6. Recursion

Hengfeng Wei (魏恒峰)
hfwei@nju.edu.cn

Nov. 10, 2023

Review

Functions

Function Definition

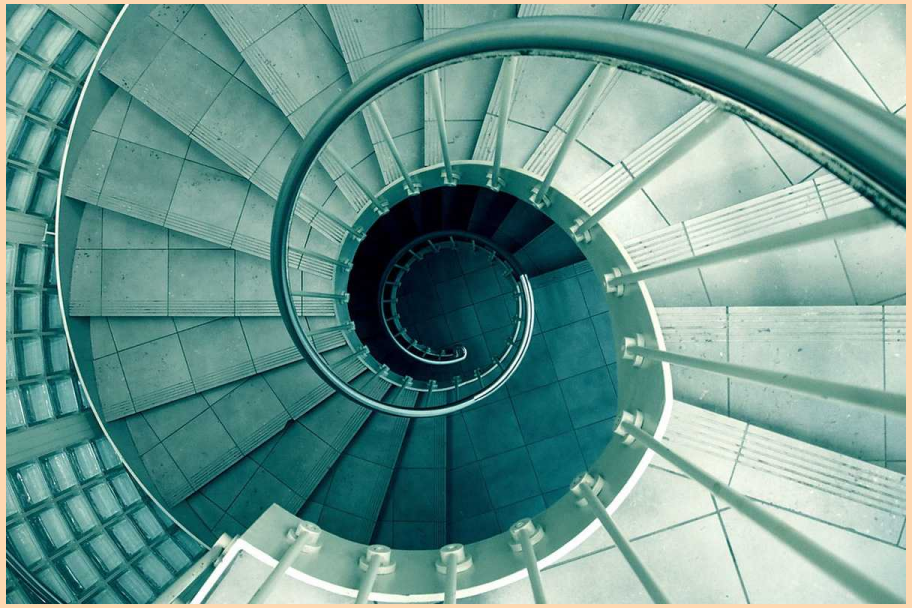
Function Declaration

Arrays as Parameters

Pass by Value

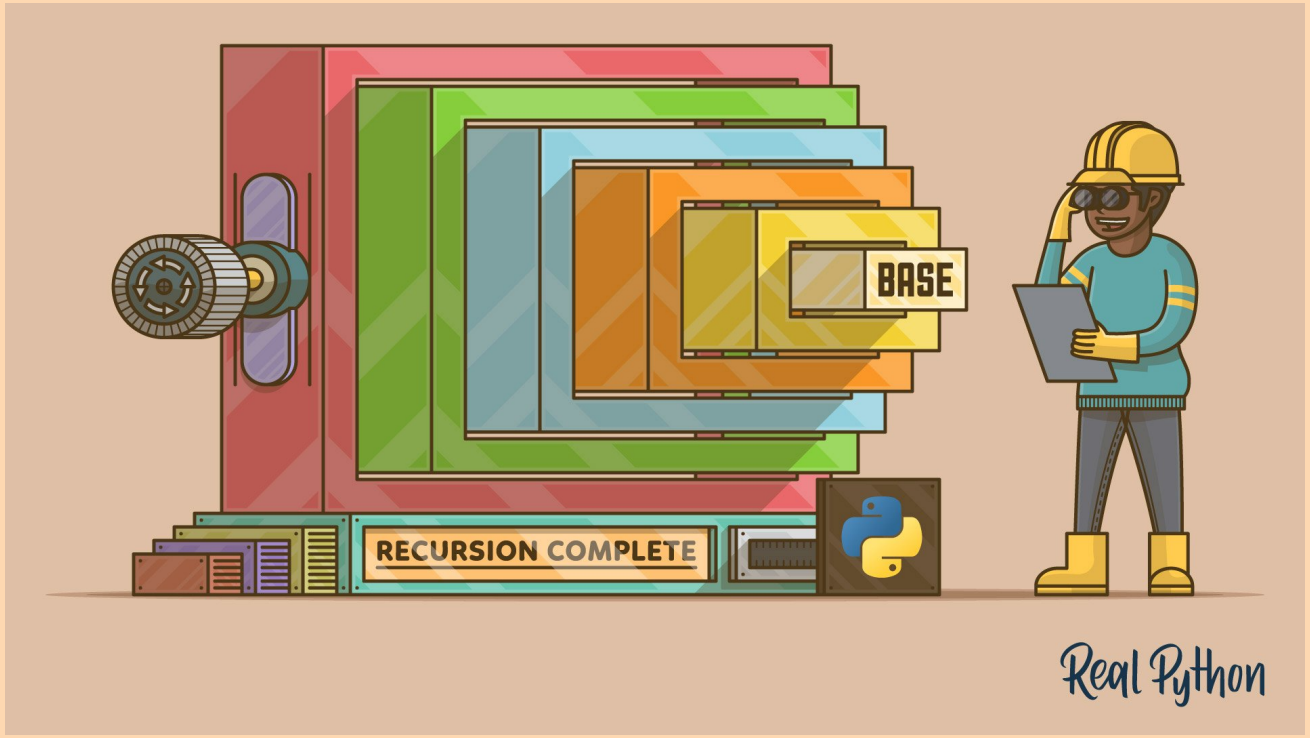
Overview

Recursive Functions (Recursion)



A function that calls itself (main-re.c).

(1) Thinking like a Computer Scientist



Solving a task by first solving its smaller subtasks

