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Readings

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The table below provides information on the course's reading assignments, which are taken from the course textbook:

[Buy at MIT Press](#)
[Buy at Amazon](#)
Cormen, Thomas, Charles Leiserson, Ronald Rivest, and Clifford Stein. [Introduction to Algorithms](#). 3rd ed. MIT Press, 2009. ISBN: 9780262033848.

SYLLABUS

In addition to the assigned course readings, see the list of [useful references](#) for the course below.

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READINGS

ASSIGNMENTS

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SES #	TOPICS	READINGS
L1	Administrivia	Chapters 1-2
	Introduction	
	Analysis of Algorithms, Insertion Sort, Mergesort	
R1	Correctness of Algorithms	
	Horner's rule	
L2	Asymptotic Notation	Chapters 3-4, excluding section 4.6
	Recurrences	
	Substitution, Master Method	
L3	Divide-and-Conquer: Strassen, Fibonacci, Polynomial Multiplication	Sections 4.2 and 30.1
R2	Recurrences, Sloppiness	
L4	Quicksort, Randomized Algorithms	Sections 5.1-5.3
		Chapter 7
R3	Heapsort, Dynamic Sets, Priority Queues	Chapter 6
L5	Linear-time Sorting: Lower Bounds, Counting Sort, Radix Sort	Sections 8.1-8.3
L6	Order Statistics, Median	Chapter 9
R4	Applications of Median	Section 8.4
	Bucketsort	
L7	Hashing, Hash Functions	Sections 11.1-11.3
L8	Universal Hashing, Perfect Hashing	Section 11.5
R5	Quiz 1 Review	
Q1	Quiz 1, In-class	
R6	Binary Search Trees, Tree Walks	Sections 12.1-12.3
L9	Relation of BSTs to Quicksort	Section 12.4
	Analysis of Random BST	
L10	Red-black Trees, Rotations, Insertions, Deletions	Chapter 13
R7	2-3 Trees, B-trees	
L11	Augmenting Data Structures, Dynamic Order Statistics, Interval Trees	Chapter 14
L12	Skip Lists	Skip Lists handout (PDF)

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SES #	TOPICS	READINGS
L13	Amortized Algorithms, Table Doubling, Potential Method	Chapter 17
L14	Competitive Analysis: Self-organizing Lists	Sleator, Daniel D., and Robert E. Tarjan. "Amortized efficiency of list update and paging rules." <i>Communications of the ACM</i> 28, no. 2 (February 1985): 202-208.
R9	Competitive Analysis: Ski Rental, Randomized Competitive Algorithm	
L15	Dynamic Programming, Longest Common Subsequence	Chapter 15
L16	Greedy Algorithms, Minimum Spanning Trees	Sections 16.1-16.3 and 22.1 Chapter 23
L17	Shortest Paths I: Properties, Dijkstra's Algorithm, Breadth-first Search	Section 22.2 Chapter 24
L18	Shortest Paths II: Bellman-Ford, Linear Programming, Difference Constraints	
R10	Graph Searching: Depth-first Search, Topological Sort, DAG Shortest Paths	Sections 22.3-22.4
L19	Shortest Paths III: All-pairs Shortest Paths, Matrix Multiplication, Floyd-Warshall, Johnson	Chapter 25
L20	Quiz 2 Review	
L21	Ethics, Problem Solving (Mandatory Attendance)	
Q2	Quiz 2, In-class	
L22	Advanced Topics	Dynamic Multithreaded Algorithms handout (PDF)
L23	Advanced Topics (cont.)	
R11	Advanced Topics	
L24	Advanced Topics (cont.)	Demaine, Erik D. "Cache-Oblivious Algorithms and Data Structures." To appear in <i>Lecture Notes from the EEF Summer School on Massive Data Sets</i> , a volume of <i>Lecture Notes in Computer Science</i> . Berlin, Germany: Springer-Verlag.
L25	Advanced Topics (cont.) Discussion of Follow-on Classes	
	Final Exam	

Useful References

Aho, Alfred V., John E. Hopcroft, and Jeffrey D. Ullman. *The Design and Analysis of Computer Algorithms*. Reading, MA: Addison-Wesley, 1974. ISBN: 0201000296.

The classic text, but it lacks topics in network flows and linear programming, as well as more recent algorithms.

———. *Data Structures and Algorithms*. Reading, MA: Addison-Wesley, 1983. ISBN: 0201000237.

Revised and more elementary version of the first six chapters of *The Design and Analysis of Computer Algorithms*.

Baase, Sara. *Computer Algorithms: Introduction to Design and Analysis*. 2nd ed. Reading, MA: Addison-Wesley, 1988. ISBN: 0201060353.

General reference, although the exposition is sometimes terse or sketchy.

Bentley, Jon Louis. *Programming Pearls*. Reading, MA: Addison-Wesley, 1986. ISBN: 0201103311.

Applications of algorithm design techniques to software engineering.

———. *More Programming Pearls: Confessions of a Coder*. Reading, MA: Addison-Wesley, 1988. ISBN: 0201118890.

More applications of algorithm design techniques to software engineering.

