CS 105: Department Introductory Course on Discrete Structures

Instructor : S. Akshay

Jul 29, 2024

Lecture 01 – Introduction

Welcome to CSE@IIT Bombay!

Logistics

Course hours: Slot 4;

Mon 11:35-12:30, Tue 08:30-09:25, Thu 09:30-10:25

Office hours: To be announced.

Problem Solving/Help Session (Optional): One hour per week, run by teaching assistants. (Time and Venue to be decided)

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Attendance

As per Institute rules: SAFE

More Logistics

Evaluation

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- Midsem: 25%
- Endsem: 40%
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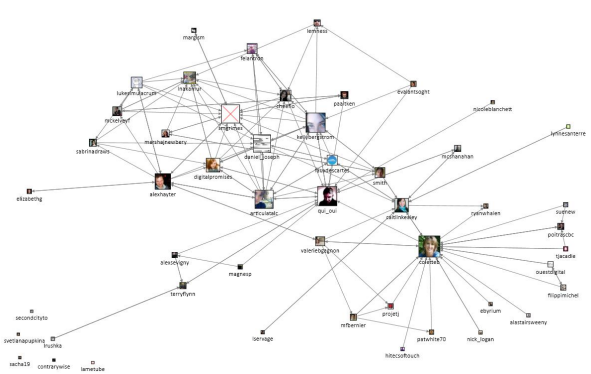
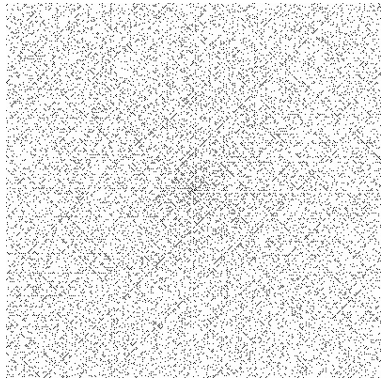
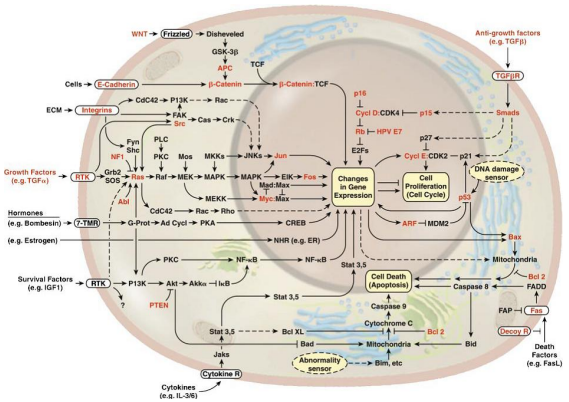
How to reach me after class?

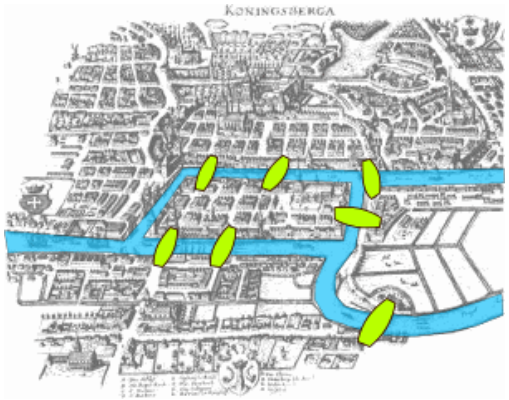
- Send a message on piazza
- Drop by my office...
  - CS 507 (5th floor of New CSE/CC building)
  - Temporarily CC 313 (3rd floor!)

Goal









First things first...

- What are discrete structures?
- Why are we interested in them?

Course Outline

What we will broadly cover in this course

1. Mathematical reasoning: proofs and structures
2. Counting and combinatorics
3. Elements of graph theory
4. If time permits: Introduction to some selected topics: e.g, abstract algebra and/or number theory

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What we don't cover

1. Logic : predicate, first-order logic– CS228
2. Discrete probability – IC102
3. Algorithms – CS218
4. Data structures – CS213 and CS293
5. Finite automata – CS310
6. Details and applications of everything above – rest of your (academic) life!

