UNIVERSITY OF SASKATCHEWAN

Department of Computer Science
176 Thorvaldson Building
110 Science Place, Saskatoon, SK, S7N 5C9, Canada
Telephone: (306) 966-4886, Facsimile: (306) 966-4884

Course Syllabus

CMPT 360: Algorithm Design Analysis and Correctness

[Mondays, Wednesdays, Fridays] [12:30 PM - 01:20 PM], 107 Physics Building

Instructor Information

Instructor	Debajyoti Mondal
Contact:	Email: d.mondal@usask.ca,
	Office Phone: (306)-966-6277
Office Hours:	After class or scheduled by email. Please put the keyword 'COMM360' in the subject line of your email for course-related communications.

Catalogue Description

This course develops and analyzes standard techniques for algorithm development which are widely applicable to computer science programs. These include greedy algorithms, branch-and-bound, dynamic programming, satisfiability, graphs and network-flow, and exhaustive search, along with proofs of correctness. The master theorem and other complexity analyses (including output-bounded and amortized complexity) are introduced. Hardware-level interactions with these algorithms and efficient data structures, including cache-obliviousness, are discussed.

Prerequisite(s):	CMPT 260 and 280, plus 9 credit units MATH or STAT
Class Time and Location:	MWF 12.30PM-1.20PM, 107 Physics Building (04-Sep-2024 to 05-Dec-2024)
Website:	canvas.usask.ca

Learning Outcomes

By the ompletion of this course, students will be expected to:

1. Learn the major methods for designing algorithms through concrete examples
2. Learn the process of verifying the correctness of algorithms and analyzing computational complexities
3. Be able to solve mathematical problems using algorithms
4. Be able to evaluate the time and memory efficiency of the algorithms

Course Overview

The course covers important aspects of computer science that often appear when developing a computer program to solve problems computationally. Designing a formal specification for a problem, developing an efficient algorithm to solve the problem, and proving the correctness and performance boundaries of the algorithms are important skills that we develop during this course.

Class Schedule

Week	Topics	Assignment/Project related Deadlines
Week 1	Basics of Algorithm Analysis	
Week 2	Recursion, Divide-and-Conquer	Assignment 1 (out)
Week 3	Backtracking Algorithms	Assignment 1 (due), Assignment 2 (out)
Week 4	Greedy Algorithm	Assignment 2 (due), Assignment 3 (out)
Week 5-6	Dynamic Programming Algorithms	Assignment 3 (due), Assignment 4 (out)
Week 7	Midterm Examination – date announced on Canvas	
Week 7-9	Graph Algorithms	Assignment 4 (due), Assignment 5 (out)
Week 10-11	Computationally hard problems/lower bounds	Assignment 5 (due)
Week 12-13	Handling hard Problems (Approximation/FPT)	
Week 11-12	Advanced algorithms and data structures	

Midterm and Final Examination Scheduling

Midterm and final examinations must be written on the date scheduled.

Final examinations may be scheduled at any time during the examination period (https://students.usask.ca/academics/exams.php); students should therefore avoid making prior travel, employment, or other commitments for this period. A student is unable to write a final examination through no fault of his or her own for medical or other valid reasons, documentation must be provided and an opportunity to write the missed exam *may* be given. Students are encouraged to review all examination policies and procedures: http://students.usask.ca/academics/exams.php.

In the College of Arts and Science, all missed final exams are handled by the Dean's office, under the deferred and supplemental examination policy. Currently, the regulations specify that an application must be made within three working days of the missed examination, with supporting documentation uploaded within five working days. The supporting documentation must show an extenuating circumstance: *"a situation or challenge beyond the student's control that negatively affects the student's well-being and lowers their typical level of functioning."* Examples of justifiable absences are given at the link here: https://artsandscience.usask.ca/academics/advisor/student-requests/deferred-exams.php.

