Shawn S Hillyer

01/16/2016

CS 261-400

# Programming Assignment 3: Problem 2

## Comparison of Linked List vs. Dynamic Array implementation of a Bag

Here is the data from the tests. Analysis follows. All tests were completed on flip.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **dynamicArrayMain.c** | | **linkedListMain.c** | |
| **Iterations** | **Memory (KB)** | **Runtime (ms)** | **Memory (KB)** | **Runtime (ms)** |
| 1000 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 |
| 4000 | 0 | 20 | 0 | 30 |
| 8000 | 0 | 90 | 0 | 120 |
| 16000 | 0 | 380 | 24 | 500 |
| 32000 | 0 | 1520 | 524 | 2030 |
| 64000 | 0 | 6090 | 1520 | 8040 |
| 128000 | 168 | 24360 | 3520 | 33350 |
| 256000 | 668 | 97470 | 7520 | 220300 |

**Which of the implementations uses more memory? Explain why.**

Memory usage for the linked list version takes more memory in the long run. This is because each element of the structure maintains a pointer to the next and previous node, which is a small but (over a large enough n) very real number.

**Which of the implementations is the fastest? Explain why.**

The dynamicArray is fastest for this type of operation. This is because the dynamicArray memory is allocated sequentially and can be iterated through more quickly by the CPU. As the loop iterates through each element, hard drive access should be faster and there will be less lookups required. In the linked list, each iteration requires the lookup of the address and the retrieval. For the dynamic array, the next index is always one simple pointer calculation (increment by one).

**Would you expect anything to change if the loop performed remove() instead of contains()? If so, what?**

I’d expect runtimes for the dynamicArray to take a lot more time than the linked list. Even though the linked list needs to locate the node by iterating through elements using a reference lookup, it makes up for this last time (see last answer) by skipping the “shifting” step. That is, in a dynamicArray bag, removing the item causes everything else to be shifted towards the first element by 1, which means the dynamic array operation will always take at least n operations to complete. The linkedList bag, however, could quickly remove a node once found. It will take, on average, n/2 time to complete the operation (if we consider the removal of the node a single simple step).