WILFRID LAURIER UNIVERSITY

LAURIER *Inspiring Lives.*

Course Syllabus

Faculty of Science

Department of Physics & Computer Science

CP 312 – C

Algorithm Design and Analysis I

Winter 2024

Instructor & Course Information			
Instructor:	Dr. Dariush Ebrahimi	**Course Location:**	N1002
Email:	debrahimi@wlu.ca	**Meeting Time:**	Mon, Wed, Fri 8:30 AM - 9:20 AM
Prerequisites:	CP264 or (CP114 and CP213); and CP214 or MA238		
Office Location:	N2076H	**Office Hours:**	Mon & Wed 9:30 AM - 10:30 AM, or by appointment
	Teaching Assistant:	Majid Ghasemi - majiddghassemi@gmail.com - SR219	

Course Calendar Description

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-first search, and breadth-first search of graphs.

Course Objective

This course will introduce students to the principles of designing and analyzing algorithms. Students will develop the skills to assess the running times of algorithms in both worst-case and average-case scenarios and comprehend essential algorithmic problems. Students will become acquainted with fundamental paradigms, techniques, and data structures employed in solving algorithmic challenges. The objective is to provide students with an understanding of various problem classes, considering their computational complexities, and to familiarize them with recent advancements in algorithm design.

Course Objectives and Learning Outcomes

By the end of this course, students will be able to:

- Employ diverse computational models, order notation, and various complexity measures (e.g., running time, disk space) to analyze the complexity and performance of different algorithms.
- Grasp the distinction between lower and upper bounds for various problems and recognize their significance in determining algorithm optimality.
- Utilize various techniques for efficient algorithm design, including divide-and-conquer, greedy, and dynamic algorithms, and apply them in algorithmic design scenarios.
- Discriminate between different sorting algorithms (e.g., insertion, merge, quick-sort, and heap sort), searching algorithms (e.g., binary search and hashing), and selection algorithms (e.g., min, max), understanding when to deploy each.

- Enhance various data structures (trees and arrays) to support specific applications.
- Familiarize themselves with advanced design and analysis techniques such as greedy algorithms and dynamic programming.
- Comprehend the techniques employed in designing fundamental graph theory algorithms, including breath-first search and depth-first search algorithms. Apply these techniques to solve related problems, such as single-source shortest paths (e.g., Dijkstra's and Bellman-Ford algorithms) and minimum spanning trees (e.g., Prim's and Kruskal's algorithms).

Course Tools and Learning Materials

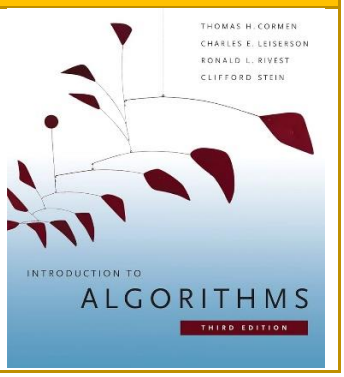
Provided Materials in Class and WLU MyLS:

Course slides

Textbook:

Introduction to Algorithm, 3rd Edition,
by Thomas H Cormen (Author), Charles E Leiserson (Author), Ronald L Rivest (Author), Clifford Stein (Author)

- **Publisher:** MIT Press
- **Date Published:** September 2009
- **Hardcover:** 1292 pages
- **ISBN:** 9780262033848
- **ISBN:** 9780262033848



Weekly Schedule(S) (Tentative and subject to changes)