(1) Thinking like a Computer Scientist

You want to solve a task and suppose you have the Mirror.

The Mirror can solve the smaller task for you magically.

(1) Thinking like a Computer Scientist

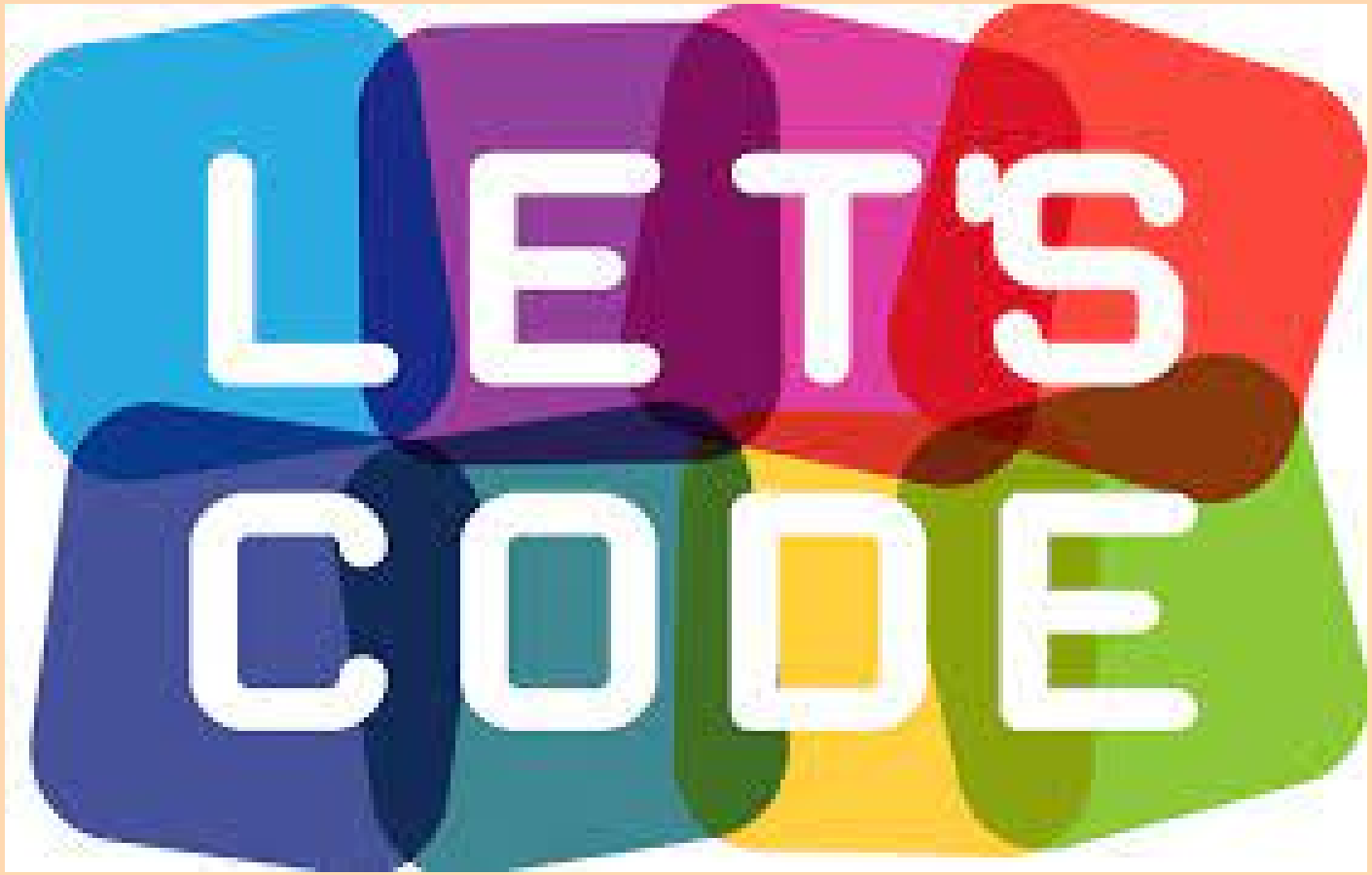
- What is a smaller task? (★★★★★)
- How to reduce the original task into the smaller task? (★★★)
- How to solve the task given the solution to the smaller one? (★★★)
- What is the smallest task? (★)

