Fall 2011. MWF 10 to 10:50 pm

A graph has vertices and edges. An edge joins two vertices, so a graph is a picture of a binary relation on the set of vertices. Graphs can be used to model many things, practical or impractical, pedestrian or fantastical, politically correct or incorrect, canine or feline. This is an introduction to graph theory. We will do things like the "handshake" lemma, degree sequences, trees, counting trees, coloring, chromatic polynomials, the marriage theorem, drawing graphs on the plane, and other topics.

I will take a discovery approach, stressing how one discovers concepts, arguments, and methods (otherwise known as "tricks") and how one would use examples to guess conjectures and then, one hopes, prove them. The grade will depend on two tests during the semester, the final, homework, and a individual project.

The formal prerequisites for this course are two or more out of MATH 2700, 3000, 3400 or a Computer Engineering course in data structures. The more important prerequisites are intellectual maturity and a genuine interest in the subject. Computer scientists will find this a useful theoretical background course. If you have any questions, please email me.

Required Textbook. Gary Chartrand, Introductory Graph Theory, Dover, 0-486-24775-9. This is a Dover paperback. It costs around $11 on the internet and many local bookstores will have it in stock at around $15.

Instructor. Joseph Kung, GAB 471C, email: kung@unt.edu

MATH 4430.001 Graph Theory.

Fall 2011. MWF 10 to 10:50am. LANG 318.

Required Textbook. Gary Chartrand, Introductory Graph Theory, Dover, 0-486-24775-9. We should do much more than in this book, but it'll provide you with an handy reference for definitions and basic results.

A free on-line textbook is by J. Bondy and U.S.R. Murty. Googling "Bondy and Murty, Graph Theory book" should get you to the site and you can view this book as a .pdf file.

Estimated cost of taking this cost, in addition to UNT tuition and course fees. The cost of the textbook, an inexpensive paperback, is from $10 to $16, depending on where you get it. You might want to print out certain chapters from Bondy and Murty; how much this costs will depend on your printer and whether you have one! I have refused a grader for this course, and so, if there is a course grader fee, you should get a refund. If you don't get this refund in due course, you have the right to demand it.

Final and test dates. There are two tests, tentatively on October 7 and November 11. The final is on December 16, 1:30 to 3:30 pm, in the usual classroom.

Grades and exams. Your final grade is determined by homework and project (25 % total, usually 10% for the project and 15% for the homework), two tests given during the semester (25% each) and the final (25%). I will hand out review sheets before each test and the final. The letter grade will be given strictly according to the recommended university standards: D = at least 60%, C = at least 70%, B = at least 80%, and A = at least 90%. Acceptable excuses for missing a test or the final are: illness or injury requiring professional medical attention, deaths of an immediate family member, or injury accidents. You may be asked to furnish documentary proof. Alternate tests will be different from the regular test and may be graded using a different procedure. Requests for alternate tests must be made *in person* during class or office hours no later than one week after the regular test time.

Your tests (but not the final) will be returned to you, usually the first class day following the test. You should be in class to pick up your test. No responsibility will be taken for tests which are not picked up within two weeks.

Homework. Homework will be assigned, once a week, almost always due on Wednesday. I will grade the homework myself, so ABSOLUTELY no late homework. See the individual schedules.

Attendence. You are expected to attend all scheduled classes. Electronic means, such as

taking a photograph, will be used to monitor this.

Prerequisites and code of conduct. The prerequisite course is MATH 1720, any MATH 2000 course or higher [so that MATH 2770, 2610 suffice], or the permission of the instructor. If in doubt, talk to me.

You may be dropped administratively at any time if you do not have the prerequisites. It is your responsibility to check that you have taken the prerequisite course. Having a prerequisite course means that you have *current* knowledge of the material covered in that course as stated in the official syllabus regardless of what your instructor for that course actually covered.

I expect you to behave in accordance with the student code of conduct. There will be **zero** tolerance of violations of this code: this particularly applies to cheating during tests and the final.

