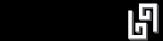
CS551 Project Part I

Bit Benders:
Ethan Childs
Michael Dushkoff
Daniel Kutnyi
Kai Iverson

University of Oregon
October 30, 2024

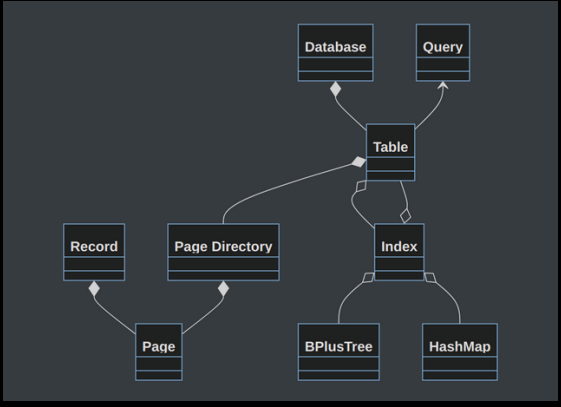
Database Architecture Overview



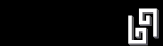
- LStore-based database
- Index optimizations
- Focus on making repeated queries faster

Database Architecture Overview

- **Page Directory**
  - Manages all pages
  - Fast strided access to pages
  - $\mathcal{P}(RID, col) \rightarrow$ $< Page, Offset >$
- **Index**
  - Handles RID lookup
  - $\mathcal{I}(col, val) \rightarrow [RID_i]$
  - $\mathcal{I}_{range}(col, v_0, v_1) \rightarrow [RID_i]$



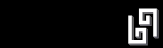
Queries - Select



Select Process

- **Find the base RID for the specified primary key using the index**
- **Find the RID for the specified version using the indirection pointer**
- **Construct the record**
  - Traverse through the versions of our record using the schema and the indirection fields and gather the latest data for this version

Queries - Insert



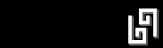
Insertion Process

1. **Construct a new record**

2. **Add a new record to the base page**

3. **Maintain the index**

Queries - Update



Update Process

1. **Fetch old required information**

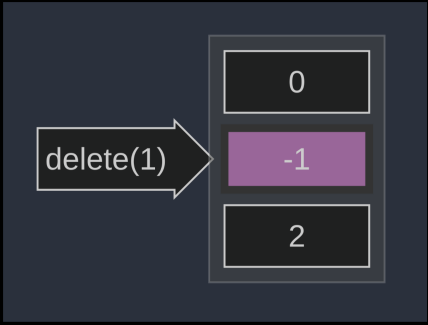
2. **Construct cumulative tail record**

3. **Write new information**

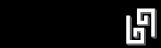
Queries - Delete

Deletion Process

- Tombstone-based deletion
- RID is marked as invalid with a -1 flag
- Index correspondingly removes the element from its structure
- Fast operation



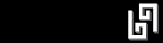
Queries - Sum



Sum Process

- Gather RIDs from valid keys in range
- Get column value for related RID from base record
  - For sum version, Get column value from related RID in the relative version
- Add value to total sum

Performance Optimizations



- B+tree node parent
- Batch insert
- Lazy index maintenance
- Index creation policy

Performance Study

Operation	Without PK Index	With PK Index
Inserting 10k records	**0.09375**	0.109375
Updating 10k records	107.203125	**0.3125**
Selecting 10k records	77.4375	**0.09375**
Aggregate (10k of 100 record batch)	0.796875	**0.0625**
Deleting 10k records	**0.015625**	0.03125

Table: Benchmark Comparison of Database Operations with and without an unordered Index on Primary Key

Questions?