



Data Structures and Algorithms Summer Syllabus

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Textbook:

Data Structure & Algorithms in Java, 6th edition (pdf)

Material Covered

The Data Structures & Algorithms course is the continuation of the ACES Java I and Java II course. We assume students have successfully taken the Java II course or passed the Java II placement test. The course will use **Java** as teaching language.

The Data Structures & Algorithms course will cover common data structures such as list, linked list, stack, queue, tree, hash table, and hash map. It will introduce the implementation and usages of those common data structures in java.util collections. We will teach different sort and search algorithms in general. Java build-in sort and search method and its applications will also be discussed in details. We will also introduce algorithm complexity analysis and Big O notation so that students can solve their problems within time and space restrictions.

After successfully completing the Data Structures & Algorithms course, students will have the **Java language foundations** and Data Structures & Algorithms knowledge to create Java applications which can solve real problems of mathematics, modeling, computation, and USA computing Olympiad silver level problems.

Class Structure

Except for the first day, the first hour is spent reviewing the previous day's homework, material, and quiz or exam. Over the next two hours we cover new material, with example problems solved by the students throughout. During the last 30 minutes, there is a comprehensive quiz with an emphasis on that day's material and in-class problem solving exercise. On Fridays, there is only one hour of new material followed by the overview of the materials taught in the week, and then the students take an hour-long comprehensive exam. Each class will include three breaks of ten minutes each.



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Schedule:

Date	Topic	Objective
Week 1		
Monday	Introduction, IDE setup and Java review	The Data Structures and Algorithm course overview. Setting up development environment. Prerequisite knowledge/skill reviews. Mini quiz to understand student levels.
Tuesday	Array List and Linked List. The implementations of array list and linked list in java.util	Introducing the concept of array list and linked list. Understanding the java java.util collection implementation of the array list and linked list.
Wednesday	Basic Sorting Algorithms. Bubble sort, selection sort, merge sort and quick sort. Sort implementations in Java Arrays.sort() and Collections.sort()	Introducing algorithms of simple sorts and efficient sorts. Introducing the java implementations of sort methods in Arrays and Collections.
Thursday	Basic Search algorithms. Linear search and binary search.	Introducing search algorithms. Working on linear and binary search. Introducing the java implementation of binary search in Arrays.
Friday	Problem solution. Using the data structures, algorithms learned in this week to solve a USACO silver level problem – Counting Hay bales .	Reviewing the new materials learned in this week. Getting familiar with USACO problems. Analyzing problem and discussing approaches. Using the knowledge and skills learned in the week to solve the problem with real code in Java and try to pass



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		all test cases.
Week 2		
Monday	Analysis of Algorithms – Big O notation and Complexity	Introducing algorithm complexity analysis and Big ON notation. Analyzing algorithms learned last week.
Tuesday	Hash, hash functions, Hash table, hash map	Introducing the concept of hash, hash function, resolving collisions through chaining and hash table. Understanding java HashMap and when and how to use HashMap.
Wednesday	Tree, Binary tree. Insertion, deletion and traversal	Introducing binary tree, insertion, deletion and traversals. Binary tree applications.
Thursday	Problem solution. Using the knowledge learned so far to solve a USACO silver level problem – Cities and States .	Reviewing the new materials learned in this week. Getting familiar with USACO problems by working on a new problem. Analyzing problem and discussing approaches. Using the knowledge and skills learned in the week to solve the problem with real code in Java and try to pass all test cases.
Friday	DSA (Data Structures & Algorithms) review and final quiz	Final review of the DSA course. Final quiz.

- Do the reading and the homework. I will go over the material in class beforehand. Programming, like mathematics, is comprehensive. You need a lot more practice, especially writing your own programs.
- Write comments for major blocks. The comments help your source code readers and help yourself when you read it in a late time.

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- Avoid cut/paste source code segments from somewhere else. Writing your own code helps in remembering the language, syntax and common class methods.
- Getting yourself familiar with online Java SE API
(<https://docs.oracle.com/javase/8/docs/api/index.html>)