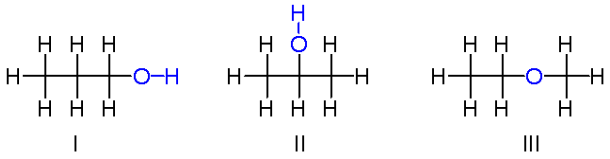
Welcome to MAT 332 F, otherwise known as **Introduction to Graph Theory**. This document provides some information about the course.

Please take a few minutes to study this handout, and keep it for future reference.

Graph Theory

From time immemorial, people have studied numbers (arithmetic) and shapes (geometry), both to solve practical problems and to gain wisdom. In modern times, technological advancement has led to the realization that graphs are another important structure which we should strive to understand.

Graphs are mathematical objects which model *interrelationships*. They come up in contexts where the important information is *how things are related*, not merely *what they are*. For instance, in Chemistry different molecules can be built out of the same atoms by bonding them in different ways. Consider propanol isomers, all of which share the same molecular formula C_3H_8O:



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Another example of a graph is furnished by a computer programme— any number of computer programmes can be assembled from a small set of routines by combining them in different ways. Yet another example is found in electrical engineering— resistors, capacitors, inductors, voltage and current sources, and switches can combine to form any number of electrical networks.

Typical questions about graphs include:

Enumeration How many graphs are there which satisfy a certain property? For example, how many isomers might one collection of atoms produce?

Subgraph Detection For a certain application, does graph G contain a smaller more manageable graph H which does the job just as well? Is process A hiding as a sub-process of process B?

Flow Let G be a network, with flow entering at *sources* $s_1, \ldots, s_n$ and leaving at *sinks* $t_1, \ldots, t_n$. Calculate the flow at a vertex p in G. How much electricity runs through each part of your machine? How much traffic can you expect driving on a certain route?

Graph Colouring Can you colour vertices of a graph with n colours such that no two vertices adjacent to an edge receive the same colours? Consider a set of jobs to be assigned rooms and time slots. Jobs can be scheduled in any order, but certain jobs can only be done in certain rooms, and pairs of jobs should not be assigned the same time slot and the same room. How can you schedule all jobs without conflict?

The core material of this course consists of the standard bare-bones essentials of graph theory. A student can get full marks from understanding only the core course material. In addition, the course features bonus material worth bonus marks.

Course Website

This course has a homepage on Blackboard, and also a course website:

`http://www.math.toronto.edu/ddmoskov/mat332/`

Both webpages *should* always contain the same information, that is the most up-to-date information regarding the course.

Instructor Information

Instructor	Office	Email	Office Hours
Daniel Moskovich	*BA 6189*	ddmoskov@math.toronto.edu	T 5-6, R 2-3

Please include [**MAT 332**] in *all* email communication about course-related matters.

Lecture: *Time:* T 2-4 *Place:* SS 2108
Time: T 4-5 *Place:* SS 1088

Tutorials

Instructor	Tutorial Room	Email	Tutorial Time
Karene Chu	*RW 142*	karene.chu@utoronto.ca	M 5-6

Tutorials begin the **third** week of classes, on September 26 2011.

Textbook

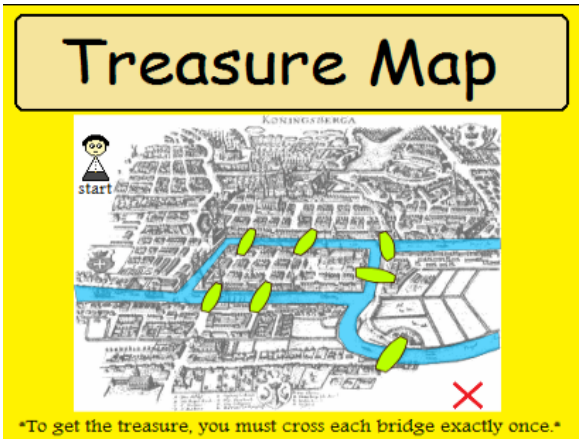
The textbook for the course is "Graph Theory", third edition, by A. Bondy and U. S. R. Murty: Springer © 2008. You can buy it at the University of Toronto Bookstore. This textbook is rigourous and good, but somewhat dry. Students may find a lighter Graph Theory reference to be useful, such as "Algorithmic Graph Theory" by D. Joyner, M. Van Nguyen, and N. Cohen, available for free download from http://code.google.com/p/graph-theory-algorithms-book/.

Course Outline

The following topics comprise the core material of this course.

- Fundamental concepts. Sections 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 2.3.
- Trees and spanning trees. Sections 4.1, 4.2.
- Flows. Sections 7.1, 7.2.
- Matchings. Sections 16.1, 16.2.
- Planarity. Sections 10.1, 10.2, 10.3.
- Graph Colouring. Sections 11.1, 11.2.

You will be expected to prove statements using double-counting, inclusion-exclusion, the pigeonhole principle, and induction.
In addition, the course will feature bonus material, worth bonus marks, which may require some linear algebra or mathematical maturity. These topics may include Catalan numbers, graph connectivity, and the matrix-tree theorem.



