

Course number and name: **CS 04222: Data Structures and Algorithms**
Credits and contact hours: 4 credits. / 5 contact hours
Faculty Coordinator: Seth Bergmann
Text book, title, author, and year: Data Structures and Algorithms in Java, Mark Weiss, 2012.

Specific course information

Catalog description: This course features programs of realistic complexity. The programs utilize data structures (string, lists, graphs, stacks, trees) and algorithms (searching, sorting, etc.) for manipulating these data structures. The course emphasizes interactive design and includes the use of microcomputer systems and direct access data files.

Prerequisites: CS 04114 Object Oriented Programming and Data Abstraction **and** (MATH 03160 Discrete Structures or MATH 03150 Discrete Mathematics)

Type of Course: Required Elective Selected Elective

Specific goals for the course

1. **big O algorithm analysis.** Students have produced an informal big O run time analysis of searching and sorting algorithms
 - ABET (b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
2. **big O data structure analysis.** Students have produced an informal big O run time analysis of various methods relating to the data structures (e.g., lists, stacks, queues, maps)
 - ABET (b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
3. **data structure selection.** Students have demonstrated the ability to make decisions on the proper use of the data structures (e.g., lists, stacks, queues, maps) for time and space criteria and discuss the advantages and disadvantages of different data structures/formats.

- ABET (b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
4. **primitive data structures.** Students have demonstrated the ability to construct, implement and utilize common data structures fusing three primitive structures: arrays, integers, and references and are able to list the most common structures and data formats for storing data in a computer system
- ABET (c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
5. **search and sort.** Students have coded and tested searching and sorting algorithms
- ABET (c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

Required list of topics to be covered

1. Data structures
 - a. Lists (Array-based), linked lists, doubly linked lists, other list types
 - b. Stacks
 - c. Queues
 - d. Trees (binary search trees)
 - e. Heaps (e.g., priority queues)
 - f. Hash tables
 - g. Sets (TreeSet, HashSet)
 - h. Maps (TreeMap, HashMap)
 - i. Iterators and List Iterators
 - j. Categories of data structures (linear v. non-linear)
2. Algorithms
 - a. Sorting (selection sort, bubble sort, quick sort, heap sort)
 - b. Searching (sequential search, binary search, hash tables)
 - c. Analysis of Algorithms
 - d. Computational complexity
 - e. Best/Worst/Average Case behavior
 - f. Optimization
3. Recursion

Optional list of topics that could be covered

1. Backtracking algorithms (Eight Queens Problem)
2. Balanced Binary Search Trees (AVL trees)
3. Dequeues
4. Introduction to NP-complete problem
5. Graph Path Algorithms