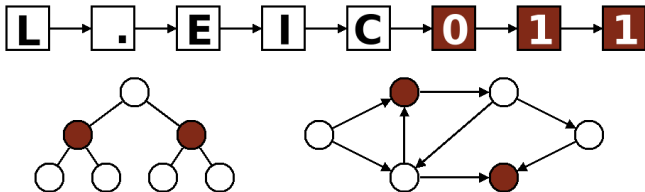


# Introduction

L.EIC

Algoritmos e Estruturas de Dados

2024/2025



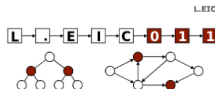
P Ribeiro, AP Tomás

# General Information

- Main Resources:

## Algorithms and Data Structures

2024/2025 Edition  
Bachelor in Informatics and Computing Engineering



**Webpage:** course webpage (classes, slides and all relevant information)

<https://www.dcc.fc.up.pt/~pribeiro/aulas/aed2425/>



**Discord:** communication/discussion ("*instant messaging*" format)



**Mooshak:** Code submissions with automatic test evaluation  
(*access to mooshak and discord will later be sent by email to the students*)

- **Theoretical Classes** *(one 2h class per week)*

- ▶ Ana Paula Tomás (FCUP)
- ▶ Pedro Ribeiro (FCUP)

- **Practical Classes:** *(one 2h class per week)*

- ▶ Ana Paula Tomás (FCUP)
- ▶ Pedro Pinto (FEUP)
- ▶ Jadna Cruz (FEUP)
- ▶ Filipa Ramos (FEUP)
- ▶ Ana Paula Rocha (FEUP)
- ▶ Bernardo Leite (FEUP)
- ▶ Iohan Soares (FEUP)
- ▶ Vanessa Silva (FCUP)

# Pre-requirements

- Students should have basic knowledge of programming and **C++**

```
// Your First C++ Program

#include <iostream>

int main() {
    std::cout << "Hello World!";
    return 0;
}
```

*Hopefully not 😊*

## Theoretical classes

- on site ("*face to face*" classes)
- (formal) exposition of the subjects, presentation of examples, analysis and discussion

## Practical classes

- programming exercises in **C++**
- no imposed IDE (suggestion: VSCode, CLion)
- automatic testing (Mooshak, unit tests)

# Evaluation

$$\text{Final Mark} = 0.7\text{Exam} + NP \geq 9.5$$

- *NP*: 2 practical tests with automatic evaluation (2.5 points each) and exercises during the semester (1 point)
- Required  $NP \geq 1.5$ . Otherwise,  $NP = 1.5$  if you pass an additional practical test.
- In "*Recurso*", only the Exam component can be improved.

## Frequency

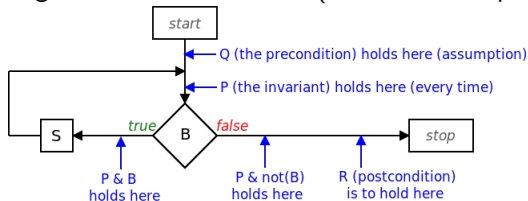
Students may not exceed the limit of absences (**25%** of TP classes)

# Objectives

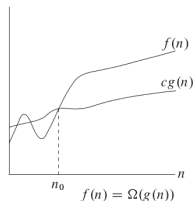
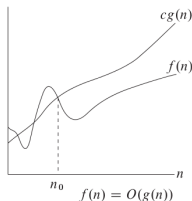
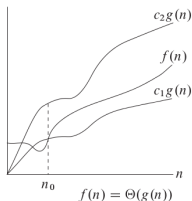
- Analyze the **correctness of simple algorithms**
- Analyze the **temporal and spatial complexity of algorithms**
- Understand the concept of **abstract data type** and know how to organize programs around this concept
- Know the **fundamental data structures and associated algorithms** and respective complexity
- **Choose appropriate** collections, data structures and algorithms to solve practical problems
- **write programs in C++** that implement and use the fundamental data structures and algorithms

# An overview of the program

- Algorithmic **correctness** (and the concept of **loop invariant**)



