Bitwise operators

- `|`
- `&`
- `^`
- `>>`
- `<<`
- `~`

Bitwise |

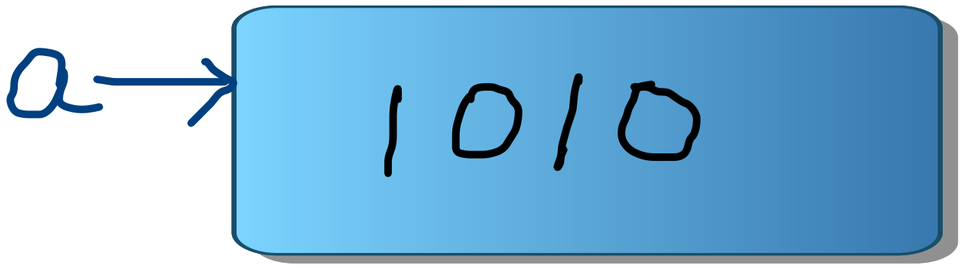
a | b

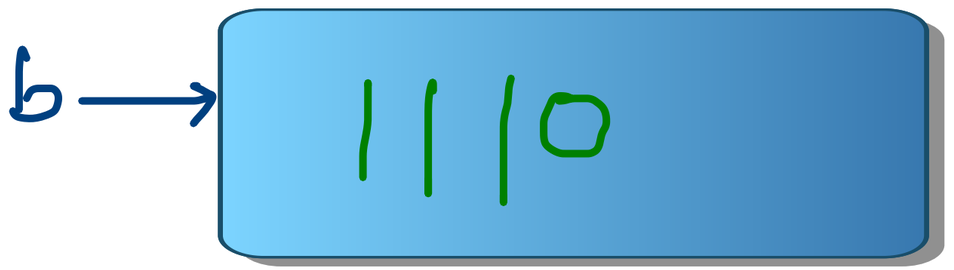
1 → True

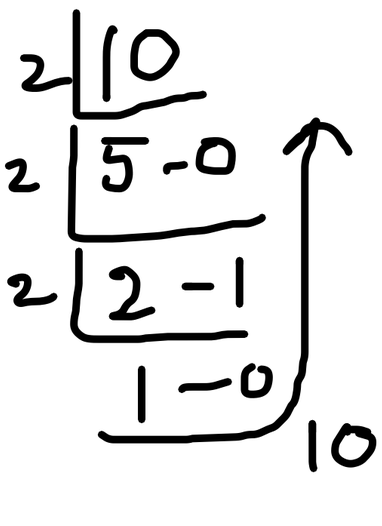
0 → False

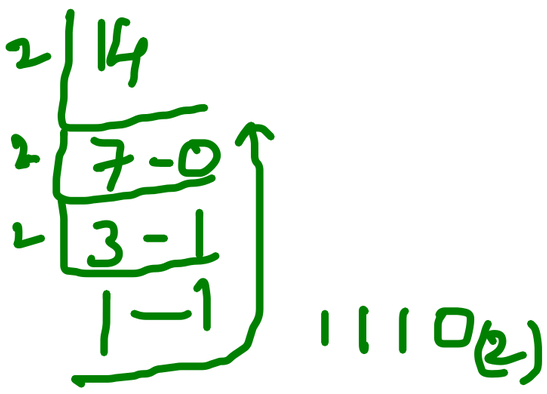
a = 10

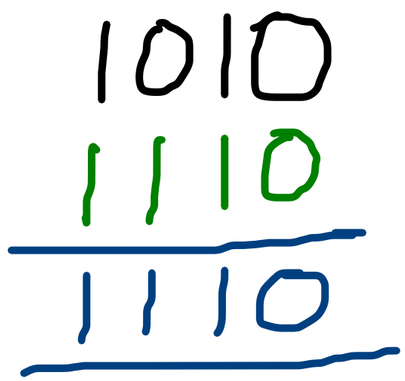
b = 14











$2^3 \quad 2^2 \quad 2^1 \quad 2^0$

1 1 1 0

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

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

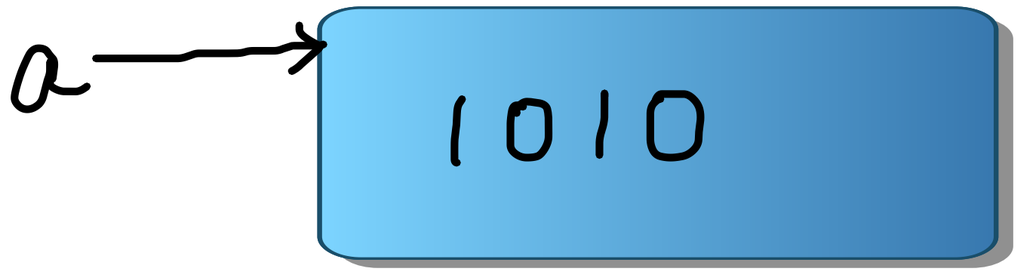
Bitwise &:

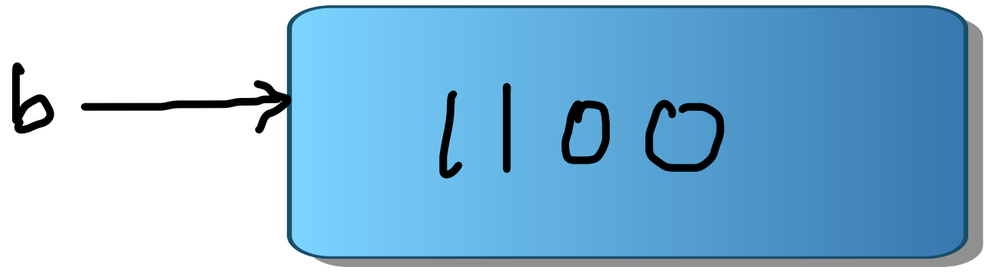
a & b

a = 10

b = 12

```
  1010
  1100
------
  1000
------
```






```
2 | 12
2 | 6 - 0
2 | 3 - 0
    1 - 1
```

$1100_{(2)}$

$2^3\ 2^2\ 2^1\ 2^0$

1 0 0 0

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

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

Bitwise ^ (XOR):