Thinking Recursively

It will be a looooooooooong way to go to master RECURSION!!!

(2) Thinking like a Computer

min.c



min-re.c sum-re.c fib-re.c gcd-re.c

bsearch-re.c ~~mergesort.c~~

Min (min-re.c)

Min (min-re.c)

$$
\begin{aligned}
\mathrm{Min}(3,5,2,7) &= \min(7, \mathrm{Min}(3,5,2)) \\
&= \min(7, \min(2, \mathrm{Min}(3,5))) \\
&= \min(7, \min(2, \min(5, \mathrm{Min}(3)))) \\
&= \min(7, \min(2, \min(5,3))) \\
&= \min(7, \min(2,3)) \\
&= \min(7,2) \\
&= 2
\end{aligned}
$$

Sum (sum-re.c)

Sum (sum-re.c)

$$
\begin{aligned}
\mathrm{Sum}(1,3,5,7) &= 7 + \mathrm{Sum}(1,3,5) \\
&= 7 + (5 + \mathrm{Sum}(1,3)) \\
&= 7 + (5 + (3 + \mathrm{Sum}(1))) \\
&= 7 + (5 + (3 + 1)) \\
&= 7 + (5 + 4) \\
&= 7 + 9 \\
&= 16
\end{aligned}
$$

Fibonacci Sequence (fib-re.c)

$$F_0 = 0$$

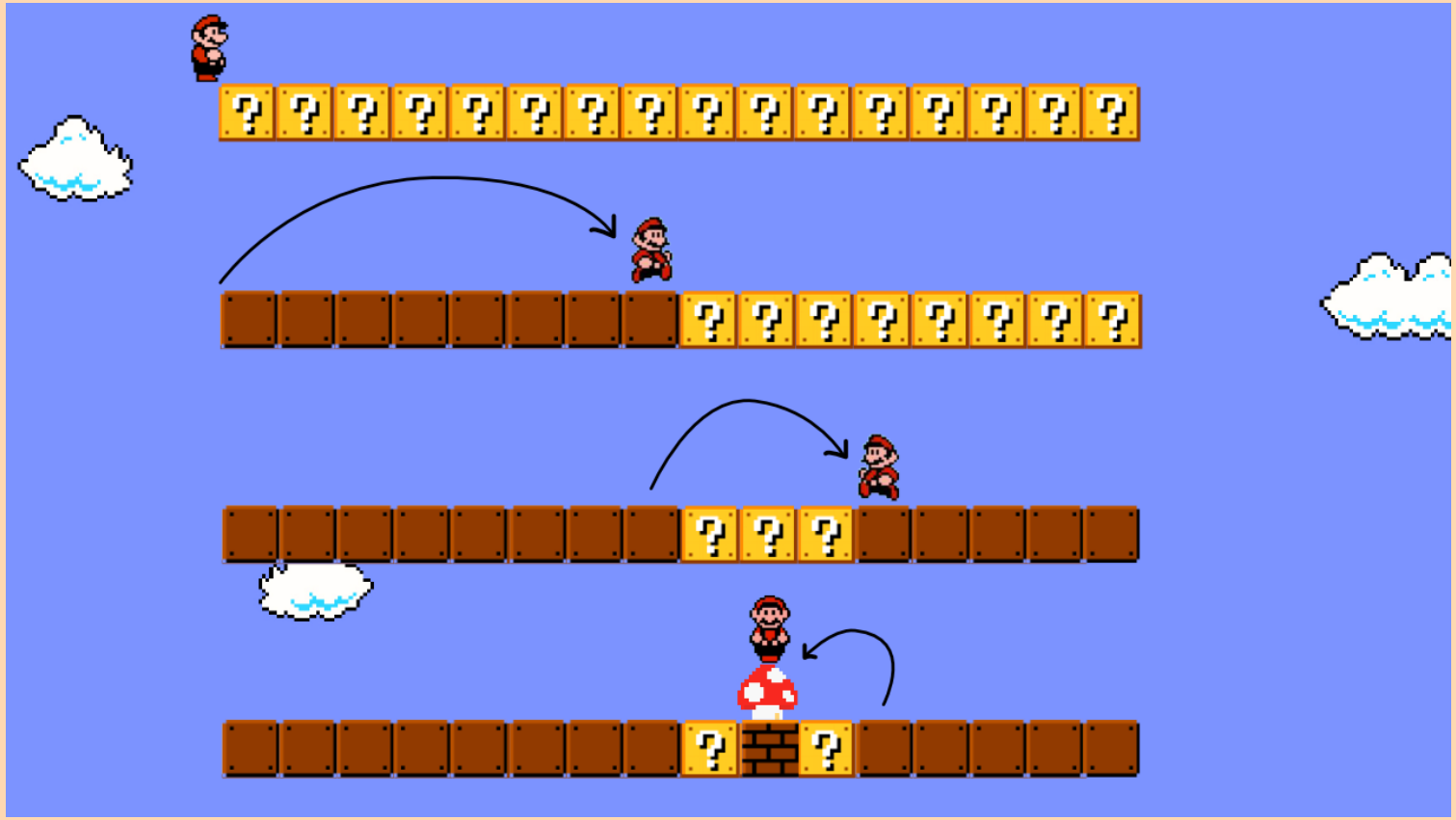
$$F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2} \quad (n > 1)$$