Week	Start Date	Topic	Remark
Week *1*	08 Jan. 2024	Introduction to Algorithms, Insertion Sort, and Analyzing Algorithms	Ch.1, Ch, 2.1 & 2.2
Week *2*	15 Jan. 2024	Characterizing Running Time	Ch. 3
Week *3*	22 Jan. 2024	Merge sort Recurrences & Divide-and-Conquer:	Ch. 2.3 Ch. 4.3 - 4.5
Week *4*	29 Jan. 2024	Heapsort	Ch. 6
Week *5*	05 Feb. 2024	Quicksort	Ch. 7.1 - 7.3
Week *6*	12 Feb. 2024	Sorting in Linear Time: Lower bound for sorting, Counting sort, and Radix sort	Ch. 8.1-8.3
Week *---*	19 Feb. 2024	**Reading Week**	**No Classes**
Week *7*	26 Feb. 2024	Dynamic Programming	15.1, 15.3-15.4 and examples
Week *8*	04 Mar. 2024	Greedy algorithm	16.1-16.2
Week *9*	11 Mar. 2024	Representation of Graphs, Breadth-First Search & Depth-First Search	Ch. 22.1 – 22.3
Week *10*	18 Mar. 2024	Minimum Spanning Trees	Ch. 23.2
Week *11*	25 Mar. 2024	Single-Source Shortest Paths: Bellman-Ford alg.	Ch. 24.1-24.2
Week *12*	01 Apr. 2024	Dijkstra's algorithm	Ch. 24.3

Student Evaluation and Grading Scheme		
Task	**Weighting**	**Due Date (subject to change)**
Quiz 1	10%	Jan. 29, 2024 – Monday @ 08:30 AM
Assignment 1	5%	Feb. 04, 2024 – Sunday @ 11:30 PM
Assignment 2	5%	Feb. 23, 2024 – Friday @ 11:30 PM
Quiz 2	10%	Feb. 26, 2024 – Monday @ 08:30 AM
Assignment 3	5%	Mar. 15, 2024 – Friday @ 11:30 PM
Quiz 3	10%	Mar. 18, 2024 – Monday @ 08:30 AM
Assignment 4	5%	Mar. 31, 2024 – Sunday @ 11:30 PM
Quiz 4	10%	Apr. 08, 2024 – Monday @ 08:30 AM
Assignment 5	5%	Apr. 10, 2024 – Wednesday @ 11:30 PM
Final Exam	35%	During Final Examination Period (April 11-27, 2024)
Total	**100%**	

Course Rules and Regulations
1. **Course Syllabus:** The course syllabus is not fixed and is subject to change based on the class flow.
2. **Posting of Materials:** The class materials like power points will be posted online on WLU MyLS before or after each class or two.
3. **Assignments Posting Dates:** Assignments will be posted on MyLS one week before the due dates and announced via email to registered students.
4. **Assignment Work:** Assignments are to be done individually without any collaboration.
5. **Assignment Submission:** Assignments must be submitted as PDF files into the designated Dropbox of MyLS. No other format is accepted.
6. **Late Assignment:** Late assignment submissions will be penalized 20% and will not be accepted after the passing three days from the due date.
7. **Quizzes and Assignments Dates:** The timing and dates of all quizzes and assignments along with their due dates are outlined in the Grading Scheme section. Note that these dates may be subject to revision, and any changes will be outlined in the Grading Scheme section, also announced in advance during class sessions and through email to all registered students.
8. **Missing Test or Quiz:** Students are advised not to schedule or plan for other commitments during class time. It is the student's responsibility to attend any exams or quizzes held during class sessions. Even in the event of a change in the exam or quiz date, students remain accountable for attending, as missing such assessments will result in a grade of zero for the missing test or quiz.
9. **Announcements:** Students are required to regularly check this course outline for any changes and check their university email for announcements from the course instructor.
10. **Examination Mode:** All quizzes will be conducted online (remotely) via the university portal (MyLS), however, the mode of the final exam will be announced.
11. **Make-Up Test:** There will be no make-up test or quiz.
12. **Passing the Course:** To pass the course, students should attain a minimum of 50% in the total of all components mentioned in the Grading Scheme Section.
13. **Participation in Class:** It is encouraged to participate in class discussions, and there will be chances to get bonus points by answering questions raised in the class.
14. **Attendance:** The university's attendance policy is followed.