a=10

b=12

a^b

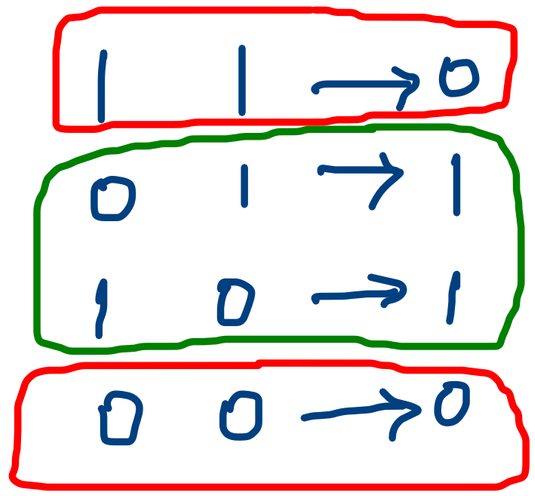
```
 1010
 1100
 ----
 0110
 ----
```

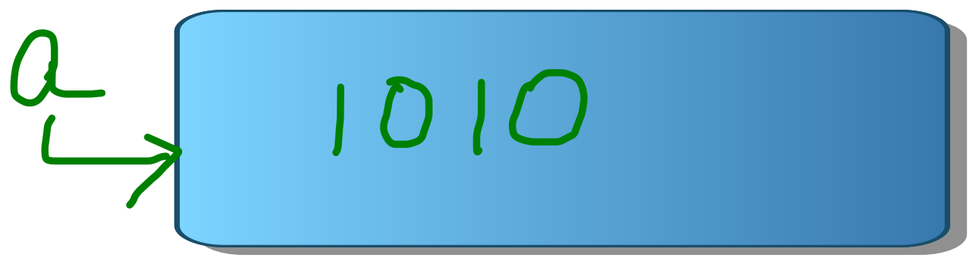
$2^3\ 2^2\ 2^1\ 2^0$

0 1 1 0

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

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





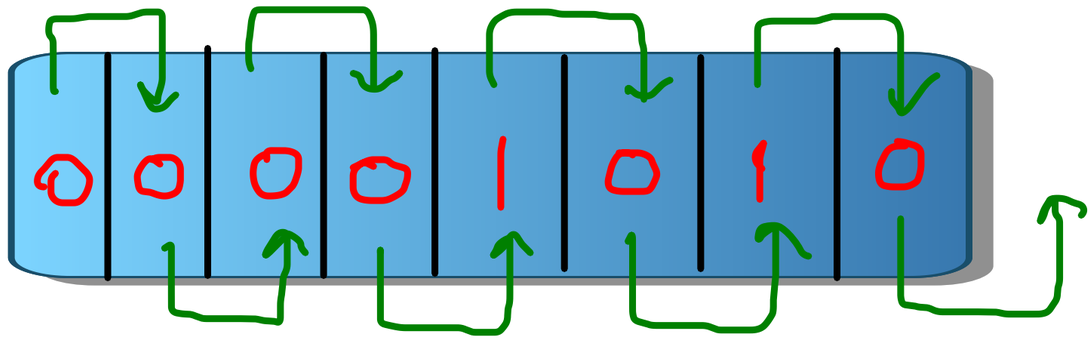
Bitwise Right Shift >>

a = 10

1010

a >> 1

101



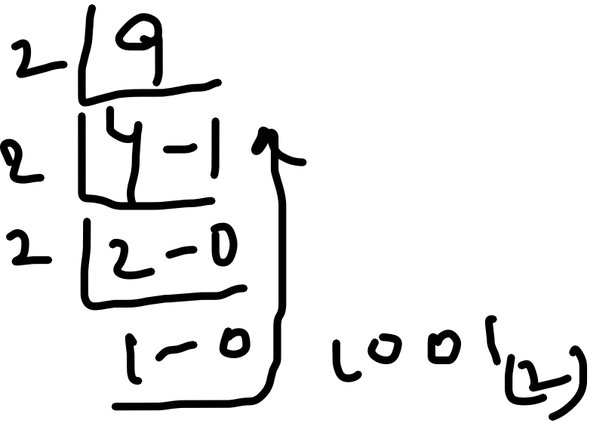
0 0 0 0 1 0 1 0