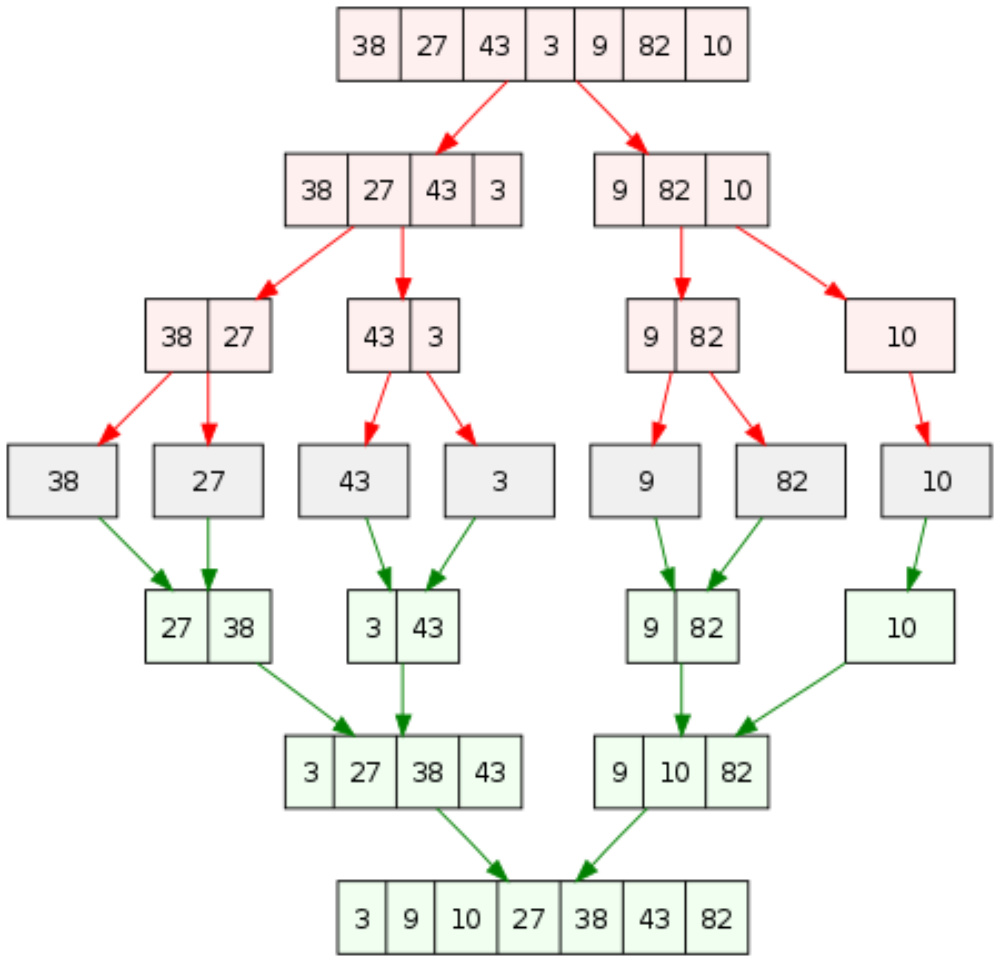
Greatest Common Divisor (gcd-re.c)

