

IT-2660: DATA STRUCTURES & ALGORITHMS

Cuyahoga Community College

Viewing: IT-2660 : Data Structures & Algorithms

Board of Trustees:

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Academic Term:

Fall 2024

Subject Code

IT - Information Technology

Course Number:

2660

Title:

Data Structures & Algorithms

Catalog Description:

Students implement data structures and algorithms while considering their time and space efficiencies. Data structures include stacks, queues, linked lists, trees, and graphs. Algorithms include sorting, searching, and hashing.

Credit Hour(s):

4

Lecture Hour(s):

3

Lab Hour(s):

2

Requisites

Prerequisite and Corequisite

IT-2650 Java Programming.

Outcomes

Course Outcome(s):

Analyze problems, design, and implement programming solutions using data structures and algorithms.

Objective(s):

1. Demonstrate the use of basic data structures and explain their design and use case scenarios including arrays, linked lists, stacks, queues, priority queues, graphs, and trees.
2. Implement hash tables including strategies for avoiding and resolving collisions.
3. Calculate the time and space efficiencies of an algorithm and underlying data structures using asymptotic analysis such as big-O notation, asymptotic notation, average-case, amortized, and worst-case analysis.
4. Implement and compare the complexities of various sorting and searching algorithms such as bubble sort, insertion sort, merge sort, quicksort, binary search, and linear search.
5. Use and understand time and space complexities of tree and graph traversal and shortest path algorithms such as depth-first search, breadth-first search, Dijkstra's, and Bellman-Ford.

Methods of Evaluation:

1. Class participation and discussion
2. Written papers
3. Lab assignments

- 4. Quizzes
- 5. Exams

Course Content Outline:

1. Develop basic algorithms to practice language fundamentals
 - a. Finding min, max, and mode
 - b. Finding a greatest common denominator
 - c. Calculate the average of a list of numbers
 - d. Find factorial
2. Types of Data Structures
 - a. Lists
 - b. Stacks and queues
 - c. Linked structures
 - d. Hashed structures
 - e. Binary Search Trees
 - f. Heaps, priority queues, graphs
3. Data Structure & Algorithm Design
 - a. Processing efficiency (Asymptotic analysis: big-O notation, average-case, amortized, worst-case)
 - b. Memory space requirements (Density)
 - c. Compare and contrast various data structures
 - i. Lists
 - ii. Stacks and queues
 - iii. Linked Structures
 - iv. Hashed structures
 - v. Binary Search Trees
 - vi. Heaps, priority queues, graphs
 - d. Logic
 - e. Syntax
4. Data structure problems
 - a. Input
 - b. Output
 - c. Processes
5. Recursion
 - a. Recursion vs. iteration
 - b. Formulating recursive algorithms
 - c. Backtracking
 - d. Problems with recursion
6. Sorting, Searching, and Hashing algorithms
 - a. Bubble sort
 - b. Heap sort
 - c. Merge sort
 - d. Quick sort
 - e. Linear search
 - f. Binary search
 - g. Linear hashing
 - h. Quadratic hashing
 - i. Linear quotient hashing
 - j. Chained hashing
7. Hashing algorithms
 - a. Avoiding conflicts
 - b. Resolving conflicts
8. Trees and graphs
 - a. Traversal
 - b. Shortest path algorithms
 - i. Depth-first
 - ii. Breadth-first

- iii. Dijkstra's
- iv. Bellman-Ford

Resources

McAllister, W. (2010) *Data Structures and Algorithms Using Java*, Jones & Bartlett Learning.

Liang, Y. (2012) *Introduction to Java Programming*, Jones & Bartlett Learning.

Liang, Y. (2020) *Introduction to Java Programming and Data Structures*, Pearson.

Main, M. (2010) *Data Structures and Other Objects Using C++*, Pearson.

La Rocca, M. (2021) *Advanced Algorithms and Data Structures*, Manning.

Wengrow, J. (2020) *A Common-Sense Guide to Data Structures and Algorithms*, Pragmatic Bookshelf.

Koffman, E. (2021) *Data Structures: Abstraction and Design Using Java*, Wiley.

Azevedo, J., Cutajar, J. (2020) *Readings from Java Data Structures*, Cengage Learning.

Resources Other

GeeksforGeeks. (n.d.). Data Structures. Retrieved from <https://www.geeksforgeeks.org/data-structures/>

JavaTpoint. (n.d.). Data Structure - Introduction. Retrieved from <https://www.javatpoint.com/data-structure-introduction>

MIT OpenCourseWare. (2020). 6.006 Introduction to Algorithms (Spring 2020). Retrieved from <https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-spring-2020/>

Oracle. (n.d.). Java. Retrieved from <https://www.oracle.com/java/>

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