Syllabus for INF 383D Mathematical Foundations of Information Studies

Fall 2014 (Unique # 28775)
F 9 am – 12 pm
UTA 1.504

Instructor: William Aspray, phone 512 471 3877, office UTA 5.432, email bill@ischool.utexas.edu

TA: Yeolib Kim, phone none, office UTA 5.548, email yeolib.kim@gmail.com

Office hours: We will search for a set time each week – most likely on Tuesday or Wednesday - that is open for most students as well as for the instructor and TA. During this time, students individually or in small groups can drop in to work on the course material without an appointment. It is also possible to make appointments to meet with the instructor or TA at other times.

Formal course description:

The course has been redesigned and is intended for students who would like a basic mathematical foundation for doing their work as information professionals, but who have received little or no formal training in mathematics or mathematically oriented disciplines since high school, or whose mathematics is very rusty. The course will focus on five types of mathematical thinking: logical, relational, recursive, quantitative, and analytical. Applications will include ones from big data, social network analysis, modeling of complex systems, and probabilities and statistics.

Textbook:

David J. Hunter, *Essentials of Discrete Mathematics.* Sudbury, MA: Jones & Bartlett, 2nd ed. (2012).

Make sure you acquire the 2nd edition. You can buy a new copy of the book at the university bookstore or online (for approximately $150), buy a used copy online (for $50 to $60), or rent a copy for the semester from either Amazon or the university bookstore. (Amazon's one-semester rental cost is $20-25.) This book is likely to have resale value (>$20) at the end of the semester if it does not become one of your prize possessions.

Some additional course description:

Just as many of our students are realizing that there are certain kinds of computing knowledge, for example about database management or usability, that will be useful to them in their professional information careers, so there are also math topics that are foundational to the work of information professionals. The most obvious one is knowing how to evaluate statistical arguments because they appear commonly in all

kinds of information work settings. But statistics is by no means the only example. Big data, e.g. massive data sets collected from user studies or online communications, are becoming increasing important to analyze as part of information work. Examining social networks, for example to identify clusters of tightly connected users in a large population, is also an increasingly common issue in information work. Understanding models of complex systems, such as those that predict the spread of the latest influenza virus, have major implications for the work of public health information professionals. These are only a few examples of the applicability of mathematics in information studies.

Students who already received college- or graduate-level instruction in mathematically oriented disciplines such as mathematics, statistics, operations research, computer science, information technology, natural science, engineering, or mathematical social sciences (e.g. mathematical economics or quantitative business studies) are discouraged from taking the course - unless it has been a considerable time since they have received training in these disciplines and they feel rusty about their comprehension of the mathematics. All others are welcome; and the material is well within the capacity of every School of Information student. I will take it as a personal failure if students who work diligently in the course cannot master the material.

The course will focus on the part of mathematics known as discrete mathematics (e.g. integers, graphs, sets, algorithms, and logical statements) as opposed to continuous mathematics (e.g. calculus). Discrete mathematics has became much more important in the last 70 years because it is closely aligned with how digital computers work.

We are using a highly regarded textbook that has been tested on many students who have not had much mathematics instruction in college. We will take a moderate rather than a fast pace. Significant parts of every class meeting will be devoted to working through problems - by oneself, with a small number of other students, or with the instructor or teaching assistant.

There will be numerous quizzes, so that the scope of material to be covered on any one quiz will be narrow. These quizzes are intended primarily to help you to determine how well you understand the material, not to determine your course grade. If you have been a diligent student (including coming to class regularly, reading the assigned material on schedule, and working some problems to practice at learning), you will get a good grade in the class – no matter what scores you get on the quizzes.

The instruction (or perhaps occasionally the TA) will present some material each class, e.g. new mathematical concepts, key examples, solutions to problems, background material, review of material that many students had difficulty with in earlier quizzes, etc. Most of the class time will be devoted to students working

individually or in small groups on problems. Both the instructor and the TA will be in attendance and ready to work with you individually or in small groups.

Student requirements:

1. Read the assigned material in advance of class – and do so with a mathematical frame of mind (we will discuss what this means in class).
2. Regularly attend class and actively participate in the classroom activities.
3. Select, study, and present on a customization project of your own choosing. The idea here is to select some topic that you want to know about and that might be helpful to you in your further study of information or in your work as an information professional. It must be a topic that has a significant mathematical component. Possibly with some help from the instructor or TA, you will work through the material (e.g. as represented by a research paper or a particular kind of statistical analysis that happens in the workplace or a quantitative social network analysis that is of professional interest) to the point that you understand the material well enough to present it to the class. This is considered to be a moderate rather than a major project (less effort than one would make in writing a term paper). If small groups of students have an interest in working together on a single project, that is acceptable. The TA is particularly knowledgeable about statistics and statistical software, while the instructor is particularly knowledgeable about logic, so a project in these areas would receive knowledgeable support but other topics are also appropriate.

Academy Integrity:

I take academic integrity seriously and enforce it in my classes. I follow the University of Texas policies, which can be found at http://deanofstudents.utexas.edu/sjs/acint_student.php and on webpages that are linked to from this page. If you have any questions about academic integrity, please ask me in advance of any questionable action.

Reading Schedule (complete this reading prior to class):

August 29 No assigned reading

September 5 2.1 (graphs), 2.2 (sets)

September 12 2.3 (functions), 2.4 (relations and equivalences)

September 19 2.5 (partial orderings), 2.6 (graph theory)

September 26 3.1 (recursive relations), 3.2 (closed-form solutions and induction)

October 3 3.3 (recursive definitions), 3.4 (proof by induction)

October 10 3.5 (recursive data structures), 4.1 (basic counting techniques)

October 17 4.2 (selections and arrangements), 4.3 (counting with functions)

October 24 4.4 (discrete probability), 4.5 (counting operations in algorithms)

October 31 4.6 (estimation), 5.1 (algorithms)

November 7 5.2 (three common types of algorithms), 5.3 (algorithm complexity)

November 14 5.4 (bounds on complexity), 5.5 (program verification)

November 21 5.6 (loop invariants), 6.2 (social networks)

November 28 Thanksgiving Recess – no class, no assigned reading

December 5 6.3 (structure of languages), 6.4 (discrete-time population models)

Related courses:

The material in Chapter 1 of our textbook, on logical thinking, is covered in detail in Professor Wickett's course on information modeling (INF 385T), so we will not be spending much time on this material here. The core masters course on understanding research (INF 397C) will cover some of the material on statistics, although the focus will be on learning various research methods and not on the mathematical/statistical detail. The same can be said of the core doctoral course on the research enterprise (INF 391.D.11), although this course will spend more time on learning to use the research methods than the masters-level course does. There are introductory graduate-level courses in statistics offered across campus; many of our students take those in the education school.