$$\gcd(a, b) = \gcd(b, a \,\%\, b)$$

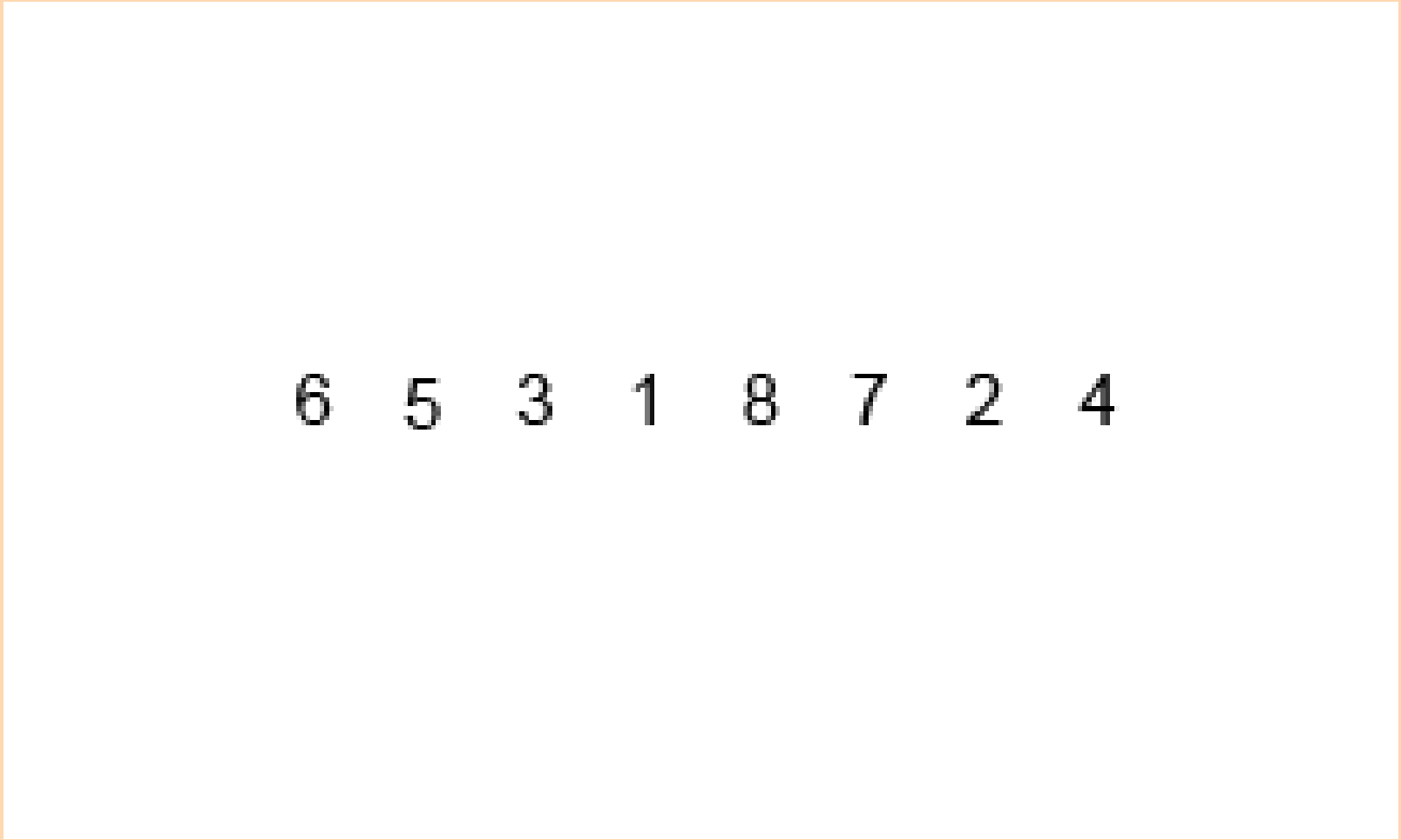
Binary Search (bsearch-re.c)



MergeSort (mergesort.c)



MergeSort (mergesort.c)




SEE
YOU
NEXT
WEEK