

Bitwise operators

1

2

3

4

5

6

Bitwise

a / b

1 → True
0 → False

$$a = 10$$

$$b = 14$$

$$\begin{array}{r} 2 \overline{) 10} \\ 2 \overline{) 5 - 0} \\ 2 \overline{) 2 - 1} \\ \underline{1 - 0} \end{array} \uparrow 1010_{(2)}$$

$$\begin{array}{r} 2 \overline{) 14} \\ 2 \overline{) 7 - 0} \\ 2 \overline{) 3 - 1} \\ \underline{1 - 1} \end{array} \uparrow 1110_{(2)}$$

a → 1010

b → 1110

$$\begin{array}{r} 1010 \\ 1110 \\ \hline 1110 \end{array}$$
$$\begin{array}{r} 2^3 & 2^2 & 2^1 & 2^0 \\ 1 & 1 & 1 & 0 \end{array}$$

$$2^3 * 1 + 2^2 * 1 + 2^1 * 1 + 2^0 * 0$$

$$8 + 4 + 2 + 0 \Rightarrow 14$$

Bitwise & :

$a \& b$

$$a = 10$$

$$b = 12$$

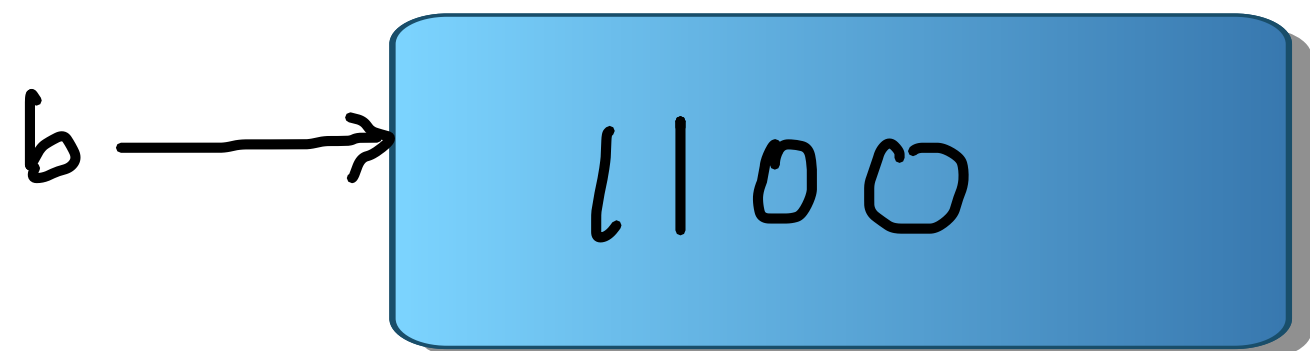
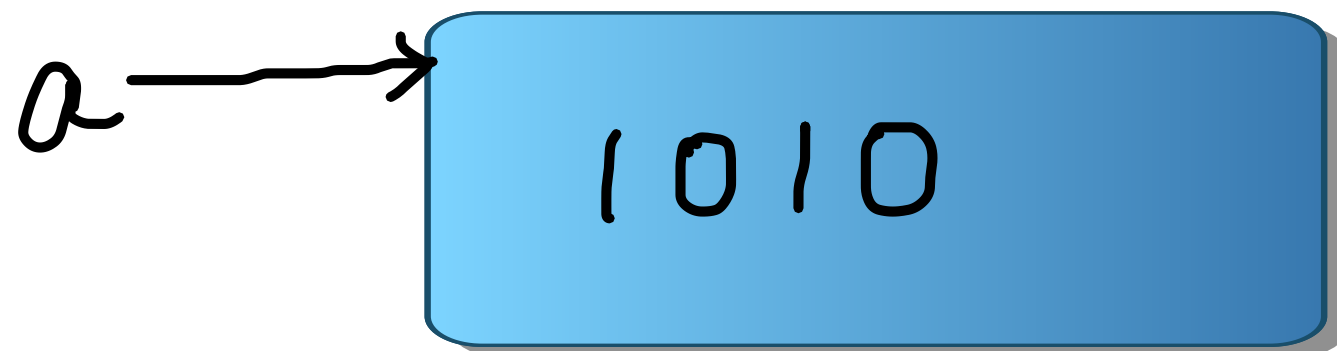
$$\begin{array}{r} 2 \overline{) 12} \\ 2 \overline{) 6} - 0 \\ 2 \overline{) 3} - 0 \\ \underline{1} - 1 \end{array} \uparrow 1100_{(2)}$$

$$\begin{array}{r} 1010 \\ 1100 \\ \hline 1000 \end{array}$$

$$\begin{array}{cccc} 2^3 & 2^2 & 2^1 & 2^0 \\ 1 & 0 & 0 & 0 \end{array}$$

$$2^3 * 1 + 2^2 * 0 + 2^1 * 0 + 2^0 * 0$$

$$8 + 0 + 0 + 0 \Rightarrow 8$$



Bitwise \wedge (XOR):

