COMP 2711:
Discrete Mathematical Tools for Computer Science

What is ~~discrete~~ mathematics?

non-continuous

- What's the problem with real numbers?
  - Computers cannot handle real numbers (Church-Turing thesis)
- Topics in discrete mathematics
  - Logic
  - Number theory and cryptography
  - Induction and Recurrence
  - Counting (combinatorics)
  - (Discrete) probability theory
  - Graph theory

Many interesting (or head-scratching?) problems

- Knights and Knaves (logic)
  - There are two kinds of inhabitants on an island, knights, who always tell the truth, and knaves, who always lie.
  - You encounter two people A and B.
  - A: “We are both knaves”
  - B says nothing
  - Question: Who is a knight and who is a knave?

Monty Hall Problem (Probability)

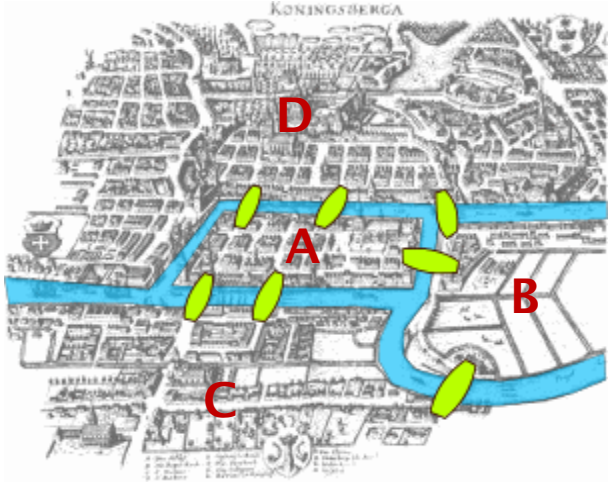
- Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a prize; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 2, which has a goat. He then asks to you, “Do you want to switch to door No. 3?”
- Answer 1: It’s 50-50, no need to switch.
- Answer 2: Switch.

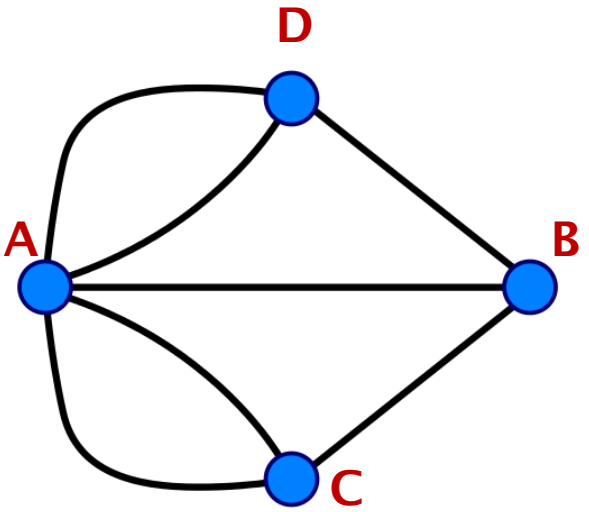
Monty Hall Problem

- A notoriously confusing problem
  - 87% respondents gave the wrong answer in a survey
- Another common rule in games
  - Eliminate a wrong answer first
  - In this case, the two remaining doors have equal probability to have the prize
- Now suppose the doors have the prizes with probabilities 0.5, 0.3, 0.2
  - You choose door 1 first, then Monty opens door 2.

The Seven Bridges of Königsberg

- Q: Can you find a path to cross all seven bridges, each exactly once?





- Q: (Reformulated as a graph problem) Can you find a path in the graph that includes every edge exactly once?

Why study discrete mathematics?

- It's a required course for CS students
  - Foundation of computer science
- Mathematical maturity
  - Modeling, reasoning, brain training
  - Basis for more advanced mathematics
- Useful in many other fields
  - Operations research (IEDA)
  - Chemistry
  - Biology
  - Economics (game theory, decision theory, etc.)

How to Study Discrete Mathematics?

- Some students find it difficult, while others find it easy
- Focus is on mathematical reasoning and problem solving
- Understanding more important than memorizing!
- Exercises!
- Independent thinking!