CSCE2203 – Analysis and Design of Algorithms Lab
Fall 2024 Project Specification

Project Assignment: Algorithmic Solutions to Real-World Problems

Explore a problem, analyze it, and experiment with multiple algorithmic approaches to design solutions. You'll compare the efficiency, complexity, and suitability of each algorithm to understand how different algorithmic paradigms address specific problem requirements.

Project Requirements:

1. Choose a **real-world problem** of interest. It can be in any domain but must be solvable with algorithmic approaches. Describe the problem clearly. Explain its real-world significance, complexity, and why it is worth solving.
2. **Abstract the problem**, defining its key components and translating it into a form that can be approached algorithmically. Specify the input, output, and any constraints that make the problem unique.
3. Solve the problem using **three distinct algorithmic approaches**. Discuss the rationale behind each approach, including any trade-offs you anticipate. [throughout this semester we've studied: brute-force and recursive, transform and conquer, greedy, exclude and conquer, divide and conquer, dynamic programming and backtracking.]
4. **Evaluate each algorithm's efficiency** (e.g., time and space complexity), accuracy, and suitability for the problem. Compare and contrast the algorithms, highlighting strengths, weaknesses, and cases where one might outperform the others.
5. Be prepared to **present your work**; explain your process, justify your algorithm choices, demonstrate your implementation and discuss your analysis and evaluation.

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Suggested Problems:

- Vending Machine Change Optimization: give customers change
- Optimal Path for a Cleaning Robot: clean a rectangular area efficiently, avoiding obstacles, and reach the charging station before the battery runs out.
- Optimizing Social Media Posting Times: to maximize engagement by posting at optimal times, but can only post a limited number per day.
- Coupon Selection for Maximum Savings: A shopper has multiple coupons but can only use a subset due to terms and conditions, aiming to maximize savings.
- Optimal Product Placement on Shelves: display a variety products to maximize sales within limited shelf space.
- Determining Feasible Routes for a Delivery Drone: to minimize battery usage.
- Choosing Questions for an Exam: a balanced set of questions, where durations are chosen to fit a time constraint while maximizing topic coverage.
- Organizing a Hike with Multiple Paths: to take the safest and shortest path in a forest with several trails.
- Balancing Ingredients in a Recipe: A chef has limited ingredients and wants to create the most popular dishes without running out.
- Planning Stops on a Road Trip: A group wants to stop at key locations but must reach their destination within a day.
- Optimizing Delivery Routes for Multiple Vehicles: assign routes to multiple drivers to minimize overall travel time and fuel costs.
- Efficiently Managing Call Center Staffing: to ensure optimal staffing levels throughout the day to minimize wait times and staffing costs.
- Determining Emergency Response Routes: to find routes to multiple incident locations, minimizing overall response time.
- Scheduling Factory Interdependent Production Tasks: multiple tasks depend on each other and need scheduling to minimize downtime.
- Other…