Database Practicum HW4

B+ Tree Index

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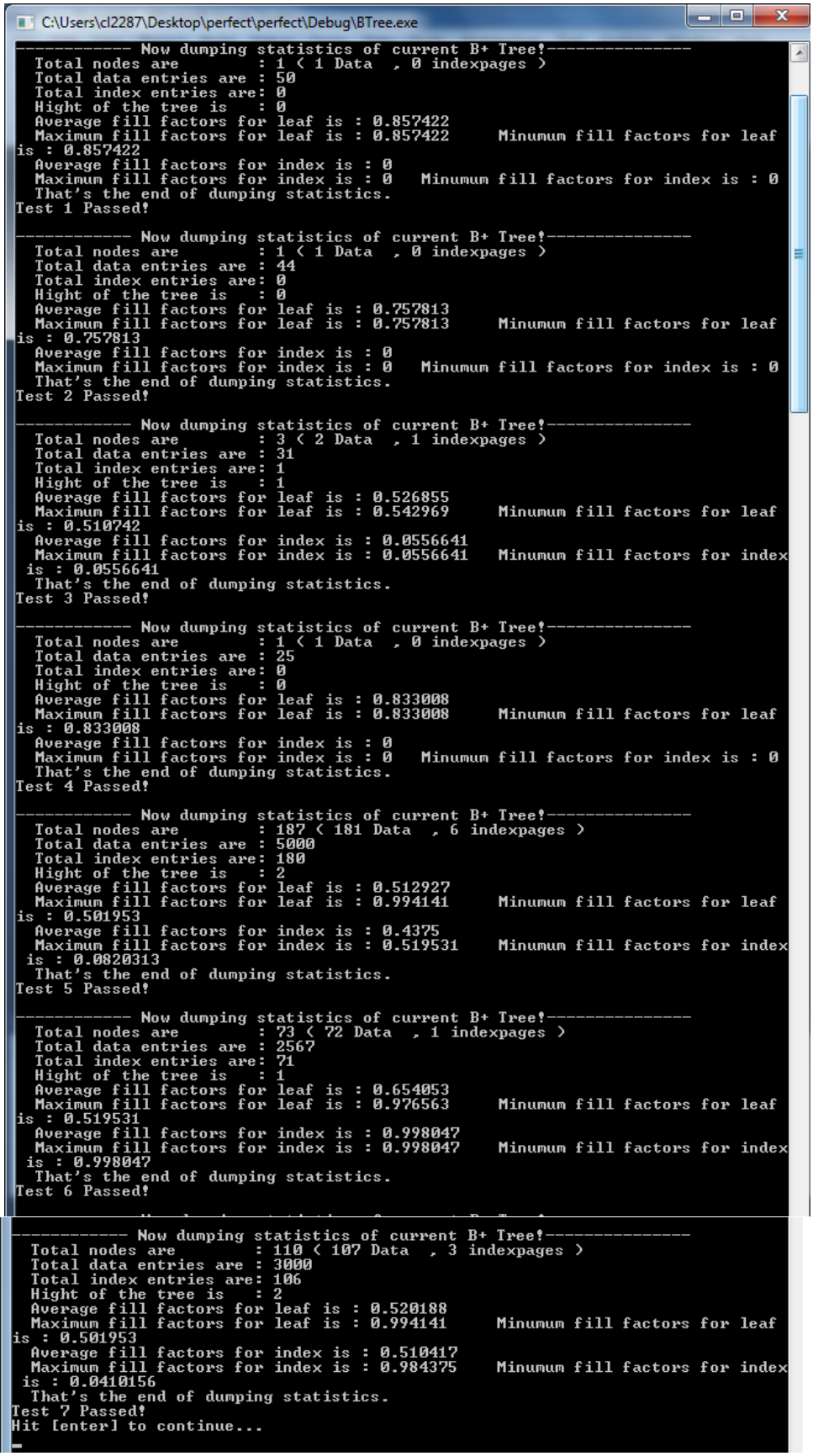

Test Results for:

- Test 1: Only Insertion on a single node
- Test 2: Insertion and Deletion on a single node
- Test 3: Insertion with Leaf Split
- Test 4: Leaf Node Merge
- You don't have to pass this test case.
- Test 5: Large Workload, Insertion Only
- Test 6: Large Workload, mixed Insertion/Deletion
- Test 7: Test BTreeScan

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This program implements a B+ Tree index for a database system.

Implementation:
Insertion and deletion:
Starting from a leaf page, the leaf page is split into 2 leaf pages and a root page after the first leaf page is full. Then we recursively implement insertion, going from the root node to the leaf node, and propagate a (key, value) pair back up the tree if a leaf or index node is full and split into 2. If a leaf node is split, then the pair (smallest key, new leaf page ID) is propagated up the tree. If an index node is split, the new index node's smallest key is deleted and its corresponding value (page ID) is set as the left link. The pair (smallest key (just deleted), new index page ID) is propagated up the tree. If the root node is full and split, we split the root index node into 2 index nodes, and also make a root node, whose left link points to the original index node, and the first inserted record points to the new index page. In the header page, reset the pointer to the root page .
We always split the nodes such that the smaller half is in the original node and the bigger half is in the new node. This way, the original node's left link and the upper tree level's node pointer to the original node can be left unchanged and correct.
The problems we encountered were that open scan returns the leaf page's (key, datarid), and at first we thought the returned rid is the record ID of where the record is stored in the leaf page. We took some time to plan how to code recursion of propagating up the (key,value) pair if a leaf or index node is split, and how to merge and redistribute should a page is deleted. We made our own functions to implement recursion.

• Any assumptions you made to get the code to work.
No assumption beyond the instructions in the instruction sheet.
• A description of any test cases you wrote and why they are useful. You should also include the code of these test cases in the project.
We did not write our own test cases. We used the btreeDriver test cases.
• Any known bugs. If your code fails a test case, explain the symptoms and what you think the problem might be.
We did not have any bug. All tests passed.
- A description of your performance measurements, if you elected to do the extra credit.

The statistics of tests 1-7 are included. The leaf nodes and non-root index nodes are at least 50% full, as required. From test 5 insertions, some leaf nodes are almost full (99.41%), but most are just over 50% full. From test 6 mixed insertion and deletion, the leaf average fill factor is somewhat higher (65.41%) than 50% because of node merging and redistribution from deletion.