Course Syllabus
CP312: Algorithm Design and Analysis 1
Physics and Computer Science, Science, Waterloo
Fall | 2019

Instructor information
INSTRUCTOR NAME: **Reaz Ahmed** | Physics and Computer Science
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Office Hours : GIVE TIMES available on MyLS chat | Office hours: Tuesdays 6:00 pm to 7:00 pm
Also available by appointment or email: Please expect the response time to be anywhere between 24 to 48 hours

Course Information

CP312: Algorithm Design and Analysis I
Analysis of the best, average and worst-case behaviors of algorithms. Algorithmic strategies: brute force algorithms, greedy algorithms, divide-and-conquer, branch and bound, backtracking. Fundamental computing algorithms: O(n log n) sorting, hash table, binary trees, depth- and breadth-first search of graphs.

Pre-requisites:
CP264 (or CP114 and CP213) and MA238.

Course topics: References are to the prescribed text.

Week 1	Introduction	(1.1, 1.2, 1.3, 1.4, App. A, 2.1)
Week 2	Algorithm analysis	(2.3, 2.3, 2.4)
Week 3	Recurrence relations	(Appendix B)
Week 4	Brute force algorithms	(3.1, 3.2,3.4)
Week 5	Depth first search and breadth first search	(3.5, 4.2)
Week 6	Decrease and conquer	(4.1, 4.4,4.5)
Week 7	Divide and conquer	(5.1,5.2, 5.3, 5.4)
Week 8	Transform and conquer, part 1	(6.1, 6.4,6.5)
Week 9	Transform and conquer, part 2	(6.6, other material)
Week 10	Dynamic programming	(8.1, 8.2, other material)
Week 11	Greedy algorithms	(9.1, 9.2, 9.3)
Week 12	Advanced topics	(12.1, 12.2, 7.3)

Course Overview and Approach/Framework
CP312 builds on the introduction to algorithms given in CP164 to further develop how to analyze algorithms. It explores the theoretical underpinnings of algorithm analysis and the rationale behind it. An additional objective of the course is to introduce the concept of algorithm design, to explore some common algorithmic design techniques, and to

experiment with some different algorithmic approaches to various problems. This course is a direct prerequisite to CP414 which further develops the theory of computing. CP312 also supports all computer science applications by teaching algorithmic best practices.
In this online course students are expected to work diligently every week on suggested problems and to participate in the discussion board. If they have difficulty, they should ask for help during the weekly office hours.

Course Goals and Learning Outcomes

Learning Outcome – by the end of the course students should be able to:
1. Determine the algorithmic complexity for both iterative and recursive programs.
2. Solve recurrence relations using several methods.
3. Determine which algorithmic techniques are suited to a particular problem.
4. Describe common algorithm design techniques such as divide-and-conquer, greedy, dynamic programming
5. Construct algorithms using a range of techniques
6. Understand and apply the mathematical notation and techniques that underpin algorithm analysis

Course Tools and Learning Materials

Textbook: A. Levitin, Introduction to the Design and Analysis of Algorithms, 3rd edition, Boston: Pearson Education, 2012.

Students should have a nonprogrammable calculator for use on the midterm and final exam. The Casio FX-300MSPlus calculator is recommended. For students writing the final exam on the Laurier Waterloo or Brantford campus, only the Casio FX-300MSPlus calculator is allowed on the final examination.

There will be some materials on electronic reserve with the library: https://ares.wlu.ca/ares/

Student Evaluation

Quizzes	20%
Class Participation	5%
Midterm	25%
Final Exam	50%
Total	**100%**

A student must earn at least 50% on the final exam to be eligible to pass the course.

The final mark will be converted to a letter grade in accordance with the conversion table found on the University website.

Class Participation 5%
Discussion boards for selected topics will be opened in mylearningspace. Class participation means asking and answering questions in the boards, or making useful suggestions to the instructor on course material. In lessons 1,2,4,8, and 10 a discussion topic will be presented to you and graded based on the rubric provided below. Please note that you will not be able to see anyone else's post until you contribute to the discussion board first. You will gain up to 25 marks which will be translated into a grade out of 5% of your overall final grade for participating in discussions.

Grading Rubric for Online Discussions

Criteria	Excellent	Good	Developing	Poor
Grasp of Lesson Concepts /3	Exceptional effort, clearly worked through an interesting response to the discussion prompt or to another student's comment. Integrated specific concepts from course material. (3.0)	Solid effort, work reflects that concepts have been thought carefully about and worked through. (2.5)	Shows some effort and understanding of specific concepts. (1.5 – 2.0)	Not much effort, or no specific integration of course material. (0-1)
Communication, Coherence, and Creativity /2	Writing is sophisticated, clear, respectful, and uses proper grammar and spelling; content of posts is original and thoughtful (2)	Writing is clear, uses proper grammar and spelling, content of posts shows thought but could use more originality (1.5)	Writing is mostly clear with some grammar and spelling errors, posts are unoriginal or missing content, communication style needs improvement (1.0)	Poorly written with many grammar and spelling errors, communication in posts is ineffective or disrespectful (0-0.5)

Grading Rubric for Quizzes, Midterm, and Final Exam

For questions requiring written answers, the criteria of the online discussion (Grasp of concepts) will be applied. For calculations, design questions, pseudocode questions, and analysis questions, solutions will be judged on correctness, clarity, efficiency, and sophistication.

