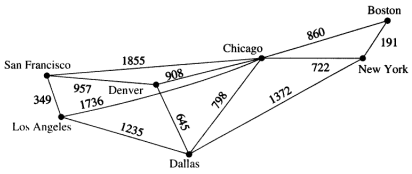
Course Description

Ve203 Discrete Mathematics

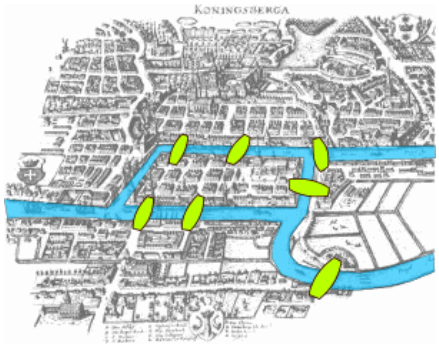
[redacted] Term [redacted] 2020
Summer

Prerequisites: None.

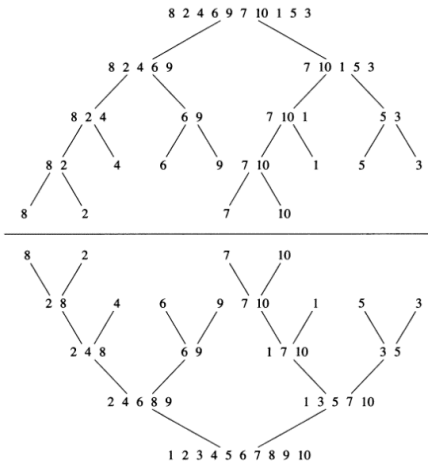
Course website: http://umji.sjtu.edu.cn/personal/horst/teaching/ve203.html



Weighted Graphs and Shortest Paths



The Königsberg Bridges



The Merge Sort Algorithm

The Pigeonhole Principle

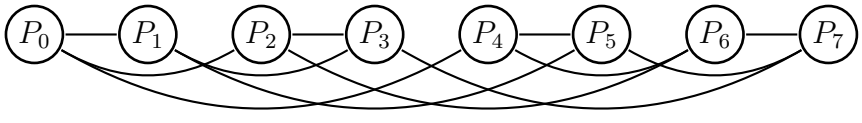
Intended Audience: ECE undergraduate students.

Description: The present course is different from many other math courses at the JI in that it does not give an in-depth look at any one topic. Instead, we visit several different mathematical fields that are loosely grouped together under the heading "discrete mathematics". These fields have in common that they deal with problems related to integers as opposed to the real numbers. Hence the problems can often be formulated in quite elementary terms. Many of these problems are classical, having been analyzed by natural philosophers and scientists for centuries or (in some cases) millenia.

That said, the various topics in this course are not just of abstract interest; with the advent of computers, it has been found that fields such as logic, number theory and computability have important applications in the real world. Many things we take for granted (such as secure online banking) would not be possible without the developments in these fields.

There is no formal prerequisite for this course. However, we will occasionally use knowledge borrowed from the calculus of single-variable functions, such as is taught in Vv156 or Vv186. The course is of natural interest for students majoring in ECE, as much of the mathematical background is required in other courses, such as "Ve281 Data Structures and Algorithms" or "Ve478 Logic Circuit Synthesis and Optimization". However, the present course is also of interest for any student wishing to gain a broader general knowledge of mathematics. Many of the concepts covered here, such as number theory, graph theory or combinatorics, are not introduced in any other course.

The course aims to cover logic, set theory, number systems (natural numbers, integers, rationals), number theory, applications to cryptography, algorithms, various generalizations of mathematical induction, elementary combinatorics, elementary probability and probabilistic algorithms, graph theory and trees, and (if time permits) Boolean algebra.



Hypercube Networks

Keywords: Logic, set theory, equivalence relations, construction of natural numbers, integers, rational and real numbers, induction (complete and structural), number theory, algorithms, asymptotic notation, combinatorics, recurrence relations, generating functions, elementary probability, relations, graph theory, trees.

