VIETNAM NATIONAL UNIVERSITY – HO CHI MINH CITY

INTERNATIONAL UNIVERSITY

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Semester 2 (2024-2025)

Algorithms & Data Structure

IT013IU

FINAL REPORT

DSA VISUALIZER

Group1

No.	Full name	ID
1	Lương Trần Đạo	ITITWE21119
2	Đỗ Duy Anh	ITCSIU21163

Instructor: Tran Thanh Tung, Ph.D

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CHAPTER 1: INTRODUCTION

1.1. Background

Understanding Data Structures and Algorithms (DSA) is essential for anyone pursuing computer science or software engineering. However, many students find DSA concepts abstract and difficult to comprehend through traditional methods. To bridge this gap, I developed a web-based visualization tool that brings DSA concepts to life through interactive and graphical representations.

1.2. Scope and Objectives

The goal of this project is to develop a web-based application that helps users understand how fundamental data structures and algorithms operate by visualizing their processes in real time.

1.3. Technologies Used

Technology	Purpose
React.js	Frontend framework for UI
CSS	Styling and layout
JavaScript	Algorithm logic and interactivity
HTML	Structure and static content
Node.js & npm	Dependency management

CHAPTER 2: FEATURES AND FUNCTIONALITY

2.1. Sorting Visualizations

Implemented sorting algorithms:

- **Bubble Sort**
- **Selection Sort**
- **Insertion Sort**
- **Merge Sort**
- **Shell Sort**
- **Quick Sort**

Each sorting algorithm animates the process of comparing and swapping values. Users can visually follow how an unsorted array transforms into a sorted one.

2.2. Searching Visualizations

Implemented:

- **Linear Search**: Visually highlights each element checked until the target is found.
- **Binary Search**: Demonstrates the divide-and-conquer approach on a sorted array.

2.3. Stack & Queue

Stack and Queue operations are demonstrated using high-quality static images. These showcase:

- Stack (LIFO behavior)
- Queue (FIFO behavior)

2.4. Binary Tree

Implemented:

- **Pre-order**: Pre-order traversal visits the node with highlights in the order: Root -> Left -> Right
- **In-order:** In-order traversal visits the node with highlights in the order: Left -> Root -> Right
- **Post-order:** Post-order traversal visits the node with highlights in the order: Left -> Right -> Root

CHAPTER 3: IMPLEMENT AND RESULTS

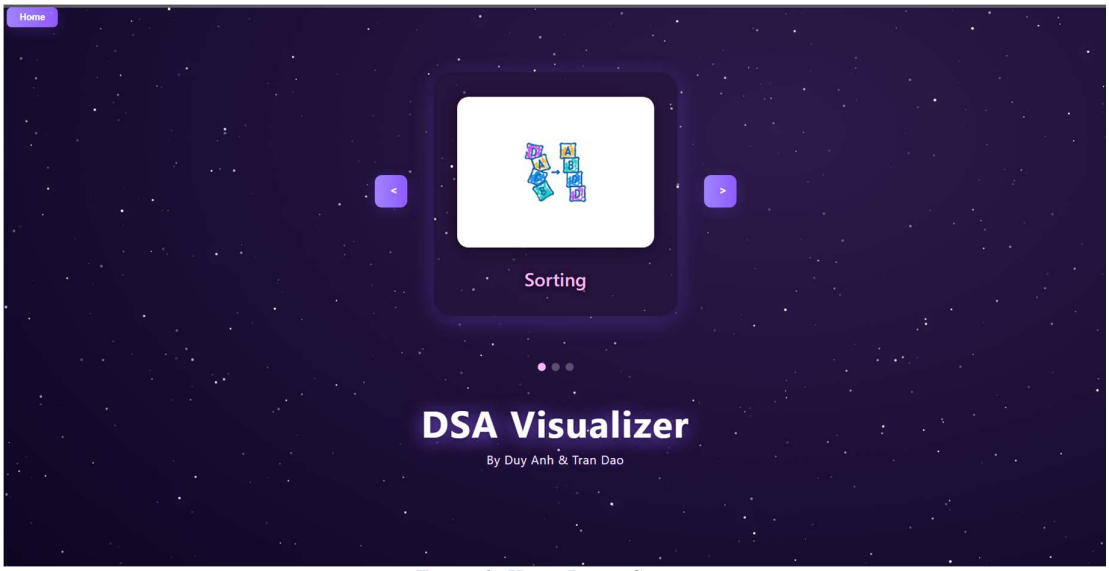

Figure 1: Home Page - Sorting

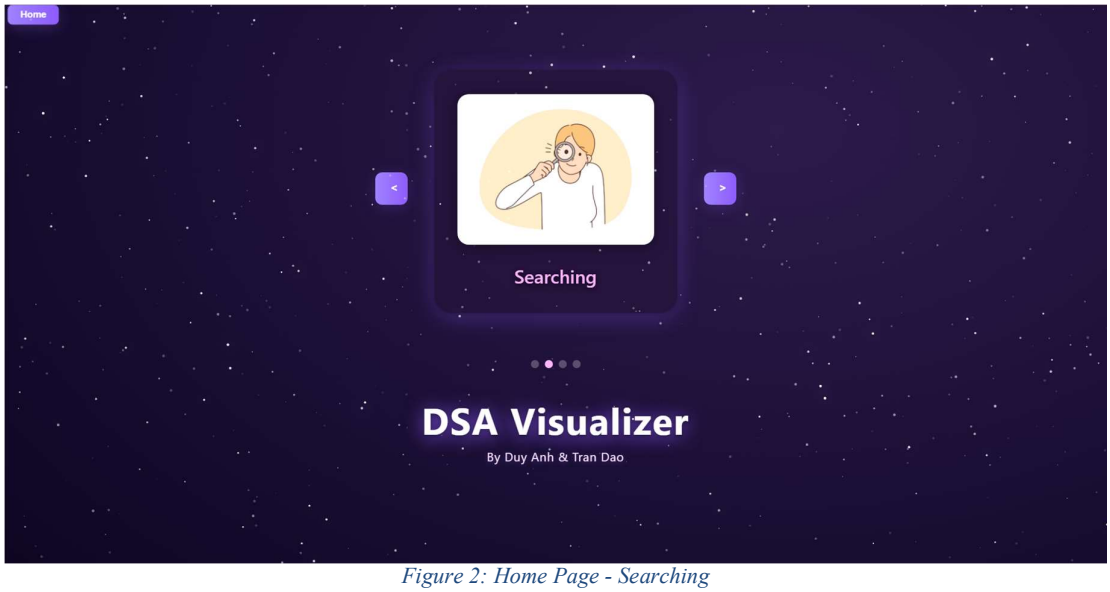

Figure 2: Home Page - Searching

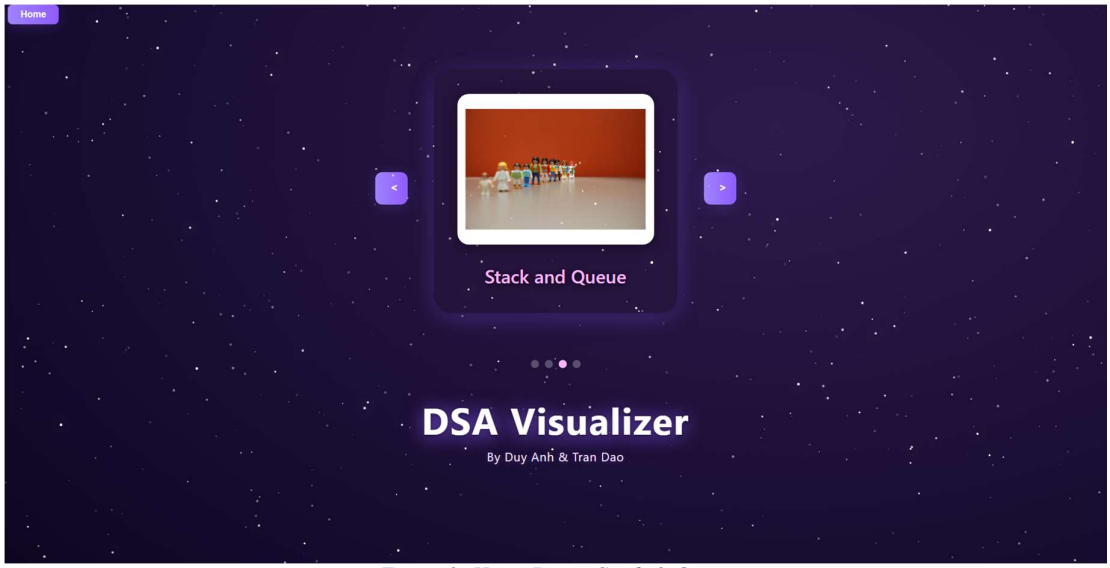

Figure 3: Home Page - Stack & Queue

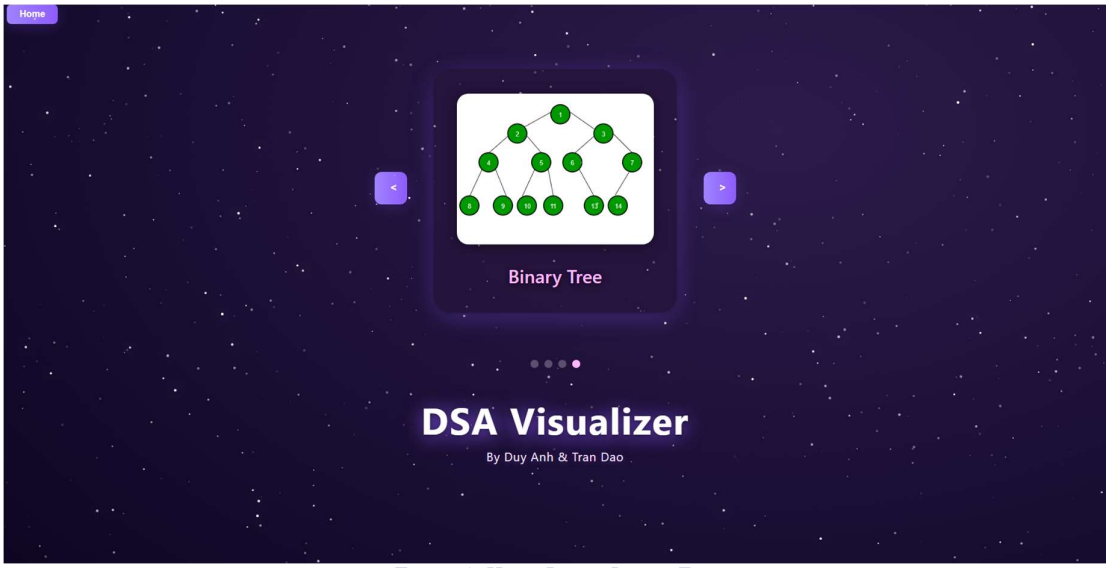

Figure 4: Home Page - Binary Tree

Home Page of the Project, where users can choose between “Sorting”, “Search”, “Stack & Queue”, and “Binary Tree”.

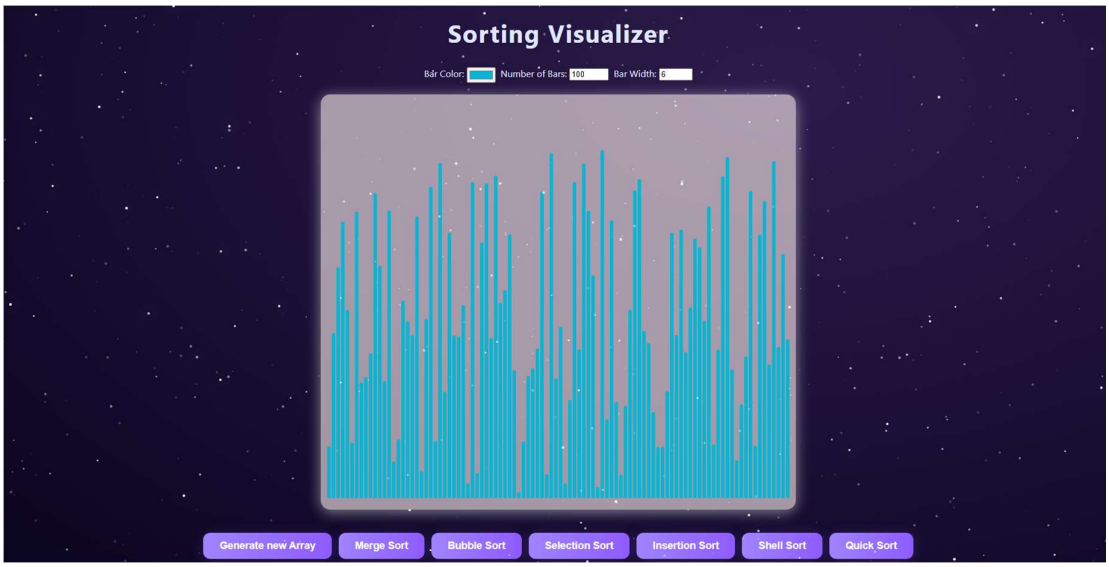

Figure 5: Sorting Visualizer

Users can generate a random array and select any Sort they want to see how the Sorting algorithms work.

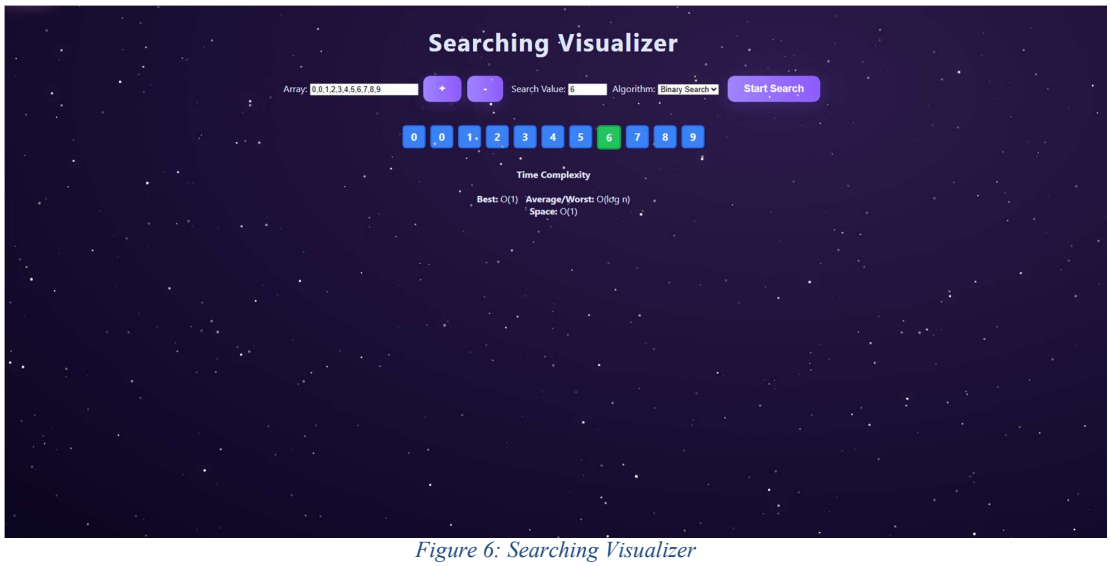

Figure 6: Searching Visualizer

Users can insert random numbers into the array, and the number they want to search for. Choosing between "Linear search" and "Binary search" to see the algorithms of searching.