Note that AES accommodations for examinations are separate from this scheduling policy. Students are reminded that they must register with AES in order to obtain accommodations and that they must adhere to the AES deadlines.

Length and Mode of Final Examination

The length of the final examination is 3 hours. The students will be asked the following types of questions:

1. True/False and Multiple Choice Questions
2. Computational questions: The students will be given a problem and asked to apply a technique from the course to derive a solution.
3. Short/Long answer items: The student will be given a claim, and they will be asked to present their thoughts to justify or refute the claim.

Required (and other) Resources

We will mainly follow the book 'Algorithms', but the lecture will discuss examples from several books and resources. All required materials will be posted on Canvas.

Required Texts

Algorithms by Jeff Erickson (obtain at http://jeffe.cs.illinois.edu/teaching/algorithms/ - Links to an external site.)

Recommended Texts

The following books are recommended and can be found in the University of Saskatchewan library.

- Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to algorithms. MIT press. (you can access the book online from the Usask library).
- Skiena SS. The algorithm design manual. New York: springer; 1998. (you can access the book online from the Usask library).

Assessment Details

Intangibles may be considered in the determination of your grade.

Assignment dates are approximate, and may change based on class progress.

All students must be properly registered in order to attend lectures and receive credit for this course.

Grading Scheme

The course evaluation will be based on assignments, midterm and final examination.

Table 1: Grading Scheme

Item	*Description*	*Weighting*
Assignments	5 Assignments (7% each)	35%
Midterm Examination	80 minutes	25%
Final Examination	180 minutes	40%
	Total	100%

For all assignments and exams, you must write the answers in your own words. Do not communicate with any person. **Do not share any of your answers with any other individual at any time even after the assignment deadline or after the examination.**

Students' work may be assessed by one or more teaching assistants/markers assigned for this course.

Evaluation Components

5 Assignments
Value: 7% each, and hence 35% of the final grade
Due Date: The class schedule lists approximate deadlines. The exact dates are announced on Canvas.
Type: Descriptive and Programming Questions
Description: Descriptive questions: Upload all your answers as a single PDF file. Artificial intelligence text generator tools are allowed for gaining insights, but the use of the text generated by these tools is not allowed for assignment submission. You must write the answers in your own words that reflect your thought process.

Implementation of an algorithm: Because this is CMPT360, you already know Java (from CMPT270) data structures (from CMPT280) along with pre- and post-conditions (from CMPT270 and 280). Use GIT (from CMPT145), to display your test-driven approach (learned in CMPT145 and honed in CMPT270) and make commits showing the incremental development of your program.

Midterm Exam
Value: 25% of the final grade
Date: The class schedule lists approximate deadlines. The exact dates are announced on Canvas.
Length: 80 minutes
Type: invigilated, in class
Description: No text, calculators or computers allowed. The following types of questions are asked.

1. True/False and Multiple Choice Questions
2. Computational questions: The students will be given a problem and asked to apply a technique from the course to derive a solution.

Final Exam
Value: 40% of the final grade
Date: *scheduled by the registrar*
Length: 3 hours
Type: online using Canvas
Description: No use of online search, calculators, book or other resources beyond what is accessible through the Canvas course web page. The following types of questions are asked.

1. True/False and Multiple Choice Questions
2. Computational questions: The students will be given a problem and asked to apply a technique from the course to derive a solution.
3. Short/Long answer items: The student will be given a claim, and they will be asked to present their thoughts to justify or refute the claim.

Submitting Assignments

Assignment submissions must be made on Canvas.

Late Assignments

I will accept late assignments only for seven (7) days beyond the due date. The penalty for your delay is 10 percentage points per day of lateness from the value of the assignment, including weekend days, when assignments can be submitted electronically. If you submit electronically a late assignment, you still have to submit a paper copy at the start of the following lecture. Extensions may be granted only in exceptional circumstances (documented illness or emergency). You must show evidence that you have started and made progress when negotiating the extension.

