

Competitive Programming
Workshop @ MANIT

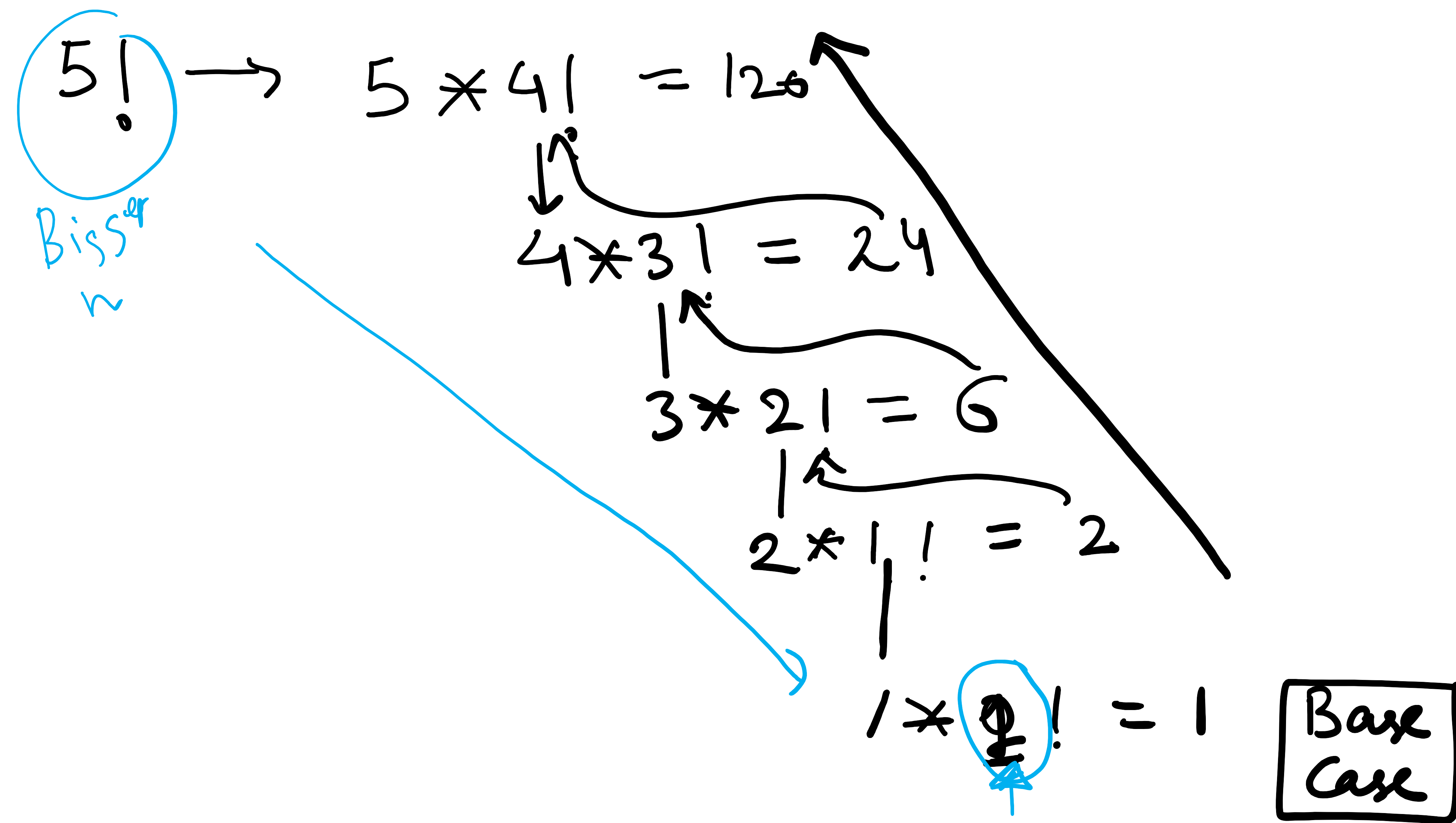
T-factorial

$$5! = 120$$

$$n! = 1 \times 2 \times 3 \dots n$$

Recurrence

$$\underbrace{f(n)}_{\downarrow n!} = n * \underbrace{f(n-1)}_{\downarrow (n-1)!} \quad \begin{matrix} n \\ \downarrow \end{matrix}$$



PMI

- ① Solve for smallest case. } Base Case
Assumption Prove $f(0) = \text{True}$.
② $f(k)$ is TRUE } Hypothesis
③ $f(k+1)$ is also True } Rec Case

