

CSC 427: Data Structures and Algorithm Analysis

Fall 2006

Course goals

- To appreciate the role of algorithms in problem solving and software design; selecting among competing algorithms and justifying choices based on efficiency.
- To understand the specifications and implementations of standard data structures and be able to select appropriate structures in developing programs.
- To develop programs using different problem-solving approaches, and be able to recognize when a particular approach is most useful.
- To be able to design and implement a program to model a real-world system, and subsequently analyze its behavior.
- To recognize the importance of object-oriented techniques, and be able to utilize inheritance and polymorphism to build upon existing code.

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Algorithm analysis

big-Oh notation

- formal definition, rate-of-growth analysis, asymptotic behavior
- underlying big-Oh classifications for data structure operations

searching & sorting

- sequential search vs. binary search
- insertion sort vs. selection sort vs. merge sort vs. heap sort
- specialized sorts: frequency counts, radix sort

recursion

- base case(s), recursive case(s), analysis via recurrence relation

algorithmic approaches

- *divide&conquer*: binary search, merge sort, tree algorithms, ...
- *greedy*: optimal change (U.S.), job scheduling, min spanning tree, ...
- *backtracking*: N-queens, blob count, boggle search, ...
- *dynamic*: optimal change, binomial coefficient, ...

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Data Structures

low-level data structures

- *linked lists*: singly-linked vs. doubly linked, header node(s)
- *trees*: recursive processing, binary search tree, balanced tree variants, tries, heaps
- *hash table*: hash function, collisions, load factor, rehashing, probing vs. chaining
- *iterators*: Iterable interface, Iterator interface

lists

- *List interface*: get, set, add, remove, contains, indexOf, size, iterator, ...
- *implementations*: ArrayList implementation, LinkedList

sets

- *Set interface*: add, remove, contains, clear, size, iterator, ...
- *implementations*: TreeSet, HashSet

maps

- *Map interface*: get, put, remove, containsKey, keySet, size, ...
- *implementations*: TreeMap, HashMap

priority queues

- *PriorityQueue class*: peek, add, remove, size, iterator, ...

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Object-oriented programming

class design

- interacting classes, private data fields & public methods, generics, ...

interfaces:

- implementing an interface, polymorphism

inheritance:

- extending a class, overriding methods, polymorphism

GUI design/building

HW1 (ASCIIimation): class design, String/ArrayList manipulation, GUI, timer events

HW2 (radix sort): 2-D structure implementation, experimentation, big-Oh analysis

HW3 (keyword index): TreeSet vs. HashSet, design with polymorphism, Set & Map

HW4 (gift givers): problem solving, Set & Map, I/O correctness

HW5 (Boggle): Trie implementation, recursive backtracking, GUI

HW6 (Sudoku): algorithm (backtracking) + data structure (2-D) + GUI

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Final exam

Tuesday, December 12

10:00 - 11:40

- similar format to previous tests, slightly longer
 - ✓ true/false or multiple choice
 - ✓ short answer
 - ✓ trace/explain/analyze data structure and/or algorithm
 - ✓ trace/explain/modify/write code
- emphasis placed on integrating concepts from throughout the course
 - think big picture
 - be prepared to apply a variety of tools & techniques to a problem
- study advice
 - ✓ review lecture notes
 - ✓ use quizzes & [review sheet](#) as study guides, but must fill in details
 - ✓ read the text to complete the picture, get a different perspective