Criteria That Must Be Met To Pass

Students must complete the midterm and final examinations to be eligible to receive a passing grade (50% or higher) in the course.

Attendence Expectation

You are expected to attend the classes, participate in the class discussions and ask clarification questions. However, the grading for this course does not have any attendance or participation component.

Grading Concerns

Please contact the marker regarding any assignment marking concerns, with a CC to the instructor. Should you continue to have concerns, please escalate to the instructor. Please note that should your concern be a comparison with anothers work, both must be submitted for regrading: we reserve the right to re-grade your work and the others work. Furthermore, the instructor will re-grade the entire work, not just selected portions.

Persuant to Academic Appeals policy, no complaints will be be accepted or investigated unless received less than 30 days after the grade is posted for the work.

System Outages

System (canvas, labs, network) outages of 6 hours or longer, in the 24 hours before a deadline, automatically grant a 24-hour extension. Shorter outages, even if they overlap with a deadline, do not. Most systems allow re-submission, students are counseled to submit early, and submit regularly as progress is made.

Recording of the Course

Recording of the course will only be allowed in certain circumstances. Please see the instructor for information on how to receive approval.

Copyright

Materials posted on course management systems or distributed in class will be made available in accordance with Canadian copyright laws. Students are reminded of their obligation to also abide by this legislation.

Course material created by your professors and instructors is their intellectual property and ***cannot be shared without written permission****. This includes exams, PowerPoint/PDF lecture slides and other course notes. If materials are designated as open education resources (with a creative commons license) you can share and/or use them in alignment with the CC license. Other copyright-protected materials created by textbook publishers and authors may be provided to you based on license terms and educational exceptions in the Canadian Copyright Act.*

You are responsible for ensuring that any copying or distribution of materials that you engage in is permitted by the Universitys *Use of Materials Protected By Copyright* Policy. For example, posting others copyright-protected materials on the open internet is not permitted by this policy unless you have copyright permission or a license to do so. For more copyright information, please visit `https://library.usask.ca/copyright/students/index.php` or contact the University Copyright Coordinator at 306-966-8817.

Student Feedback

You will be provided opportunities throughout the term to provide feedback about the course. This will include the use of the University administered course feedback system, SLEQ, both partway through the class and at the end of term, and less formal methods. I value this feedback and use it to modify and improve the course to best meet student learning needs.

Academic Integrity

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are urged to read the Regulations on Academic Misconduct and to avoid any behaviour that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence.

For help developing the skills for meeting academic integrity expectations, see `https://academic-integrity.usask.ca/students.php`.

Students are encouraged to ask their instructors for clarification on academic integrity requirements.

All students are encouraged to be aware of the rules for courses set out in the University Academic Courses Policy on Class Delivery, Examinations, and Assessment of Student Learning.

Students in this course are required to show a completion certificate for the Academic Integrity Tutorial.

Artificial intelligence text generator tools (also known as large language models) **are** permitted in this course following specific guidance on proper use as provided with assessment instructions. Improper use of such tools will be considered academic misconduct in this course.

Students wanting to connect their assessment in this course to assessments they have completed in another course must get explicit permission of the instructor in order to avoid potential academic misconduct of self-plagiarism.

Collaboration Policy

You may neither possess work from other students (including those not enrolled in this course) nor share your work (rough drafts, finished answers, or graded assignments) with another student at any time during the course: **before and after** any assignment is due. Study groups and group discussion are encouraged; but if you plan to employ these then you must adhere to a strict ***no-recording*** policy:

> Collaboratively, you may discuss and sketch on a non-permanent surface (e.g. whiteboard), but no written-on-paper and no typed-into-computer activities are allowed. Every student must leave the discussion without a record (no written notes or printed document, no computer file, no photograph, and no audio/video recording) and must reproduce the result from their own memory. The impermanent surface must be erased before leaving the discussion and commencing to construct your answer.

