Applied Data Science and Machine Learning Course

Course Instructor

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Lecture – 01

Review on Basic Programming Techniques

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Introduction

Basic Programming Skills combine two things:
i) design of algorithms
ii) implementation of algorithms

The design of algorithm requires

(i) problem solving skills
(ii) mathematical thinking

The implementation of algorithm requires

(i) good programming skills

NB: It is not enough that the idea of algorithm is correct but the implementation also has to be correct.

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Time Complexity

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    //code
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```
for(int i=1;i<=n;i++){
    //code
}
```

→ O(n)

```
for(int i=1;i<=n;i++){
    for(int j=1;j<=n;j++){
        //code
}
}
```

→ O(n^2)

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Sorting

Given an array that contains n elements, your task is to sort the elements in ascending or descending order.

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Given sequence

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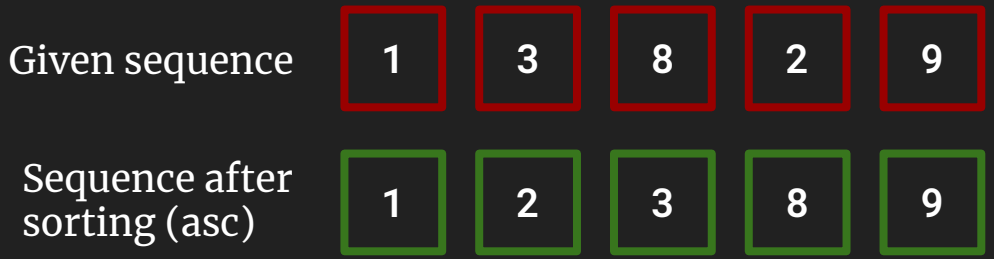

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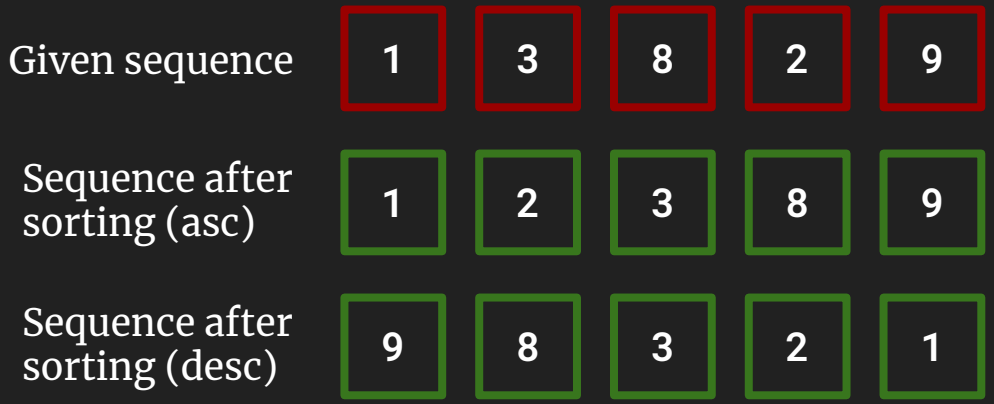

Types of Sorting

Sorting is considered one of the most important algorithms. Researchers and practitioners have been trying to optimize it as more as they can.

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Different Types of Sorting:

i) Bubble Sort >>> O(n^2)

ii) Insertion Sort >>> O(n^2)

iii) Merge Sort >>> O(nlogn)

iv) Bucket Sort >>> O(max element in the array)

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Greedy Algorithms

A greedy algorithm constructs a solution to the problem by making a choice that looks best at that moment.

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Some of the common toy problems that are solved or attempted to be solved by greedy algorithms are:

i) Coin Problem

ii) Scheduling

iii) Tasks and deadlines

iv) Minimizing Sums

v) Data Compression

Scheduling

A classic problem:
Given n events with their starting and ending times, find a schedule that includes as many events as possible.

