Purdue University. **CS 580 Algorithm design and analysis** Aug 20, 2018

Syllabus

Lecturer: Elena Grigorescu

1 Basic info

Place and time: 10:30 am-11:20, MWF, Lawson Computer Science Bldg B155
Instructor: Prof. Elena Grigorescu,
elena-g@purdue.edu; Office hours: Wed 1-2pm LWSN 1209.
Teaching Assistants:
Young-San Lin: nilnamuh@gmail.com. Office Hours: 1:30-2:30pm Tue/Th HAAS G50.
Minshen Zhu: minshen.zh@gmail.com, Office Hours: 2-3pm pm Mon/Fri HAAS G50.
Class website: https://www.cs.purdue.edu/homes/egrigore/580FT18/
Piazza: piazza.com/purdue/fall2018/cs580/home
Required textbook Algorithm Design by J. Kleinberg, E. Tardos. Pearson Education.

Description A tentative list of topics includes scheduling problems, minimum spanning tree problems, data compression, network flow, NP and computational intractability, approximation algorithms, randomized algorithms, sublinear algorithms.

Prerequisites Undergraduate algorithms (CS 381). Mathematical maturity.

Grading The final grade will be computed as follows:
20% for homework,
20% for the midterm 1,
20% for midterm 2,
35% for the final,
5% for class participation (good answers in class and on piazza will be rewarded.)

2 Exams

Midterm 1 Monday October 1st, 8-9:30pm ME 1061
Midterm 2 Wednesday November 7th, 8:00 - 9:30pm ME 1061
Final Set by the university during finals week.
Note: Do not schedule an interview trip at exam times; do not schedule to leave town before the final exam date is posted (it could be on Saturday).
All exams are closed book and closed notes. There will be no make-up exams. The score for a missed exam is 0. Exceptions will be made to the above policies in case of serious illness or bereavement.

3 Assignments

There will be weekly or biweekly Psets. You are responsible to complete the entire homework assignment. The assignments and the solutions will be posted on Blackboard.

Your solutions should be *typed* in any text editor you prefer (LaTeX, Word, etc). You will find pointers on LaTeX on the class website.
Assignments need to be submitted to Blackboard as one PDF file, with the additional specifications:

- For assignment number x, the name of the submitted file needs to be LastName.FirstName.x.PDF.
- You must include the *Collaboration and Resources statement*. See the *Collaboration policies* for the exact format.
- You are allowed two uploads. The last version uploaded will be graded.
- After your submission, you should download the file and open it to ensure a valid pdf file was uploaded.
- Do not e-mail an assignment to a TA or the instructor.
- Each assignment states its due date and time. An assignment submitted after the due date and time is considered *late*. See the *late homework* policy below. Do not count on a successful upload one minute before the deadline as network fluctuation do happen.
- *Every assignment needs to include the following:* On the top of the first page: your full name as it appears on Blackboard, your Purdue e-mail address, and the assignment number.
- If you are requesting an extension due to an illness or an emergency, you are expected to contact the instructor before the due date.
- An interview trip is not a valid excuse for an extension on an assignment. You are expected to plan accordingly.

Some assignments might have an optional problem. The optional problem does not count towards your score, unless your grade will be a borderline case.

If you don't know the answer to a question you will receive 15% of the grade for the problem if you admit it up-front by writing "I don't know how to solve this problem" and nothing else. If your solution is wrong you get a score of 0 for that problem. This option does not apply to the optional problem.

Please ask your questions on piazza.com (http://piazza.com/purdue/fall2018/cs580) and answer your colleagues' questions to receive up to the 5% in class participation.

Late homework The following penalties apply for late homeworks:

- Late reports turned in within 24 hours of the deadline will receive a 10 % penalty.
- Reports turned in 24 hours late, but within 48 hours of the deadline will receive a 25 % penalty.
- Reports turned in more than two days after the deadline will be counted as a zero.

Grading and Regrading For a re-grade on a homework contact the TA responsible for the question within 14 days from the date when the assignment was officially returned. Similarly, for a regrade on an exam contact the instructor within 14 days from the date the exam was returned. No re-grading after this period. A re-grade means that the *entire* assignment/exam undergoes a re-grade.

