

Course Information

Instructor: Steph Durocher Lectures: 10:00–11:15 am, Tue. & Thu. in EITC E2-360
Office: EITC E2-412 Office hours: 9:00–9:45 am Tue. or by appointment
Email: <mailto:durocher@cs.umanitoba.ca> (allow 48 hours for response)
Web: <http://www.cs.umanitoba.ca/~comp7750>

Course Description. COMP 7750 (Graph Drawing): The design and analysis of efficient algorithms for drawing a given graph in the plane subject to given constraints and optimization criteria. Possible topics include drawing rooted trees, planarity testing, drawing planar graphs, straight-line drawings, point-set embeddings, visibility graphs, and contact graph representations. Prerequisites: COMP 3170 (or equivalent) and written consent of instructor.

Overview. COMP 7750 (Graph Drawing) is intended as an advanced course in theoretical computer science that provides a graduate-level introduction to the field of graph drawing for students with a strong undergraduate foundation in algorithms and data structures. Lectures will discuss fundamental concepts, algorithms, and techniques in graph drawing. Graph drawing is a field at the intersection of algorithms, graph theory, and combinatorial geometry that examines algorithmic questions related to drawing graphs on surfaces. An instance of a graph drawing problem consists of the combinatorial description of a graph G , a surface Σ (e.g., the Euclidean plane), and a set of constraints C (e.g., all vertices must be drawn as points and all edges must be drawn as vertical or horizontal line segments, no two of which may cross). The corresponding problem is to design an algorithm that constructs an embedding of G onto Σ (a mapping of the vertices and edges of G to Σ) that satisfies C , or determine that no such embedding exists.

Course Goals and Intended Learning Outcomes. This course exposes students to a new and rapidly growing algorithmic field within computer science that has applications in information visualization (e.g., network analysis, social networks, and linguistics), cartography, and bioinformatics. Students will discuss fundamental concepts in graph drawing, techniques used to draw graphs to satisfy common constraints and optimization criteria, and important recent related research developments in graph drawing.

Prerequisites. An upper-year undergraduate course in algorithm analysis such as COMP 3170 is required, as is a course in discrete mathematics such as COMP 2130. Consent of the instructor is required for undergraduate students. Students are expected to have a strong background in theoretical computer science (e.g., a grade of A or A+ in COMP 3170). Students will be required to complete a mandatory quiz during the first week of classes to help determine whether they possess the required background. Quiz marks will not count towards course grades, but students are required to pass the quiz to continue in the course. There is no need to study any specific material before the quiz. Students are expected to be familiar with intermediate topics in design and analysis of algorithms, data structures, and discrete mathematics, including sorting, searching, big Oh notation, trees, logic, set theory, and graph theory. Students are expected to be familiar with fundamental graph theoretic concepts, including cycles, spanning trees, adjacency matrices, adjacency lists, vertex degree, directed vs. undirected graphs, diameter, planarity, complete graphs, bipartite graphs, shortest paths, and graph isomorphism.

Textbook. A list of required reading will be provided on the course webpage as these are assigned throughout the term. No book is required to be purchased, but recommended textbooks will be suggested. These include:

- di Battista, Eades, Tamassia, and Tollis. *Graph Drawing: Algorithms for the Visualization of Graphs*. Prentice Hall (1999).
- Nishizeki and Rahman. *Planar Graph Drawing*. World Scientific (2004).
- Tamassia (editor). *Handbook of Graph Drawing and Visualization*. CRC Press (2013).

Syllabus. Topics to be covered in the course will include the following, subject to change at the discretion of the instructor and/or based on the learning needs of the students.

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| 1 introductory concepts in graph drawing | 5 drawing planar graphs |
| 2 drawing trees | – straight-line drawings |
| – rooted trees | – convex drawings |
| – k -trees | – orthogonal drawings |
| – outerplanar graphs | – visibility drawings |
| – series-parallel graphs | – contact graph representation |
| 3 drawing layered graphs | 6 point-set embeddings |
| 4 planarity testing | 7 graph crossing number |

Grading. All students will be required to complete three assignments, a midterm exam, a final exam, and a course project (consisting of a project proposal, a class presentation, and a written report). Grades will be calculated according to the following table:

		letter grade	% grade	grade point
		A+	90–100	4.5
		A	80–89	4.0
		B+	75–79	3.5
		B	70–74	3.0
		C+	65–69	2.5
		C	60–64	2.0
		D	50–59	1.0
		F	0–49	0.0
assignments	30%			
midterm exam	15%			
final exam	30%			
course project	25%			

Assignments. Assignments will consist of problem sets, seeking constructive solutions to algorithmic problems related to lecture material and assigned reading. Solutions should include sufficiently detailed descriptions, presented clearly and unambiguously. Three assignments will be distributed in class during the term. You will have one week to complete each assignment individually. Solutions must be submitted by the start of class on the due date. Include your name, student number, and email address at the top of the first page on all submitted material, as well as the names of people with whom you have discussed your assignment solution. Cite any sources to which you refer, as you should do when presenting any scientific document. You must submit your solution electronically using UMLearn. Only pdf files will be accepted. To permit the prompt distribution of solutions and return of marked assignments, **late assignments will not be accepted.**

Examinations. There will be a midterm exam held in class and a final exam held during the December exam period. Exams will be closed book.