$$a = 10$$

$$b = 12$$

$a \wedge b$

$$\begin{array}{r} 1010 \\ 1100 \\ \hline 0110 \end{array}$$

$$\begin{array}{cccc} 2^3 & 2^2 & 2^1 & 2^0 \\ 0 & 1 & 1 & 0 \end{array}$$

$$2^3 * 0 + 2^2 * 1 + 2^1 * 1 + 2^0 * 0$$

$$0 + 4 + 2 + 0 \Rightarrow 6$$

1	1	$\rightarrow 0$
0	1	$\rightarrow 1$
1	0	$\rightarrow 1$
0	0	$\rightarrow 0$

a \rightarrow 1010

b \rightarrow 1100

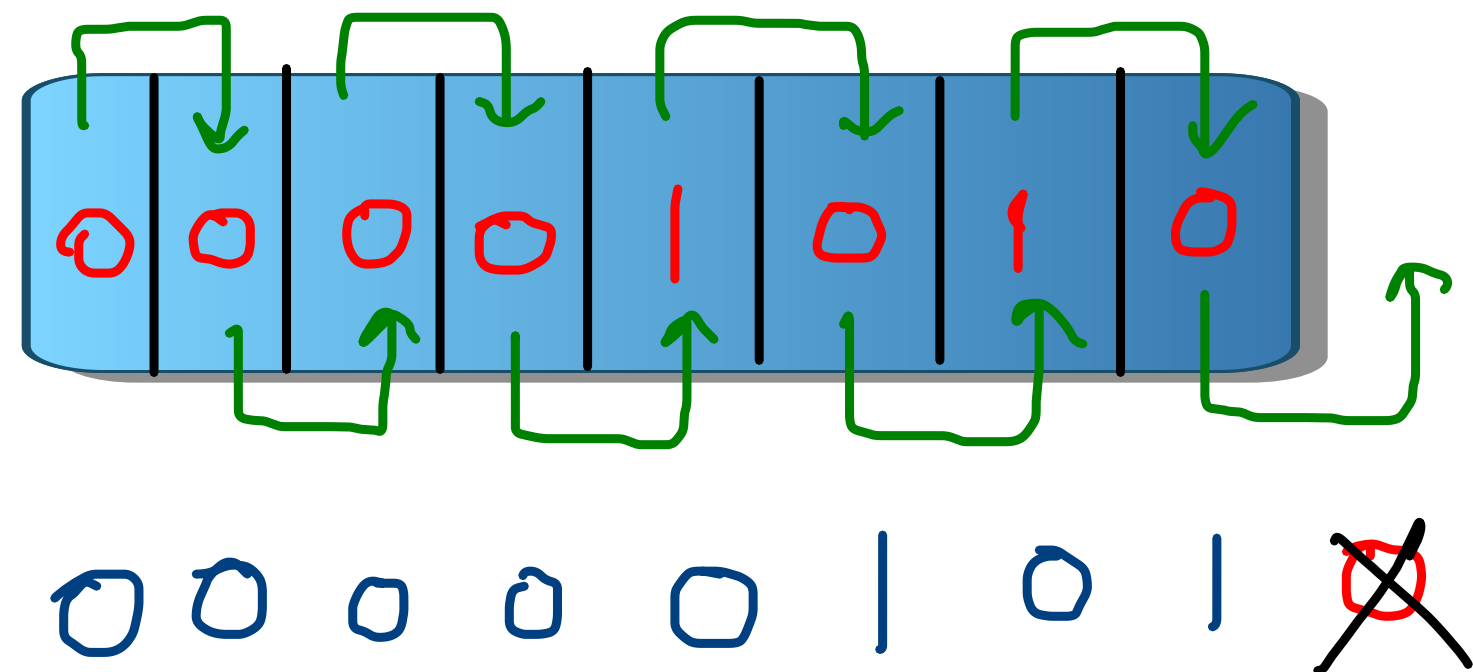
Bitwise Right Shift \gg

$a = 10$

$a \gg 1$

1010

101~~0~~



0 0 0 0 0 1 0 1 ~~0~~

0 0 0 0 0 ²1 ¹0 ⁰1

$4 + 0 + 1 \Rightarrow 5$

```
a = 9
```

```
print(a >> 1)
```

$$\begin{array}{r} 2 \overline{) 9} \\ 2 \overline{) 4} - 1 \uparrow \\ 2 \overline{) 2} - 0 \\ \underline{1 - 0} \end{array} \text{ } 1001_2$$