4 Collaboration policy

You may collaborate on your homework with your colleagues, however you *must* write down the solutions yourself. Do not copy another students homework and do not allow another student copy your homework. Turning in a solution that you could not explain to the instructor is considered cheating.

Discussions with other students and use of other resources should be appropriately acknowledged as follows. *Every problem on an assignment needs include a Collaborators and Resources (CR) statement:* This means every problem on every assignment includes information on collaboration and use of on-line material. Help you get from a TA does not count as collaboration.

You are expected to complete the following CR template for each problem:

- Names of students enrolled in class communicated/collaborated with: Name1, Name2, ,
- Names of students not enrolled in class who provided help: Name1, Name2, ,
- Name of tutor (if applicable):
- On-line resources consulted and made use of: URLs, one per line
- State none if there is no one to mention or no resources to cite.
- An assignment problem that does NOT contain a CR statement will not be graded.

5 Learning Objectives

Students who complete the course, will have demonstrated the ability to do the following:

1. Perform basic algorithm analysis including:

   Use big O-notation formally to give asymptotic upper bounds on time and space complexity of algorithms. Use recurrence relations to determine the time complexity of recursive algorithms. Solve elementary recurrence relations, e.g., using some form of a Master Theorem. Give examples that illustrate time-space trade-offs of algorithms.

2. Apply and modify algorithmic strategies and approaches including:

   Describe and use major algorithmic techniques (brute-force, greedy, divide-and-conquer, dynamic programming, graph explorations, max-flow-min-cut algorithms). Determine appropriate algorithmic approaches to apply to a given problem. Describe heuristic problem-solving methods. Understand the mapping of real-world problems to algorithmic solutions. Explain the major graph algorithms and their analysis and employ graphs to model application problems. Evaluate and compare different algorithms using worst-,

average-, and best-case analysis. Demonstrate the ability to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and explain an implementation of the algorithm in a particular context.

3. Explain and apply foundational computational complexity concepts including:

   Define the classes P and NP. Explain the significance of NP-completeness. Provide examples of NP-complete problems. Explain the impact pf NP-complete problems to different application domains. Explain the difference between NP-complete and NP-hard. Prove that a problem is NP-complete. Use reduction techniques between problems. Demonstrate the use of approximation algorithms for NP-hard problems. Explain the Halting problem and other undecidable problems.

4. Describe how we deal with NP complete problems and what lies beyond NP-completeness:

   Describe approximation and randomized algorithms, as well as fixed parameter tractable problems. Compare game problems and determine their space complexity.

5. Use randomization to obtain sublinear-time algorithms. Apply Chernoff and Markov bounds to analyze randomized algorithms.

6 Cheating/plagiarism

Academic Integrity Behavior consistent with cheating, copying, and academic dishonesty is not tolerated. Depending on the severity, this may result in a zero score on the assignment or exam, and could result in a failing grade for the class or even expulsion. Purdue prohibits dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty. (Part 5, Section III-B-2-a, University Regulations) Furthermore, the University Senate has stipulated that the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest. (University Senate Document 7218, December 15, 1972). You are expected to read both Purdues guide to academic integrity ($http://www.purdue.edu/purdue/about/integrity\_statement.html$) and Prof. Genes Spaffords guide ($http://spaf.cerias.purdue.edu/integrity.html$) as well. You are responsible for understanding their contents and how it applies to this class.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Purdues Honor Pledge: As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue.
https://www.purdue.edu/provost/teachinglearning/honor-pledge.html

7 Posting class material

Posting materials associated to the class (e.g., solutions to homework and exams, etc) without the written permission of the instructor is forbidden and may be a violation of copyright.

8 Emergency preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Here are ways to get information about changes in this course. **Course website:** https://www.cs.purdue.edu/homes/egrigore/580FT17/ , **Instructor's email:** elena-g@purdue.edu, **Instructor's phone:** 765 496 1185

9 Violent Behavior Policy:

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.