COURSEBOOK for COMPSCI.220FT

Algorithms and Data Structures

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Introduction

Chapter 1.1 prepared by Dr. Georgy Gimel'farb covers basic practical and theoretical aspects of algorithm analysis, as applied to searching and sorting algorithms you started to study in the COMPSCI.105 course. Also it overviews array-based symbol tables. Techniques are presented for measuring program performance, in particular, the Big-Oh notation for expressing efficiency of a program, basic recurrences to estimate running times, and similar tools. Performance of basic sorting and searching algorithms is analysed in detail with respect to most popular data types such as lists and tables. For example, simple but inefficient Insertion sort is compared to much more efficient Mergesort, Quicksort, and Heapsort algorithms that implement powerful divide–and–conquer techniques. Note that both Quicksort and Mergesort are implemented in the Java Collections framework.

Although these subjects had been already discussed in brief in COMPSCI.105, the present course studies efficiency of sorting and searching algorithms more thoroughly. You will find more details in the recommended textbooks [6, 12] (see Bibliography on pp. 13–14), as well as in numerous other books on algorithms and data structures you can find in libraries and bookshops, in particular, in [1, 2, 5, 8, 9, 13, 14, 16] and so forth. Although the older books may use outdated or even antiquated programming languages (such as Pascal, Modula, or Fortran), the algorithms and data structures are basically the same as they reflect programming experience of many years...

Chapters 2 and 3 were written by Dr. Michael Dinneen, with modifications by Dr. Mark Wilson.

Chapter 2 contains the reference material on graph algorithms. Topics include computer representations (adjacency matrices and lists), graph searching (BFS and DFS), and basic graph algorithms such as computing the shortest distances between vertices and finding (strongly) connected components.

Chapter 3 contains the reference material on automata theory. Topics include deterministic and nondeterministic finite-state machines (DFA/NFA), regular expressions, and algorithms dealing with regular languages. More information can be found in [7].

Chapters 4 and 5 are prepared by Andrew MacGibbon. Chapter 4 presents the reference material on context-free grammars and parsing adapted from Chapter 11 of [2].

Chapter 5 is adapted from the Java "Collections" tutorial and the Java API documentation.

Appendices A and B give additional information about the above topics.

Appendix A compiled by Dr. Georgy Gimel’farb presents Java abstract data types (ADT).

Appendix B written by Dr. Michael Dinneen describes a graph ADT.

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