Call Stack

7 - $\text{un2}()$
30

main()
a=10
3

Call Stack

inc $\underbrace{1, 2, 3, \dots, n}$

Rec $\left\{ \begin{array}{l} \underline{\text{inc}(n)} \\ \underline{\text{dec}(n)} \end{array} \right.$ $n, n-1, \dots, 1$

inc(n-1)

$\underbrace{1, \dots, n-1}_{\text{call}(n-1)} \quad \textcircled{n} \quad \text{print}(n)$

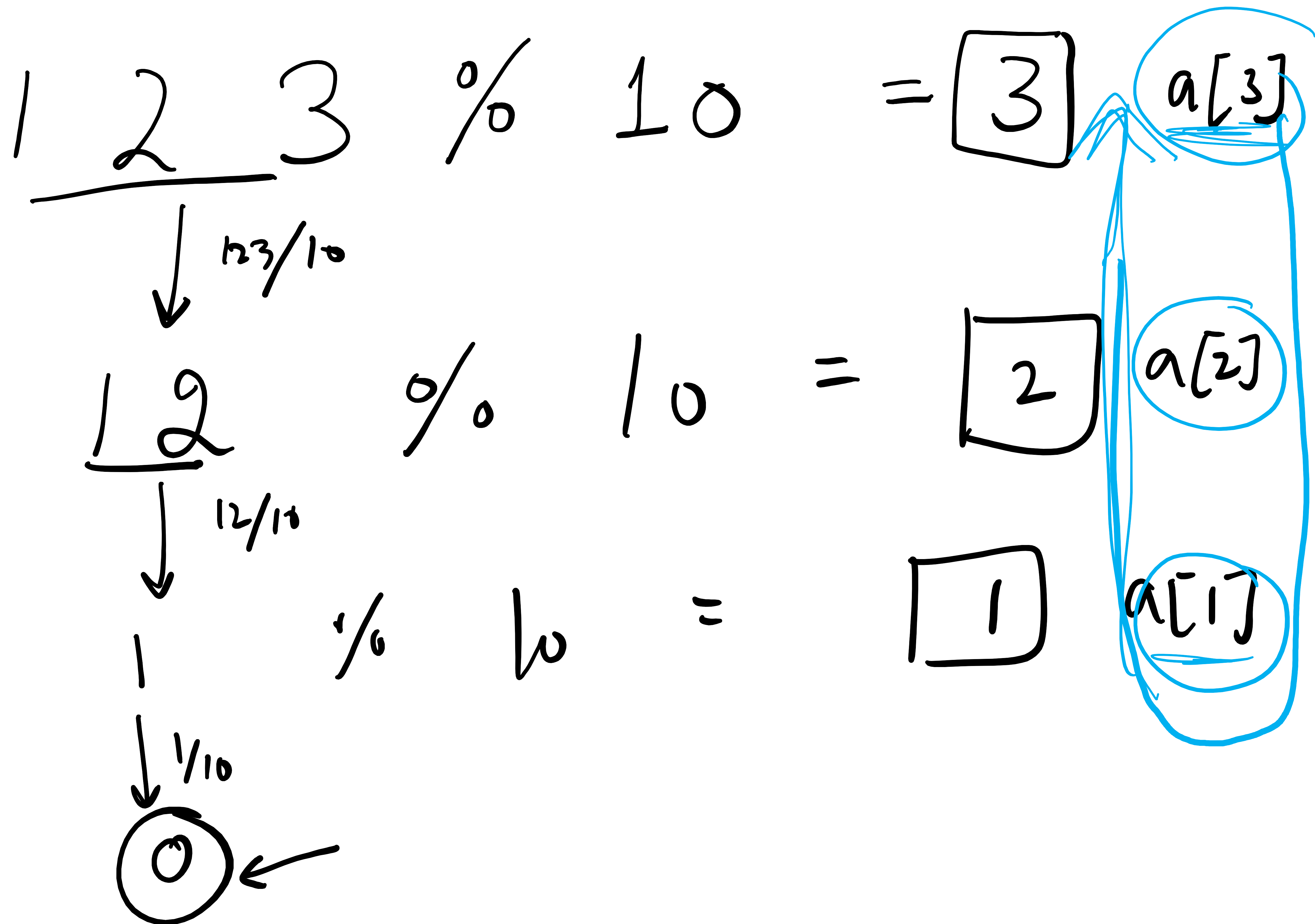
5 \dots 1

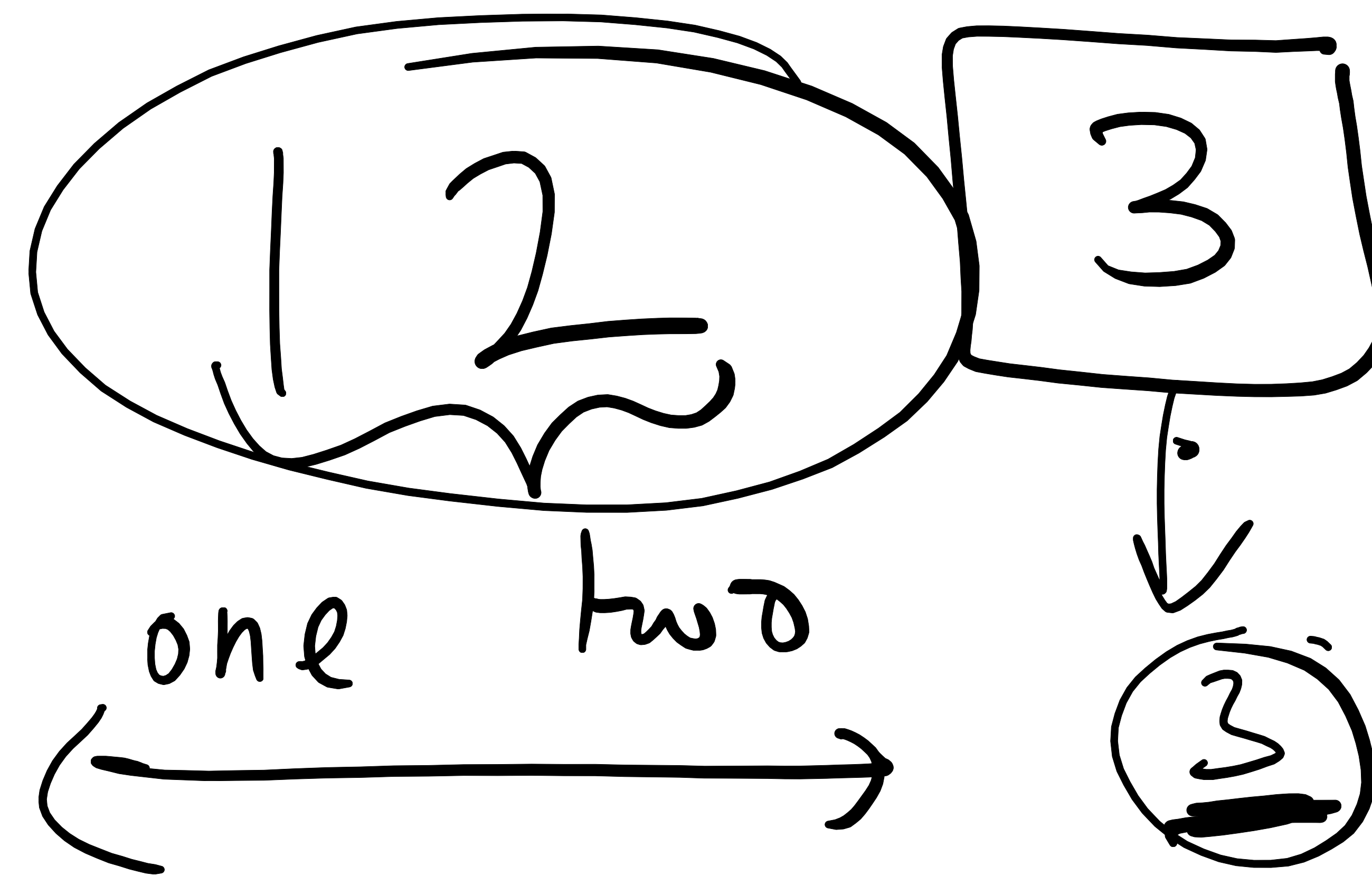
5 dec(4)
4, 3, 2, 1

1 2 3 \Rightarrow one two three

A diagram illustrating a mapping from the numbers 1, 2, and 3 to the words 'one', 'two', and 'three'. The numbers are on the left, and the words are on the right, separated by an implication symbol (\Rightarrow). Three curved arrows originate from the numbers and point to the words: an arrow from '1' to 'one', an arrow from '2' to 'two', and an arrow from '3' to 'three'.