Course Project. The course project is required for graduate students and optional for undergraduate students. The purpose of the course project is for students to select and explore a topic in graph drawing, to study a current research problem in that topic, to make a new contribution on that topic (see below), and to present the results, in both a written report and a class presentation. The nature of the project can vary; examples include:

- writing a survey paper on a current topic in graph drawing,
- writing code to implement and compare the performance of algorithms for solving a problem in graph drawing, or
- exploring possible solutions to an open problem on a given topic in graph drawing.

As part of the project, graduate students will be asked to submit a preliminary project proposal, a final written report, and to give a class presentation. Students may choose to complete the project individually or in groups of two.

Assigned Reading. In addition to reading assignments from the textbook, journal and conference publications will be assigned as reading (approximately one paper per topic). Students will be expected to discuss and answer questions (in class and in examinations) related to the material contained in these assigned papers.

Important Dates.

September 8	first class	November 18	VW deadline
September 29	project proposal due	November 24	assignment 3 due
October 6	no class (fall reading break)	November 24	project presentations begin
October 13	assignment 1 due	December 8	last class
October 25	midterm exam	December 8	project final report due
November 3	assignment 2 due	December 15	final exam

Referencing Style. Assignments and projects should use one of the standard citation formats for Compute Science, such as ACM, IEEE, or AMS. For example:

Boucher, C., Erdos, P., and Obama, B. *Title of Article*. *Journal of Algorithms* 10(2), 104–122 (2016).

Academic Integrity. The Faculty of Science takes academic integrity very seriously. Any evidence of academic dishonesty on assignments, labs and/or tests will be forwarded to the appropriate authorities for potential disciplinary actions.

The University Student Discipline By-Law may be accessed at: http://umanitoba.ca/admin/governance/governing_documents/students/student_discipline.html. Information from the Faculty of Science regarding Cheating and Plagiarism can be found at <http://umanitoba.ca/faculties/science/undergrad/resources/webdisciplinedocuments.html>.

Students are encouraged to discuss course concepts and the general interpretation of homework problems with other students in the class. No written record should be taken from such discussion. Each student must work on the final solution of assignment problems independently. On a cover page, each student must list the names of people with whom he or she has discussed the assignment solution. Following conventions for citing reference materials in scientific writing is mandatory. Submitting the work of another person as your own constitutes academic misconduct. Any course work that does not follow these guidelines will be

considered plagiarism and will be reported to the Faculty of Science. Students are to abide by the university's policies regarding academic dishonesty which can be found on this web site:

http://umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/

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Course Technology. It is the general University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. The student can use all technology in classroom setting only for educational purposes approved by instructor and/or the University of Manitoba Student Accessibility Services. Student should not participate in personal direct electronic messaging / posting activities (e-mail, texting, video or voice chat, wikis, blogs, social networking (e.g. Facebook) online and offline gaming during scheduled class time. If student is on call (emergency) the student should switch his/her cell phone on vibrate mode and leave the classroom before using it. (Copyright S. Kondrashov. Used with permission)

Class Communication. The University requires all students to activate an official University email account. For full details of the Electronic Communication with Students please visit: http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2014_06_05.pdf

Please note that all communication between myself and you as a student must comply with the electronic communication with student policy (http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html). You are required to obtain and use your U of M email account for all communication between yourself and the university.

Student Accessibility Services. If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation. Student Accessibility Services <http://umanitoba.ca/student/saa/accessibility/>
520 University Centre

204 474 7423

mailto:Student_accessibility@umanitoba.ca

Academic Recourses. Various academic resources are available to students including the Science and Technology Library and various departmental help centers.

Health & Mental Health Resources. Students with Health and/or Mental Health issues may seek advice and/or help from Student Counselling Center, Student Accessibility Services, and University Health Services.

Respectful Behaviour Resources. Students are expected to act in a respectful manner. Policies regarding respectful work and learning environment and sexual assault can be found at http://umanitoba.ca/admin/governance/governing_documents/community/230.html.

Final Examinations, Grades and Grade Appeals Resources. Final examination and grades policies can be found at http://umanitoba.ca/admin/governance/governing_documents/academic/1299.html.

Students wishing to appeal their term work grade can do so through the Registrars office. A fee is charged for each appeal.

To view your final examination, please check with the department offering the course for policies.

To appeal your final grade, you can initiate the process at the Registrars office. A fee will be charged for each appeal. See the Registrars office for more information.

Limited Access and VW Resources. Students who fail or VW from a course will be subject to limited access to that course in future terms. That is, students will not be able to register for a course (for which they have VWed or failed) during the limited access registration period. For more information, please see the policy document for repeated courses at http://www.umanitoba.ca/admin/governance/media/Repeated_Course_Policy_-_2016_09_01.pdf.