Information found online can be used for understanding only, essentially as a mechanical collaborator in the policy above. But, you cannot submit anything you find online as your own work, and you must complete your own work without referring to the online information once you've started writing your answer. If you need to refer back to the online information, you must erase your partial answer and reconstruct it again *ab initio*, after closing access to the online information and deleting any copy of it.

Offering another's work (especially that found online) as your own is academic misconduct. If you afford yourself the benefit of the *no-recording* policy and discuss with others, you must identify in your submission, all of the individuals with whom you discussed the work, and identify any online sources you consulted. Furthermore, one student's unauthorized possession of other students' work (even after the due date) is also *prima facia* evidence of academic misconduct on the part of both students, even if one is not registered in this class.

Access and Equity Services (AES) for Students

Access and Equity Services (AES) is available to provide support to students who require accommodations due to disability, family status, and religious observances.

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates.

Students who require accommodations for pregnancy or substantial parental/family duties should contact AES to discuss their situations and potentially register with that office.

Students who require accommodations due to religious practices that prohibit the writing of exams on religious holidays should contact AES to self-declare and determine which accommodations are appropriate. In general, students who are unable to write an exam due to a religious conflict do not register with AES but instead submit an exam conflict form through their PAWS account to arrange accommodations.

Any student registered with AES, as well as those who require accommodations on religious grounds, may request alternative arrangements for mid-term and final examinations by submitting a request to AES by the

stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

In particular, assignment accommodations are expected to be exercised occasionally (i.e. not for every assignment) and with a minimum of 24 hours notice before the deadline. Otherwise, the occurrence will be addressed as an *acute* situation, just like any other student submitting late. If AES cannot provide an accommodation, e.g. a lab computer customized for CompSci lab exams isn't available in a private room and for extra time, and the department or course-structure cannot accommodate it either, e.g. the flipped classroom cannot allow extensions on pre-class-time coursework, then the student is out-of-luck: they can choose to withdraw from the course or accept the obstacles and do the best they can.

Student Supports

Academic Help — University Library

Visit the University Library and Learning Hub to find supports for undergraduate and graduate students with first-year experience, study skills, learning strategies, research, writing, math and statistics. Students can attend workshops, access online resources and research guides, book one-on-one appointments or hire a subject tutor through the USask Tutoring Network.

Connect with library staff through the AskUs chat service or visit various library locations on campus.

Enrolled in an online course? Explore the Online Learning Readiness Tutorial.

Teaching, Learning and Student Experience

The Teaching, Learning and Student Experience unit (TLSE) focuses on providing developmental and support services and programs to students and the university community. For more information, see the student's web site.

College Supports

Students in Arts and Science are encouraged to contact the Undergraduate Student Office and/or the Trish Monture Centre for Success with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources. Contact information is available at the UnderGraduate Student Office.

Financial Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central.

Gordon Oakes Red Bear Student Centre

The Gordon Oakes Red Bear Student Centre is dedicated to supporting Indigenous student academic and personal success. The Centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The Centre is an intercultural gathering space that brings Indigenous and non-Indigenous students together to learn from, with, and about one another in a respectful, inclusive, and safe environment. Visit `https://students.usask.ca/indigenous/index.php`; or students are encouraged to visit the GORBSCS website.

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success and facilitates international education experiences at the University of Saskatchewan and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and *English as a Second Language* students and their families in their transition to the University of Saskatchewan and to life in Canada. ISSAC offers advising and support on matters that affect international students and their families and on matters related to studying abroad as University of Saskatchewan students. Please visit `https://students.usask.ca` for more information.

Treaty Acknowledgment

As we gather here today, we acknowledge that the Saskatoon campus of the University of Saskatchewan is on Treaty Six Territory and the Homeland of the Métis. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. We recognize that, in the course of your studies, you will spend time learning other traditional territories and Métis homlands. We wish you safe, productive, and respectful encounters in these places.

Acknowledgements

This syllabus is constructed around M. Dahl's excellent template distributed to the College.