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$$5^4 = 625$$

$$a^n = a \cdot a^{n-1}$$

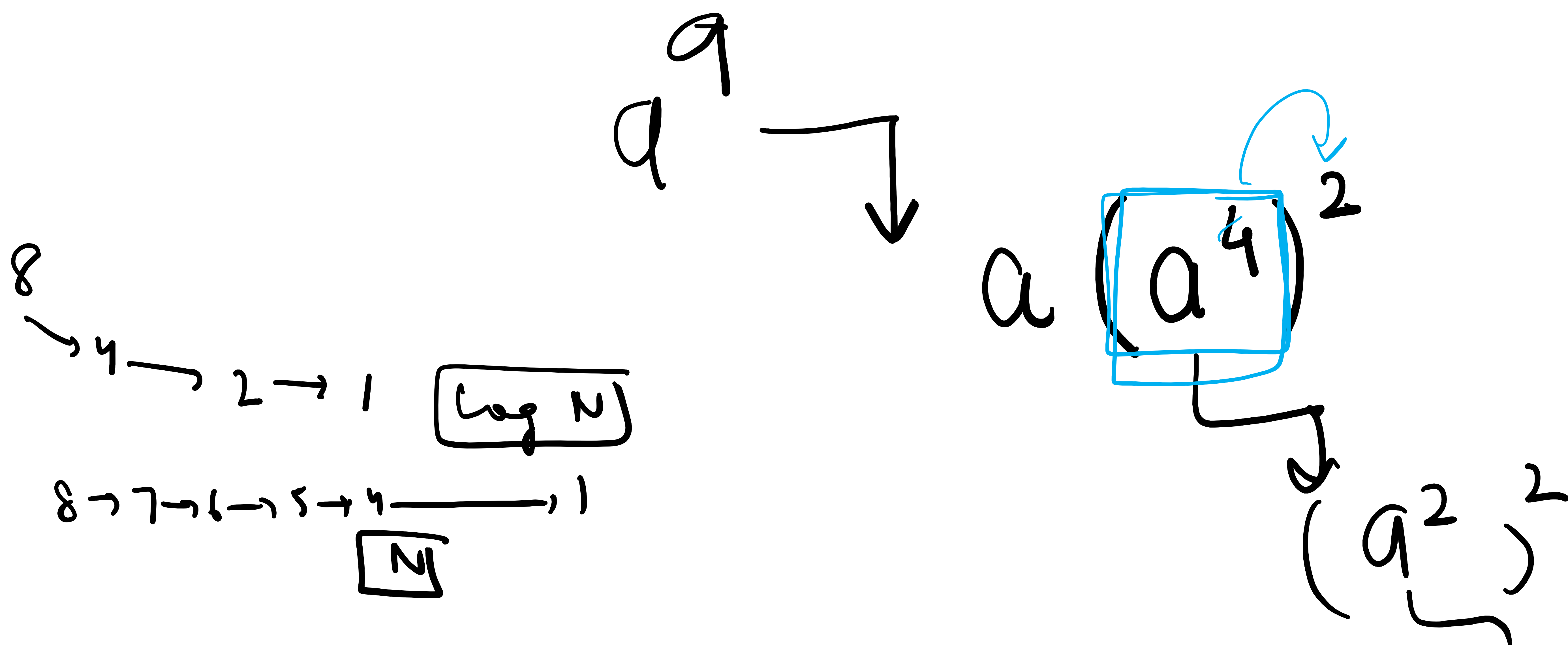
power

$$f(a, n) = a \cdot f(a, n-1)$$

$$f(a, n) \longrightarrow f(a, n/2)$$

$$a^n = (a^{n/2})^2 \quad n \text{ is even}$$

$$= a (a^{n/2})^2 \quad n \text{ is odd}$$



$$\begin{array}{c} \downarrow \\ (a^1)^2 \\ \searrow \\ a(a^0)^2 \end{array}$$

$$\frac{n}{2^0}$$

0

$$\frac{n}{2^1}$$

1

$$\frac{n}{2^2}$$

2

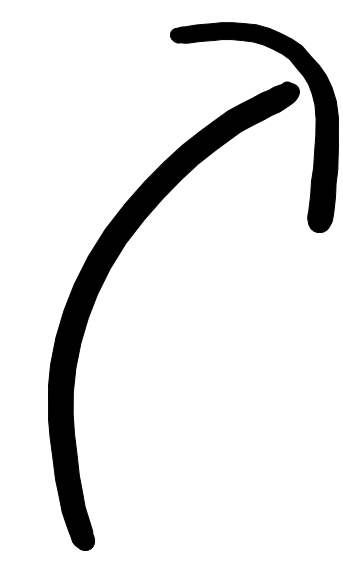
...

$$\frac{n}{2^k}$$

$$= 1$$

$$\begin{array}{l} \log_2 n = \log_2 2^k \\ \Rightarrow \boxed{k = \log_2 n} \end{array}$$

$$n = 2^k$$



$$\frac{n}{2^k} = 1$$