

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
 - Counting (combinatorics)
 - (Discrete) probability theory
 - Number theory and cryptography
 - Induction and Recurrence
 - Graph theory

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 (IELM)
 - Chemistry
 - Biology
 - Economics (game theory, decision theory, etc.)

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.



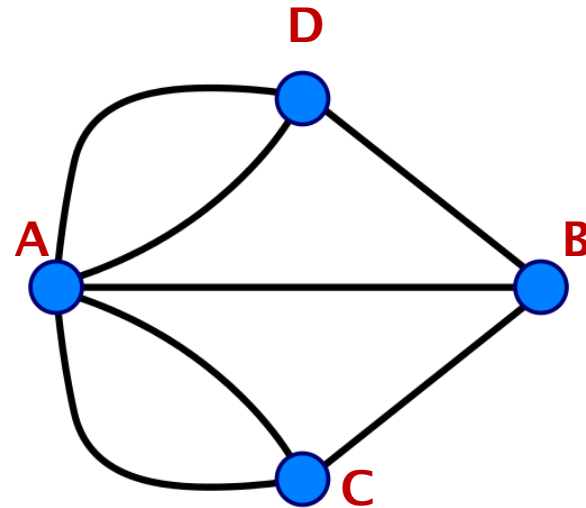
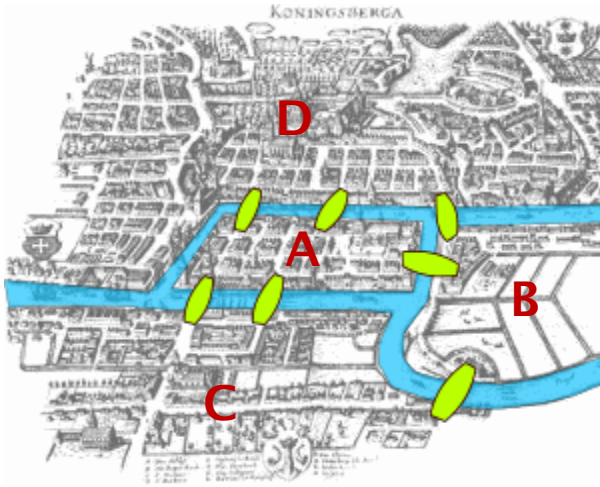
Monty Hall Problem

- A notoriously confusing problem
 - 87% respondents gave the wrong answer in a survey
 - including Nobel prize winners
- Another common rule in games
 - Eliminate a wrong answer **first**
 - In this case, the two remaining doors have equal probability to have the prize



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?

How to Study Discrete Mathematics?

- Many students find it difficult
- Focus is on mathematical reasoning and problem solving
- Understanding more important than memorizing!
- Exercises!
- Independent thinking!
- Course website on Canvas