———. *Writing Efficient Programs*. Englewood Cliffs, NJ: Prentice-Hall, 1982. ISBN: 0139702512.

Performance hacking extraordinaire.

Brassard, Gilles, and Paul Bratley. *Algorithmics: Theory and Practice*. Englewood Cliffs, NJ: Prentice-Hall, 1988. ISBN: 0130232432.

Good examples and problems. Focus on methods rather than specific problems.

Chung, Kai Lai. *Elementary Probability Theory with Stochastic Processes*. New York, NY: Springer-Verlag, 1974. ISBN: 0387900969.

Intuitive introduction to probability.

Even, Shimon. *Graph Algorithms*. Rockville, MD: Computer Science Press, 1979. ISBN: 0914894218.

Broad treatment of graph algorithms, including network flow and planarity.

Feller, William. *An Introduction to Probability Theory and Its Applications*. 3rd ed. 2 vols. New York, NY: John Wiley & Sons, 1968, 1971. ISBN: 0471055111, 0471055122.

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Freeman & Co., 1979. ISBN: 0716710447.

Reference book devoted to NP-completeness. The second half contains an extensive list of NP-complete problems and references to algorithms in the literature for polynomial-time special cases.

Gonnet, Gaston H. *Handbook of Algorithms and Data Structures*. Reading, MA: Addison-Wesley, 1984. ISBN: 020114218X.

Code in Pascal and C, comparisons of actual running times, and pointers to analysis in research papers.

Gusfield, Dan. *Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology*. Cambridge, UK: Cambridge University Press, 1997. ISBN: 0521585198.

General treatment of algorithms that operate on character strings and sequences.

Horowitz, Ellis, and Sartaj Sahni. *Fundamentals of Computer Algorithms*. Potomac, MD: Computer Science Press, 1978. ISBN: 0914894226.

Good on data structures, dynamic programming, and branch-and-bound algorithms.

Kingston, Jeffrey H. *Algorithms and Data Structures: Design, Correctness, Analysis*. Reading, MA: Addison-Wesley Publishing Co., 1991. ISBN: 0201417057.

A nice introductory book on data structures, with a good chapter on algorithm correctness.

Knuth, Donald E. *The Art of Computer Programming*. 3rd ed. 3 vols. Reading, MA: Addison-Wesley, 1997. ISBN: 0201896834. ISBN: 0201896842. ISBN: 0201896850.

Encyclopedic work in three volumes: (1) Fundamental Algorithms, (2) Seminumerical Algorithms, and (3) Sorting and Searching.

Lawler, Eugene L. *Combinatorial Optimization: Networks and Matroids*. New York, NY: Holt, Rinehart, and Winston, 1976. ISBN: 0030848660.

Graph algorithms (dense graphs), network flows, and linear programming. First few chapters are excellent.

Liu, Chung L. *Introduction to Combinatorial Mathematics*. New York, NY: McGraw-Hill, 1968. ISBN: 0070381240.

Combinatorial mathematics relevant to computer science. Excellent problems.

Manber, Udi. *Introduction to Algorithms: A Creative Approach*. Reading, MA: Addison-Wesley, 1989. ISBN: 0201120372.

Elementary text with an emphasis on creativity.

Mehlhorn, Kurt. *Data Structures and Algorithms*. 3 vols. New York, NY: Springer-Verlag, 1984. ISBN: 038713302X. ISBN: 354013641X. ISBN: 0387136428.

Three volumes: (1) Sorting and Searching, (2) Graph Algorithms and NP-Completeness, and (3) Multidimensional Searching and Computational Geometry. Lecture notes on basic and advanced topics.

Niven, Ivan, and Herbert S. Zuckerman. *An Introduction to the Theory of Numbers*. 4th ed. New York, NY: John Wiley & Sons, 1980. ISBN: 0471028517.

Readable introduction to number theory.

Papadimitriou, Christos H., and Kenneth Steiglitz. *Combinatorial Optimization: Algorithms and Complexity*. Englewood Cliffs, NJ: Prentice-Hall, 1982. ISBN: 0131524623.

Linear programming and its variants.

Press, William P., Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling. *Numerical Recipes in C: The Art of Scientific Computing*. Cambridge, UK: Cambridge University Press, 1988. ISBN: 052135465X.

Code for numerical algorithms.

Reingold, Edwin M., Jurg Nievergelt, and Narsingh Deo. *Combinatorial Algorithms: Theory and Practice*. Englewood Cliffs, NJ: Prentice-Hall, 1977. ISBN: 013152447X.

Good on recurrence relations and binary search trees.

Sedgewick, Robert. *Algorithms*. 2nd ed. Reading, MA: Addison-Wesley, 1988. ISBN: 0201066734.

Elementary text with an excellent breadth of topics. Light on analysis, but lots of figures.

Sipser, Michael. *Introduction to the Theory of Computation*. Boston, MA: PWS Publishing Company, 1997. ISBN: 053494728X.

A good text on computability and complexity theory.

Tarjan, Robert Endre. *Data Structures and Network Algorithms*. Philadelphia, PA: Society for Industrial and Applied Mathematics, 1983. ISBN: 0898711878.

Advanced book with tons of good stuff.

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