

# Phase 3 Report

## Report for Phase 3 - B+Tree Indexing Assignment

In completing Phase 3 of the B+Tree Indexing assignment, our team has made significant progress in the understanding and development of a B+Tree-based indexing system.

Roll Number	Team Member	Contributions
2020101005	Pratyush Mohanty	Insertion, Analysis
2021121001	Debanil Chowdhury	Deletion, Analysis
2020111024	Amey Kunte	Deletion, Analysis

### Part(a) Insertion (Contributor: Pratyush)

The insertion operation involved adding records to the B+Tree structure. We implemented the insertion functions in the LeafNode and InternalNode classes. In the LeafNode, when an overflow occurs, we split the leaf into two nodes, ensuring that all properties of the B+Tree are maintained. In the InternalNode, we appropriately chose the child to insert the record into and handled any overflows, performing necessary redistributions or merges.

### Part(b) Deletion (Contributors: Debanil, Amey)

The deletion operation was more complex than insertion, as it required handling underflows in the B+Tree. When a node underflows, we followed a specific order of preference: redistribution with a left sibling, merge with a left sibling, redistribution with a right sibling, and merge with a right sibling. This ensured that the B+Tree structure remained balanced and maintained its properties.

### Part(c) Performance Analysis (Contributors: Pratyush, Debanil, Amey)

We also conducted a performance analysis by implementing the RANGE command, which allowed us to measure the number of block accesses needed when using the B+Tree and when not using it. We executed range queries for a range of values and compared the results to evaluate the efficiency of our B+Tree indexing system. We generated plots to visualize the distribution of block accesses with and without the B+Tree, and we conducted this analysis for three different values of FANOUT.

### General Learnings

Throughout this phase, we gained valuable insights into the inner workings of B+Tree structures, their insertions, deletions, and how they can significantly improve the

performance of indexing in database systems. We also learned about the importance of maintaining the balance and properties of the B+Tree during insertions and deletions.

In conclusion, the completion of Phase 3 was a significant step in our project. We successfully implemented B+Tree insertion and deletion operations and conducted a performance analysis to evaluate the effectiveness of our indexing system. This phase has deepened our understanding of B+Tree indexing and its application in Data Systems.