



# UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

## COMPUTER PROGRAMMING, ALGORITHMS AND DATA STRUCTURES

Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	INF/01 (COMPUTER SCIENCE)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	ARTIFICIAL INTELLIGENCE
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	Annual (04/10/2021 - 17/06/2022)
ECTS	12
Lesson hours	110 lesson hours
Language	English
Activity type	WRITTEN AND ORAL TEST
Teacher	FERRARI STEFANO (titolare) - 6 ECTS DONDI PIERCARLO - 6 ECTS
Prerequisites	None
Learning outcomes	<p>The course introduces the student to programming in Python and solving computational problems using algorithms. The main notions of imperative programming (variables, expressions, loops, functions, recursion, input / output) and the fundamental elements of object-oriented programming are provided. The course also illustrates the analysis and design of algorithms (asymptotic analysis, dynamic programming, greedy algorithms), presents the most important data structures (arrays, lists, trees, graphs) and the algorithms that work on them.</p>
Course contents	<p>Module 1: Computer Programming</p> <p>Computer science overview</p>

- logic circuits
- computer architecture
- operating system
- computer network
- information systems

#### Imperative programming

- top-down / bottom-up programming
- values, variables, expressions
- I/O instructions
- constructs, selection, loop
- functions, recursion
- I/O file
- libraries

#### Object-oriented programming

- fields and methods
- data types (arrays, lists)

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### Module 2: Algorithms and Data Structures

#### Introduction

- concept of algorithm and structured data
- notion of cost (time / space)

#### Complexity measure

- asymptotic notations for cost functions
- methods of analysis (worst case, average, best case)

#### Analysis of recursive algorithms

- abstract data types (stacks, queues, trees)
- tree visit algorithms

#### Sorting algorithms

- SelectionSort, InsertionSort, BubbleSort, HeapSort, MergeSort, QuickSort
- cost of the order (comparison / exchanges)
- lower bound

#### Search algorithms

- type of dictionary data
- binary search trees
- hash table

#### Algorithms on graphs

- visit
- greedy techniques
- coverage
- shortest path

<b>Reccomended or required readings</b>	<p>Think Python: How to Think Like a Computer Scientist by Allen B. Downey Beijing: O'reilly Media</p> <p>Problem Solving With Algorithms and Data Structures Using Python, 2nd edition, By Brad Miller and David Ranum Franklin Beedle &amp; Assoc</p> <p>(Optional) Introduction to Algorithms, 3rd edition By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein The MIT Press</p>
<b>Assessment methods</b>	<p>Written test</p>
<b>Further information</b>	
<b>Sustainable development goals - Agenda 2030</b>	<p><a href="#">\$ibl legenda sviluppo sostenibile</a></p>