

Maths for Computing (CSL2040)

- Vimal Raj Sharma

Lecture 1

Course Overview, Administrivia, Logic, Propositions

Course Overview

Goal of this course: Learn mathematics that is useful and necessary for other CS courses.

Tentative Plan:

- ▶ **Logic and Set Theory:** Propositional logic, Predicates, and Quantification, Natural Deduction, Naive Set Theory.
- ▶ **Proof Techniques:** Introduction to Proofs, Well-Ordering Principle, Induction, Proof by contradiction.
- ▶ **Combinatorics:** Counting, Permutations, Combinations, Partitions, Pigeonhole Principle, Inclusion-exclusion, Binomial theorem.
- ▶ **Graph Theory:** Properties of graphs, Graph Matching and Coloring.
- ▶ **Models of Computation:** DFA, NFA, Equivalence of NFA and DFA, Regular Expressions, Pumping Lemma of Regular Languages, Context Free Grammar, Turing Machines, Undecidability.

Administrivia

Grading:

- ▶ 40% - Assignments.
 - ▶ 5 assignments, one for each module of the course.
 - ▶ **Weightage Distribution:** 6-8-10-8-8.
- ▶ (15 + 15)% - Minors.
- ▶ 30% - Major.

Books:

- ▶ A Walk Through Combinatorics by Miklós Bóna.
- ▶ Discrete mathematics and its applications by Kenneth H. Rosen.

Office Hours: 3-5 PM on Thursday, in CSE 307.

Course Site: <http://home.iitj.ac.in/~vimalraj/courses/csl2040.html> (will be up soon)

Attendance: As per the institute policy.

Administrivia

More Rules/Advice:

- ▶ You are allowed to seek **hints** for the assignment.
- ▶ Mention the source of help in the assignment.
- ▶ Mindlessly **copying** will attract a **huge penalty**.
- ▶ Exams will sometimes have questions based on assignments.
- ▶ Tutorials:
 - ▶ Will be held in **two batches**.
 - ▶ **Time:** Tuesday, 3-4 PM and 4-5 PM.
- ▶ Problems for tutorials and assignments will be given at the end of the lecture slides.
- ▶ Deadline for an assignment will be four days after the completion of a module.
- ▶ If I am not here till **9:10 (Google time)**, then the class is cancelled and a compensatory class will be announced.



Hopefully, it will never happen.

Logic

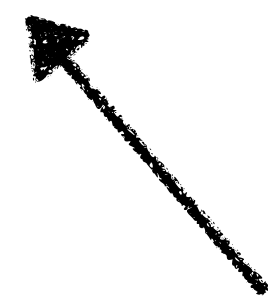
What is logic?

Logic focuses on reasoning or how to reliably get from **assumptions** to **conclusions**.

Example 1:

Assumptions: {
1. All men are mortal.
2. Socrates is a man.

Conclusion: Socrates is mortal.



Valid conclusion

Example 2:

Assumptions: {
1. All cats are mortal.
2. Socrates is mortal.

Conclusion: Socrates is a cat.



Invalid conclusion

Pitfalls of Natural Language in Reasoning

Natural language is sometimes **imprecise**:

Assumption: {
1. Only married couples can book a room in hotel Moonlight.
2. Jay and Ella are married.

Conclusion: Jay and Ella can book a room in hotel Moonlight.

Issue: May be Jay and Ella are not married to each other?

Natural language is sometimes **ambiguous**:

Assumptions: {
1. Nothing is better than eternal happiness.
2. McDonald's burger is better than nothing.

Conclusion: McDonald's burger is better than eternal happiness.

Issue: 'Nothing' has different meaning in both assumptions.

Propositional Logic

Definition: A **proposition** is a sentence that is either true or false, but not both.

Sentences that are propositions:

1. New Delhi is the capital of India. ← *True*
2. 45 is a prime number. ← *False*
3. The current time is 9:00 PM IST. ← *False*
4. $10 * 8 = 80$. ← *True*

Sentences that are not propositions:

1. What place is this? ← *It's a question.*
2. Hold it carefully. ← *It's an instruction*
3. This sentence is false. ← *It can neither be true nor be false.*
4. $x + 1 = 2$ ← *Whether it is true or false depends on value of x .*

Tutorial Problems

1. Think of some sentences that are neither questions nor instructions, but still not propositions.