Number System and Codes

BCD (8421)

- The 8421 is a type of Binary Coded Decimal (BCD) is alphanumeric
- This expresses each decimal digit with a binary code.
- Because decimal number span 0 – 9 that is ten counts, there are only ten code groups in BCD.

Decimal	0	1	2	3	4	5	6	7	8	9
BCD	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001

Converting Decimal to BCD

- This means that numbers 10 – 15 are invalide codes under BCD.

Decimal	10	11	12	13	14	15
BCD	1010	1011	1100	1101	1110	1111

- Convert 6, 13, 48, 269, 180 into BCD
- 6 = 0110, 13 = 00010011, 48 = 01001000
- **269 = 001001101001**
- **180 = 000110000000**

Converting BCD to Decimal

- You start from the right hand side and represent each four binary digit with its corresponding decimal. e.g.
- **100100100111** = **927**
- **1000000101010110****0010** = 81562
- The following are invalid BCD codes. Why?
- 10100011
- 10111010

Addition of BCD

- This is performed just like binary additions however we need to always check after addition whether any of the BCD in the answer is greater than 9
- If any is greater than 9 we need to add 6 to the final answer to get the results
- 1000 8 1001 9
- + 0001 + 1 +1000 +8
- 1001 9 10001 17

- 1001 9
- +1000 +8
- 1**0001** 17

answer is 1**1** not 17 invalid we need to add 6

10001

+ 0110

1**0111** The answer now is valid

Gray Codes

- This is not weighted and not numeric
- This signifies a single bit change from one code to the other and can therefore be used for error checking.
- We do not perform addition or subtraction on gray codes

- To find the gray code equivalent of a binary code

1. Repeat the leftmost digit of the binary number as the leftmost digit of the gray code
2. Add the various binary digits and discard any carry.

Converting Binary to Gray Code

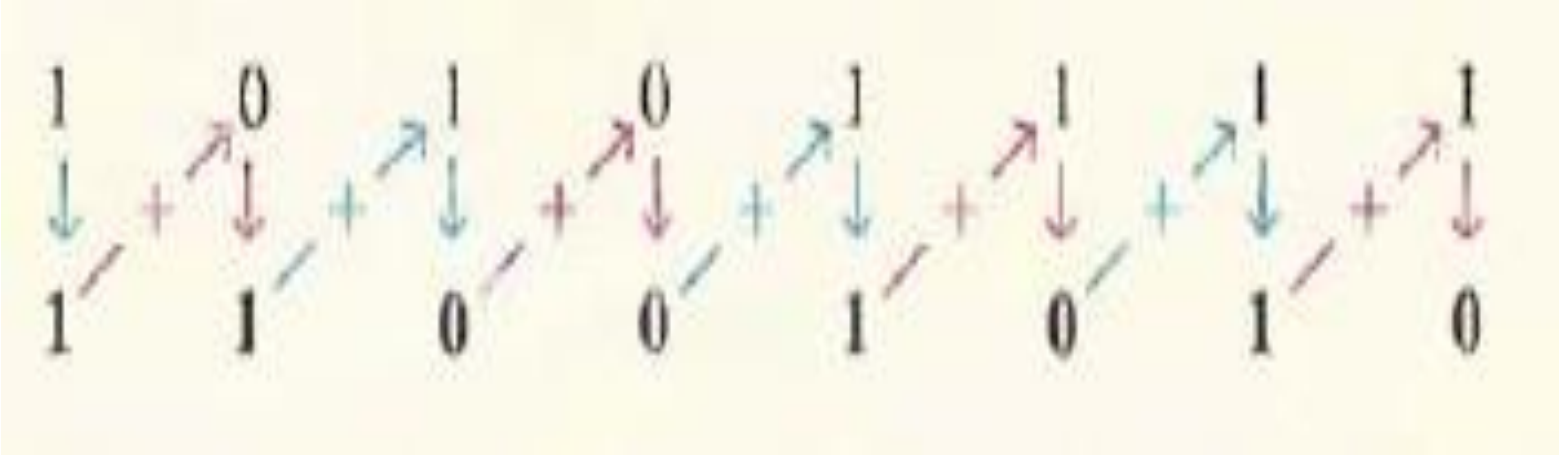
1. Example 101001

. 1 + 0 + 1 + 0 + 0 + 1

- 1 11101
- Convert 11010001 to gray code
- Answer 10111001

Converting Gray code to Binary

- Here we use the reverse order binary addition
- Again we repeat the first digit and then perform the reverse computation



- Example compute the binary number from the following gray codes
- 11010101001
- 00110101011
- 11100001110

Solution

- 11010101001 = **10011001110**

  Gray **Binary**
- 00110101011 = **00100110010**

  Gray **Binary**
- 11100001110 = **10111110100**

  Gray **Binary**

ASCII

American Standard Code for Information Interchange

- This is an alphanumeric code used to represent various characters and numbers
- ASCII has 128 characters and symbols that can be represented by 7 bits
- The extended ASCII has 8 bit character representation.

Parity bit (Error detection)

- Parity bits are used to detect errors.
- This actually uses a number of ones (1) to check the error
- There are two types of such bits

1. Odd parity (odd number of 1s)
2. Even parity (even number of 1s)

Parity bit cont.

- If the code
- **1**0001 is transmitted for instance using parity bit, then the left bit is the parity. This is an event parity transmission. Even number of 1s
- **1**0101 is transmitted. It is an odd parity transmission because the transmitted code must have odd number of ones

Parity transmission

EVEN PARITY		ODD PARITY	
P	BCD	P	BCD
0	0000	1	0000
1	0001	0	0001
1	0010	0	0010
0	0011	1	0011
1	0100	0	0100
0	0101	1	0101
0	0110	1	0110
1	0111	0	0111
1	1000	0	1000
0	1001	1	1001

Home Work 2

1. Convert 589 and 450 to BCD
2. Find the binary equivalent of 145 and 227
3. Find the gray code equivalent of 2 above
4. Find the binary equivalent of the gray codes 1011010 and 1010001
5. Find the parity bit if 1010101 and 1100001 are transferred using odd and even parity

Required parity bits to check for error

Good Luck