

# NUMBERS

[BACK](#)

1

2

3

**1**

**2**

**3**

---

**$10^2$**

**$10^1$**

**$10^0$**

**1**

**2**

**3**

---

**$10^2$**

**$10^1$**

**$10^0$**

**100**

**10**

**1**

**1**

**2**

**3**

---

**$10^2$**

**$10^1$**

**$10^0$**

$$= 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 1 \times 100 + 2 \times 10 + 3 \times 1$$

$$= 123$$

4

1

2

3

---

?

$10^2$

$10^1$

$10^0$

4

1

2

3

---

$10^3$

$10^2$

$10^1$

$10^0$

$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

**4**

**1**

**2**

**3**

---

**$10^3$**

**$10^2$**

**$10^1$**

**$10^0$**

$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$$

**4**

**1**

**2**

**3**

---

**$10^3$**

**$10^2$**

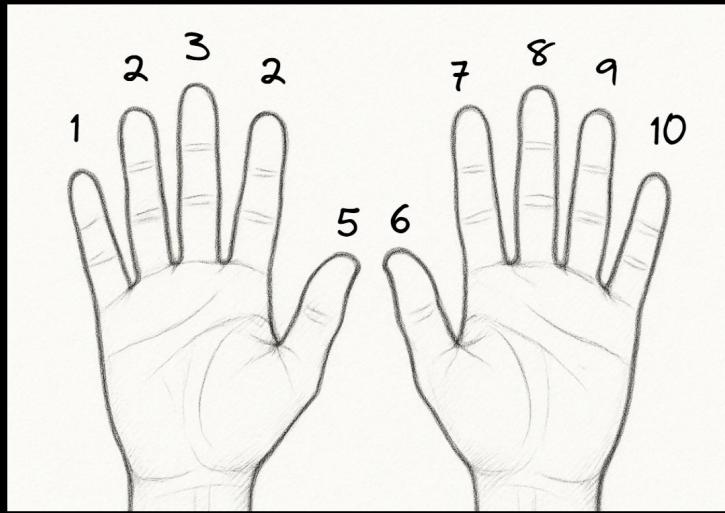
**$10^1$**

**$10^0$**

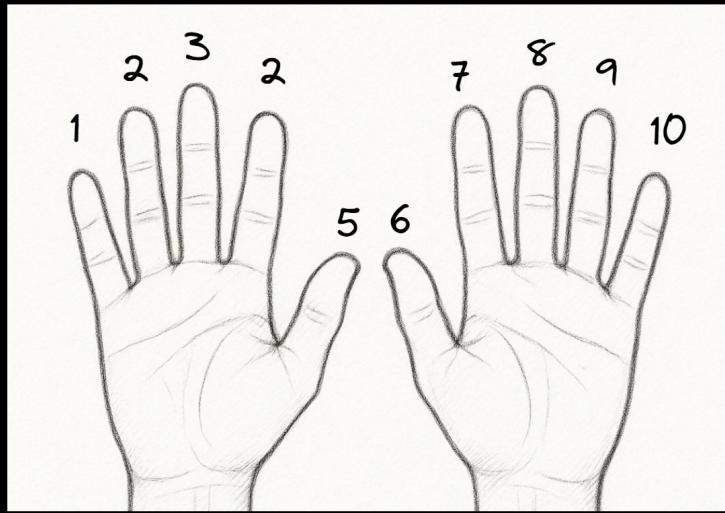
$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$$

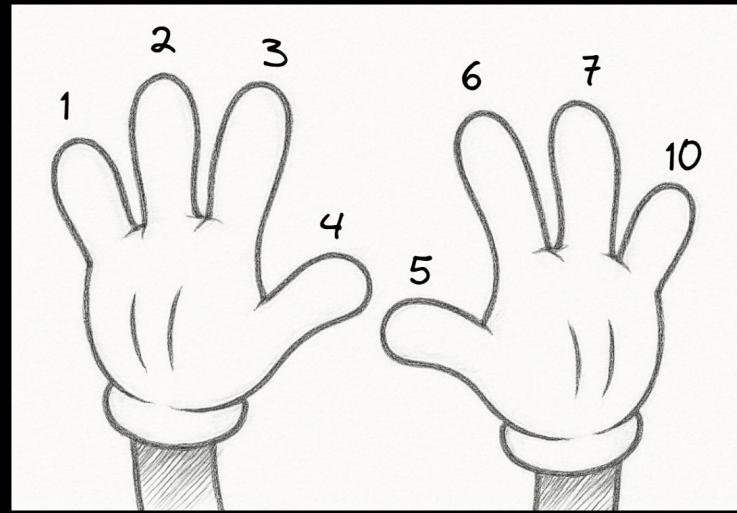
$$= 4123$$



human hand



human hand



cartoon character's hand

1

2

3

(octal)