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Event	Starting Time	Ending Time
A	1	3
B	2	5
C	3	9
D	6	8

Scheduling(cont.)

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Scheduling(cont.)

Algorithm - 1

Select as short events as possible

Scheduling(cont.)

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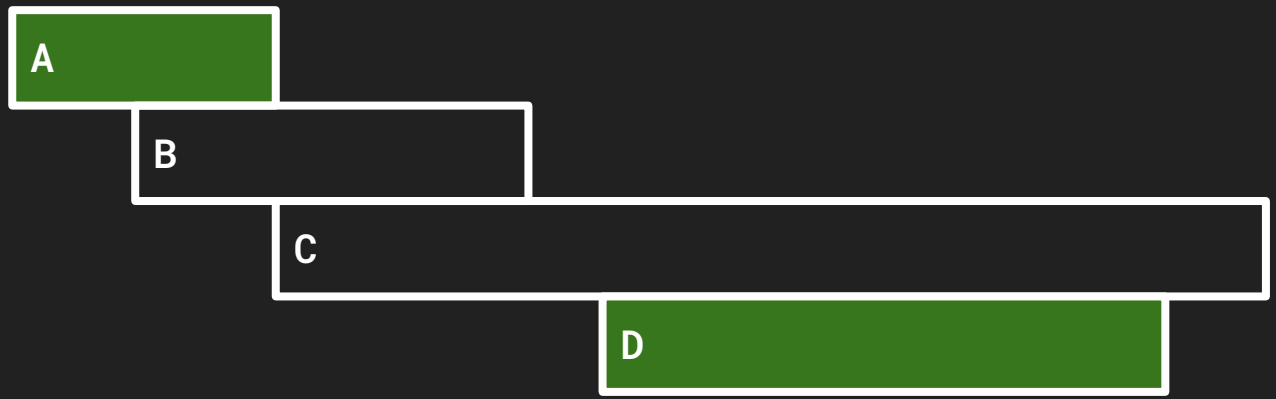
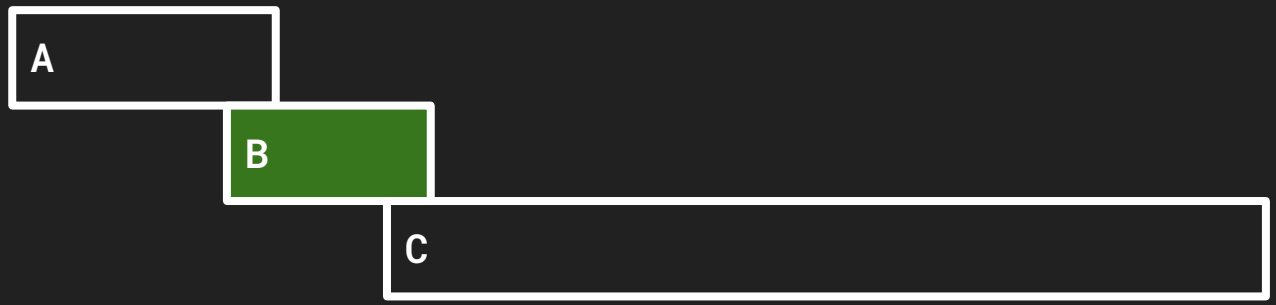


Scheduling(cont.)

Counter Example



Scheduling(cont.)

Algorithm - 2

Select the next possible event that begins as early as possible.

Scheduling(cont.)

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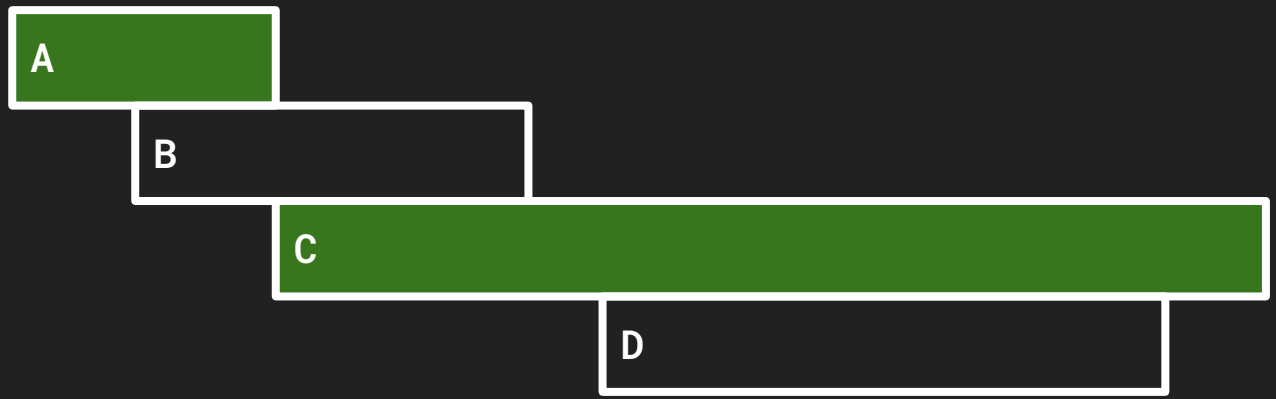

Scheduling(cont.)

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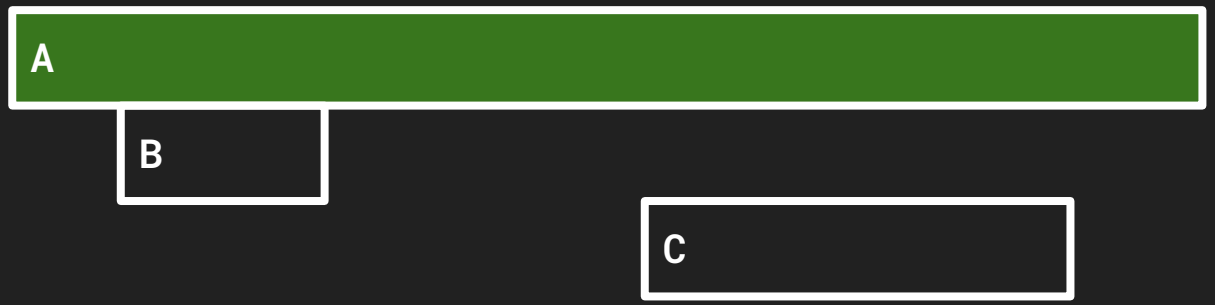

Scheduling(cont.)

Algorithm - 3

Select the next possible event that ends as early as possible.

Scheduling(cont.)

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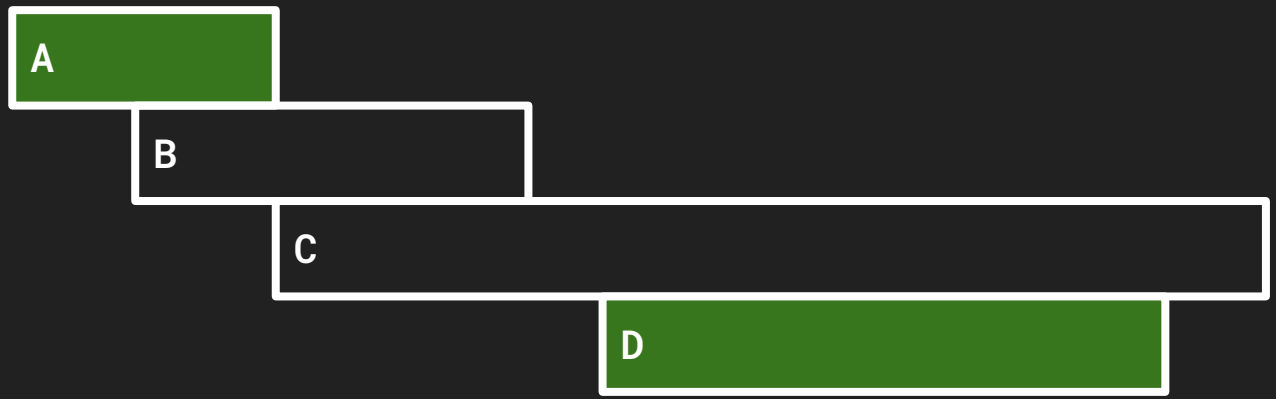

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Recursion

Recursion is a method of solving a problem where the solution depends on solutions to smaller instances of the same problem.

Fibonacci Sequence f(n) = f(n-1) + f(n-2)

