

A decorative graphic on the left side of the slide features a cluster of 3D-rendered numbers (0-9) and various numerical bases (2, 4, 5, 8, 9, 10, 15, 21, 30, 40, 50, 60, 80, 90). The numbers and bases are arranged in a dynamic, overlapping pattern, with some appearing to float above others. The bases are small superscripts. The entire graphic is rendered in a light gray color with soft shadows, giving it a three-dimensional appearance. The background of the slide is white, and the bottom features a blue and black wavy design.

# Base Numbering Systems

Bitwise Operations

Base 10	$10^2 = 100$	$10^1 = 10$	$10^0 = 1$
0	0	0	0
1	0	0	1
2	0	0	2
3	0	0	3
4	0	0	4
5	0	0	5
6	0	0	6
7	0	0	7
8	0	0	8
9	0	0	9
10	0	1	0
11	0	1	1
12	0	1	2
13	0	1	3
14	0	1	4
15	0	1	5

Base 16	$16^1 = 16$	$16^0 = 1$
0	0	0
1	0	1
2	0	2
3	0	3
4	0	4
5	0	5
6	0	6
7	0	7
8	0	8
9	0	9
10	0	A
11	0	B
12	0	C
13	0	D
14	0	E
15	0	F

Base 2	$2^4 = 16$	$2^3 = 8$	$2^2 = 4$	$2^1 = 2$	$2^0 = 1$
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1

# Compliment (~)

~	
~0000	1111
~1111	0000

# Bitwise AND (&)

&	0		1	
	0		1	
0	0	0	0	0
1	0	0	1	1

10 = 1010

7 = 0111

10 & 7 = 1010

0111

----

0010 = 2

# Bitwise OR (|)

	0	1
0	0	1
1	1	1

10 = 1010

7 = 0111

10 | 7 = 1010

0111

----

1111 = 15

# Bitwise EOR (^)

$\wedge$	0	1
0	0	1
1	1	0

10 = 1010

7 = 0111

10  $\wedge$  7 = 1010

0111

----

1101 = 13



# Bitwise Right Shift (>>)

Shifts bits to the right:

$$8 \gg 1 = 1000 \gg 1 = 0100 = 4$$

$$8 \gg 2 = 1000 \gg 2 = 0010 = 2$$

$$8 \gg 3 = 1000 \gg 3 = 0001 = 1$$

$$8 \gg 4 = 1000 \gg 4 = 0000 = 0$$

# Bitwise Left Shift (<<)

Shifts bits to the left:

$$8 \ll 1 = 1000 \ll 1 = 10000 = 16$$

$$8 \ll 2 = 1000 \ll 2 = 100000 = 32$$

$$8 \ll 3 = 1000 \ll 3 = 1000000 = 64$$

$$8 \ll 4 = 1000 \ll 4 = 10000000 = 128$$