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Textbooks

- Discrete Mathematics and its Applications with Combinatorics and Graph Theory, by Kenneth H Rosen.
- Discrete Mathematics by Norman Biggs.
- More will be listed on webpage as we go along.

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Prerequisities

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- Logical mind and critical thinking

Chapter 1: Proofs and Logical reasoning

Outline of next few classes

- Propositions, statements
- What/why of proofs and some generic proof strategies
- Mathematical induction

Propositions

What is a proposition?

- It is raining
- $1 + 1 = 2$
- every odd number is a prime
- $2^{67} - 1$ is a prime
- $(n + 1)(n - 1) = (n^2 - 1)$ for any integer n

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What is common between these statements?

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- $x + 1 = 8$

Propositional calculus

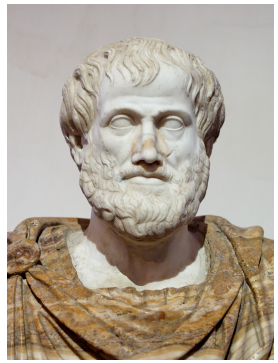

Figure: Aristotle (384 – 322 BCE)

- propositions are statements that are either true or false.
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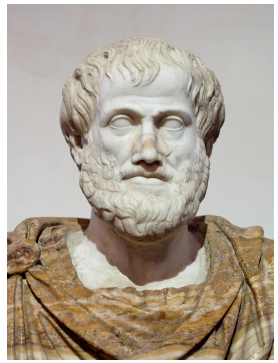

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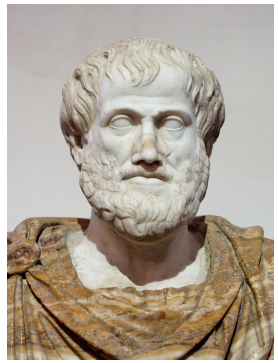

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- "if it is raining, it will be wet" : $p \to q$
- This is one way to combine propositions!

Propositional calculus and Boolean algebra

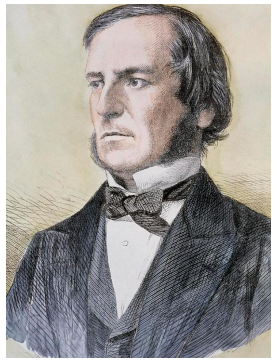

Figure: George Boole (1815 – 1864)

Combining propositions

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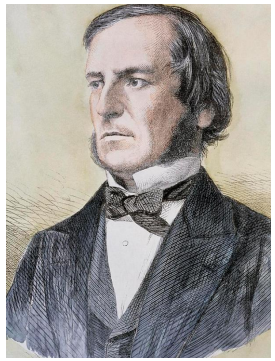

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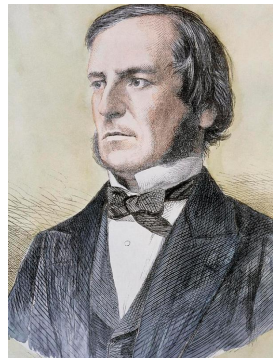

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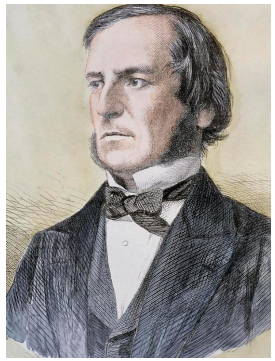

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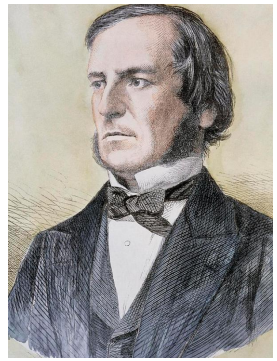

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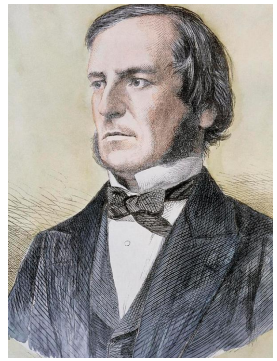

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- If it is raining or there is a sprinkler overhead and I dont have an umbrella, then I will get wet: $((p \vee q) \wedge r) \rightarrow s$.