# CS640: Computational Complexity Theory

## 1. Objectives:

We will start this course by mathematically formalizing computation and algorithms. Our approach in the course would be to look at famous concrete problems and prove theorems about their uncomputability, or, if computable, then how fast can they be computationally solved. The problems we will cover in this course are: the halting problem, boolean formula satisfiability (the P!=NP question), quantified boolean formula, formula minimization, polynomial identity testing, undirected graph reachability, permanent and graph isomorphism. While studying these computational problems we will define various complexity classes and develop various tools used in modern complexity theory.

## 2. Prerequisites:

Knowledge of Theory of Computation, Algebra.

## 3. Course Contents:

- Turing machine
- Non-deterministic time
- Time/Space Hierarchy
- Space complexity
- Counting complexity classes
- Randomization
- Circuits
- Interaction

## 4. Special Emphasis:

Fundamentals of Complexity.

## 5. Lecture, Tutorial & Lab Schedule & Venue:

Mon,Thu (10:30-12); KD102

## 6. Office Hours:

Mon, 12-1pm in RM203.

## 7. Evaluation Components & Policies:

MidSem Exam (30%) , EndSem Exam (40%), Assignments (30%), Participation and Talks (Bonus marks).

## 8. Course Policies:

Anti-cheating policy https://www.cse.iitk.ac.in/pages/AntiCheatingPolicy.html

## 9. Books & References:

BOOKS
Book, Complexity Theory: A Modern Approach, Sanjeev Arora and Boaz Barak.
Book, Computational Complexity: A Conceptual Perspective, Oded Goldreich.

ONLINE STUFF
Complexity Zoo, Scott Aaronson.
Blog, Lance Fortnow.