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University and Course Policies Approved by the Senate
1. **Academic Calendars:** Students are encouraged to review the Academic Calendar for information regarding all important dates, deadlines, and services available on campus.
2. **Accessibility:** Students requiring accommodation are advised to contact Accessible Learning Centre if they require academic accommodations because of a disability. Review the Registration page for information about intake and documentation requirements. Deadlines: Students are responsible for meeting posted deadlines for registering with Accessible Learning and booking accommodated exams. Accessible Learning cannot guarantee accommodations for requests received after posted deadlines.
3. **Plagiarism:** Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by course instructors, students are required to submit their written work in electronic form and have it checked for plagiarism.
4. **Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (e.g., honesty, integrity, reliability), fairness, caring, respect, responsibility, and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and non-academic behavior. The University has a defined policy concerning academic misconduct. As a Laurier student, you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. 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 is not a defense.
5. **Final Examinations:** Students are strongly urged not to make any commitments (e.g., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. Refer to the Handbook on Undergraduate Course Management for more information.
6. **Class Attendance:** Any student who, in the opinion of instructors, is absent too frequently from lectures or laboratory periods will be reported to the dean of the faculty. On the recommendation of the department concerned, such a student after due warning by the dean shall be debarred from taking the final examination in that course. Refer to the Handbook on Undergraduate Course Management for more information.
7. **Gender Inclusivity:** This course will be conducted in an affirming and mutually respectful atmosphere for people of all gender expressions and identities. I was provided with a class roster with your name as it appears on the official enrollment information. If you use a name different from the roster, please let me know at your earliest convenience. You can also share your gender pronouns with me if you like. Members of the class are expected to refer to one another by the name and pronouns identified by each student. If you are comfortable, you can also let your classmates know about your name and pronouns. The Centre for Student Diversity, Equity, and Inclusion (CSEDI) has developed a website outlining how to request a different name to appear on some university records and systems such as Zoom, MyLS, and email. The website also provides information about Laurier's Inclusive Washroom Initiative, support resources at Laurier, and more.
8. **Classroom Use of Electronic Devices:** Mobile devices (laptops, tablets, smartphones) are permitted provided they are used for educational purposes and in a manner that is respectful of the instructor and other students – see Policy 9.3.

9. **Use of Zoom for Instructional Purposes**: Wilfrid Laurier University uses a range of technologies to facilitate in-person and remote instruction. Zoom is currently used for remote course delivery, including lectures, seminars, and group office hours, which may be recorded, stored, and shared through MyLS for access by students in the course. For these course activities, students are permitted to turn off their cameras or use an alternative name to maintain their privacy after they have confirmed this with their course instructors. Student personal information is collected and used in the course by University policies and the Notice of Collection, Use, or Disclosure of Personal Information. All exams and mid-terms in the course that are conducted online will be proctored using only technologies approved for assessment at Laurier as outlined on this page.

10. **Syllabus Statement: 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 MyLS, are the intellectual property of the course instructors. 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 course content to third-party websites violates instructors' 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 instructors. Failure to follow these instructions may be in contravention of the university's Student Non-Academic Code of 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.

11. **Foot Patrol, the Wellness Centre, and the Student Food Bank (Recommended):** The University approved the inclusion of information about select wellness and safety services and supports on campus in the course information provided to students. (Approved by Senate November 28, 2011.) Specific language (by campus) is provided below.

    Multi-campus Resource:

    - Good2Talk is a postsecondary school helpline that provides free, professional, and confidential counseling support for students in Ontario. Call 1-866-925-5454 or through 2-1-1. Available 24-7.

    Kitchener/Waterloo Resources:

    - Waterloo Student 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 are accommodated.
    - Waterloo Foot Patrol: 519. 886.FOOT (3668). A volunteer-operated safe-walk program, available Fall and Winter daily from 6:30 pm to 3 am. Teams of two are assigned to escort students to and from campus by foot or by van.
    - Waterloo Student Wellness Centre: 519-884-0710, x3146. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2nd floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays, and Fridays from 8:30 am to 4:15 pm. Contact the Centre at x3146, wellness@wlu.ca or @LaurierWellness. After-hours crisis support is available 24/7. Call 1-844-437-3247 (HERE247).