Number system: Computer Application in Pharmacy Pharmacy

The technique to represent and work with numbers is called number system. Decimal number system is the most common number system. Other popular number systems include binary number system, octal number system, hexadecimal number system, etc.

| Binary	Octal	Decimal	Hexadecimal
Has 2 symbols	Has 8 symbols	Has 10 symbols	Has 16 symbols
Symbols are 0,1	Symbols are 0, 1, 2, 3, 4, 5, 6 and 7	Symbols are from 0 to 9	Symbols are 0 to 9 and A to F where A is equal to 10, B is equal to 11 and so on till F
Also Called Bit, Positional value System	Positional value system	Positional value system	Positional value system
Value expressed in base of 2	Value expressed in base of 8	Value expressed in base of 10	Value expressed in base of 16
Eg: $(101001)_2$	Eg: $(256)_8$	Eg: $(8502)_{10}$	Eg: $(6E5)_{16}$

Binary Number System

The easiest way to vary instructions through electric signals is two-state system – on and off. On is represented as 1 and off as 0, though 0 is not actually no signal but signal at a lower voltage. The number system having just these two digits – 0 and 1 – is called binary number system.
Each binary digit is also called a bit. Binary number system is also positional value system, where each digit has a value expressed in powers of 2, as displayed here.

2^5	2^4	2^3	2^2	2^1	2^0

In any binary number, the rightmost digit is called least significant bit and leftmost digit is called most significant bit .

MSB   LSB
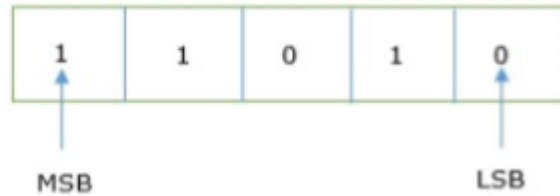
And decimal equivalent of this number is sum of product of each digit with its positional value.

$$11010_2 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

$$= 16 + 8 + 0 + 2 + 0$$

$$= 26_{10}$$

Computer memory is measured in terms of how many bits it can store. Here is a chart for memory capacity conversion.

- 1 byte = 8 bits
- 1 Kilobytes = 1024 bytes
- 1 Megabyte = 1024 KB
- 1 Gigabyte = 1024 MB
- 1 Terabyte = 1024 GB
- 1 Exabyte = 1024 PB
- 1 Zettabyte = 1024 EB
- 1 Yottabyte = 1024 ZB

Octal Number System

Octal number system has eight digits – 0, 1, 2, 3, 4, 5, 6 and 7. Octal number system is also a positional value system with where each digit has its value expressed in powers of 8, as shown here –

8^5	8^4	8^3	8^2	8^1	8^0

Decimal equivalent of any octal number is sum of product of each digit with its positional value.

$$726_8 = 7 \times 8^2 + 2 \times 8^1 + 6 \times 8^0$$

$$= 448 + 16 + 6$$

$$= 470_{10}$$

Decimal Number System

Decimal number system is a base 10 number system having **10 digits** from **0 to 9**. This means that any numerical quantity can be represented using these 10 digits. Decimal number system is also a positional value system. This means that the value of digits will depend on its position. Let us take an example to understand this.

Say we have three numbers – 734, 971 and 207. The value of 7 in all three numbers is different–

- In 734, value of 7 is 7 hundreds or 700 or 7×100 or 7×10^2
- In 971, value of 7 is 7 tens or 70 or 7×10 or 7×10^1
- In 207, value of 7 is 7 units or 7 or 7×1 or 7×10^0

The weightage of each position can be represented as follows –

10^5	10^4	10^3	10^2	10^1	10^0

In digital systems, instructions are given through electric signals; variation is done by varying the voltage of the signal. Having 10 different voltages to implement decimal number system in digital equipment is difficult. So, many number systems that are easier to implement digitally have been developed. Let's look at them in detail.

Hexadecimal Number System

Octal number system has **16 symbols – 0 to 9 and A to F** where A is equal to 10, B is equal to 11 and so on till F. Hexadecimal number system is also a positional value system with where each digit has its value expressed in powers of 16, as shown here

16^5	16^4	16^3	16^2	16^1	16^0

Decimal equivalent of any hexadecimal number is sum of product of each digit with its positional value.

