Data Structures and Algorithms

Inclusive Eutopia-Designing a city for all

Course Project Report

School of Computer Science and Engineering
2022-23

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1. Course and Team Details

1.1 Course details

Course Name	Data Structures and Algorithms (Theory and Lab)
Course Code	20ECSC205 and 19ECSP201
Semester	III
Division	B
Year	2022-23
Instructor	Prakash Hegade

1.2 Team Details

Si. No.	Roll No.	Name
1.	215	Anushika Kothari
2.	217	Shreya Pai
3.	226	Ritesh Hiremath
4.	227	Shreepad Joshi

2. Introduction

Data structures and algorithms are fundamental concepts in computer science that are crucial for building efficient and scalable software systems. Data structures are used to store and organize data, while algorithms are used to manipulate and process that data. The course covers a wide range of topics, including arrays, linked lists, stacks, queues, trees, graphs, sorting algorithms, and searching algorithms.

The knowledge and skills gained from this course are applicable to various industries, including software engineering, data science, artificial intelligence, and many more. This course provides a strong foundation in data structures and algorithms, which are essential for developing efficient and optimized software systems.

The project we have built, a utopian city using DSA algorithms, is an excellent example of how data structures and algorithms can be applied to solve real-world problems. In this project, we have used various DSA algorithms to design and build an ideal city, considering factors such as population, transportation, infrastructure, and more. By applying the knowledge gained from this course, we have been able to develop a solution that is optimized and efficient.

Through this project, we have not only applied the concepts learned in the course, but we have also gained valuable experience in project management, teamwork, and problem-solving. This project has provided us with the opportunity to showcase our skills and creativity, while also applying our knowledge to a practical scenario.

In conclusion, the course Data Structures and Algorithms is essential for anyone who wants to develop a strong foundation in computer science. The knowledge and skills gained from this course are applicable to various industries, making it a valuable asset for anyone seeking to enhance their career prospects. The utopian city project we have built is an excellent example of how data structures and algorithms can be applied to solve real-world problems, and it has provided us with valuable experience in project management, teamwork, and problem-solving.

3. Problem Statement

The challenge of designing a utopian city is of immense importance.

The City of Utopia is committed to creating a better future for its citizens and visitors.

In order to ensure this, we need to implement a city model that will provide a comprehensive framework for the city to develop and grow sustainably.

This model should include a plan for infrastructure and public services, a vision for the city's economy, and a strategy for addressing social and environmental challenges.

It should also take into account the needs of the citizens, including their safety, health, and well-being.

The city model should be developed with input from stakeholders and experts, and should be long-term, adaptable, and flexible in order to accommodate future changes.

This model will serve as the foundation for Utopia's future success, and is essential for creating a livable and prosperous city.

We need to design a city model for a utopian city that is socially, economically and environmentally sustainable.

Furthermore, the model must be designed to ensure that the city is resilient in the face of climate change, economic and social disruption, and any other potential problems.

In addition to this, the model must be cost-effective and take into account the needs of all citizens and all stakeholders involved.The framework includes but is not limited to:

- An efficient transportation system.
- An efficient waste management system.
- Comprehensive housing policy.
- Equitable taxation system.
- Promotes a healthy lifestyle.
- Comprehensive education system.

4. Functionalities

Sl. No.	Function Name	Description	DS and Algorithm Used	Efficiency
1.	print_citizen()	Prints the details of all the citizens.	Linked list	$O(n)$
2.	get_income ()	Prints top 10 citizens with highest income.	Bubble Sort	$O(n^2)$ n:total citizens
3.	add_citizen ()	Inserts a new citizen record .	Linked list insertion.	$O(n)$
4.	remove_citizen()	Deletes an existing citizen record.	Linked list deletion.	$O(n)$
5.	get_population()	Prints the total number of people residing in each house in creasing order.	Insertion Sort	$O(n^2)$
6.	get_patients()	Sorts the patients based on the level of emergency.	Quick Sort	$O(n\log n)$
7.	Get_family_tree	Prints the details of the family(eldest member to youngest)	Heap Sort	$O(n\log n)$
8.	get_customer()	Prints the first 5 customers who have checked in.	Merge Sort	$O(n\log n)$
9.	bfs()	Finds optimal distance between each node from a given node,to reduce traffic congestion.	BFS	$O(v+e)$ v:number of vertices. e:number of edges.
10.	cable_connection()	Prints the T.V. cable connectivity around the city.	DFS	$O(v)$ v:number of vertices.
11.	Get_details	Prints the details of the mentioned citizen.	Brute force string search	$O(nm)$
12.	true_caller	For a given phone number ,fetches the details of the citizen the number belongs to.	Knuth-Morris-Pratt string matching Algo (KMP)	$O(n+m)$
13.	Waste_pickup	Gives the shortest path to travel through	Prim's	$O(E \log V)$

		the city for waste pickup.		E : number of edges V : number of vertices
14.	Water_pipeline	Gives the optimal path to reduce the cost of laying a water pipeline.	Kruskal's and selection sort	$O(E \log V)$
15.	ambulance_service()	Prints the shortest route to reach the destination from the hospital	Dijkstra's	$O((E+V)\log V)$
16.	find_bus()	Checks if there is a direct bus connectivity between two locations	Warshal	$O(n^3)$
17.	Bst_students()	Creates bst of students of particular standard based on their percentage	Binary Search tree	$O(\log n)$
18.	get_path()	Gives the shortest path from a point to every other point.	Floyd	
19.	Unique_number()	Checks if the student id of every student in the school is hashed to a unique key.	Hashing	$O(1)$

5. Project Tools

Si. No.	Measure	Value
1.	Total Functions in project	19
2.	Total number of lines of code (Including comments, newlines etc.)	2505 (main.c+settings.h +locals.h)
3.	Number of Errors	0
4.	Number of Warnings	70
5.	Team Satisfaction about Project	97

6. Learning and Takeaway

Here are our take away and learnings from the course and the course project:

Knowledge and understanding of DSA algorithms: As a team, we have gained a better understanding of how DSA algorithms work and how they can be applied to solve real-world problems. We have also learned about data structures such as graphs, trees, and heaps.

Problem-solving skills: The process of designing a city of Utopia using DSA algorithms required us to break down the problem into smaller components, analyze them, and come up with solutions. This has helped us develop our problem-solving skills as a team.

Creativity and innovation: Designing a city of Utopia required us to think creatively and come up with innovative solutions to various problems. This has helped us develop our creative thinking and problem-solving skills as a team.

Project management skills: Completing a project of this nature required us to plan, manage, and execute the project from start to finish. This has helped us develop our project management skills as a team, which are highly valued in many fields.

Communication skills: Throughout the project, we had to communicate our ideas and solutions to each other, our instructors, and potentially other stakeholders. This has helped us develop our communication skills as a team, which are important in many professions.

Overall, our team has gained a range of valuable skills and knowledge through this project that can be applied in various fields. We are proud of what we have accomplished and look forward to applying our newfound knowledge and skills in future endeavors.

Si. No.	Roll	Name	Contribution Rank
1.	215	Anushika	1
2.	217	Shreya	1
3.	226	Ritesh	1
4.	227	Shreepad	1

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