Textbooks:

- K. H. Rosen, *Discrete Mathematics and its Applications*, 6th Ed., McGraw-Hill International Edition 2007.

Other literature will be recommended as needed.

Syllabus:

	Lecture	Lecture Subject
May 12	1	Basic Concepts in Logic
14	2	Basic Concepts in Set Theory
15	3	Natural Numbers and Mathematical Induction
19	4	Natural Numbers and Mathematical Induction
21	5	Equivalence Relations, Integers, Rationals
26	6	Functions, Sequences, Real Numbers
28	7	Divisibility Theory of the Integers
29	8	Diophantine Equations
June 2	9	Prime Numbers and their Distribution
4	10	The Theory of Congruences
9	11	Factorization and Verifying Primality
11	12	~~**First Midterm Exam**~~
13	13	Algorithms and Computational Complexity
16	14	Algorithms and Computational Complexity
18	15	Computer Arithmetic
23	16	Recurrence Relations and Divide-and-Conquer Algorithms
30	17	Recurrence Relations and Divide-and-Conquer Algorithms
July 2	18	Combinatorics
7	19	Combinatorics
9	20	Applications of Probability
10	21	Applications of Probability
14	22	**Second Midterm Exam** – date to be announced
16	23	Graphs
21	24	Graphs
23	25	Paths and Circuits in Graphs
24	26	Planar Graphs
28	27	Trees
30	28	Trees
Aug 4	29	Applications of Graph Theory
6	30	**Final Exam**

May 25: Assignment 1 due
June 5: Assignment 2 due
Assignment 3 due

Course Grade Components:

- First midterm exam: 25%
- Second midterm exam: 25%
- Final exam: 25%
- Course work: 25%

June 21: Assignment 4 due
June 24: Midterm 1
July 1: Assignment 5 due
July 8: Assignment 6 due
July 15: Assignment 7 due
July 22: Assignment 8 due
July 29: Assignment 9 due
Aug 5: Assignment 10 due

Honor Code Policy:

Use of External Sources
When faced with a particularly difficult hoemwork problem, you may want to refer to other textbooks or online sources such as Wikipedia. Here are a few guidelines:

- Outside sources may treat a similar sounding subject matter at a much more advanced or a much simpler level than this course. This means that explanations you find are much more complicated or far too simple to help you. For example, when looking up the "induction axiom" you may find many high-school level explanations that are not sufficient for our problems; on the other hand, wikipedia contains a lot of information relating to formal logic that is far beyond what we are discussing here.

- If you do use any outside sources to help you solve a homework problem, *you are not allowed to just copy the solution*; this is considered a violation of the Honor Code.

- The correct way of using outside sources is to understand the contents of your source and then to write in your own words and without referring back to the source the solution of the problem. Your solution should differ in style significantly from the published solution. *If you are not sure whether you are incorporating too much material from your source in your solutions, then you must cite the source that you used.*

Collaboration with other students
The rules forcollaboration on course work (weekly assignment) problems in this course are quite simple: you must never show any other student your written work. You are not allowed to write down formulas for another student, or to let them see hour homework, or to demonstrate something to them on a blackboard or use any other type of written communication.

You are allowed to talk about the course work, but may not communicate in writing. For example, it is OK to tell another student "I solved this equation by applying l'Hopital's rule." It is not OK to actually show another student the written calculations of how you did this.

The following actions are examples of violations of the Honor Code:

- Showing another student your written solution to a problem.

- Sending a screenshot of your solution via QQ, email or other means to another student.

- Showing another student the written solution of a third student; distributing some student's solution to other students.

- Viewing another student's written solution.

- Copying your solution in electronic form (LaTeX source, PDF, JPG image etc.) to the computer hardware (flash drive, hard disk etc.) of another student. Having another student's solution in electronic form on your computer hardware.

Of course, during exams, no communication of any kind (verbal or written) is allowed!

If you have any questions regarding the application of the Honor Code, please contact me or any of the TAs.