CS5371

Theory of Computation

General Info, Scope, Textbook Assessment, ...
General Information

- Web page:
- Lecturer:
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- Tutor:
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- Meeting times:
  - Tue 1410 — 1500, Fri 1520 — 1710
- Consultation:
  - Send us email for appointments!!
What will you learn from this course?

• How to define a computer?  Automata theory
• Are there problems that a computer cannot solve? If so, can we find one such problem?  Computability theory
• For problems that a computer can solve, some problems are easy (e.g., sorting) and some are difficult (e.g., time-table scheduling). Any systematic way to classify problems?  Complexity theory
Part I: Automata Theory

- Study very simple “computer” called automaton (plural: automata)
- Though very simple, they can solve some decision problems. E.g., is an input sequence of 0s and 1s, such as 101110101, representing a binary number divisible by 5?
- Study what kind of decision problems can be solved by automaton? What kind of decision problems cannot be solved?
Part II: Computability Theory

• Introduce a slightly more complicated computer called “Turing Machine”
  - We will show that (in some sense) Turing Machine has the same power as an ordinary computer

• Show that some problems (although sounds like easy) cannot be solved by computers
Part III: Complexity Theory

• Focus on problems solvable by computers
• Time Complexity: How difficult w.r.t. time requirement? P, NP, NP-Complete
• Space Complexity: How difficult w.r.t. space requirement? PSPACE, NL
• Problems that are outside the above classes (so that they need much more time or space to solve)
Part IV: Advanced Topics
(if we have time)

- Approximation Algorithm
- Probabilistic Algorithm
- Interactive Proof Systems
- Parallel Computation
- Cryptography
Textbook & References

• Textbook
  - Introduction to the Theory of Computation (2nd Edition), by Michael Sipser
  - We will follow very closely to this book

• References
  - Computational Complexity, by C. Papadimitiou
  - Introduction to Automata Theory, Languages, and Computation, by J. Hopcroft, R. Motwani, and J. Ullman.
Assessment

5 Assignments: Best four (@9.25%)
  * 37%
Remaining one * 3%
Midterm Quiz: 10%
Final Exam: 50%

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Total 100%
Study Tips

• Have a fresh mind in lectures & tutorials (don’t eat too much at lunch time :-))
• Don’t be shy, ask questions in class
• Try your best to do every assignment (Can exchange high-level ideas with your classmate, but must do it yourself)
• Study textbook, and try the exercises
• Most importantly: Have fun!