**1**

**2**

**3**

(octal)

---

**8<sup>2</sup>**

**8<sup>1</sup>**

**8<sup>0</sup>**

**1**

**2**

**3**

(octal)

---

**$8^2$**

**$8^1$**

**$8^0$**

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

**1**

**2**

**3**

(octal)

---

**$8^2$**

**$8^1$**

**$8^0$**

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

$$= 1 \times 64 + 2 \times 8 + 3 \times 1$$

**1**

**2**

**3**

(octal)

---

**$8^2$**

**$8^1$**

**$8^0$**

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

$$= 1 \times 64 + 2 \times 8 + 3 \times 1$$

$$= \mathbf{83} \text{ (decimal)}$$

decimal

8

octal

?

decimal

octal

?



7

decimal

16

octal

?

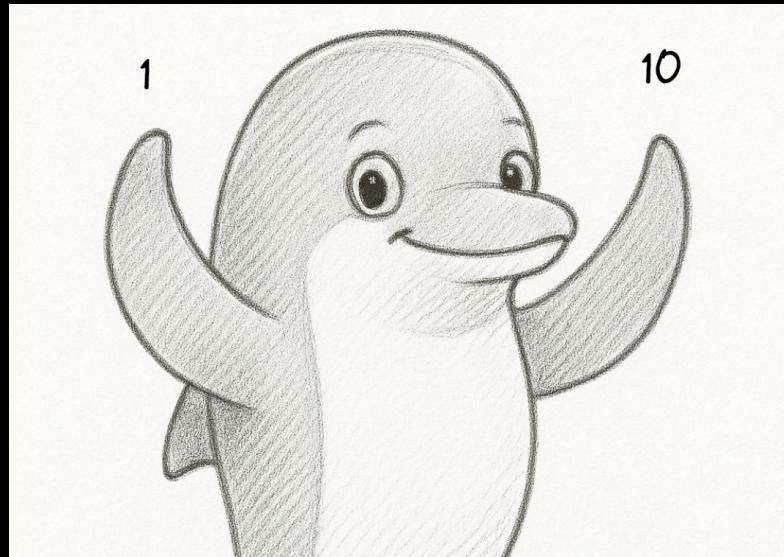
decimal

octal

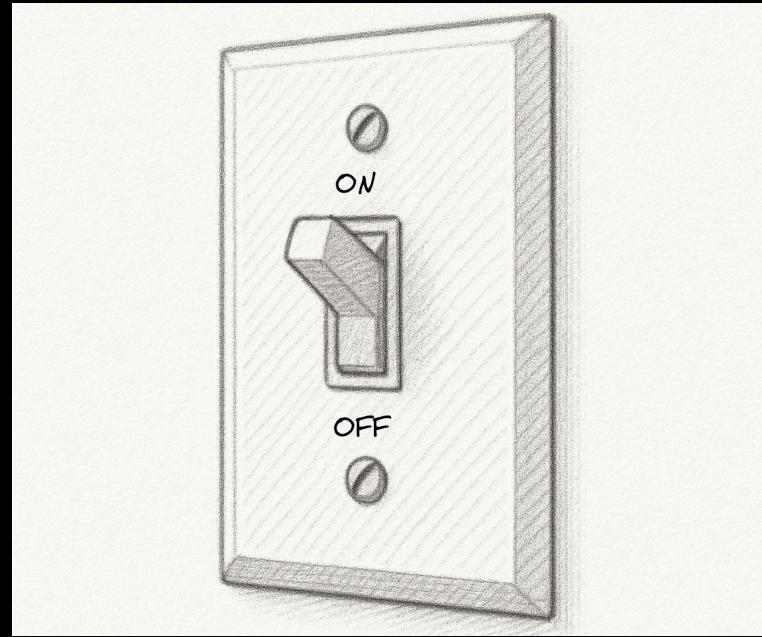
?



100



what now?



a binary number is like a switch

0, 1, ...

0, 1, 10, ...

0, 1, 10, 11, ...

0, 1, 10, 11, 100, ...

0, 1, 10, 11, 100, 101, ...

0, 1, 10, 11, 100, 101, 110

1 1 0 (binary)

**1**

**1**

**0**

(binary)

---

**$2^2$**

**$2^1$**

**$2^0$**

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

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

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

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

$$= 1 \times 4 + 1 \times 2 + 0 \times 1$$

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

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

$$= 1 \times 4 + 1 \times 2 + 0 \times 1$$

$$= 6 \text{ (decimal)}$$

2 3 4 5 6

0, 1, 10, 11, 100, 101, 110

# place value systems

$$N = d_n * R^{n-1} + \dots + d_2 * R^1 + d_1 * R^0$$

$$d \in \{ 0, 1, \dots R-1 \}$$

$n$  = number of digits

$R$  = base

R ≥ 2