APPLIED ALGORITHMS - FALL'22
CSCI-B505/INFO-I500
TENTATIVE SYLLABUS

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Welcome to the "Applied Algorithms" course in Fall 2022 semester. In this course, we will focus on enhancing our skills in algorithm design and analysis by visiting computational challenges in real-world applications. The weekly schedule below summarizes the topics that we plan to cover in this journey, where exploring the elegance, intelligence, fun, and joy in computing will be of our priority.

- **WEEK 1-3, Introduction and review of the fundamentals:** Overview of measuring the time/space complexity, asymptotic notation, growth of functions, arrays, linked lists, stacks, queues and trees via visiting some interesting problems.
- **WEEK 4, Amortized analysis:** How to achieve the analysis of algorithms that are hard to perform with the classical approach?
- **WEEK 5, Recursions and divide-and-conquer algorithms:** Understanding the recursion concept, the master theorem, sample divide-and-conquer algorithms based on recursions.
- **WEEK 6, Dynamic programming:** Efficient handling of recursive tasks with overlaps. Edit distance, knapsack problems with dynamic programming.
- **WEEK 7, Heaps and Huffman Codes:** The priority-queue data structure and the Huffman coding implemented with the heap.
- **WEEK 8, MIDTERM**
- **WEEK 9, Selected topics in sorting, selection and order-statistics :** Dictionaries, k-th smallest element, rank/select and wavelet tree data structures.
- **WEEK 10, Greedy Algorithms and Introduction to Graph Algorithms:** Greedy algorithm design concept with examples, and introduction to fundamental concepts in graph representation.
- **WEEK 11, Graph Algorithms:** Shortest path, minimum spanning tree, graph coloring, etc. with some real life scenarios.
- **WEEK 12, Randomized algorithms:** The concept of randomization with examples.
- **WEEK 13, Hashing:** Fundamental concepts in hashing, Bloom-filters, min-hash, etc.
- **WEEK 14, No classes due to Thanks Giving holiday.**
- **WEEK 15, Algorithms on streaming data:** Reservoir sampling, Misra-Gries and Count-Min Sketch algorithms for heavy-hitters detection.
- **WEEK 16, Miscellaneous topics**

Prerequisites: We assume the students enrolling in this course

i. have the basic undergraduate knowledge of algorithms and data structures,

ii. can code in *Python*, and

iii. have the undergraduate knowledge on probability and discrete mathematics.

Grading:

- Homework : 50%. (Your average will be computed by excluding your worst score.)
- Midterm: 20%
- Final: 20%
- LAB attendance & performance: 10% (Your worst score will be excluded from your average.)

Text books and learning materials:
There are many great textbooks on algorithms and data structures that you can refer to. Particularly, I would like to suggest the following ones listed below. Remember that additional papers and reading materials may be provided during the lectures.

- The Algorithm Design Manual, 3rd Edition by Steven Skiena
- Introduction to Algorithms, Cormen *et al.*
- Data Structures and Algorithms in Java (or *in Python* or *in C/C++*), Goodrich *et al.*

Important notes about the execution of the course

- Almost every week there will be a homework assignment, which will require pen & paper work or programming or (mostly) BOTH! Please note that you will be doing the coding exercises in Python.
- You can discuss on the questions and programming exercises of the homework assignments. However, each student will submit her/his own work, which should be prepared as a single individual. Cheating and plagiarism is strictly forbidden and the related policies of the university will be followed. Please check code of academic ethics at https://policies.iu.edu/policies/aca-33-code-academic-ethics/index.html. The uniqueness of your submitted work will be considered in the grading. Automated tools will be used to detect the similarities of the homeworks.
- Late submission of homework assignments will never be accepted regardless of what the situation is. Considering that your average point of homework assignments will be computed by excluding your worst score, you can use this opportunity to amortize any unfortunate event you may experience during the semester.
- Homework assignments will be announced each Friday at 5:00 pm, and the submissions due will be the next Friday 4:69pm unless another special announcement is made.
- This course does not aim to teach any programming, but only to enhance your skills in algorithms. You will be doing a lot of coding during this term, but we have no special intention to improve your programming practice.
- LAB sessions will focus on improving your understanding via working on real coding exercises. At each LAB you will be introduced a coding exercise, and you are expected to work on solving it. Both your attendance to the LAB and your efforts during the LAB session will be considered for your LAB grade.
- You can visit the instructor and the teaching assistants on the specified office hours without any need to a prior appointment.
- We will be following the policies of the Indiana University Bloomington, whenever required. You can reach these policies at https://policies.iu.edu/index.html. Please check the regarding rules and regulations particularly for the code of ethics, code of conduct, and particularly, the COVID updates https://www.iu.edu/covid/index.html.

- We will be using a platform, which will be announced in the first weeks of the course, as the main discussion and communication. You can ask questions or share your comments on others questions. You will be receiving regarding updates soon.
- Each student is enrolled in a LAB section, which will be managed by an associate instructor. **The AI of your LAB section is your primary contact point for** EVERY **issue you need to communicate.** The second point of contact is the head associate instructor Ravichandra Pothamsetty `rapotham@iu.edu`. He will contact with me whenever needed and solve your issue. During all communications, please remember we have over three hundredth students!