CS3340 Analysis of Algorithms

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• **Textbook:**

  Algorithm Design and Application (2014)
  by M.T. Goodrich and R. Tamassia

• **Assignments:**

  3 assignments, 10 % each
  all three will involve some programming
  use Java, C or C++
  should be independent work

• **Examinations:**

  Midterm Exam, 25%
  Final Exam, 45%
  close-book exams
Goals of the course

- Survey important data structures and algorithms to help us design efficient programs (software)
- Introduce mathematical techniques for the analysis of algorithms
Synopsis

- **Algorithms**: precisely stated general problem-solving methods suitable for computer implementation

- **Data structures**: methods of organizing data involved in computation

- They are central objects of study in computer science

- They go hand-in-hand: neither can be studied fruitfully without knowledge of the other
World of algorithms

• Sequential algorithms

• Parallel algorithms:
  many computers or processes working concurrently
    - synchronously: all computers working together to solve a problem such as sorting
    - asynchronously: computers working independently usually on a network (distributed database systems)

• Randomizing algorithms:
  flip a coin, use outcome wisely

• Approximation algorithms:
  find good approximation in polynomial time
• Computational geometry:
  very useful for robotics

• Computational biology algorithms:
  solving molecular biology problems with computational methods

• Genetic algorithms:
  use mutation, splicing and other genetic principles for optimization

• DNA computing algorithms:
  used for computation by solely manipulating DNA strands

• etc.
Topics

- Induction, order of magnitude, solving recurrence relations.
- Sorting. Various sorting methods: quicksort, mergesort, heapsort, etc. Lower bounds on sorting. Selection.
- String matching and sequence comparison. Huffman coding.
- Union-find.
- Graph algorithms:
  depth-first search, cycles, topological sort, shortest paths, transitive closure, spanning trees, connected components, maximum flow.
(... continued)

- Algorithms design techniques:
  divide-and-conquer, dynamic programming, analysis of recurrences
- NP-completeness
- Parallel algorithms