Spiked Math http://spikedmath.com/120.html

Grading Scheme

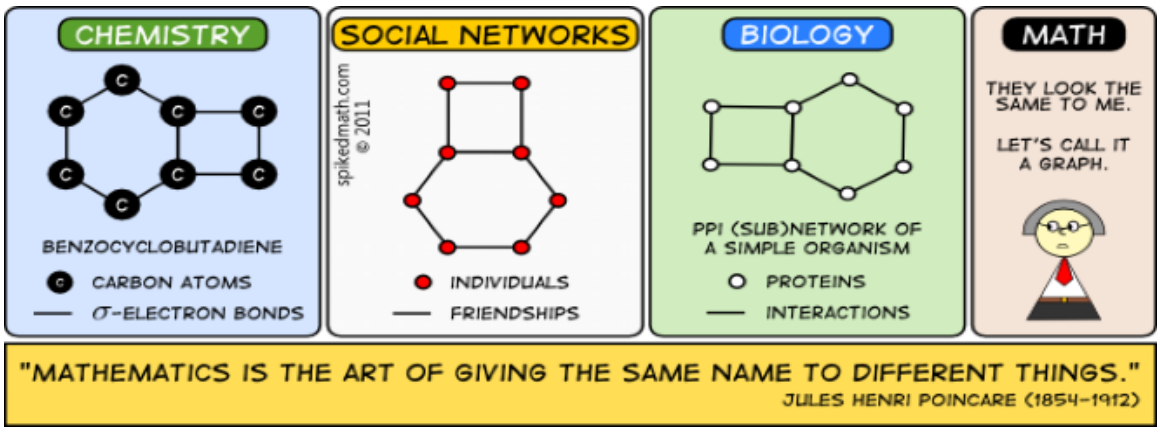
Item	Posted by	Due Date	Weight
Assignment 1	Sept 18	Oct 4	6%
Assignment 2	Oct 2	Oct 18	6%
Midterm		Oct 25	26%
Assignment 3	Oct 30	Nov 15	6%
Assignment 4	Nov 13	Nov 29	6%
Final exam		Dec 9–20	50%

Notes:

- To pass this course, you must achieve a mark of 40% on the final exam.
- If your final exam mark is higher than your midterm mark, the midterm is counted with only 16% weight, and the final with 60%.
- On the midterm and on the final exam, if you cannot answer a question (or part of a question), you will receive 1 point for that question (or for part of that question) if you write "I don't know" and nothing else.

Assignment Submission

All assignments are due *by 3pm* on their due date. You may submit assignments in class.
If you are unable to complete homework or if you miss a term test due to illness or other circumstances outside of your control, please contact your instructor immediately in order to receive special consideration. Note that special consideration will be given on an individual basis and will not be given automatically. In other words, you risk getting a mark of zero for missed work unless you contact the instructor promptly.
In the case of illness, medical documentation must be supplied on the standard University of Toronto Student Medical Certificate. You can also obtain a paper copy of this certificate from your college registrar or in your registration handbook. (A simple "note" from your doctor is not acceptable.)



Spiked Math `http://spikedmath.com/382.html`

Lateness Policy

Late assignments will be accepted up to 25 hours after their deadlines with the following penalties.

Submission time	Penalty
by 3pm on Tuesday	none
by 10am on Wednesday	-10%
by 4pm on Wednesday	-25%

Note that lateness penalties will be computed as a percentage of the total marks on the assignment, not of the mark you obtain. Late assignments must be submitted directly into the instructor's personal mailbox on the 6th floor of Bahen Center (in the Math Department office), unless you require special consideration (see the section above for details). **Please write the *exact* submission time on your assignment if you are submitting late.**

Bonus Marks

Graph theory is a rich subject, and it's a shame to limit ourselves to the centre of the course syllabus. In the following cases, bonus points will be awarded for going beyond the fundamentals.

- Problem sets and tests will contain bonus questions worth up to 15 points. So the maximum mark for a problem set or a test (including bonuses) could be as much as 115%. The bonus questions will either be more difficult, or will concern topics mentioned only tangentially in the lectures.
- Students may elect to give 5-10 minute oral presentations on topics in the book (or outside the book). Oral presentations are worth a bonus of up to 5% on the final mark of the course. Presentations may be given jointly (feel free to work in teams!), but joint presentations might be graded more strictly.

If your final mark for the course ends up being more than 100% thanks to bonus marks, then it will be 'rounded down' to 100%.

Plagiarism

Plagiarism is a form of academic fraud and is treated very seriously by the Faculty of Arts & Science. **The assignments you hand in must not contain anyone else's work or ideas without proper attribution.** A working definition of plagiarism suitable for this course may be found at `http://www.northwestern.edu/provost/students/integrity/plagiarism.html`.
In science, collaboration is the norm, and in this course student collaboration is permitted to an extent. Namely, you are permitted to abstractly discuss possible solutions to a problem with other students. You are also permitted to submit a joint answer to a problem set question. If two students have contributed to the solution of the problem, please write both names and student numbers near the problem, and you may share the marks. In addition, oral presentations may be joint.
However, a student is forbidden from guiding another student through a solution step by step. In the unfortunate event that this does inadvertently happen, the students either have to work out a fundamentally different solution so that both can submit separately, or the answer has to be submitted as a joint answer.

Conclusion

The course material is fun and useful. Let's all have fun and learn a lot in Fall 2011!