



BROWN
Computer Science

CS1570: Design and Analysis of Algorithms

Lecture 0a: Introduction

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What is this course about?

The theoretical study of design and analysis of computer algorithms

- What is an “Algorithm”?
 - A recipe which specifies a sequence of steps which allow to obtain a desired output from a given algorithm
- Basic goals of an algorithm
 - Always **terminates**
 - Always **correct**
 - **Efficient** use of **computational resources**
 - Time (#steps, #operations)
 - Space (#memory words being used)

Design and analysis of Algorithms

- **Analysis:** predict the cost of an algorithms in terms of resources and performance
 - Lower bounds to the time/space requirement of algorithms
 - They are a gauge of the quality of algorithms implementations
- **Design:** construction of algorithms which minimize the running time and memory utilization
 - Upper bounds, ideally matching the corresponding lower bounds

Why is efficiency important?

Why focus on algorithmic efficiency instead of hardware performance?



Can't we just get better memories and CPUs?

- As hardware performance increases so do computational requirements!
- Consider a scenario in which we have attained ideal computational and memory units according to **physical limitations**
 - We maximize the use of available surface space (e.g., number of transistors, number of memory storage units)
 - Only a limited amount of memory may be physically close to the computational units
 - Access time introduced by the latency of the data transmission even if data travels at the speed of light

A mathematical approach to algorithm analysis

- We evaluate the performance of algorithms in an **hardware-independent mathematical model**
 - We count the number of operations
 - Number of memory locations
- **General** analysis which is “**portable**” to every* hardware platform
- Actual performance (i.e., execution time) ultimately **depends on hardware specifications** (e.g., FLOPS, Bus bandwidth, Cache size)

About this Course

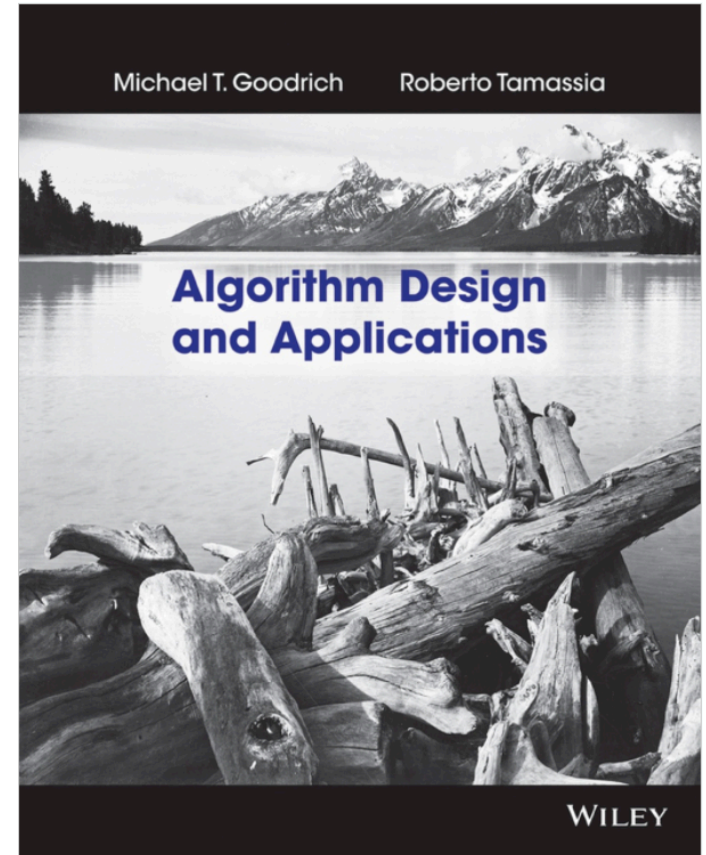
- CS1570 is traditionally considered challenging
 - I expect (and hope) that you will find this to be true =)
- A very different kind of course
 - In many ways, a pure theory course
 - But very grounded (the models of computation are not abstract at all)
 - Proofs are an integral part of the course, although during class and in the textbook we often rely on informal proofs
 - But the reasoning must still be clear!
- The only way to learn this material is by doing problems
 - You should expect to spend several hours per week on homework
 - You should expect to read parts of the text 2-3 times
 - Do not give up after 5 minutes if you are stumped by a problem!

Course Staff

<http://cs.brown.edu/courses/csci1570/staff.html>

Textbook and course materials

- M. T. Goodrich, R. Tamassia - Algorithms Design and Applications, Wiley, 2014, ISBN: 978-1-118-33591-8
- Course website:
<http://cs.brown.edu/courses/csci1570/index.html>
 - Use the course Syllabus for reference
 - Lecture Slides available on the website
 - Zoom links and class videos available on Canvas
 - Always log into to class zoom meeting early **after** class
 - Homework and Midterm assignments published on the website
- Piazza



Homework and Midterms

- Homework every other week: Posting dates and hand-back dates posted on the website. Two weeks total time for each homework.
 - Work in a group, but think and try to solve each problem yourself!
 - List you collaborators on your submission
 - Always write your own solutions
 - Do not “distribute the problems within the group”
 - Use piazza
- 2 take-home Midterms each covering the first (resp., second) part of the class.
 - One week for each midterm assignment
 - No collaboration is allowed!
 - TAs will only answer questions regarding clarifications on the assignments
 - Questions should be asked privately on Piazza

Homework and Midterms

- Simple late submission policy:
 - A “budget” of 4 total days,
 - You can use up to 2 days for an assignments
 - Requests for extension due at least 24 hours before deadline using Google form available online
- At the beginning of the course, all students are required to subscribe to the collaboration policy (<http://cs.brown.edu/courses/csci1010/files/doc/collab.pdf>)

How to do well

- You must understand the concepts well!
 - If you do not , there is almost no chance of success =(
- If you do understand the concepts, there is very little else to learn!
 - You can do really well =D
- You must do problems. There's no replacement for this.
 - Discuss problems and solutions in group but always write your own solutions
- Attending lectures is highly advised!
- Don't postpone learning; you will not be able to “make up” later.
 - Start the homework early on!
- Topics get hard quickly.
- Use Piazza well!
- Come to office hours!