Other matters. All university policies will apply to this course. Any requests arising from university policy *(including but not limited to a request for accomodation for certified disabilities or religious observances* **at any time during the semester***)* must be submitted to me in writing before 11 am, Friday, September 2, 2011, or five business days after you have enrolled for this course, whichever is later. Your request must be delivered to me in person during one of the scheduled class periods and a signed receipt must be obtained from me for any request to be valid.

Important note about schedules, review sheets, and other handouts.

Schedules are given out every week. The schedules are intended to give you useful information. Handouts, such as review sheets, will also be given out. Information on schedules or handouts might be changed and errors will be corrected; these amendments will be announced during class. You are responsible for keeping track of these amendments, as well as making sure you get all the schedules and other handouts.

Fine print. There are **no** verbal agreements in this course. If you think that I promise you something, be sure to get it from me in writing! This handout is intended as an general guide to the policies pertaining to the administration of this course. This handout does not replace or supercede any official university document.

Instructor. Joseph Kung. GAB 471C. Office hours: Mondays 11 to 12, 3:30 to 4:30, Wednesdays 11 to 12, 1 to 2 pm; and other times by appointment.

e-mail: kung@unt.edu [Expect delays and computer breakdown when using email.] Phone 940-565-4084.

MATH 4430.001 Graph Theory. Syllabus

The syllabus consists of 7 topics, labeled by p_i, where $1 \leq i \leq 7$ and p_i is the ith prime. Each topic, except topic 2, takes about two weeks (that's 6 class periods), except when it does not. Reality would be a randomizer, and will determine the exact time devoted to each topic. The topics will also be permuted by a random permutation, so that with probability $1/e$, no topic will be found in the order given below. We will focus on structural and enumerative aspects of graph theory; the algorithmic aspects will be downplayed, as it will be done in the CE dtat structure courses. The emphasis will be on ideas, not defintiions, how to do things and get an answer, rather than *Satz-Beweis* (that's German for Theorem-proofs). I will do things in class that are not in textbooks.

Topic 2. (about 2 class periods) Basic graph theory. Differenet ways of picturing a graph. Traffic lights at an intersection.

Topic 3. Hamiltonian cycles. The Trotter-Johnson method for generating permutations by adjacent transpositions. Generating a "random" permutation and a "random" subset or partition.

Topic 5. Trees, spanning trees, the matrix-tree theorem.

Topic 7. Eulerian cycles. The bridges of Königsberg. The number of Eulerian cycles. de Bruijin sequences.

Topic 11. Coloring and flows in graphs, chromatic, flows, and Tutte polynomials.

Topic 13. How many graphs are there, how many are connected, exponential generating functions.

Topic 17. Matching theorems and the Gale-Shapley algorithm (this is one algorithm we will do).

The two tests are scheduled tentatively on Friday, 9-23-2011and Friday 11-4-2011, but they can change by ± 2 class days. If these are bad days, let me know as soon as possible. The final will be on the date and time determined by the UNT final schedule [Friday, December 16, 8 to 10am].

First week. Friday 8-26, Monday 8-29, Wednesday, 8-31.

Topics. A. Traffic lights at an intersection.

B. The Trotter-Johnson graph and the T-J algorithm.

C. Graphs for generating random objects.

First homework. Due Wednesday, 8-31-2011. Homework comes in two parts, the "standard" part, which everybody should be able to do, is required, and counts towards your grade. There is also a part which requires "magic" . This is optional and you will get Hogwarts points for it. Hogwarts points are useless, as UNT is not Hogwarts. So you will do the magical part because it is fun and you want to do it.

Reading. Read Chapter 1 of the textbook.

1. Standard. (10 UNT points each; 20 points total)

(a) Draw the traffic-light graph (discuss in class for the case of 4 roads) for 5 roads, with some explanation how you did the drawing. Determine the minimum number of cycles needed.

(b) Repeat for 6 roads.

2. Magic. (20 Hufflepuff points) Describe or drawin an explciit way the traffic-light graph for n roads. Determine the minimum number of cycles (a function of n) for n roads.