$\text{DS}_A SSIGNMENT_2$

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November 2024

Performance Analysis of Tree Data Structures

Table 1: Performance of Tree Data Structures (in seconds)

Number of Searches	BST (seconds)	AVL (seconds)	B-Trees (seconds)
5,000	24.10	23.40	19.85
10,500	18.25	17.80	17.00
18,500	15.95	15.50	14.02
Average Time	19.43	18.90	16.96

Generalized Asymptotic Analysis

- **Binary Search Tree (BST):**

  - Best-case complexity: $O(\log n)$
  - Worst-case complexity: $O(n)$ (observed in imbalanced trees)
  - Observed performance indicates some imbalance, especially for large datasets, leading to slower operations compared to AVL and B-Trees.

- **AVL Tree:**

  - Complexity for all operations: $O(\log n)$
  - Empirical results align with theoretical expectations. AVL outperforms BST due to its strict balancing but is marginally slower than B-Trees due to rebalancing costs.

- **B-Trees:**

  - Complexity for all operations: $O(\log n)$
  - Observed performance matches theoretical efficiency, excelling in handling large datasets due to reduced node traversal and optimized cache utilization.