

Syllabus for the Algorithms qualifying examination
Computer Science Department

Date Last Revised: August, 2002

Notice

The syllabus may, and probably will, change for future offerings. Be sure that you are studying from the right syllabus, not from an obsolete one.

Major Texts

- CLR Cormen, Thomas H., Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms," McGraw-Hill/MIT Press, New York, 2001. Note: This is the new edition.
- SWK Sedgewick, Robert, "Algorithms in C, Parts 1-5," (or C++) Addison-Wesley, Boston, 1998.
- GT Goodrich, Michael and Tamassia, Roberto, "Algorithm Design: Foundations, Analysis and Internet Examples," John Wiley & Sons, 2002.
-

Supporting Texts

- GJ Garey, Michael, R. and David S. Johnson, "Computers and Intractability: A Guide to the Theory of NP-Completeness," Freeman, SF, 1979.
- HB Hochbaum, Dorit, "Approximation Algorithms for NP-Hard Problems," PWS Publishing Company, Boston, 1997.
- AKL Akl, Selim, "The Design and Analysis of Parallel Algorithms," Prentice-Hall, Inc., NJ, 1989.
- ORK O'Rourke, Joseph, "Computational Geometry in C, 2nd Edition," Cambridge University Press, Cambridge, UK, 1998.
- GKP Graham, Ronald L., Donald E. Knuth, and Oren Patashnik, "Concrete Mathematics," Addison-Wesley, Reading, MA, 1989.
- GG Gonnet, Gaston H., "Handbook of Algorithms and Data Structures," Addison-Wesley, Reading, MA, 1984.
-

Major Topics

1. Mathematical prerequisites

- evaluation of sums
- solution of recurrence relations
- generating functions
- elements of probability
- number theory
- complex numbers
- calculus
- linear algebra

CLR, Ch 4, Appendices A-C

SWK, Part 1

GT, Ch 1

KN, Vol 1: Ch 1, Ch 2, Vol 2: Ch 4

GKP

2. Models of Computation

- RAM
- PRAM

CLR, Ch 1, Ch 2

GT, Ch 1, Ch 14

3. Strategies

- divide and conquer
- matroids
- greedy method
- dynamic programming
- DFS/backtracking
- approximation algorithms
- randomized algorithms
- parallel and distributed algorithms

CLR, Ch 2, Ch 5, Ch 8, Ch 15, Ch 16, Ch 22, Ch 27, Ch 35

GT, Ch 5, Ch 11, Ch 13, Ch 14

AKL

HB

4. Analysis Techniques

- asymptotic analysis
- probabilistic analysis
- amortized analysis

CLR, Ch 3, Ch 5, Ch 17

SWK, Part 1

GT, Ch 1

5. Data Structure topics

- elementary structures: lists, stacks, queues
- heaps
- hashing
- trees, BSTs, red-black trees, B-trees
- disjoint sets

CLR, Ch 10-14, 18-21

GT, Ch 2, Ch 3

SWK, Part 2

KN, Vol 1: Ch 2, Vol 3: Ch 6

Comer, Cougla, "The Ubiquitous B-Tree," Computing Surveys 11(2):121-137, June 1979.

6. Sorting

- lower bound on comparison-based sorting
- QuickSort, HeapSort, MergeSort, InsertionSort
- median finding
- searching
- selection
- sorting in linear time

CLR, Ch 6-9

GT, Ch 4

SWK, Part 3, Part 4

KN, Vol 3: Ch 5

GG, Ch 3 (searching), Ch 4 (sorting), Ch 5 (selection)

7. Graphs

- representations
- DFS, BFS
- MSTs
- topological sorting
- connected components
- shortest paths
- flows

CLR, Ch 22-26

GT, Ch 6-8

SWK, Part 5

8. Polynomials

CLR, Ch 30

GG, Ch 6

KN, Vol 2: Ch 4

9. Matrix Arithmetic

CLR, Ch 28

GG, Ch 6

10. NP-Completeness

CLR, Ch 34

GT, Ch 13

GJ

11. Linear Programming

CLR, Ch 29

12. Number-Theoretic Algorithms

CLR, Ch 31

GT, Ch 10

KN, Vol 2: Ch 4

13. String Matching

CLR, Ch 32

GT, Ch 9

14. Computational Geometry

CLR, Ch 33

GT, Ch 12

ORK, Ch 3, Ch 7