National University of Sciences and Technology
School of Electrical Engineering and Computer Science
Department of Computing

CS 250 Data Structures and Algorithms

Spring 2024

Semester Project

Announcement Date: 4th April 2024

Proposal Due Date: 14th April 2024 at 11:59 pm (on LMS)

Project Submission Due Date: 13th May 2024 at 11:59 pm (on LMS)

Instructor: Bostan Khan

Semester Project for Data Structures and Algorithms Course

Welcome to the semester projects for the Data Structures and Algorithms course. This is an opportunity for you to apply the knowledge and skills you've gained throughout the semester to real-world engineering problems. Please carefully read the following instructions for choosing a project and forming groups:

Choosing a Project:

1. Review the list of project ideas provided to you by the instructor. Each project idea covers a different aspect of electrical engineering and involves the application of data structures and algorithms.
2. **If you have a good idea of your own, you can propose that instead choosing from the list.**
3. Consider your interests, skills, and career goals when selecting a project. Choose a project that you find engaging and relevant to your academic and professional development.

Forming Groups:

1. Form groups of three students each for the semester project. Collaborating in groups will allow you to leverage each other's strengths and work more efficiently on the project.
2. Choose group members who have complementary skills and are committed to contributing equally to the project. Diversity in skills and perspectives will enhance the quality of your work.
3. If you are unable to find a group, please inform the instructor as soon as possible. The instructor will assist you in forming a group or assign you to a group.

Proposal Submission:

1. Prepare a project proposal document outlining your chosen project, proposed approach, and initial plan for implementation. The proposed approach should utilize data structures and algorithms studied during the semester.
2. The proposal document should include the following sections:
    - Title of the project
    - Names and student IDs of group members
    - Brief description of the project
    - Objectives and goals of the project

- Proposed approach and methodology
- Any additional resources or support needed for the project

3. Submit the proposal document to the instructor by **14th of April**. Late submissions will not be accepted.

Proposal evaluation:

1. The proposal document will be worth **5-10%** of the total project marks.
2. The proposal will be evaluated based on the clarity of the project description, feasibility of the proposed approach, and the coherence of the implementation plan.

Implementation Instructions for the projects:

Each project should be implemented with proper GUIs/interfaces for users to interact with. The implementation should be free of bugs and errors and should give a seamless working experience.

Possible Project Ideas:

1. **Flight Reservation System:** Design a flight reservation system that allows users to search for flights, book tickets, and manage reservations. Implement efficient data structures and algorithms for managing flight schedules, seat availability, and booking transactions.
2. **Stock Market Analysis Tool:** Develop a tool to analyze historical stock market data using algorithms like moving averages, trend analysis, and pattern recognition. Implement features for visualizing stock trends, predicting future prices, and evaluating investment strategies.
3. **Pathfinding Algorithms for Games:** Create a simple game environment where characters navigate through obstacles to reach a goal. Implement pathfinding algorithms such as A* or Dijkstra's algorithm to find the shortest path from the character's current position to the goal.
4. **Online Shopping System:** Build an online shopping platform where users can browse products, add items to their cart, and complete purchases. Implement efficient data structures and algorithms for managing product inventory, processing orders, and handling user interactions.
5. **Genetic Algorithm for Optimization:** Develop a genetic algorithm to solve optimization problems such as the knapsack problem, traveling salesman problem, or scheduling problem. Experiment with different genetic operators and parameters to find optimal solutions efficiently.
6. **Blockchain Simulation:** Simulate the basic functionalities of a blockchain system, including transaction validation, block creation, and consensus mechanism.

Implement data structures and algorithms for maintaining a decentralized ledger and ensuring data integrity.

7. **Natural Language Processing Tool:** Build a tool for processing and analyzing natural language text. Implement algorithms for tasks such as tokenization, stemming, sentiment analysis, and named entity recognition. Use data structures like hash tables and trees for efficient text processing.
8. **Job Scheduling System:** Design a job scheduling system that allocates tasks to multiple processors or machines efficiently. Implement scheduling algorithms such as Round Robin, Shortest Job First, or Priority Scheduling, and analyze their performance under different workloads.
9. **Healthcare Management System:** Develop a system for managing patient records, appointments, and medical histories in a healthcare setting. Implement data structures and algorithms for efficient search and retrieval of patient information, scheduling appointments, and generating reports.
10. **Sensor Data Analysis Platform**: Develop a platform that can ingest, store, and analyze data from various sensors commonly used in electrical engineering applications. Implement algorithms for data cleaning, feature extraction, and anomaly detection.
11. **Power Grid Optimization**: Design algorithms to optimize power distribution in a smart grid system. This project could involve implementing graph algorithms to minimize energy loss, maximize efficiency, and ensure reliability in power transmission.
12. **Fault Detection in Electrical Systems**: Create algorithms to detect and diagnose faults in electrical systems based on sensor data. This project could involve techniques such as machine learning for pattern recognition and anomaly detection.
13. **Circuit Simulation and Analysis**: Develop a software tool for simulating and analyzing electrical circuits. Implement data structures and algorithms for circuit representation, simulation, and analysis, including techniques such as nodal analysis and circuit optimization.
14. **Signal Processing Algorithms**: Develop algorithms for processing and analyzing signals commonly encountered in electrical engineering, such as audio signals or biomedical signals. This could involve techniques such as Fourier analysis, digital filtering, and spectral analysis.
15. **Internet of Things (IoT) Device Management**: Create a system for managing and monitoring IoT devices used in electrical engineering applications. Implement data structures and algorithms for device discovery, communication, and data processing.

16. **Power Consumption Optimization in IoT**: Design algorithms to optimize power consumption in IoT devices used in electrical engineering applications. This project could involve techniques such as sleep scheduling, duty cycling, and energy-efficient routing protocols.
17. **Robotics Path Planning**: Develop algorithms for path planning and obstacle avoidance in robotics applications relevant to electrical engineering.
18. **Real-Time Power Monitoring System:** Develop a real-time system for monitoring power consumption in electrical grids or individual devices. Implement data structures and algorithms for efficient data collection, aggregation, and visualization.
19. **Smart Home Energy Management:** Create a smart home energy management system that optimizes energy usage based on user preferences and real-time data from sensors. Implement algorithms for load balancing, scheduling, and predictive analytics.
20. **Machine Learning for Power Forecasting:** Use machine learning techniques to forecast power consumption or generation in electrical grids. Implement algorithms for time series forecasting, regression analysis, and model evaluation.