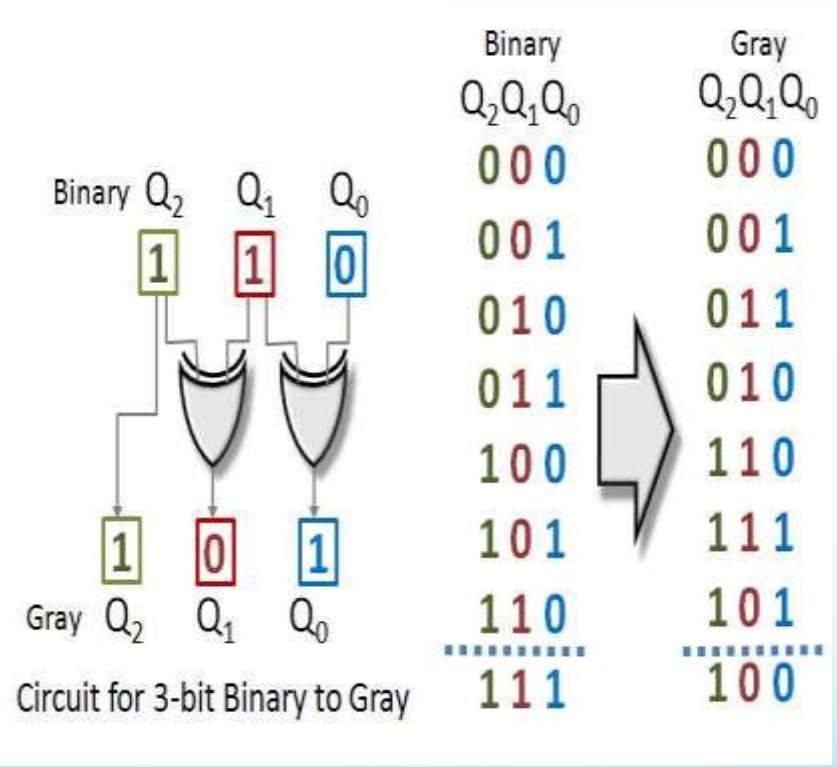


Conversion from Binary to Gray Code

- 1 0 1 1 0

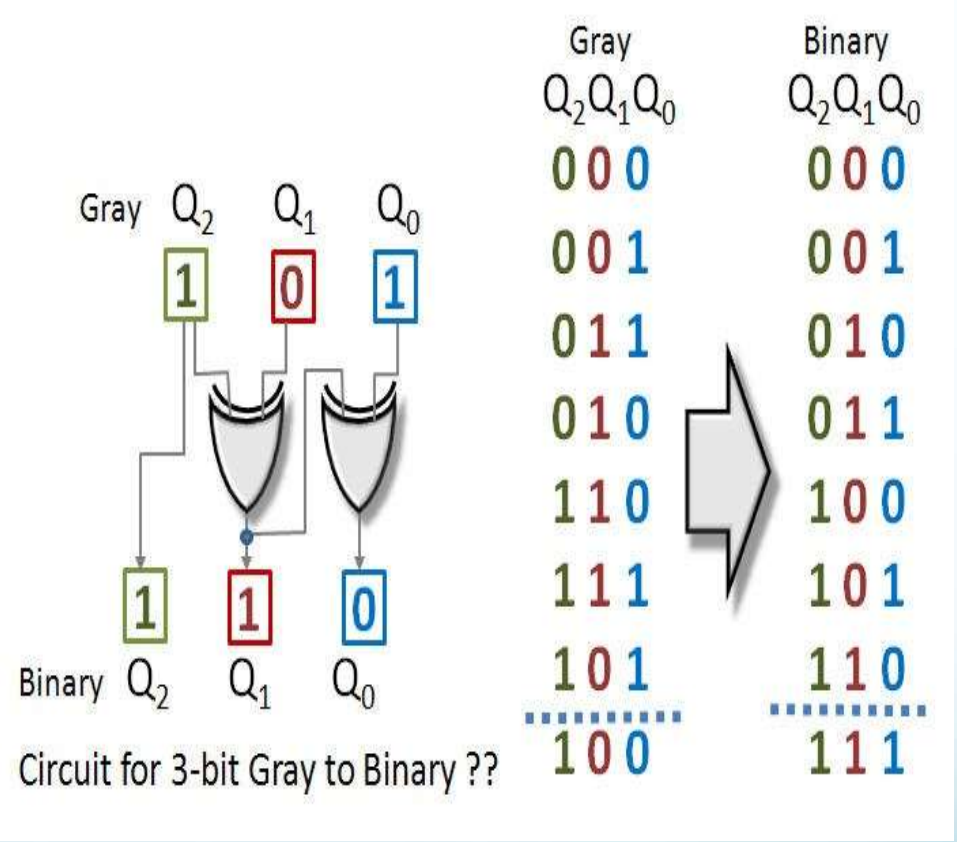
- First one copied
- Take ex-OR or add (Ignore Carr
  Left to right

- 1 1 1 0 1



Conversion from Gray to Binary Code

- 1 1 0 1 1
- First one copied
- Take ex-OR or add (Ignore Carry) diagonally from lower Left to upper right digit
- 1 0 0 1 0



ASCII Character Code

- The American Standard Code for Information Interchange (ASCII) uses seven bits to code 128 characters, representing the alphabets, decimal numbers, and various other symbols.
  - The following ASCII chart allows you to specify the characters in decimal representation by concatenating the column headings to the row headings.
    - For example, the character 5 is represented in binary as 0110101

ASCII Table

	$B_7B_6B_5$							
$B_4B_3B_2B_1$	000	001	010	011	100	101	110	111
0000	NULL	DLE	SP	0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

ASCII Table (Contd ……)

Control Characters:

NULL	NULL	DLE	Data link escape
SOH	Start of heading	DC1	Device control 1
STX	Start of text	DC2	Device control 2
ETX	End of text	DC3	Device control 3
EOT	End of transmission	DC4	Device control 4
ENQ	Enquiry	NAK	Negative acknowledge
ACK	Acknowledge	SYN	Synchronous idle
BEL	Bell	ETB	End of transmission block
BS	Backspace	CAN	Cancel
HT	Horizontal tab	EM	End of medium
LF	Line feed	SUB	Substitute
VT	Vertical tab	ESC	Escape
FF	Form feed	FS	File separator
CR	Carriage return	GS	Group separator
SO	Shift out	RS	Record separator
SI	Shift in	US	Unit separator
SP	Space	DEL	Delete

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ACK	Acknowledge	SYN	Synchronous idle
BEL	Bell	ETB	End of transmission block
BS	Backspace	CAN	Cancel
HT	Horizontal tab	EM	End of medium
LF	Line feed	SUB	Substitute
VT	Vertical tab	ESC	Escape
FF	Form feed	FS	File separator
CR	Carriage return	GS	Group separator
SO	Shift out	RS	Record separator
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Error-Detecting Code

- Error-Detecting uses an eighth bit (added to 7-bit ASCII character) to indicate parity.
  - A parity bit is an extra bit that is set to 0 or 1 as needed to make the total number of 1's either even or odd.
  - In an odd-parity code, the parity bit is specified so that the total number of ones is odd.
  - In an even-parity code, the parity bit is specified so that the total number of ones is even.
  - It detects one, three or any odd combination of errors but even combination of errors is undetected.

1 1 0 0 0 0 1 1 **0 1 0 0 0 0 1 1**

Added even parity bit **Added odd parity bit**

End of Lecture