CS 584: Theory of Computation/Complexity Theory
Purdue University, Spring 2017

1 Basic info

Instructor: Elena Grigorescu, elena-g@purdue.edu.

TA: Akash Kumar, akash.mnnit@gmail.com

Time/location: M/W 4:30-5:45 pm, LWSN B134.

Website: http://www.cs.purdue.edu/homes/egrigore/584ST17/

Text: *Introduction to the Theory of Computation* by Michael Sipser, 3rd edition, Cengage Learning. Recommended: Computational Complexity: A Modern Approach, by Sanjeev Arora and Boaz Barak, Cambridge University Press

Office hours: Mon 9:30 am LWSN 1209

2 Description

This is an introductory graduate level course on the theory of computation. We will focus on the fundamental mathematical model of a Turing Machine, discuss its powers and limitations, discuss computational resources that a TM might use (time, space, randomness) and the complexity classes associated with them (P, NP, PSPACE, BPP, RP, etc). In the latter part of the course we'll cover more advanced topics, possibly including Interactive Proofs (IP, PCP).

Prerequisites: Mathematical maturity: familiarity with proofs, discrete math and algorithms.

3 Tentative schedule

Computability (1-2 weeks)
Complexity (remaining time): P; NP; Cook-Levin's Theorem; Space complexity; L, NL, NL=coNL, PSPACE (and games); Hierarchy theorems; Probabilistic computation: BPP, RP, coRP; Kolmogorov complexity, Advanced topics (Interactive Proofs (IP), Probabilistically Checkable Proofs (PCP), Zero Knowledge Proofs (ZKP)))

4 Homework instructions

The homeworks are due *before class* on the due date, in hard copy. Extensions to homeworks will be granted only in exceptional circumstances in accordance to Purdue policies.

Your solution should be as concise as possible, while including all the necessary details.

If you do not know the solution to a problem you'll receive 25% of the grade if you write"I honestly do not know how to solve this problem" on the solution sheet and nothing else. Otherwise, your solution will be graded according to its content (nonsense will be penalized)

There might be an extra optional problem on the homeworks. Optional problems will not be used in computing your final score. They might however be taken into account in assigning grades for borderline cases. The 25% option does not apply to optional problems.

Collaboration policy You may discuss the problem sets with other students in the class, however you *must* write up the solutions yourself. If you collaborate, specify who you worked with. No other solution sources are allowed. *No collaboration is allowed on the optional problems.*

Academic integrity Cheating/plagiarism on homeworks or exams will result in a score of 0 and will be subject to Purdue's academic integrity policies
(http://www.purdue.edu/odos/aboutodos/academicintegrity.php)

5 Project

The project will consist of a short presentation of a paper from a theoretical CS conference on a topic in complexity theory (eg. FOCS/STOC/SODA/RANDOM/CCC/ICALP) and *scribe notes* for this paper. Optional: You may treat this as a research project as well. Please discuss this with me.

6 Exams

There will be no make-up exams.

7 Grading

20% for the homework (expect biweekly)
30% for the midterm
35% for the final
10% for the project (Optional: treat it as a research project.)
5% for class participation (this includes writing LaTeX solutions to requested HW problems, for class review)