University of Washington, Tacoma
TCSS 543, **Section B**: Advanced Algorithms
Course Organization

Autumn 2018

Course Description: This course prepares students for analysis and use of advanced algorithms. It covers advanced graph, number theoretical (with applications to cryptography), approximation (with performance guarantees), and probabilistic algorithms, Turing machines, and NP-completeness.

Instructor:

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Course website: https://canvas.uw.edu.

Class Time and Place: Tue Thu 1:30 – 3:30pm @ PNK 104

Office hours: Tue 10:15 – 11:15am, Thu 12:15 – 1:15pm @ CP 127, or else by appointment (in this case, *send e-mail beforehand*). *Exceptions*: no office hour on November 27th and on December 11th (finals week).

Communication: *I do not read my emails through Canvas*. Email me at pbarreto@uw.edu directly. However, I will post announcements via Canvas. For topics of general interest to the entire class, please use the "Discussion" mechanism via Canvas. You are expected to check your email and Canvas announcements regularly.

Prerequisites: TCSS 343 or equivalent.

Textbook: *Algorithm Design*, 1st edition, Jon Kleinberg and Éva Tardos, Pearson/Addison-Wesley, 2006. (**Also recommended**: *Introduction to Algorithms*, Thomas Cormen, Charles Leiserson, Ronald Rivest, and Clifford Stein, MIT Press. **Also recommended**: research papers on the subject).

Course Learning Outcomes: By the end of the course, you should be able to:

- Apply appropriate algorithm design and analysis techniques (e.g. divide-and-conquer, dynamic programming, greedy) in a range of computational problems;
- Apply skills in devising algorithms and showing that they are (or are not) efficient using Big-Oh analysis;
- Compare the performance of algorithms in terms of formal analysis;
- Understand the importance and role of the theory of NP-completeness in the study of algorithms;
- Implement algorithms, empirically analyze their performance, and compare with their theoretical performance.

Grading: homework assignments (20%), programming project with final presentation (20%), midterm exam (25%), final exam (35%).

Homework will be distributed, and must be submitted, through Canvas in PDF format, and will always be due at midnight. Submissions more than 6 hours late will be penalized 20% and no submissions will be accepted 24 hours after the due date.

Each homework assignment, the programming project, the midterm, and the final exam are worth 30 points each but may contain bonus options, so a good performance can improve the corresponding contribution to the final grade somewhat beyond the percentages above. The presentation of the programming project corresponds to one half of that assignment's grade. The resulting overall weighted grade will of course saturate at 100%.

Your homework must be typeset: you can use LaTeX, MS Word, or similar tools to prepare your work, and upload the reports in PDF format. *Scans of manually written homework are not acceptable and different file formats are not acceptable*.

Reading Assignments: Keep up. Your ability to grasp the material and get the most out of lectures will depend largely on how much preparation you do before class. We will cover nearly all chapters pretty much marching straight through, although we will skip several sections along the way.

Collaboration: You are allowed to collaborate on the homework to the extent of formulating your ideas as a group. However **you must write up the solutions/code completely on your own**. You must also list the names of everyone whom you discussed the problem set with. You may not consult materials in written or electronic form (including videos or any media) other than the course materials in coming up with your solutions.

Programming assignment: You can form your own group consisting of 1 or 2 people for the programming assignment (but not for non-programming homework). If you would like to work on the programming project on your own, it is ok. *You are expected to manage any personnel issues within your own group*. **You will be required to make a brief (~10 min) presentation on your last programming assignment in the last lecture.** The final presentation corresponds to half the available points for the compiler building project.

Use of materials from the internet: Unless otherwise specified, you are expected to use only materials from the textbook and lectures to solve the problems in your homework and assignment. You can use other materials for your group project, but if you do, **make sure you acknowledge the source**. Failing to do that would be a case of plagiarism.

Plagiarism: A major part of your experience at UW Tacoma will be reading, synthesizing, and using the knowledge and ideas of others. To plagiarize is to use the ideas—or unique phrasing of those ideas—without acknowledging that they originate from someone or someplace other than you. Attributing where you get your information builds your own authority to speak on that topic and provides valuable backing to the arguments you make. Attribution also distinguishes your ideas and words from those of others who came before you. At the University of Washington, plagiarism is a violation of the student conduct code, and the consequences can be serious. Though citing, quoting, and paraphrasing can be

confusing at first, it is essential for your success at UWT that you familiarize yourself with these important conventions of academic writing. Additionally, plagiarism can be understood differently in various disciplines. For instance, the ways in which one summarizes others' ideas in texts, or attributes information from texts in one's own paper, are not the same in the sciences as they are in the humanities, or the social sciences. This means it is vital that you understand the specific expectations and guidelines for writing that will help you avoid plagiarizing in this class. If you have questions about what amounts to plagiarism, you are strongly encouraged to seek guidance from faculty and the Teaching and Learning Center as soon as possible.