Quizzes 20%

The quizzes will test your understanding of material covered to various points throughout the course. The quizzes may include short concept questions. Some questions may include writing pseudocode. Some questions may be multiple-choice. The quizzes will be conducted online using the Respondus Lock down browser. The quiz will be available starting at XXXXX on Day XXX of Weeks 3, 5, 9, and 11 and will close at XXX on the same day. Check the course calendar for an exact date. You will have 30 minutes to write an online quiz. Although you can decide when to start your 30 minutes, please note that once started you will not be able to pause or restart your quiz. To prepare for the quiz you should read the lessons, do the exercises and review the quizzes. The quiz is closed book. No material (the course lessons, your own notes, a computer, etc.) is allowed, although you may use a nonprogrammable calculator. When you are ready, you may access the quiz by clicking on "Quizzes" and then selecting the appropriate Quiz number at the top of your MyLS webpage.

Midterm 25%

The midterm will test your understanding of material covered in Lessons 1 through 6. The test may include short concept questions. Some questions may include writing pseudocode. Some questions may be multiple-choice. The midterm will be conducted online using the Respondus Lock down browser. The test will be available starting at XXXXX

on Day XXX of Week 7 and will close at XXX on the same day. Check the course calendar for an exact date. You will have 1.5 hours to write the online midterm. To prepare for the test you should read the lessons, do the exercises and review the quizzes. The test is closed book. No material (the course lessons, your own notes, a computer, etc.) is allowed, although you may use a nonprogrammable calculator.. When you are ready, you may access the midterm by clicking on "Quizzes" and then selecting "Midterm" at the top of your MyLS webpage.

Final 50%

The final exam is cumulative and will cover material from Lessons 1 through 12. The exam must be written in person, either at Laurier if you are within 100km of the Waterloo or Brantford campus, or at an Exam Centre location if you are not. The Final exam will be scheduled by the Final Exams Office. Ensure you check with the Final Exam schedule to learn when the final exam for this course will be scheduled. To prepare for the exam you should read the lessons, do the exercises, and review the quizzes. The exam is closed book, although you may use a nonprogrammable calculator.. The exam's format is the same as that of the midterm test. You will have 2.5 hours to write the exam.

Weekly Schedule(s) (lecture, lab, seminars, tutorials, etc.) Weeks assigned are tentative only and the course may proceed faster or slower or in a slightly different order than this outline.

Week # / Date	Topic / Theme / Unit	Lesson Outcomes	Learning Activities
Week 1	Introduction		• Read Lesson 1 • Participate in Discussion Board question 1
Week 2	Algorithm Analysis	• Understand and apply the mathematical notation and techniques that underpin algorithm analysis	• Read Lesson 2 • Participate in Discussion Board question 2
Week 3	Recurrence Relations	• Solve recurrence relations using several methods. • Understand and apply the mathematical notation and techniques that underpin algorithm analysis	• Read Lesson 3 • Write Quiz 1
Week 4	Brute Force Algorithms	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 4 • Participate in Discussion Board question 4
Week 5	Depth First Search and	• Describe common	• Read Lesson 5

	Breadth First Search	algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Write Quiz 2
Week 6	Decrease and conquer	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 6
Week 7	Divide and conquer	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 7 • Write Midterm
Week 8	Transform and conquer, part 1	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 8 • Participate in Discussion Board question 8
Week 9	Transform and conquer, part 2	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 9 • Write Quiz 3
Week 10	Dynamic programming	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of	• Read Lesson 10 • Participate in Discussion Board question 10

		techniques	
Week 11	Greedy algorithms	• Describe common algorithm design techniques • Determine the algorithmic complexity • Construct algorithms using a range of techniques	• Read Lesson 11 • Write Quiz 4
Week 12	Advanced topics	• Determine which algorithmic techniques are suited to a particular problem.	• Read Lesson 12

Office Hours:

The instructor will be available for 2 x 1 hour slots each week using the chat feature on MyLS for ease of student access. My office hours are indicated in the first paragraph of this syllabus. If the conversation is of a private nature, a MyLS email may be more appropriate or a private chat can be set up. Please do not hesitate to contact the instructor to set up an alternative time if the listed office hours do not work for you!

Communication Policy

Communication between your instructor and the class as a whole will be through the Newsfeed on MyLearningSpace (MyLS). Individual communication will be through MyLS e-mail. E-mails should be responded to by the instructor within 24hrs hours or less, except on weekends or holidays. Please check for an answer to your question in the course syllabus and course roadmap before sending an e-mail, as many times the answer to most questions are found in one of these documents.

