University of Saskatchewan
Department of Computer Science
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Course Syllabus
CMPT 280.3: Intermediate Data Structures and Algorithms

Catalogue Description

Object oriented design of formal abstract data types. This course focuses on data structure design and use in Java. Basic data structures are reviewed in an object oriented context and new data structures and related algorithms are introduced: ordered trees, balanced trees, simple spatial trees; graph representations and searching: path algorithms, depth/breadth first searches, direct and B-tree files; and advanced sorting algorithms. There is emphasis on algorithm analysis in the context of measuring the efficiency of various data structure operations and suitability of data structures to various tasks.

Prerequisite: CMPT 270

Website: http://moodle.cs.usask.ca/

Class, Instructor, and Tutorial Information

	Lecture – Section 02	Tutorial – Section T02	Tutorial – Section T04
Time	M,W,F 1:30pm–2:20pm	W 4:00pm–5:30pm	TR 4:00pm–5:30pm
Location	THORV 271	THORV 124	Thorv 124
Instructor	Mark Eramian	Arianne Butler	Arianne Butler
Email	eramian@cs.usask.ca	alb153@mail.usask.ca	alb153@mail.usask.ca
Consulting	Mon., 2:30-4:30, SPINKS Lab	TBA	TBA

Course Objectives

Upon completion of this course, successful students should be able to:

- use and implement data structures for efficient storage and retrieval of data in collections: lists, queues, balanced trees;
- use and implement graph data structures: adjacency list, adjacency matrix;
- use and implement abstract iteration mechanisms for containers and graphs;
- create new data structures with minimal effort and maximum re-use through restriction and extension of existing data structures;
- implement customized data structures from scratch within an object-oriented design framework;
- choose appropriate data structures for maximizing efficiency of data storage and retrieval for a given task;
- solve problems that can be represented by a graph using basic graph algorithms: e.g. spanning tree, shortest path algorithms, max-flow; and
- select form among advanced sorting algorithms the one that is most suitable to a particular data-sorting problem based on the nature of the data to be sorted.

Student Evaluation

Grading Scheme

Assignments	40%
Midterm Exam	15%
Final Exam	45%
Total	100%

Criteria That Must Be Met To Pass

Students must write the final exam. If a student does not write the final exam, the student will receive a grade of at most 49%.

Attendance Expectation

- Students are expected to attend every class, and participate actively. There will be short reading assignments for all classes, and students are expected to come to class having completed the readings. There will be group problem-solving activities in class; come prepared and do not disappoint your group. There is no penalty for missed lectures, however, attendance in class is crucial for success in the course.
- Students are expected to attend all tutorial sessions. These are opportunities to practice the course material with the guidance of a teaching assistant. There will also, on occasion, be new materials presented in tutorials that are not presented in class which will be covered on examinations. This is because tutorials contain some flexible time whose content is driven by the needs of the students. Sometimes this means that content will be presented without being prepared in advance and such content will not appear in lectures or be posted online, but will still be fair-game for testing on examinations. There is no penalty for missed tutorial sessions, but it is expected that students will attend and take advantage of the opportunity for asking questions, seeing more examples, and getting additional practice.

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

Midterm Examination Scheduling

The mid-term exam date will be held **outside of class on the evening of February 15th, 6pm-7:30pm**.

Final Exam Scheduling

The Registrar schedules all final examinations, including deferred and supplemental examinations.

"Students must not make travel plans or schedule other activities during the period scheduled for examinations. Deferred examinations are not granted for these reasons." (http://www.usask.ca/programs/colleges-schools/arts-science/#DeferredandSupplementalExaminations-15)

Course Overview

Lectures will be opportunities to apply the concepts covered in the course, discuss them, look at examples, and solve problems, as well as to ask questions and receive guidance; we will not use much class time reading slides to you. **Short readings** will be assigned before each class, and you will be expected to be prepared to discuss, ask questions, and participate. **Tutorial** times are listed below; these are your opportunities to review and practice the current week's material under the guidance of a teaching assistant. We will have one **midterm** examination (see above for the schedule). The **final examination** is scheduled by the university.

Assignments are mostly weekly, to ensure that all the relevant material is put into regular, consistent practice. Some early assignments may seem easy, and later assignments will definitely challenge you. Even a simple assignment can turn into a time-consuming affair if you get stuck on something that blocks your progress. Working at the last minute is a guaranteed source of stress and burn-out. To manage your workload you must learn effective time management. Start every assignment early, to allow yourself time to get help if you run into a problem. Make use of the teaching resources (instructors' office hours, TAs, labs, lectures, discussion forums etc.) available to you.

Textbook Information

Required Texts and Resources

- Required Textbook: M. Eramian, Intermediate Data Structures and Algorithms (Course Readings for CMPT 280), second edition, 2015. **You cannot buy this in the bookstore! This book is available for free on the course website.**

Recommended Texts

- Java reference: Big Java: Early Objects, 5th edition, by Cay Horstmann, Wiley & Sons, 2013.
  (You don't have to buy this, but if you want a book on Java, this one is pretty good. Does not include Java 8, but we should not be using any language features specific to Java 8.)

Lecture Schedule

The following schedule is approximate. Other topics may be added if time allows.

