Computer Science Faculty - Software Engineering
Analysis of Algorithms

Analysis of Algorithms‘ Course Lectures
(Recursive Algorithms)

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Fall, 2024

Session Overview

1. Recursion
   - Recursive Method
2. Examples
   - Factorial
   - Fibonacci Sequence

Recursion

Iteration

- for statement
- while statement

Technique in which a method call itself. Easy way for complex problems

- Each time the parameter become smaller.

Drawbacks

- Non-efficiency for some problems
- Overhead
- Base case definition
- Parameters

Recursion

For recursion to be correct, there should be a "Yes" answer for the following 3 questions:

1. Is there another solutions for the problem?
2. Is the smaller form of the problem is the same as the whole problem?
3. Is the whole method is working correctly?

To solve a problem recursively do the following:

1. Specify the problem
2. Specify the size of the problem for each call
3. Specify the base case (s)
4. Specify the general case (s)

Factorial

- $n! = n * (n-1) * (n-2) * ....3 * 2 * 1$

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

Factorial

(1) Write and Implement a Recursive Algorithm Function for Factorial Calculation?
(2) Trace and Simulate with Specific Instances!

Fibonacci Sequence

Fibonacci numbers of Fibonacci Sequence Numbers

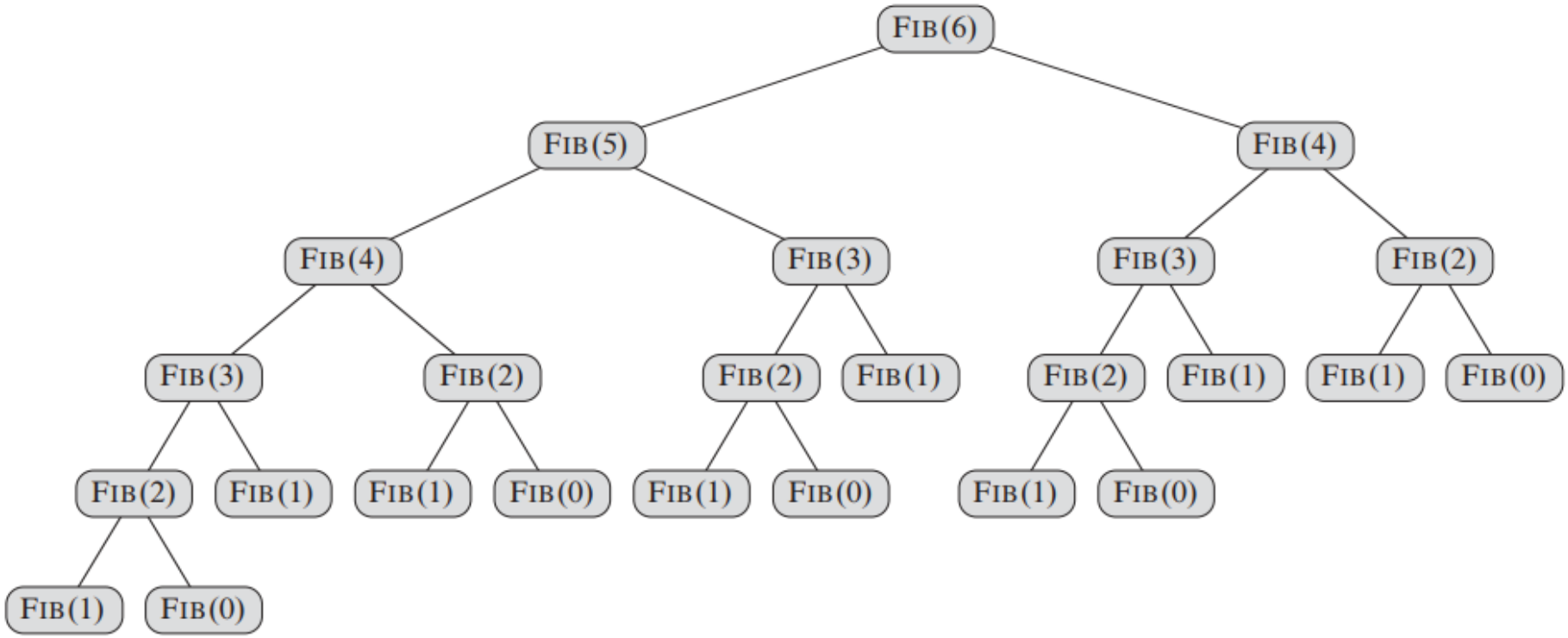
- $F_0 = 0$,
- $F_1 = 1$,
- $F_i = F_{i-1} + F_{i-2}$, for $i \geq 2$

e.g.

- $0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...$

Fibonacci Sequence

Recursive Procedure Instances of Fibonacci Numbers



Fibonacci Sequence

(1) Write and Implement a Recursive Algorithm/Function for Fibonacci Sequence Calculation?

Exercise

Write a recursive method to calculate power of numbers

- e.g. X^Y

Write a recursive method for Euclidean Algorithm (GCD)

- e.g. $\mathrm{GCD}(60, 25)$

Write a recursive method for Binomial Coefficients (Pascal)

- e.g. $(x+1)^6 = x^6 + 6x^5 + 15x^4 + 20x^3 + 15x^2 + 6x + 1$

The End

Questions? Comments?