Data Structure and Algorithm (PROG2103)

Lecturer : So Yong Quay

Data Structure and Algorithm

- Code : PROG2103
- Status : Core
- Credit hours : 3
- Prerequisite:
  - Fundamental of Software Design and Development (PROG1003) / Introduction to Programming (PROG1013)
  - Mathematics for Computing (MATH1003)

Objectives

- Introduce data structure concept and show how those concepts are useful in problem solving.
- Show how the concept can be made by using a programming language.
- Provide analysis approaches to analyze the complexity time of difference algorithm.

Learning Outcome

Upon completion of this course, students will be able to:

- Explain the concept of difference data structures and algorithms.
- Apply the various data structures and algorithm in difference area to solve the problem.
- Analyze the complexity time of the difference algorithms.

Synopsis

- Introduction to Data Structures and Algorithm
- Discuss stacks and their Language Implementation
- Introduce queues, priority queues, linked lists and their implementations.
- Introduce sorting and their implementations.
- Cover recursion, its applications, and its implementation
- Introduce Binary Tree, Heaps and their implementations
- Introduce Graph, Dynamic Programming and their implementations
- How to analyze complexity time for the algorithm

Main Text Book

Frank M. Carrano, Timothy M. Henry. Data Structures and Abstractions with JAVA. 5th edition. New York Pearson. 2019

Supplementary Text Book

Y. Daniel LIang. Introduction to Java Programming and Data Structures. 12th edition. New York: Pearson Educaiton. 2020.

Robert Lafore. Data Structures & Algorithm in Java. 2nd edition. Indiana: SAMS, 2003.

Contents

1. Introduction to Data Structures and Algorithms
   - What are Data Structures and Algorithms
   - Overview of Data Structures
   - Overview of Algorithms

Contents

2. Analyzing the Efficiency of Algorithms
   - Asymptotic Notation
   - Big O Notation
   - The Omega Notation
   - The Theta Notation

Contents

3. Array
   - The Basics of Arrays
   - Ordered Array
   - The Order Workshop Applet (Linear Search and Binary Search)

Contents

4. Simple Sorting
   - Bubble Sort
   - Selection Sort
   - Insertion Sort

Contents

5. The Stack and Queue
   - Stacks and its implement
   - Queues and its implement
   - Priority Queues

Contents

6. Linked Lists
   - Links
   - A Simple Linked List (Singly Linked List)
   - Finding and Deleting Specified Links
   - Double-End List
   - Doubly Linked List
   - Linked-List Efficiency

Contents

7. Recursion, Searching and Divide-and-Conquer
   - Some Interesting Recursive Applications
   - Factorials
   - The concept of the Divide-and-Conquer
   - A Recursive Binary Search
   - Mergesort

Contents

8. Advanced Sorting
   - Shellsort
   - Partitioning
   - Quicksort

Contents

9. Trees and Search
   - Tree Terminology
   - How Do Binary Search Trees Work
   - Finding a Node
   - Inserting a Node
   - Deleting a Node
   - Traversing the Tree

Contents

10. Heaps
    - Introduction to Heaps
    - Heapsort

Contents

11. Exploring Graph and Search
    - Introduction to Graphs
    - Searches (Depth-First Search, Breadth-First Search)
    - Minimum Spanning Trees
    - Topological Sorting with Directed Graphs
    - The Shortest-Path Problem

Contents

12. Dynamic Programming
    - Introduction to dynamic programming
    - Calculation the binomial coefficient
    - Shortest paths problem
    - Complexity time of Floyd algorithm

Assessment scheme

Assignment (5)	20%
Test (2)	40%
Final Examination	40%

Test 1: Introduction to Data Structures and Algorithms, Analyzing the Efficiency of Algorithms, Array, Simple Sorting, The Stack and Queue, Linked List

Test 2: Analyzing the Efficiency of Algorithms, Recursion, Searching and Divide-and-Conquer, Advanced Sorting, Trees and Search, Heaps

Test

1. Test 1
   - Date: 5/04/2022 (Tuesday)
   - Time: 10 am – 12 pm

2. Test 2
   - Date: 19/04/2021 (Tuesday)
   - Time: 10 am – 12 pm