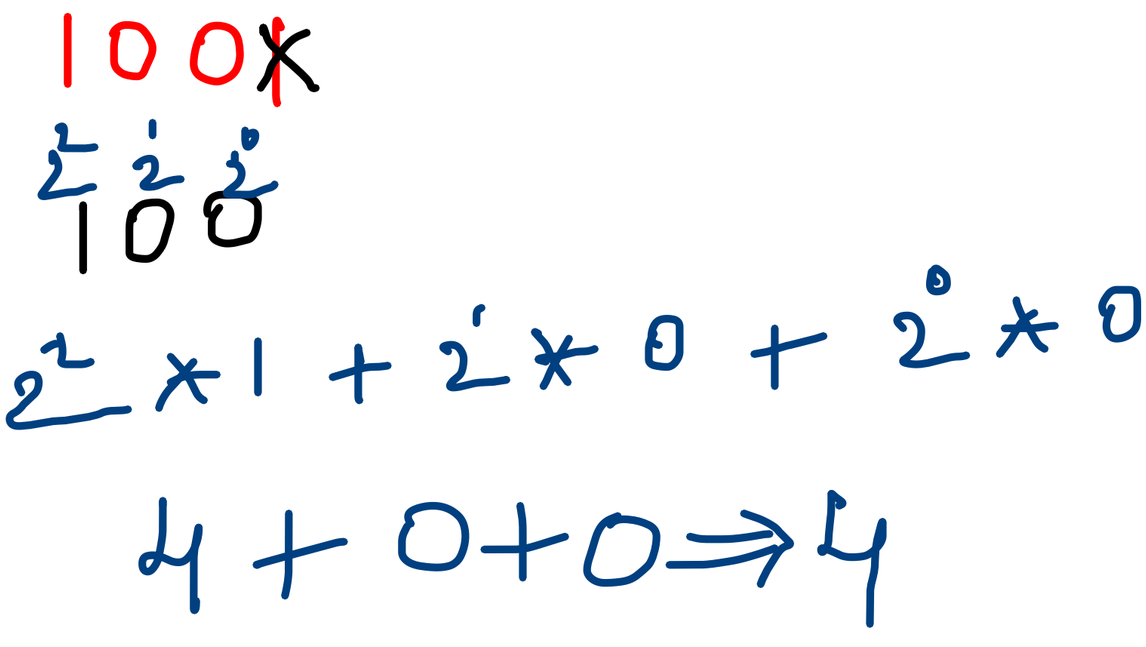
2^2 2^1 2^0

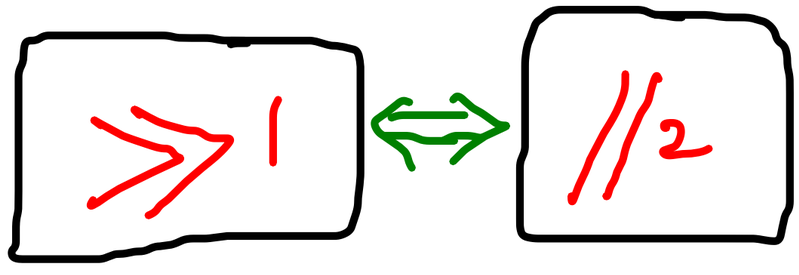
0 0 0 0 0 1 0 1

4 + 0 + 1 ⇒ 5

```
a = 9
print(a>>1)
```







a = 14

a >> 2

2	14		
2	7	0	
2	3	1	
	1	1	

$1110_{(2)}$

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

$2 + 1 \Rightarrow 3$

```
a = 3812
print(a>>4)
```

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

$$(1906)//2$$

$$(953)//2$$

$$(476)//2$$

238

Bitwise left shift <<

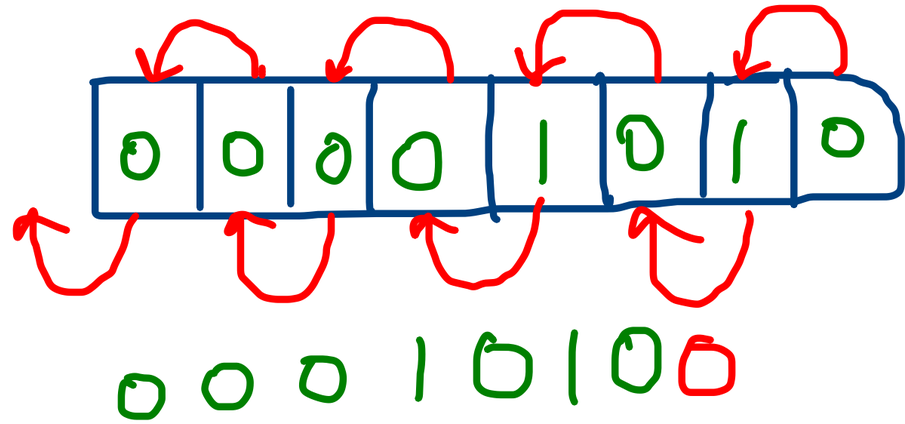
a = 10

a << 1

10100

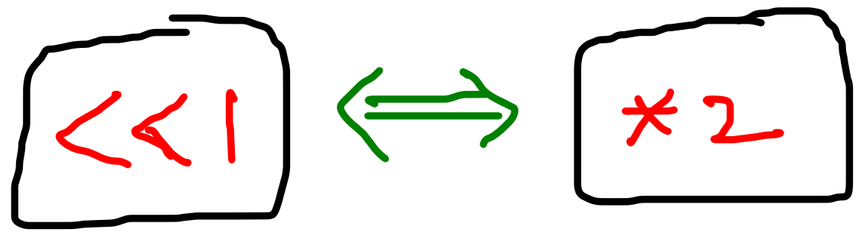
2^4 2^3 2^2 2^1 2^0

10100



$2^4 * 1 + 2^3 * 0 + 2^2 * 1 + 2^1 * 0 + 2^0 * 0$

$16 + 0 + 4 + 0 + 0 \Rightarrow 20$



$a = 35$

$a << 4$

$$(((35 * 2) * 2) * 2) * 2$$

$$(70) * 2$$

$$(140) * 2$$

$$(280) * 2$$

$$560$$

Bitwise complement ~ :

a = 10

-10 -1 ⇒ -11

① change value sign

② add -1