CS5371
Theory of Computation

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

• Web page (temp):

• Lecturer:
  - Wing-Kai Hon (韓永楷), wkhon@cs

• TA:
  - Yu-Han Lyu (呂昱翰), g944352@oz

• Meeting times:
  - Tue 1410 — 1500, Fri 1520 — 1710

• Consultation hours: To be announced
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? \( P, \text{NP, NP-Complete} \)
• Space Complexity: How difficult w.r.t. space requirement? \( \text{PSPACE, NL} \)
• 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 * 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!