Data Structures Course Wrap Up

December 2017

Topics – Introduction to Data Structures

- Overview of Data Structures: data, data abstractions, structures, algorithms, implementation, IDEs.
- Java Basics
- Eclipse: An Introduction
- Object-Oriented Programming: Core Ideas
- Object-Oriented Programming in Java
- Lists & Java Collections Framework
- ArrayLists, Linked Lists
- Algorithm Efficiency
- Stacks & Queues
- Recursion
- Trees
- Sets & Hash Tables
- Sorting Algorithms
- Graphs

Topics – Basics, Java, OOP in Java

- **Data:** What is data? What is a data structure? What is data abstraction? Role of data in everyday applications: deconstructing Uber - kinds of elements, data, logistics, etc. Overview of data structures, algorithms & complexity.
- **Introduction to Java:** Writing and running Java programs. Using Eclipse. Program structure, data types, variables, constants, storage model (simple and reference types), type casting. Arrays, array initialization. Functions, String type, exceptions and exception handling, file I/O. Errors - Syntax errors & runtime errors. Exceptions - checked & unchecked exceptions. Exception Handling - try-catch blocks. File IO - local data files & web data files.
- **Object-Oriented Programming in Java:** Objects & classes. Class & instance variables, constructors, methods (accessors, modifiers, predicates, print method), this. UML. Subclass, superclass, interfaces, etc.
- **Java Collections Framework**

Topics – Linear Data Structures

- **ArrayLists**
- Implementing ArrayLists: Using fixed sized arrays; using dynamic arrays.
- **Linked Lists:** Single/Double-linked Lists.
- **Iterators:** Java Collections Framework.
- **Stacks & Queues**: Applications of stacks (finding palindromes, arithmetic expressions). Applications of Queues (discrete event simulation).
- Implementing Stacks and Queues.
- Converting Infix expressions to postfix. Evaluating postfix expression

Topics – Algorithms 1

- **Space & Time Complexity:** Big-O notation.
- **Recursion**
- Examples of recursive functions – fact, sum, etc. Towers of Hanoi. Recursive linear search in an array.
- **Search:** Making the search method generic: .equals(), Comparable interface. Linear & Binary Search.
- **Sorting:** Quadratic Sorting algorithms- Selection Sort, Bubble Sort, Insertion Sort.

Topics – More Data Structures

- **Trees:** An Introduction. Hierarchical data structures. properties of trees. Tree traversals.
- **Binary Trees:** Definition & Implementation. Tree traversals – pre-order, in-order, and post-order traversals.
- **Binary Search Trees:** Heaps & Priority Queues.
- **Sets & Maps:** Sets in Java. Hash tables: hash functions, collisions, open addressing, linear probing, chaining, load factor. Hash tables in Java.

Topics – Algorithms 2

- **Merge Sort**
- **Heap Sort**
- **Quick Sort**

Syllabus for Exam 3

- **Sorting:** Quadratic Sorting algorithms- Selection Sort, Bubble Sort, Insertion Sort.
- **Trees:** An Introduction. Hierarchical data structures. properties of trees. Binary Trees- definition and applications. Tree traversals.
- **Binary Trees:** Definition & Implementation. Tree traversals – pre-order, in-order, and post-order traversals.
- **Binary Search Trees:** Heaps & Priority Queues.
- **Sets & Maps:** Sets in Java. Hash tables: hash functions, collisions, open addressing, linear probing, chaining, load factor. Hash tables in Java.
- **Sorting:** Log-linear sorting algorithms - Merge Sort, Heap Sort, Quick Sort

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