Course Description

This course teaches the theoretical underpinnings of Computer Science, beginning with formal languages and automata, computability theory, and complexity theory with the goal of developing understanding of the power and limits of different computational models. Topics covered include: regular languages and finite automata; context-free grammars and pushdown automata; Turing machines; undecidable languages; the classes P and NP; NP completeness. Due to the abstract nature of the subject, assignments and challenges will be provided to strengthen the intuitive understanding of these topics.

Organization

This course is taught through in-class lectures as well as through online supplementary materials that may be provided from time to time. This class will also utilize online forums when necessary, to provide for inter-student communication, peer help, and other announcements.

Course Objectives

Upon completing the course, the student will be able to do the following:

1. Use mathematical formalisms to describe the models of computation.

2. Use mathematical formalisms to describe computational problems as they relate to the various language and complexity classes.

3. Use theorems, lemmas, and various proof techniques (e.g. construction, induction, contradiction, etc.) to categorize computing problems into their respective language and complexity classes.

4. Identify, describe, and critique real-world computational problems in terms of the language and complexity classes.

5. Use \LaTeX{} as a tool to clearly communicate the ideas and problems addressed throughout the course.
General Course Topics

1. Regular Languages and Finite Automata
2. Context-Free Grammars
3. Context-Sensitive Grammars
4. Pushdown Automata
5. Turing machines
6. Undecidable Languages
7. The classes P and NP
8. NP Completeness

Text and Required Supplies/Resources

- Online resources as required.
- Resources will be updated at https://nd.edu/~cpennycu.

Grading Plan

- Grade composition: Homework — 55%
  Chapter 1 & 2 Test — 15%
  Chapter 3 & 4 Test — 15%
  Chapter 5 & 7 Test — 15%

- Grades are calculated as the percentage of earned points out of the total possible points in that point class (*e.g.*, Homework).
- Extra Credit may be assigned from time to time at the discretion of the Instructor.

Classroom Rules of Conduct

1. Use of electronics are permitted during lectures, providing that their use is related to the lecture subject and that it is not distracting to other students.
2. Homework is due at the beginning of class on the stated due date, unless otherwise indicated.
3. No late homework will be accepted. No excuses are accepted.
4. All work that a student submits must be his or her own, original solution to the problem or assignment. Any exceptions to this rule will be explicitly stated.
5. All work must conform to the CSE specific application of the Honor Code (https://cse.nd.edu/undergraduates/honor-code).
6. Any and all plagiarism, cheating, unauthorized answer-sharing, or any other form of academic dishonesty will be strictly dealt with in accordance with the Notre Dame Academic Code of Honor (http://honorcode.nd.edu/).