UNIVERSITÀ DI PAVIA

Anno Accademico 2022/2023

COMPUTER PROGRAMMING, ALGORITHMS AND DATA STRUCTURES	
Enrollment year	2022/2023
Academic year	2022/2023
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 (03/10/2022 - 19/06/2023)
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	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 during the first module. The second module illustrates the most important data structures (linear, trees and graphs) and the main algorithms that work on them. The students will also learn how to analyze algorithms and how to use them to solve problems of medium complexity.
Course contents	Module 1: Computer Programming 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
- encapsulation, abstraction, inheritance, and polymorphism
- data types (arrays, lists)

++++++++++++++++++++++++

Module 2: Algorithms and Data Structures

Introduction
- Definitions of algorithm and structured data
- Methods for algorithms analysis (Big-O Notation, worst case, average, best case)

Main data Structures
- Linear (stack, queues, linked lists)
- Trees
- Graphs

Search and Sort
- Search (binary search, binary search trees, hash table)
- Sort (SelectionSort, InsertionSort, BubbleSort, HeapSort, MergeSort, QuickSort)

Algorithms on trees and graphs
- visit/traversal
- connected components
- topological sorting
- minimum spanning tree
- shortest path

Main algorithm approaches:
- Divide and Conquer
- Greedy algorithm
- Dynamic Programming

Teaching methods	For both modules: Frontal lessons (theory) and laboratories (programming in Python)
Reccomended or required readings	For Module 1: Think Python: How to Think Like a Computer Scientist by Allen B. Downey Beijing: O'reilly Media

	For Module 2: Problem Solving With Algorithims and Data Structures Using Python, 2nd edition, By Brad Miller and David Ranum Franklin Beedle & Assoc (Optional) Introduction to Algorithms, 3rd edition By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein The MIT Press
Assessment methods	Module 1: Project ... Module 2: Written test (open questions and exercises about theory) Programming (solve a problem applying the concepts learned during the theoretical and labotory lectures)
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile