

Final Project: Interactive Sorting and Searching System Using Binary Search Trees

You will develop an interactive program that uses a Binary Search Tree for managing and sorting data. The system will allow users to insert, delete, and search for elements while visualizing the changes in the tree structure dynamically. The project will emphasize understanding the **BST** properties and using in-order traversal for sorting.

Key Objectives:

1. Core BST Operations:

- Implement the following operations:
 - **Insertion:** Add a new element while maintaining **BST** properties.
 - **Deletion:** Remove an element while preserving the **BST** structure.
 - **Search:** Locate a specific element and highlight its position in the tree.

2. Sorting with BST:

- Perform in-order traversal of the **BST** to generate a sorted array.

3. Dynamic Visualization:

- Provide a graphical representation of the **BST**.
- Update the visualization dynamically as elements are inserted or deleted.
- Highlight the path taken during each operation.

4. Optional Enhancements (Bonus):

- Implement balancing techniques such as **AVL** for optimal performance.
- Compare the efficiency of BST-based sorting with other algorithms like **QuickSort** and **MergeSort**.
- Use color-coding to differentiate visited nodes during search or deletion.
- Animate node movements during insertion and deletion.

Deliverables:

1. Source Code:

- Modular implementation of BST operations (insert, delete, search, traverse).
- Real-time visualization updates.

2. Interactive Demo:

- Users can input elements to insert, delete, or search.
- The system updates and displays the BST dynamically with sorting results.

3. Report:

- Analyze performance for different datasets (e.g., sorted, random, and reversed data).
- Discuss any challenges faced during implementation.

Project Guidelines:

1. Submission Details:

- **Deadline:** The source code and project report must be submitted to chemseddine.chohra@gmail.com before **January 5th, 2025**.
- **Late Submissions:** Any delay will result in a penalty of **-0.25 per day**.

2. Group Work:

- Students can work in groups of up to **4 members**.

3. Validation Session:

- A validation session will be held on **January 15th, 2025**, where students must present their project and answer questions to demonstrate their understanding.

4. Plagiarism Policy:

- Each group must submit a unique project. Any projects found to be overly similar will be subject to investigation, and penalties will apply to all involved groups. This may include grade reduction or project rejection.