```
int fibonacci(int n){

    if (n<=1) return n

    return fibonacci(n-1) + fibonacci(n-2)
}
```

Recursion(cont.)

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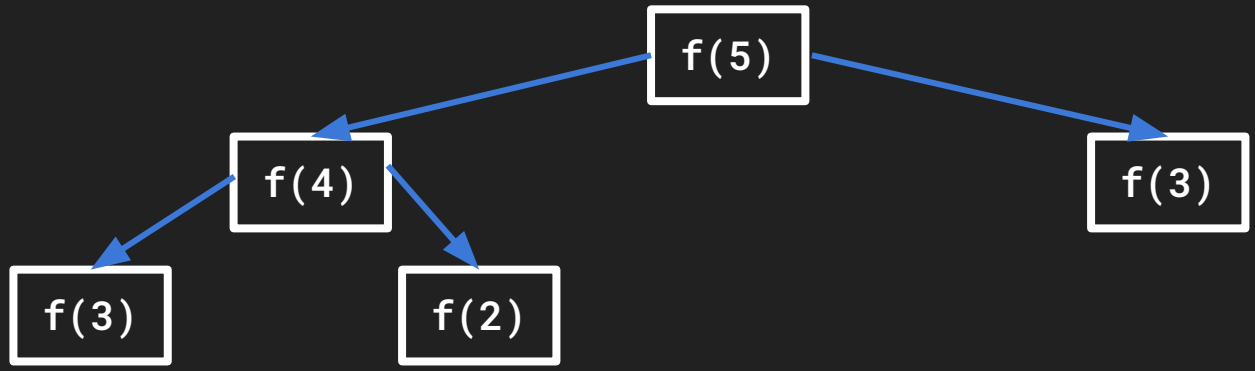
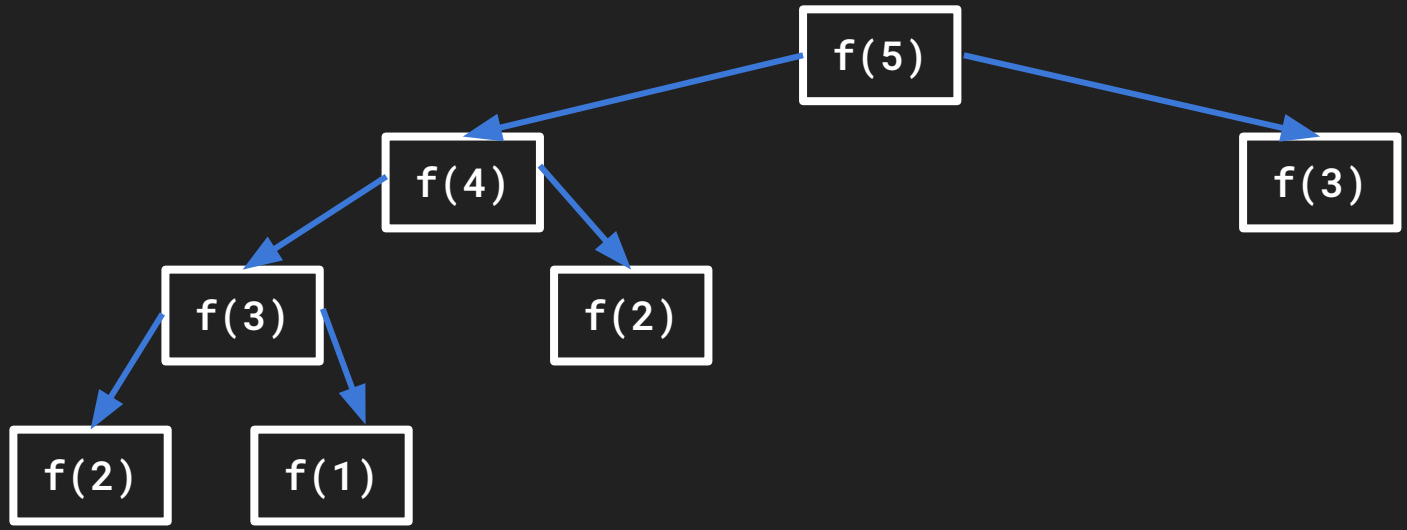
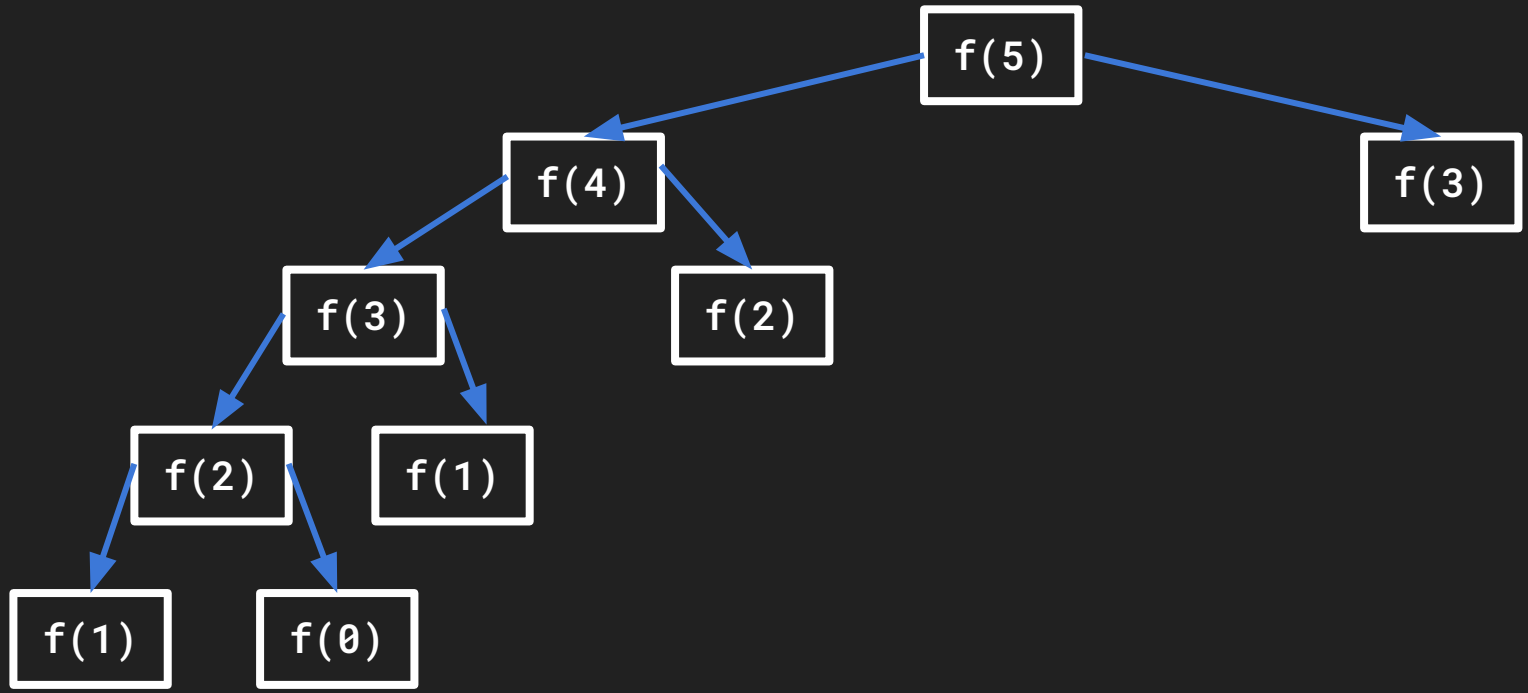


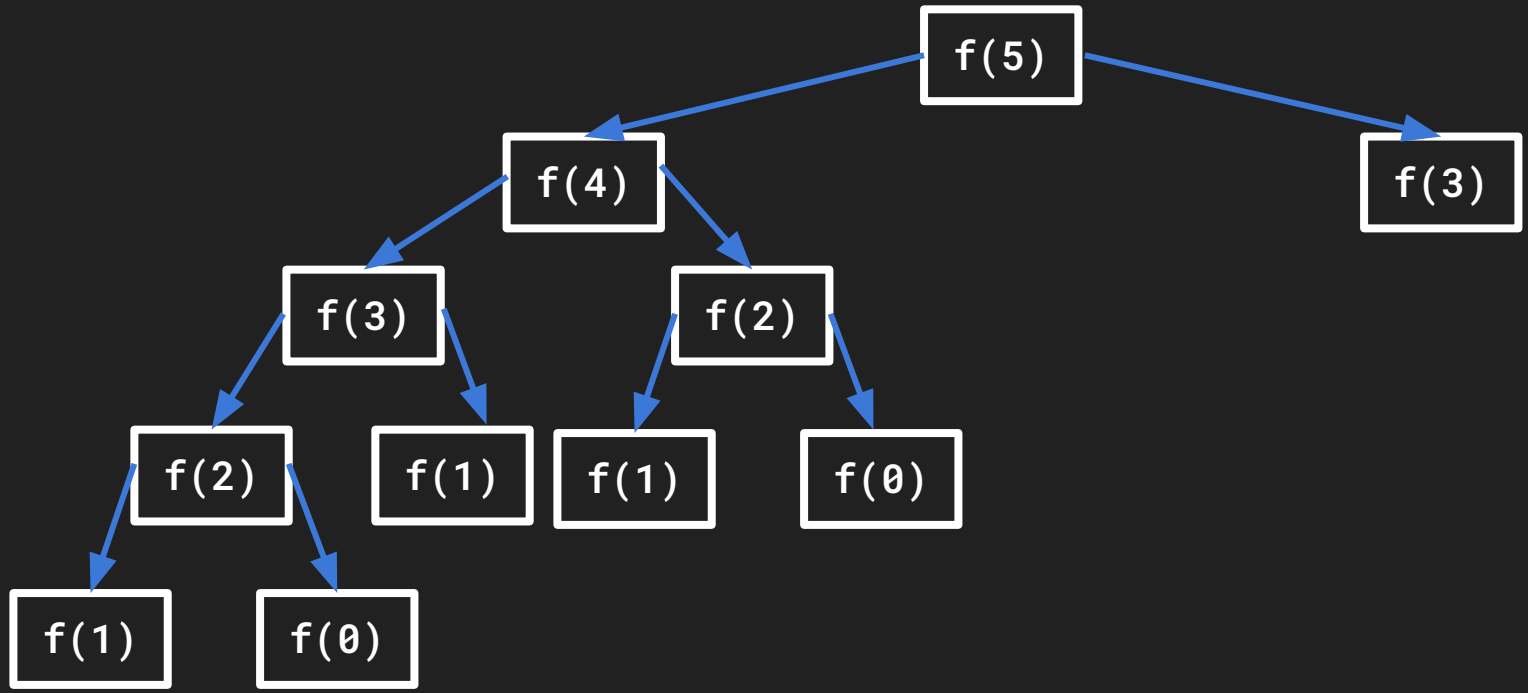
Recursion(cont.)



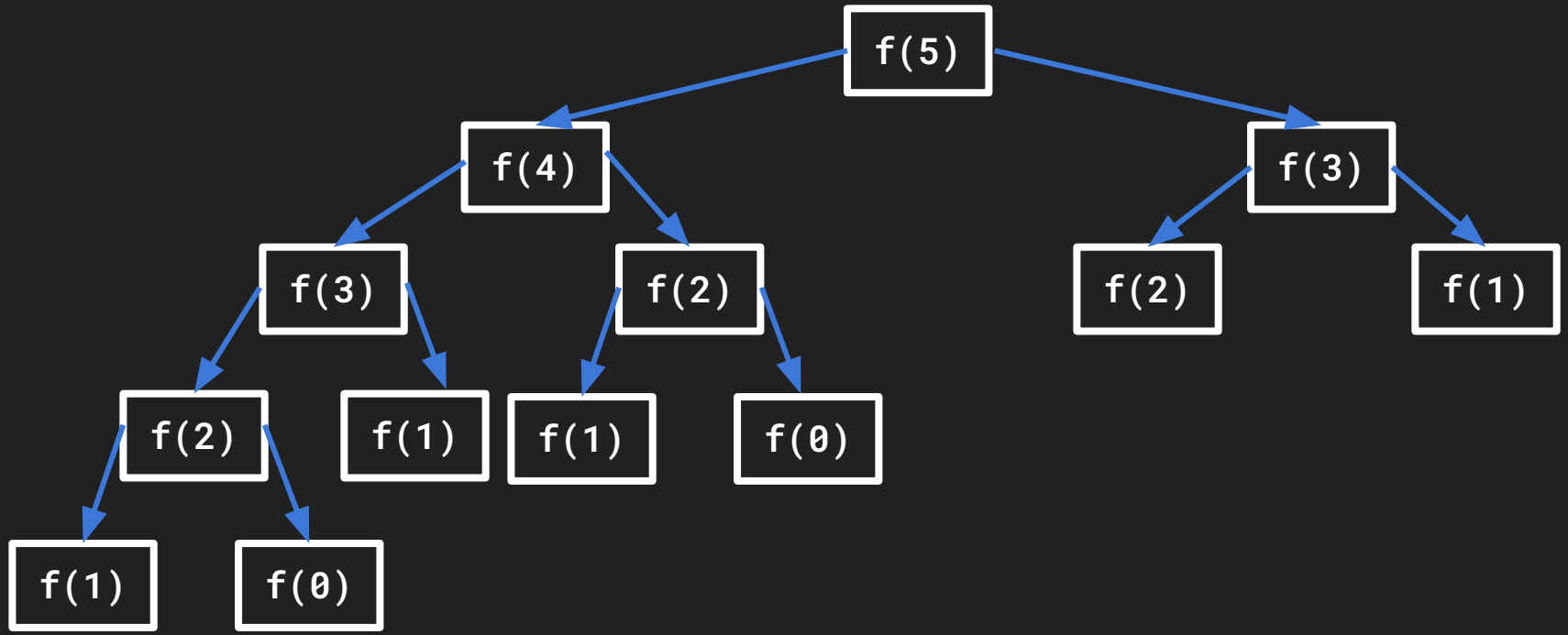
Recursion(cont.)



Recursion(cont.)



Recursion(cont.)



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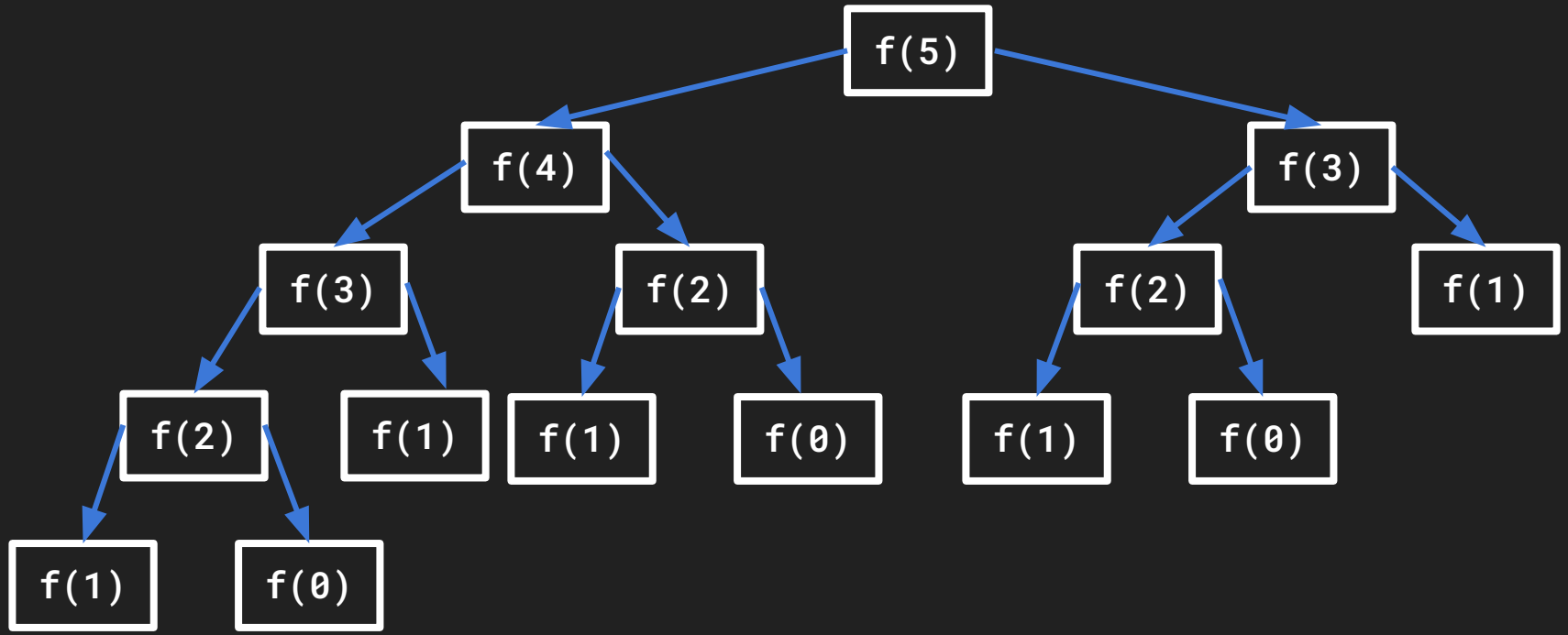
