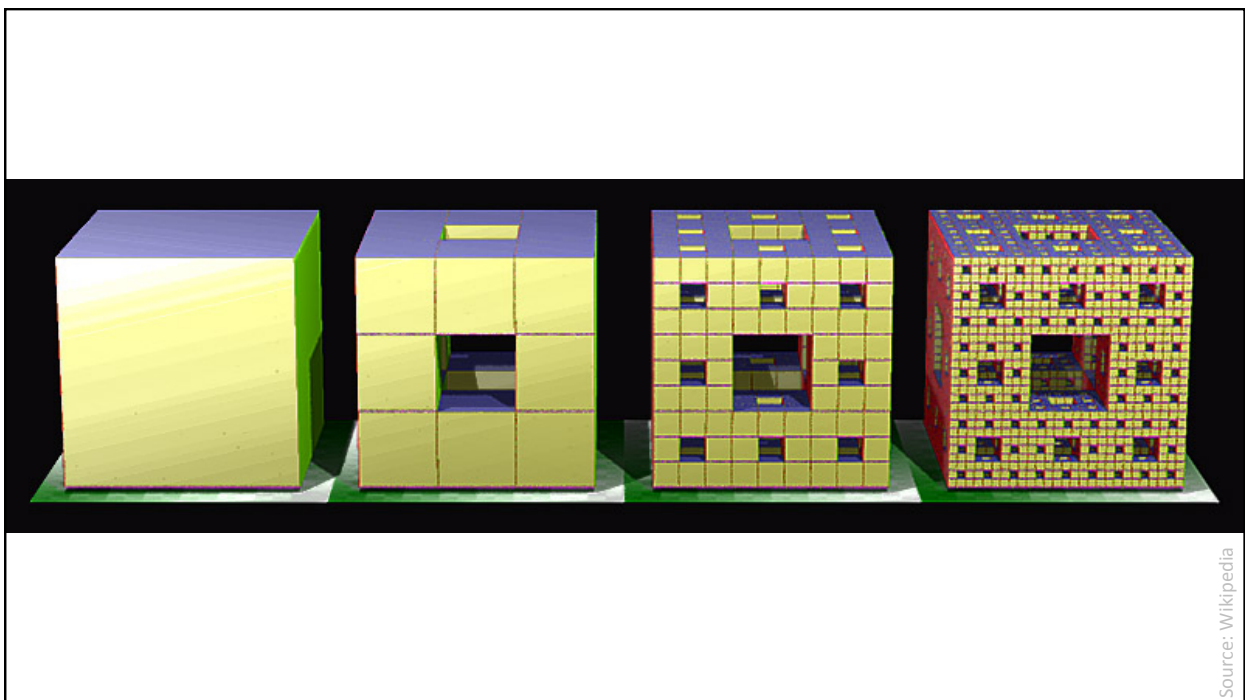


UNDERSTANDING RECURSION



Factorial

Task: Write a recursive method to compute the factorial of a natural number **n**

$$\text{fac}(n) = n! = n * (n-1) * \dots * 2 * 1$$

$$\text{fac}(5) = 5! = 5 * 4 * 3 * 2 * 1$$

$$\text{fac}(4) = 4! = 4 * 3 * 2 * 1$$

Factorial

Trick: 1. Assume you have the problem solved for a simpler task

$$\text{fac}(n) = n! = n * (n-1) * \dots * 2 * 1$$

$$\text{fac}(n-1) = (n-1)! = (n-1) * \dots * 2 * 1$$

$$n! = n * (n-1)!$$

$$\text{fac}(n) = n * \text{fac}(n-1)$$

Factorial

Trick: 2. Check the border conditions

$$\text{fac}(0) = 0! = 1$$

Factorial

$$\text{fac}(n) = \begin{cases} 1 & (\text{if } n=0) \\ n * \text{fac}(n-1) & (\text{if } n>0) \end{cases}$$

Factorial

$$\text{fac}(n) = \begin{cases} 1 & (\text{if } n \leq 1) \\ n * \text{fac}(n-1) & (\text{if } n > 1) \end{cases}$$

```
long fac (int n) {  
    if (n<=1) return 1;  
    else     return n*fac(n-1);  
}
```

} Base case
} Recursive case

Operational View

fac(3) → 3*fac(2)

fac(2) → 2*fac(1)

fac(1) → 1

fac(3) → 3*fac(2) → 3*(2*fac(1)) → 3*(2*1) → 6

Mathematical View

$$\text{fac}(3) = 3 * \text{fac}(2) = 3 * 2 = 6$$

$$\text{fac}(2) = 2 * \text{fac}(1) = 2 * 1 = 2$$

$$\text{fac}(1) = 1$$

