

# Algorithms & Data Structures

Spring 2009, Ithaca College

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## What We Will Do: Topics

- ▶ Review of core concepts from CS-220 and CS-115
- ▶ **Divide-and-conquer techniques:** Quick-sort, binary search, matrix multiplication, convex-hull problems
- ▶ **Decrease-and-conquer:** Depth/breadth first search, topological sort
- ▶ **Transform-and-conquer:** Gaussian elimination, balanced trees, heaps
- ▶ **Dynamic programming:** Binomial coefficients, Warshall's/Floyd's algorithms, knapsack problem, optimal matrix multiplication order
- ▶ **Greedy techniques:** Prim's algorithm, Kruskal's algorithm, Dijkstra's Algorithm, Huffman trees
- ▶ **Basic Computability:** Tractability, P/NP/NP-complete classes

## What We Will Do: Fundamentals

- ▶ Learn **asymptotic notations** and basic **efficiency classes**
- ▶ Learn an **analysis framework** based on asymptotic classes
- ▶ Analyze performance of **recursive** and **non-recursive** algorithms
- ▶ Compare performances of **competing solutions**
- ▶ Understand why **Discrete Math** (CS-115) and **Data Structures** (CS-220) are required in the computer science major
- ▶ See computation from a perspective very different than that of **Computer Organization** (CS-210)
- ▶ **Learn how to solve some very important problems**

## Required Textbook

We are using this book:



Second edition, uses Java **1.5**  
Generic programming through  
**generics**

We are NOT using this book:



First edition, uses Java **1.4**  
Generic programming through  
**class hierarchy**

## Course Info

- ▶ **Class time:** Lectures, labs (Java based OOP), sample problems, paper discussions.
- ▶ **Homework:** Problem sets due almost every Monday; a few programming projects.
- ▶ **Programming:** Only to reinforce the ideas; this is not really a programming class (but will make you a much better programmer).
- ▶ **Exams:** Three non-cumulative closed book exams during the semester; one paper based open book final.
- ▶ **Lecture notes:** Will be handed out at the beginning of lectures; missing pieces will be provided during lectures only.
- ▶ **Course pace:** Fast, and I mean that. Don't let the material accumulate; you will not be able to catch up, especially once we start AVL trees.

## Academic Integrity

- ▶ You've all taken the SAT-English test which expects you to know almost every word in the English language (e.g. nugatory, bamboozle, desultory, etc). So one would think that taking the time to define what cheating and plagiarism mean should be completely unnecessary. But, as past incidents have shown, it is not. Our rules are simple: (i) study together; (ii) When working on homework problems, do everything by yourself.
- ▶ **Final:** There will be an honor code to which you'll have to read, understand, sign, and (well) honor.

MY HOME NUMBER IF YOU HAVE TO REACH ME: 319-0129

## Grading

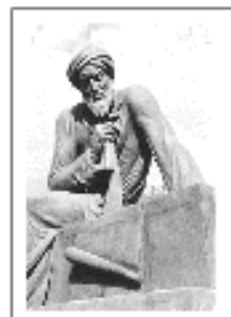
- ▶ Grading scheme:

Exams	$3 \times 15\% = 45\%$
Final	20%
Homework	30%
Presence	5%

- ▶ The lowest problem set score will be dropped.
- ▶ The scores will be curved once at the end of the semester; the *lower bound* letter grades will be based on the table on the right.

Range	Grade
95-100	A
90-94	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-73	C-
67-69	D+
64-76	D
60-63	D-
00-59	F

## Algo-what? What-rithm? What-What?



- ▶ **Muhammad ibn Musa al-Khwarizmi** was born sometime before 800 A.D. in an area not far from Baghdad and lived at least until 847.
- ▶ He wrote his *Al-jabr wa'l muqabala* (from which our modern word "algebra" comes) while working as a scholar at the House of Wisdom in Baghdad.
- ▶ In addition to this treatise, al-Khwarizmi wrote works on astronomy, on the Jewish calendar, and on the Hindu numeration system.
- ▶ The English word "algorithm" derives from the Latin form of al-Khwarizmi's name.