CS601
Algorithms and Complexity

Instructor: Rohit Gurjar
TAs : Abhinandan Singh, Jalay Shah, Nilesh Tanwar, Vivek Kumar, Roshan Raj

https://www.cse.iitb.ac.in/~rgurjar/CS601/
Objectives

• How to design algorithms.

Try something

See if it works

When to stop this loop?

Yes

No

A toolbox to help Creative process

Requires diligence

Great!!
Algorithm’s correctness

• How to argue that an algorithm is not correct: show bad examples

• Arguing algorithm’s correctness

  • Correctness by confidence: I came up with it, so it must be correct
  
  • Correctness by examples: because it works for my favorite examples

  • Correctness by authority: It’s just obvious

• Formal proofs of correctness

  • if it is not obvious to the CS601 class
Pre-requisites

• Not recommended for students who have done or will do CS218/CS218M.

• Prerequisites:
  • Comfortable with thinking at abstract level
  • Basic run-time analysis, O-notation, Recursion.
  • Basic data structures -- array, list, tree.
  • Basic probability and combinatorics.
  • Basic graph theory -- cycles, trees, depth-first search, breadth-first search.

• Check the self-assessment quiz (course webpage)
What will you learn

✧ **Principles of designing and analyzing algorithms:**
  • Basic principles like induction/recursion.
  • Divide and Conquer,
  • Dynamic Programming,
  • Greedy Algorithms.

✧ **Beyond the basics:**
  • Bipartite Matching
  • Network Flow.
  • Reductions.

✧ **Complexity:**
  • Polynomial time and the Complexity classes NP, co-NP.
  • NP-hardness and NP-completeness.

✧ **Randomization in Algorithm Design:**
  • Random variables,
  • Linearity of expectation,
  • Applications: Approximate Max-cut, Min-cut, Quicksort. Hashing.
How will we do it

• Live lectures on Webex

• Recording will be uploaded on the course webpage.

• Communication via Moodle?

• Any suggestions are welcome.
Grading (tentative)

• Weekly Moodle quizzes (best n-2 out of n) - 10%
• 2 Programming Assignments - 20%
• 2 Theory assignments - 20%
• 2 or 3 Exams - (12.5+12.5+25) %
• Homeworks - 0%
References

- Kleinberg, Tardos (amazing book, freely available)
- Prof. Sundar’s course notes
- Motwani, Raghavan: Randomized Algorithms