$$\begin{array}{ccc} 1 & 0 & 0 \\ 2^2 & 2^1 & 2^0 \\ 1 & 0 & 0 \end{array}$$

$$2^2 \times 1 + 2^1 \times 0 + 2^0 \times 0$$

$$4 + 0 + 0 \Rightarrow 4$$

$$\boxed{\gg 1} \Leftrightarrow \boxed{// 2}$$

$$a = 14$$

$$R \gg 2$$

$$\begin{array}{r} 2 \overline{) 14} \\ 2 \overline{) 7 - 0} \\ 2 \overline{) 3 - 1} \\ \underline{1 - 1} \end{array} \uparrow 1110_2$$

$$11\cancel{10}$$

$$\begin{array}{c} 1^1 \\ 1^0 \end{array}$$

$$2^1 * 1 + 2^0 * 1$$

$$2 + 1 \Rightarrow 3$$

```
a = 3812
```

```
print(a >> 4)
```

$((((3812) // 2) // 2) // 2) // 2$

$(1906) // 2$

$(953) // 2$

$(476) // 2$

238

Bitwise left shift <<

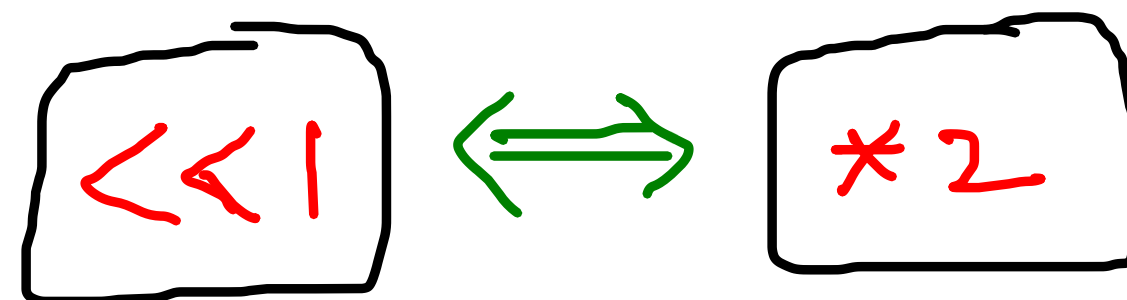
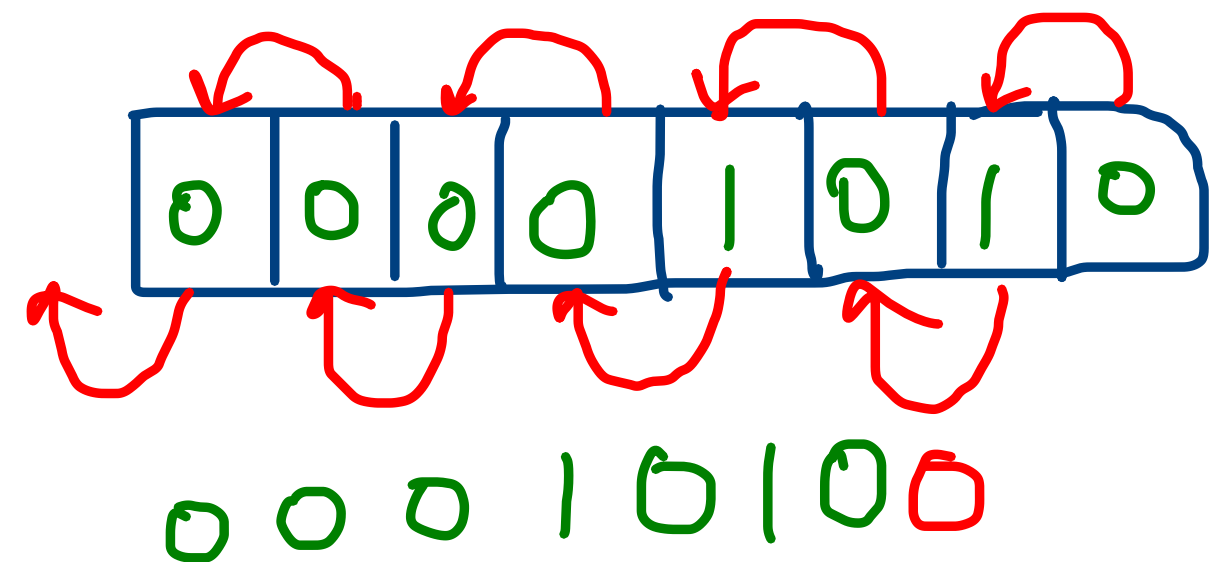
$$a = 10$$

$$a \ll 1$$

10100

$2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$
10100

$$2^4 * 1 + 2^3 * 0 + 2^2 * 1 + 2^1 * 0 + 2^0 * 0$$
$$16 + 0 + 4 + 0 + 0 \Rightarrow 20$$



$$a = 35$$

$$a \ll 4$$

$$\left(\left((35 * 2) * 2 \right) * 2 \right) * 2$$

$$(70) * 2$$

$$(140) * 2$$

$$(280) * 2$$

$$560$$

Bitwise complement ~ :

$$a = 10$$

$$-10 - 1 \Rightarrow -11$$

① change value sign

② add -1