

Macao Polytechnic University
Faculty of Applied Sciences
Bachelor of Science in Computing
Module Outline
Academic Year 2022/2023 Semester 2

Learning Module	Data Structures and Algorithms			Class Code	COMP122
Pre-requisite(s)	COMP112 Programming I				
Medium of Instruction	English			Credit	3
Lecture Hours	45 hrs	Lab/Practice Hours	0 hrs	Total Hours	45 hrs
Instructor	Dennis Wong Charles Lam		E-mail	cwong@mpu.edu.mo cklamsta@mpu.edu.mo	
Office	N46B, Wui Chi Building, Main Campus		Telephone	8599-6875 8599-6823	

Description

This learning module provides an introduction to data structures and algorithms using the Python programming language. The module begins with a brief introduction to Python, followed by the concrete and abstract linear structures: linked lists, stacks and queues. Next, the fundamentals of algorithm analysis are covered. Recursive algorithms are introduced with mathematical induction to show the elementary reasoning about algorithms. Trees are discussed with the applications in heaps and search trees. Hashing and various sorting algorithms are explained and analyzed. Finally, the module concludes with some advanced algorithms on graphs.

Learning Outcomes

After completing the learning module, students will be able to:

1. Apply the fundamental techniques in algorithm analysis. (SM1p, EA2p)
2. Define data structures for elementary algorithms (SM1p, EA1p)
3. Write elementary recursive algorithms. (SM2p, EA1p)
4. Reason about elementary recursive functions and loops. (SM2p)
5. Implement linked data structures. (SM1p, SM2p)

6. Classify and implement the fundamental sorting algorithms. (SM2p)
7. Explain and show some advanced data structures, such as Trees and Graphs, and the related algorithms. (SM2p)

Content

1. Introduction (6.0 hours)
 - 1.1. Python Programming Fundamentals
 - 1.2. Python Objects
 - 1.3. Iterators and Generators
 - 1.4. Representations of Data Relations
2. Linear Data Structures (3.0 hours)
 - 2.1. Array-Based Sequences
 - 2.2. Abstract Data Types
 - 2.3. Stacks, Queues and Deques
3. Fundamentals of Algorithm Analysis (3.0 hours)
 - 3.1. Asymptotic Complexity
 - 3.2. The Big-O Notation
 - 3.3. The Best, Average and Worst Cases
 - 3.4. Amortized Complexity
4. Recursion (6.0 hours)
 - 4.1. Recursive Problems and Solutions
 - 4.2. Recursive Method Calls
 - 4.3. Tail Recursions
 - 4.4. Mathematical Induction
5. Linked Lists (3.0 hours)
 - 5.1. Singly Linked Lists
 - 5.2. Circular Doubly Linked Lists
6. Trees and Heaps (4.5 hours)
 - 6.1. Trees and Binary Trees
 - 6.2. Priority Queues and Heaps
 - 6.3. Complete Binary Trees
7. Binary Search Trees (4.5 hours)
 - 7.1. Properties of Binary Search Trees
 - 7.2. Tree Traversals
 - 7.3. Tree Rotations

8. Hash Tables (3.0 hours)
 - 8.1. Hashing and hash functions
 - 8.2. Hash tables and collision resolution
9. Sorting Algorithms (6.0 hours)
 - 9.1. Insertion Sort
 - 9.2. Selection Sort and Heapsort
 - 9.3. Divide-and-Conquer, Mergesort and Quicksort
 - 9.4. A Lower Bound on Comparison-Based Sorting
10. Graphs (6.0 hours)
 - 10.1. Graphs and Their Representations
 - 10.2. Topological Order
 - 10.3. Depth-First and Breadth-First Search
 - 10.4. Spanning Trees
 - 10.5. Dijkstra's Shortest Path Algorithm

Teaching Method

Lectures and tutorials

Attendance

Attendance requirements are governed by the “Academic Regulations Governing Bachelor’s Degree Programmes” of Macao Polytechnic University. Students who do not meet the attendance requirements for the module will not be permitted to sit the final or re-sit examination and shall be awarded an ‘F’ grade.

Assessment

This learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 the pass score.

Item	Description	AHEP3 LO	Percentage
1. Assignments	Home-based exercises	SM2p, EA2p	25%
2. Tests	Knowledge assessment	SM1p, SM2p, EA1p	25%
3. Examination	3-hr written examination	SM1p, SM2p, EA1p, EA2p	50%
Total Percentage:			100%

Students with an overall score of less than 35 in the coursework must take the re-sit examination even if the overall score for the module is 50 or above.

Students with a score of less than 35 in the final examination must take the re-sit examination even if the overall score for the module is 50 or above.

Students with an overall final grade of less than 35 are NOT allowed to take the re-sit examination.

Teaching Material

Textbook

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser. (2013):
Data Structures and Algorithms in Python (1st Edition). Wiley.
ISBN-13: 978-1118290279

Reference

Reference book

1. Thomas H. Cormen., Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. (2009):
Introduction to Algorithms (3rd Edition, International Edition). MIT Press.
ISBN-13: 978-0262033848
2. Bradley N. Miller, David L. Ranum. (2011):
Problem Solving with Algorithms and Data Structures Using Python (2nd Edition).
Franklin, Beedle & Associates.
ISBN-13: 978-1590282571