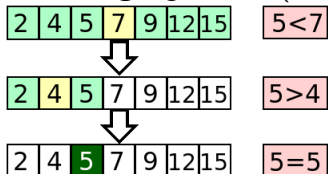
- Algorithmic **efficiency** (time and space)  
(asymptotically analysis and the **Big O notation**)



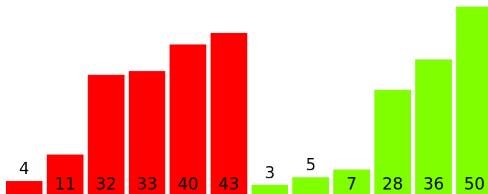


# An overview of the program

- **Searching** algorithms (linear search, binary search and variants)

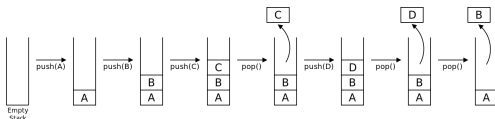
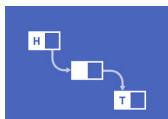


- **Sorting** algorithms (comparison based sorting and linear sorting)  
*[e.g. MergeSort, QuickSort, RadixSort, CountingSort, ...]*

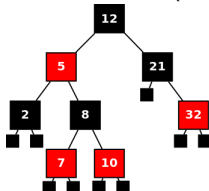
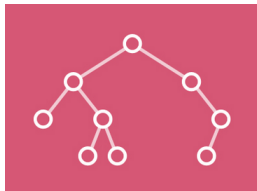


# An overview of the program

- Linear data structures: **lists, stacks, queues**

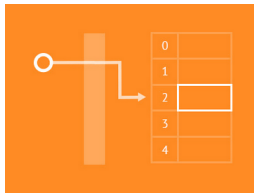


- Hierarchical data structures: **binary trees, binary search trees, balanced binary trees** and variants (*e.g. AVL and Red-Black trees*)



# An overview of the program

- Other essential data structures (**priority queues, hash tables**)



- Graphs** (concept, representation, traversal and fundamental algorithms)  
(e.g. *DFS, BFS and applications*)

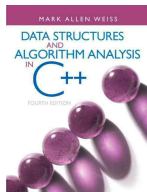


# Bibliography

## Main Books

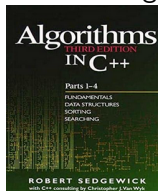
- **Data Structures & Algorithm Analysis in C++**

Mark Allen Weiss, 4th Edition, Pearson Education



- **Algorithms in C++**

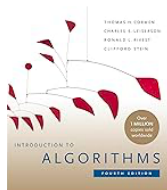
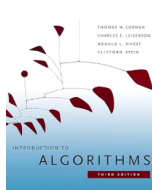
Robert Sedgewick, 3rd Edition, Princeton University



## Main Books (cont.)

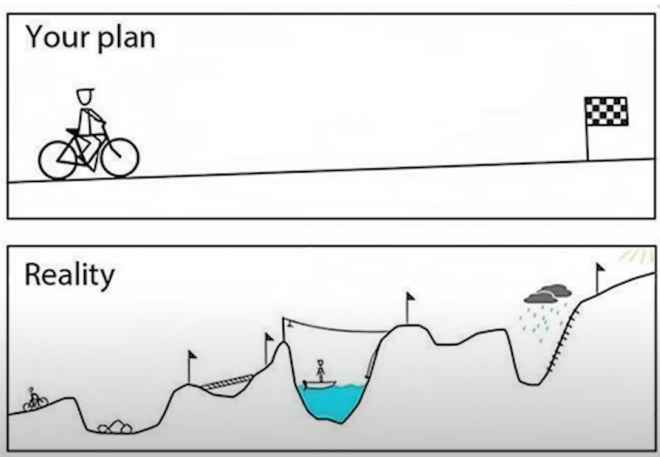
- **Introduction to Algorithms**

TH Cormen, CE Leiserson, RL Rivest and C Stein, 3rd ed. MIT Press  
(or 4th Ed) - best known as **CLRS**



# Good Work!

Genius is 1% inspiration and 99% perspiration (Thomas Edison)



Source: Mark Rober's **Super Mario Effect** Tedx Talk  
<https://youtu.be/9vJRopau0g0>