Binary codes

- Binary Coded Decimal (BCD)
  - Most commonly used code to represent decimal digits with a binary code
  - There are only ten code groups
  - Numeric code
- The 8421 BCD code
  - BCD means, each decimal digit from 0 to 9 are represented by a binary code of four bits
  - 8421 indicates the binary weights of the four bits (2^3, 2^2, 2^1, 2^0)
  - Advantage: easy of conversion between 8421 code numbers and decimal numbers

Decimal/BCD conversion

- Each decimal is represented in four bit binary
- 8421 is the predominant code, therefore whenever BCD is mentioned, it refers to 8421 code
- Invalid Codes: codes from 1010 to 1111
- Applications: Digital thermometers, digital clocks and other digital devices with seven-segment display

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

Example: Decimal/BCD conversion

- Convert the decimal numbers 35 and 2469 to BCD

3	5		2	4	6	9
0011	0101		0010	0100	0110	1001

- Convert 10000110 and 1001010001110000 to decimal

8	6		1001	0100	0111	0000
1000	0110		9	4	7	0

BCD Addition

1. Add the two BCD numbers using binary addition rule
2. The four bit sum
   - ≤ 9, it is valid BCD number
   - > 9 or if a carry bit is generated, the result is invalid
     - Add 6 (0110) to the four bit sum to skip the six invalid states and return to the 8421 BCD code

Example: BCD Addition

- Add
  - 0011 + 0100

	0011	3
+	0100	+ 4
	0111	7

  - 00100011 + 00010101

	0010 0011	23
+	0001 0101	+ 15
	0011 1000	38

Example: BCD Addition

- Add
  - 1001 + 0100

	1001		9
+	0100	+	4
	1101	← Invalid	13
+	0110		
0001	0011		
1	3		