Topic	Details
Review of Lists	• Array-based lists • Singly linked list • Insertion algorithm • Doubly/circularly linked variants.
Regression Testing	• Black-box • White-box • Managing expected and unexpected exceptions.
Generalized Collection Iteration	• Cursors • Iterators
Algorithm Timing Analysis	• Formal defintion • Statement counting approach • Active operation approach • Big-O, Big-Theta notation

Abstract Data Types and Specification	• ADT Defintion (review) • Formal specification of ADTs
Standard Trees	• Tree Traversals • Ordered Trees • General Trees
Specialized Trees (not all covered in detail)	• AVL trees • 2-3 trees • B-trees • splay trees, tries • range searching: k-D trees
Graphs	• Directed and Undirected Graphs • Breadth-first and depth-first search • Shortest Path Algorithms (e.g. Dijkstra's algoirthm)
Efficient Sorting Algorithms	• review of $O(n^2)$ searches • merge sort • quick sort • heap sort • linear sorts: bucket, radix
Extra Topics (Time permitting)	• greedy algorithms • backtracking algorithms • design of lib280 • more data structures

Assignment Schedule

Assignments will be (mostly) weekly. Later assignments will be bi-weekly, and will be lengthier. The assignment deadline schedule follows. In the highly unlikely event that this schedule is disrupted so much that an assignment needs to be cancelled, the weighting of the remaining assignments will be pro-rated so that they comprise the percentage of the final grade listed under the "Grading Scheme" section, above.

Assignment	Due Date
1	January 17, 2017, 10:00pm
2	January 24, 2017, 10:00pm
3	January 31, 2017, 10:00pm
4	February 7, 2017, 10:00pm
5	February 28, 2017, 10:00pm
6	March 7, 2017, 10:00pm
7	March 21, 2017, 10:00pm
8	April 4, 2017, 10:00pm

Tutorial sections

Tutorial sessions begin the week of January 9.

Section	Day	Time	Room
T02	Wednesday	4:00pm–5:30pm	THORV 124
T04	Thursday	4:00pm–5:30pm	THORV 124

The tutorial sessions will be guided by teaching assistants; the contact information for the teaching assistants will be made available on course Moodle webpage (`http://moodle.cs.usask.ca`).

The open undergraduate computing labs on the 3rd floor of the Spinks Addition to the Thorvaldson Building is available for student use outside of lab time. Many TAs and instructors for several CMPT courses will hold office hours in the open lab. Don't be shy. If you see an instructor or TA who is not your TA or instructor in the lab, don't hesitate to call them over to help you.

Policies

Late Assignments

Assignments are due Tuesdays at 10pm. Because of the weekly nature of assignments, late assignments cannot be accepted. That may seem harsh, but we have a schedule to keep to and falling behind will not benefit you.

Assignment Extensions

Assignment extensions may be granted on a case-by-case basis, but only for emergencies or very exceptional circumstances. Extensions may only be granted by the course instructor. Please contact your instructor before the due date to request an extension. Requests for extensions after the submission deadline for an assignment has passed will not be considered.

Missed Assignments

Students are expected to attempt (and hopefully complete!) all assignments, and all laboratory exercises. It's better to submit partially completed assignments than to submit nothing at all. An assignment for which nothing is submitted will receive a score of zero.

If you miss an assignment for medical or compassionate reasons, contact your instructor as soon as possible.

Missed Examinations

1. Students who miss the mid-term exam should contact the instructor as soon as possible. If it is known in advance that the exam will be missed, the instructor should be contacted prior to the exam.

2. "A student who is absent from a final examination for medical reasons (such as illness) or compassionate reasons (such as the illness of a child or death of a loved-one) is responsible for applying to the Undergraduate Student Office for a deferred examination. The application must be initiated within three days of the missed examination and must be accompanied by documentation (letter from a doctor, etc.)." (http://www.usask.ca/programs/colleges-schools/arts-science/#DeferredandSupplementalExaminations-15)

Incomplete Course Work and Final Grades

"When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination.

Extensions past the final examination date for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the class which factors in the incomplete coursework as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade.

In the case where the student has a passing percentile grade but the instructor has indicated in the course outline that failure to complete the required coursework will result in failure in the course, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised assigned final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed.

A student can pass a course on the basis of work completed in the course provided that any incomplete course work has not been deemed mandatory by the instructor in the course outline and/or by College regulations for achieving a passing grade." (http://policies.usask.ca/policies/academic-affairs/academic-courses.php)

For policies governing examinations and grading, students are referred to the Assessment of Students section of the University policy "Academic courses: class delivery, examinations, and assessment of student learning" (http://policies.usask.ca/policies/academic-affairs/academic-courses.php)

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals subsection of the University Secretary Website and avoid any behaviour that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct,

http://www.usask.ca/secretariat/student-conduct-appeals/academic-misconduct.php,
as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals,
http://www.usask.ca/secretariat/student-conduct-appeals/non-academic-misconduct.php.

Academic honesty is also defined and described in the Department of Computer Science Statement on Academic Honesty:
http://www.cs.usask.ca/students/academic-honesty/index.php.

For more information on what academic integrity means for students see http://www.usask.ca/secretariat/student-conduct-appeals/forms/IntegrityDefined.pdf

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check http://www.students.usask.ca/disability/, or contact DSS at 306-966-7273 or `dss@usask.ca`.

Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.

Student Supports

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site `https://www.usask.ca/ulc/`. The Student and Enrolment Services Division (SESD) focuses on providing developmental and support services and programs to students and the university community. For more information, see the SESD web site http://www.usask.ca/sesd/.