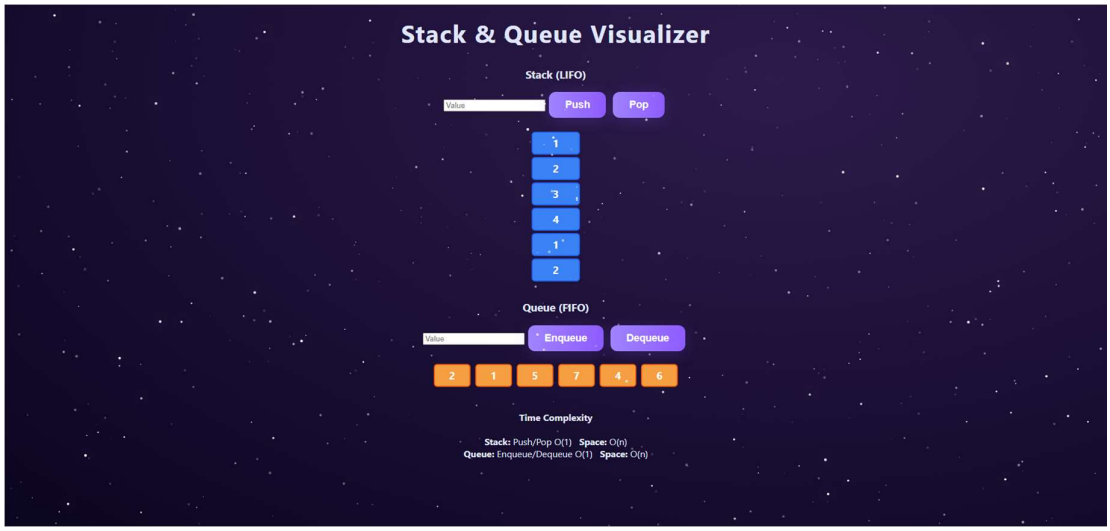

Figure 7: Stack & Queue Visualizer

Users can insert numbers to "Push" and "Enqueue". After that, they can choose "Pop" and "Dequeue" to see the algorithms of the Stack & Queue.

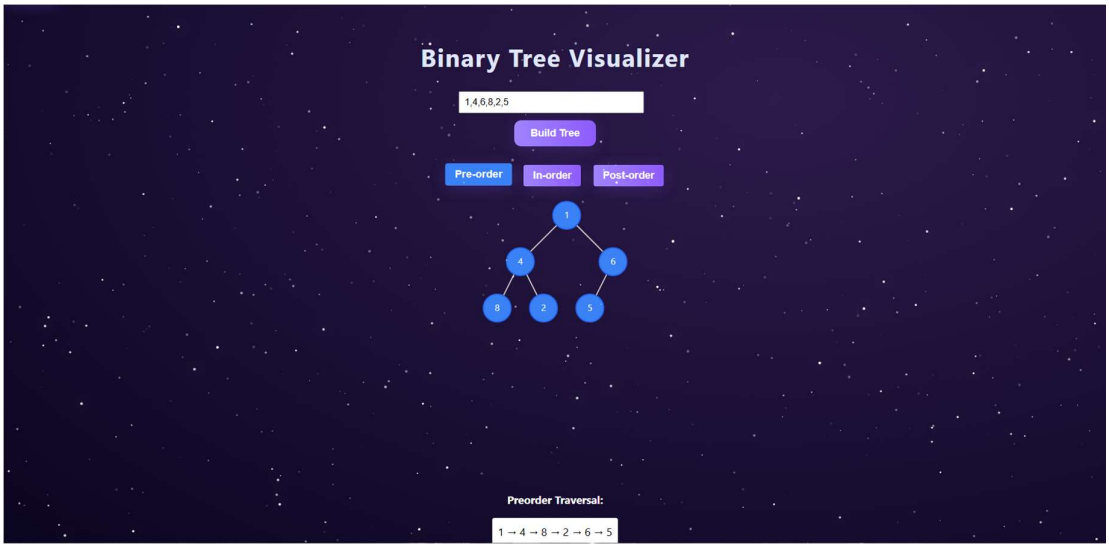

Figure 8: Binary Tree Visualizer

Users can create their own Binary Tree, after that they can choose “Pre-order”, “In-order”, “Post-order” to see the travel way of a tree.

CHAPTER 4: DISCUSSION

4.1. Benefit and Impact

- **Visual Learning**: Helps learners grasp algorithm mechanics intuitively.
- **Interactivity**: Encourages experimentation and exploration.
- **Accessibility**: Runs in any browser, no installation required.

4.2. Challenges Faced

- Animating algorithms required careful state management in React.
- Synchronizing logic with visual updates to ensure clarity.
- Designing a UI that balances simplicity with functionality.

CHAPTER 5: CONCLUSION

This project offers a compelling way to learn DSA topics through visualization. It makes abstract concepts tangible, engaging, and easier to understand. The project also served as an excellent opportunity to apply front-end development skills in a practical, impactful way.