$27FB_{16} = 2 \times 16^3 + 7 \times 16^2 + 15 \times 16^1 + 10 \times 16^0$

$= 8192 + 1792 + 240 + 10$

$= 10234_{10}$

Number System Relationship

The following table depicts the relationship between decimal, binary, octal and hexadecimal number systems.

Dec	Hex	Oct	Bin
0	0	000	00000000
1	1	001	00000001
2	2	002	00000010
3	3	003	00000011
4	4	004	00000100
5	5	005	00000101
6	6	006	00000110
7	7	007	00000111
8	8	010	00001000
9	9	011	00001001
10	A	012	00001010
11	B	013	00001011
12	C	014	00001100
13	D	015	00001101
14	E	016	00001110
15	F	017	00001111

Dec	Hex	Oct	Bin
16	10	020	00010000
17	11	021	00010001
18	12	022	00010010
19	13	023	00010011
20	14	024	00010100
21	15	025	00010101
22	16	026	00010110
23	17	027	00010111
24	18	030	00011000
25	19	031	00011001
26	1A	032	00011010
27	1B	033	00011011
28	1C	034	00011100
29	1D	035	00011101
30	1E	036	00011110
31	1F	037	00011111

Dec	Hex	Oct	Bin
32	20	040	00100000
33	21	041	00100001
34	22	042	00100010
35	23	043	00100011
36	24	044	00100100
37	25	045	00100101
38	26	046	00100110
39	27	047	00100111
40	28	050	00101000
41	29	051	00101001
42	2A	052	00101010
43	2B	053	00101011
44	2C	054	00101100
45	2D	055	00101101
46	2E	056	00101110
47	2F	057	00101111

Dec	Hex	Oct	Bin
48	30	060	00110000
49	31	061	00110001
50	32	062	00110010
51	33	063	00110011
52	34	064	00110100
53	35	065	00110101
54	36	066	00110110
55	37	067	00110111
56	38	070	00111000
57	39	071	00111001
58	3A	072	00111010
59	3B	073	00111011
60	3C	074	00111100
61	3D	075	00111101
62	3E	076	00111110
63	3F	077	00111111

Dec	Hex	Oct	Bin
64	40	100	01000000
65	41	101	01000001
66	42	102	01000010
67	43	103	01000011
68	44	104	01000100
69	45	105	01000101
70	46	106	01000110
71	47	107	01000111
72	48	110	01001000
73	49	111	01001001
74	4A	112	01001010
75	4B	113	01001011
76	4C	114	01001100
77	4D	115	01001101
78	4E	116	01001110
79	4F	117	01001111

Dec	Hex	Oct	Bin
80	50	120	01010000
81	51	121	01010001
82	52	122	01010010
83	53	123	01010011
84	54	124	01010100
85	55	125	01010101
86	56	126	01010110
87	57	127	01010111
88	58	130	01011000
89	59	131	01011001
90	5A	132	01011010
91	5B	133	01011011
92	5C	134	01011100
93	5D	135	01011101
94	5E	136	01011110
95	5F	137	01011111

Dec	Hex	Oct	Bin
96	60	140	01100000
97	61	141	01100001
98	62	142	01100010
99	63	143	01100011
100	64	144	01100100
101	65	145	01100101
102	66	146	01100110
103	67	147	01100111
104	68	150	01101000
105	69	151	01101001
106	6A	152	01101010
107	6B	153	01101011
108	6C	154	01101100
109	6D	155	01101101
110	6E	156	01101110
111	6F	157	01101111

Dec	Hex	Oct	Bin
112	70	160	01110000
113	71	161	01110001
114	72	162	01110010
115	73	163	01110011
116	74	164	01110100
117	75	165	01110101
118	76	166	01110110
119	77	167	01110111
120	78	170	01111000
121	79	171	01111001
122	7A	172	01111010
123	7B	173	01111011
124	7C	174	01111100
125	7D	175	01111101
126	7E	176	01111110
127	7F	177	01111111