COUNTING

1 2 3

1	2	3
10^2	10^1	10^0

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
?	10^2	10^1	10^0

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

4	1	2	3
?	10^2	10^1	10^0

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

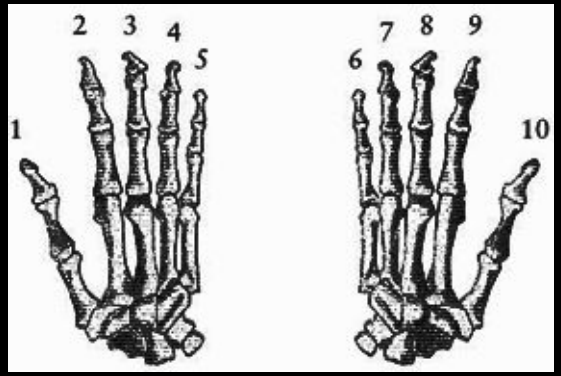
$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$

4	1	2	3
?	10^2	10^1	10^0

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

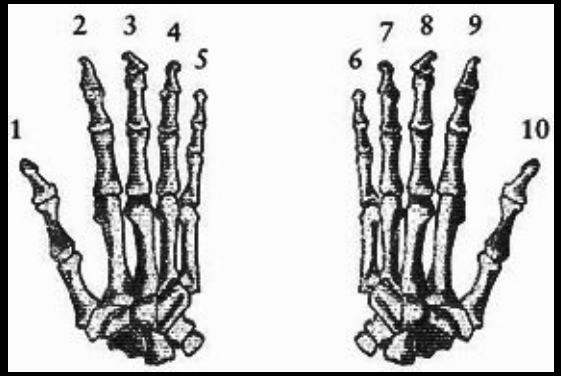
$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$

$= 4123$

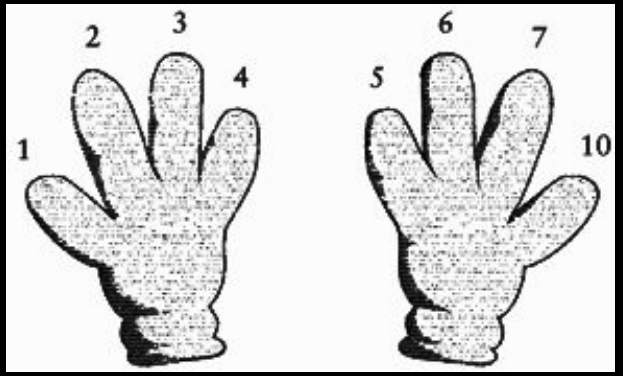


human hand

Image source: Petzold, Charles. Code: The Hidden Language of Computer Hardware and Software. 2nd ed., Microsoft Press, 2022.



human hand



cartoon character’s hand

Image source: Petzold, Charles. Code: The Hidden Language of Computer Hardware and Software. 2nd ed., Microsoft Press, 2022.

1 2 3 (octal)

1	2	3	(octal)
8^2	8^1	8^0	

$$\begin{array}{ccc} 1 & 2 & 3 \\ \hline 8^2 & 8^1 & 8^0 \end{array}$$ (octal)

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

1	2	3
8^2	8^1	8^0

(octal)

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

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

1	2	3
8^2	8^1	8^0

(octal)

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

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

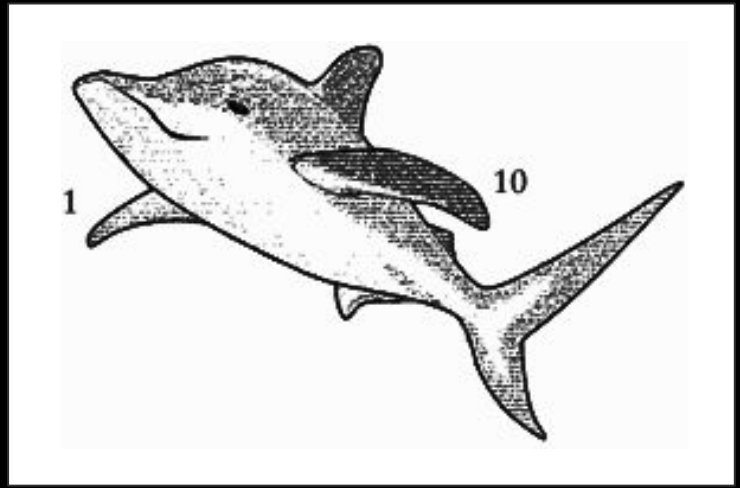
$= 83$ (decimal)


decimal
octal
8
?


decimal
octal
?
7


decimal
octal
16
?


decimal
octal
?
100



what now?

Image source: Petzold, Charles. Code: The Hidden Language of Computer Hardware and Software. 2nd ed., Microsoft Press, 2022.

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	

1	1	0
2^2	2^1	2^0

(binary)

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

1	1	0
2^2	2^1	2^0

(binary)

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

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

1	1	0
2^2	2^1	2^0

(binary)

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

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

$= 6$ (decimal)

2 3 4 5 6

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

place value systems

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

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

n = number of digits
R = base

$$R \geq 2$$