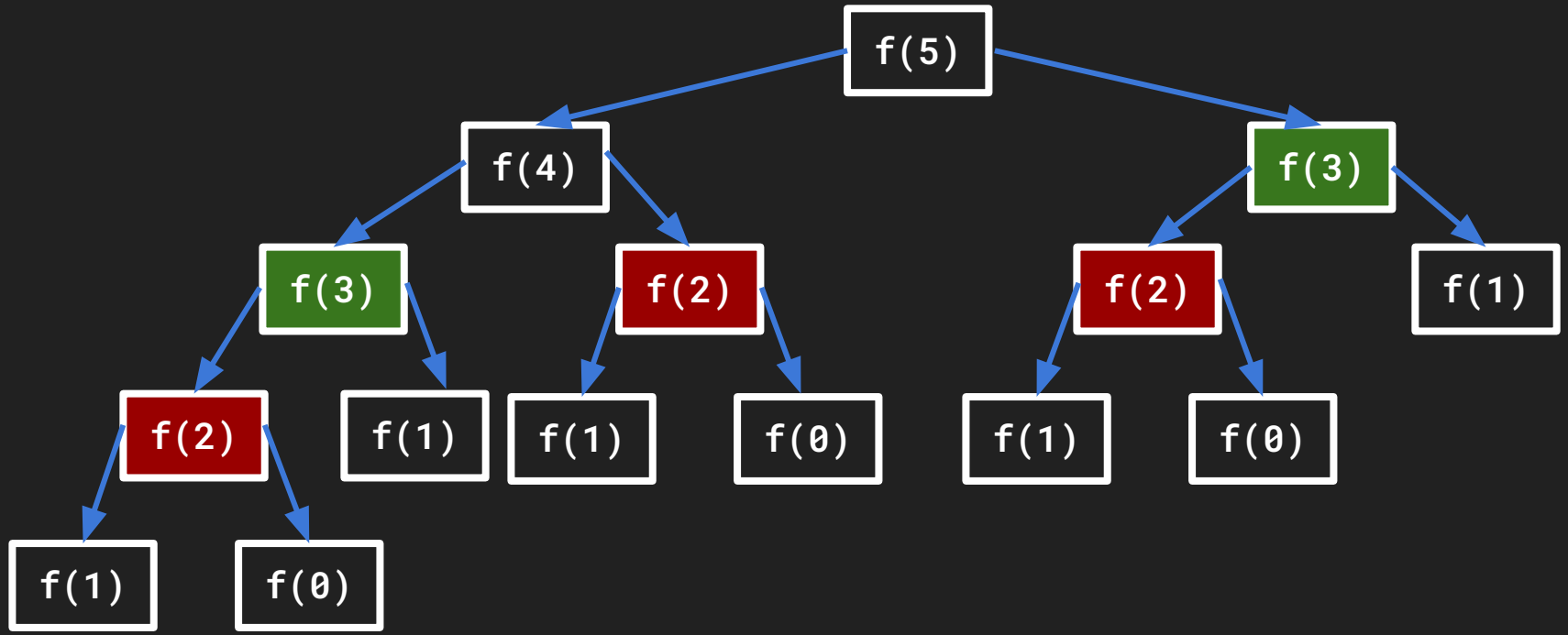
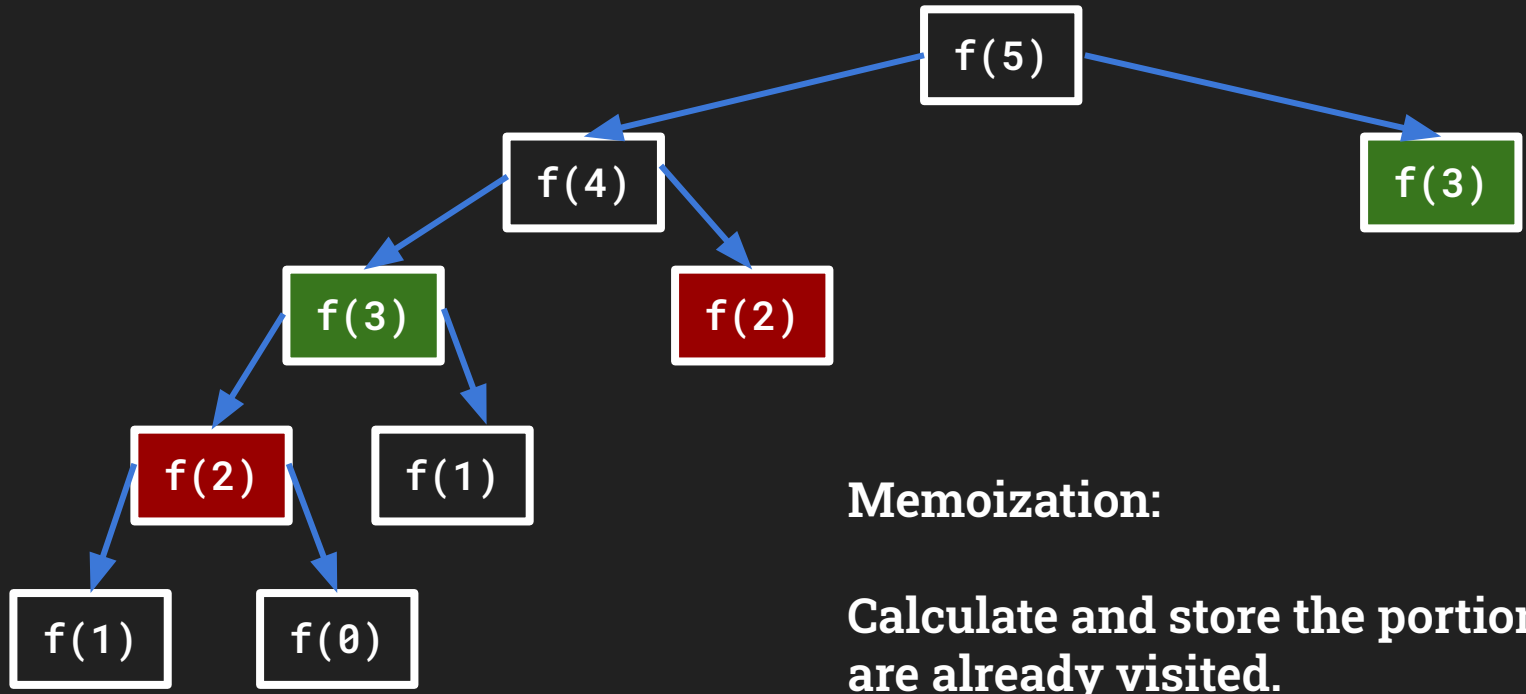


Recursion(cont.)



Dynamic Programming



Memoization:

Calculate and store the portions that are already visited.

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Setup the Environment

- VSCode
- Jupyter Notebook
- Google Colaboratory
- Kaggle