Late Work or Missed Test Policy: Students are expected to participate in discussions, quizzes, midterms, or exams on or before the due date in the format specified by the professor and as instructed. No make-up for missed discussions, quizzes, midterms, or exams will be permitted (except under exceptional circumstances as outlined in Laurier University policy). Any evaluation will not be accepted if submitted late, and a grade of F will be assigned (except under exceptional circumstances as outlined in Laurier University policy).

Intellectual Property

The educational materials developed for this course, including, but not limited to, lecture notes and slides, handout materials, examinations and assignments, and any materials posted to MyLearningSpace, are the intellectual property of the course instructor. These materials have been developed for student use only and they are not intended for wider dissemination and/or communication outside of a given course. Posting or providing unauthorized audio, video, or textual material of lecture content to third-party websites violates an instructor's the intellectual property rights, and the Canadian Copyright Act. Recording lectures in any way is prohibited in this course unless specific permission has been granted by the instructor. Failure to follow these instructions may be in contravention of the university's Code of Student Conduct and/or Code of Academic Conduct, and will result in appropriate penalties. **Participation in this course constitutes an agreement by all parties to abide by the relevant University Policies, and to respect the intellectual property of others during and after their association with Wilfrid Laurier University.**

University and Course Policies (proposed and required text)

1. **Academic Integrity/Misconduct** (cheating)**:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and nonacademic behaviour. The University has a defined policy with respect to academic misconduct. You are responsible for familiarizing yourself with this policy and the penalty guidelines, and are cautioned that in addition to failure in a course, a student may be suspended or expelled from the University for academic misconduct and the offence may appear on their transcript. The relevant policy can be found at Laurier's academic integrity website along with resources to educate and support you in upholding a culture of integrity. **Ignorance of Laurier's academic misconduct policy is not a defense. <**see: www.wlu.ca/academicintegrity **>**

2. **Special Needs:** Students with disabilities or special needs are advised to contact Laurier's Accessible Learning Centre for information regarding its services and resources. Students are encouraged to review the Academic Calendar <see: http://www.wlu.ca/page.php?grp_id=1365&p=5123 > for information regarding all services available on campus.

3. **Plagiarism:** Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by the instructor, students may be required to submit their written work in electronic form and have it checked for plagiarism. (Approved by Senate May 14, 2002)

4. **Classroom Use of Electronic Devices:** State your classroom practice and any consequences for failure to comply - see Policy 9.3 (Approved by Senate March 8, 2012)
   http://www.wlu.ca/documents/50202/9.3_Electronic_Device_Policy.pdf
   *sample syllabus statements available at: http://www.wlu.ca/documents/50198/Syllabus_statements.doc

5. **Late Assignment Policy:** Specify any penalties that will be assessed when deadlines for the completion of course components are not met (Approved by Senate May 23, 2012). NB: no assignments may be due during the two study dates that fall between the end of classes and the beginning of the exam period (see senate guidelines on academic dates).

6. **Final Examinations** – Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. (See Academic Regulations – examinations in the academic calendars)

7. **Foot Patrol, The Wellness Centre, and the Student Food Bank** (Approved by Senate November 28, 2011 – see below)

Waterloo

Student Food Bank | www.wlusu.com/food-bank/ All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
Foot Patrol – 519.886.FOOT (3668) A volunteer operated safe-walk program, available Fall and Winter, daily from 6:30pm to 3am. Teams of two are assigned to escort students to and from campus by foot or by van. http://www.wlusu.com/foot-patrol/
Peer Connect – 1.866.281.PEER (7337) A confidential listening, referral, information and support line, is available during evening hours to provide support and resources. Sunday to Thursday, 12pm – 2am | Friday to Saturday 12pm – 3am http://www.wlusu.com/peer-help-line/
The Wellness Centre | 519-884-0710, x3146 The Wellness Centre supports students' physical, emotional and mental health needs. Located on the 2nd floor of the Student Services building, booked and same-day appointments are available Monday to Wednesday 8:30 am – 7:30 pm, Thursday to Friday 8:30 am-4:15 pm. Contact: x3146, wellness@wlu.ca or @LaurierWellness. After hours crisis support available 24/7 - "Good 2 Talk" 1-866-925-5454.

Brantford

Student Food Bank | www.wlusu.com/food-bank/ All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
Foot Patrol l 519-751-PTRL (7875) A volunteer operated safe walk program, available Fall and Winter, Monday-Thursday 6:30pm-1am and Friday-Sunday 6:30-11pm. Radio dispatched teams are available upon call to escort students to and from campus as well as off-campus destinations either by foot or by van. http://www.wlusu.com/foot-patrol/
Peer Connect – 1.866.281.PEER (7337) A confidential listening, referral, information and support line, is available during evening hours to provide support and resources. Sunday to Thursday, 12pm – 2am | Friday-Saturday 12pm – 3am http://www.wlusu.com/peer-help-line/
The Wellness Centre | 519-756-8228, x5803 Students have access to support for all their health and counselling needs at the Wellness Centre. Located in the Student Centre, 2nd floor. Hours: 8:30am to 4:30pm Monday-Friday. After hours crisis support available 24/7 - "Good 2 Talk" 1-866-925-5454.

Last Updated
September 19, 2014