Binary Codes

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M	T	W	T	F	S	S	M	T	W	T	F	S	S
			1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29										

A code is simply a system of symbols by means of which meaningful communications can be effected to and from a digital circuit. Computers and other digital circuits are required to handle data which may be numeric, alphabets or special characters. But because digital circuits work in a binary manner, we have to convert the Numerals or alphabets etc. into binary format. There are various possible ways of doing this and this process is called encoding.

Various codes are in existence and they serve different purposed. Codes are also used for error detection and correction in digital circuits. Some commonly used codes are discussed here.

BCD or The 8421 Code:

A coding method much used is the straight binary code, where all numbers are coded in binary fashion. Hence 1 is 001; 7 is 0111; 105 is 1101001. This system has the disadvantage that large numbers require a great deal of hardware to handle these.

The above difficulty is encountered by using another coding system - called binary coded decimal or simply BCD. In this system, individual decimal digits are coded in binary notation and are

operated upon singly. Thus binary codes representing 0 to 9 decimal digits are allowed. for example 342 in BCD is

0011 0100 0010
(3) (4) (2)

Since 8 bit system is sufficient to handle any decimal digit, only four elements of hardware are needed to operate upon the number because each digit is operated upon at different time. Thus a single four stage register, consisting of four flip-flops can handle any decimal number. This is also called the 8-4-2-1 Code.

Table shows that 1001 is the largest four bit group in 8421 code. In other words, only 10 of the 16 possible four-bit groups are used. The 8421 code does not use the binary numbers 1010, 1011, 1100, 1101, 1110, 1111. This BCD digits are restricted to the four bit numbers from 0000 through 1001, and 1010 through 1111 cannot occur for normal operation (six invalid states).

Thus BCD or 8421 code is identical to binary through decimal number 9.

Ex-1 Convert each of the following numbers into BCD. 3, 9, 18, 34, 321 and 1472.

Sol

(a) 3 → 0011

(b) 9 → 1001

(c) 18 → 0001 1000

(d) 34 → 0011 0100

(e) 65 → 0110 0101

(f) 321 → 0011 0010 0001

1472 → 0001 0100 0111 0010

Ex Find the decimal Number represented by the following BCD codes.

(a) 10000110
(b) 00110001
(c) 1000101101000

Sol (a) 1000 0110
↓ ↓
8 6 = 86

(b) 0011 0001
↓ ↓
3 1 = 31

(c) 1001 0111 0100
↓ ↓ ↓
9 7 4 = 974

Decimal	8 4 2 1	Binary
0	0000	0000
1	0001	0001
2	0010	0010
3	0011	0011
4	0100	0100
5	0101	0101
6	0110	0110
7	0111	0111
8	1000	1000
9	1001	1001
10	0001	0000	1010
11	0001	0001	1011
12	0001	0010	1100
-	-		
15	0001	0101	1111
-	-		

11 Sunday **BCD Addetion:**

Other Three operations, Namely Subtraction, Multiplication and division can be accomplished using addition. In order to add two BCD Numbers:

(i) Add the two No. using the rules for binary addition.
(ii) If a four-bit Sum is equal to or less than 9, it is valid BCD Number.
(ii) If a four bit Sum is greater than 9 or if a Carry is Generated, it is an invalid result.

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Add 0110 (=6) to the four-bit sum in order to skip the six invalid states and return to the code 8421. If a carry results when 6 is added, simply add it to the next four bit group.

Ex 1 Add the following BCD numbers:

(a)

1000	0110	86
+ 0001	+ 0011	+ 13
1001	1001	99_{10}

The result is a valid BCD number because four bit sum is equal to 9 but not greater than 9.

(b)

1001	9
+ 0100	+ 4
1101	13_{10}

It is invalid BCD number because sum of four bit exceeds 9. Therefore add 0110 (=6):

1101 — Invalid BCD Number
+ 0110 — Add 6
0001 0011 — Valid BCD Number.

Sum of 0001 is 1 and that of 0011 is 3. Neither of them exceeds 9. Therefore it is a valid BCD number.