This statement has been revised by Kelvin Keown and Asao Inoue and submitted to the UW Tacoma Faculty Assembly on 7-28-2014. For more information, please refer to:

- Academic Honesty: Cheating and Plagiarism
- Student Counseling Center web page

Cheating: Cheating, either on an exam or turning in work that is not your own, will not be tolerated. Cheating is not only a misrepresentation of your abilities, but it is also unfair to your classmates. It also violates the mutual trust between student and teacher. You owe it to yourself and your education to hold a high ethical standard at all times. Suspected cheating cases will be reported to the University Conduct Officer.

Classroom Policy: You can use your tablets and laptops during class as long as the sound and ringer are turned OFF. However, you are expected to look away from your screen to participate in class discussion.

Lecture Slides: Where appropriate, I will provide lecture slides. However, there is no substitute for note taking. The lecture slides by themselves are not particularly useful, but if you take notes, the slides and the notes together can be very useful to help you learn the material.

Some Survival Tips: Not all of these tips may work for you, but you may find them helpful.

- Skim the book before coming to lecture to get an idea of what I will be discussing. After lecture, read the text carefully to get a good grasp of the material. Read the homework assignment when you receive it to get an idea of the kinds of things to look for in the text.
- Try doing some of the suggested exercises before doing the problems you will turn in. In many cases, the suggested exercises will be easier versions of the regular problems. Try the bonus problem only after doing the regular problems; the bonus problem is generally much harder than the regular problems. Don't spend too much time on one problem. If you get stuck on a problem, move on to another one and come back later. Or discuss it with someone (either your classmates, or me in office hours).
- Never wait until the last day to start on the homework assignment. Many of the problems require ideas to settle in your mind before being tackled. Read the assignment early to get the creative juices flowing early.
- Don't expect to be able to write down a complete answer on your first attempt. Many of you will find that a correct answer to a problem comes only after writing and rewriting your solution.

Grade Appeal Procedure: Except in case of error, I cannot change a grade that has been submitted to the Registrar.

Inclement Weather Procedure: Call 253-383-INFO or check the UW Tacoma web site to determine whether campus operations have been delayed or suspended. If the campus is open, but driving conditions are uncertain, check your emails and announcements on the Canvas course page. The Canvas page should provide information on whether a particular class will be held or not, and/or the status of pending assignments.

Teaching and Learning Center: The Teaching and Learning Center offers academic and technological support for students at all levels of expertise. For more information, visit http://www.tacoma.uw.edu/teaching-learning-center/teaching-learning-center.

Student Counseling Center: The Student Counseling Center is an on-campus resource that provides counseling to the students at UW Tacoma. There is no fee charged for Student Counseling Center services for all enrolled UW Tacoma students. For more information, see http://www.tacoma.washington.edu/studentaffairs/shw/scc_about.cfm

Access and Accommodations: Disability Support Services (DSS) offers resources and coordinates reasonable accommodations for students with disabilities. If you have, or think you have a temporary or permanent disability that requires accommodations (this can include mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DSS at 253-692-4522 or dssuwt@uw.edu , http://www.tacoma.washington.edu/studentaffairs/SHW/dss_about.cfm

Lecture Schedule:

NB: All dates are subject to change! Check calendar on Canvas regularly!

*** Week 1**	**Lecture Topics**	**Reading**	**Observations**
Sep 27	Introduction. Algorithm analysis, recurrences, Master's Theorem, divide-and-conquer strategy.	Ch. 1, Ch. 2	HW #1 posted (due Oct 18)
*** Week 2**			
Oct 2, 4	Divide-and-conquer algorithms, Mergesort, Quicksort, integer multiplication, Karatsuba's algorithm, FFT.	Ch. 5.1, 5.2, 5.5, 5.6	
*** Week 3**			
Oct 9, 11	Greedy algorithms. Graph algorithms. Minimum spanning trees (Prim's and Kruskal's algorithms).	Ch. 3, Ch. 4.1, 4.4-4.5	
*** Week 4**			

Oct 16, 18	Shortest paths (Dijkstra's algorithm), special topic: sequence comparison (Myers's algorithm, Wu-Manber-Miller improvement).	Ch. 4-4.6, selected research papers	HW#1 due (Oct 18) HW#2 posted (due Nov 8)
*** Week 5**			
Oct 23, 25	Special topic: the discrete logarithm problem.	selected research papers	
*** Week 6**			
Oct 30, Nov 1	Dynamic programming, knapsack/subset sum/partition. Review. **MIDTERM EXAM (Thu, Nov 1)**	Ch. 6.4-6.6	
*** Week 7**			
Nov 6, 8	Network flow (I).	Ch. 7	HW#2 due (Nov 8) Project posted (due Dec 3)
*** Week 8**			
Nov 13, 15	Network flow (II), bipartite matching.	Ch. 7	
*** Week 9**			
Nov 20	Approximation algorithms, graph coloring, Brélaz's algorithm. **THANKSGIVING**	selected research papers	
*** Week 10**			
Nov 27, 29	The classes P and NP, verification algorithms for NP problems, NP-hardness, the Cook-Levin theorem, reductions, NP-completeness.	Ch. 8.1-8.3	
*** Week 11**			
Dec 4, 6	students' presentations, final review		Project due (Dec 3)
*** Week 12**			
Dec 11	**FINAL EXAM (Tue, Dec 11)**		