ICCS315 Applied Algorithms

Assignment 1 Report

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Contents

Chapter 1

Resizeable Arrays

Traditionally, resizable array has a high amortized cost depending on α for expansion and shrinking. HAT array theoretically fares with a constant amortized cost on expansion and shrinking. Our goal is to perform teh benchmarking of the actual implementation of traditionaly resizable array and Sitarski's HAT array.

1.1 Set up

Both of data structure implementations are written in C++ which runs on ubuntu server. The actual implement is in Github.

1.2 Append latency

In this section, the cost of appending one key to the array mainly comes from reading memory. On tradditional resizable array, pushing new key to the back costs approximatetly 47 cycles from reading memory pointer which needs to be conducted at most the entire array. On the other hand, Sitarski's HAT array takes less cycle per apeend operation which is 26 cycles since the entire array is separated into b size where b where $b = 2^k$.

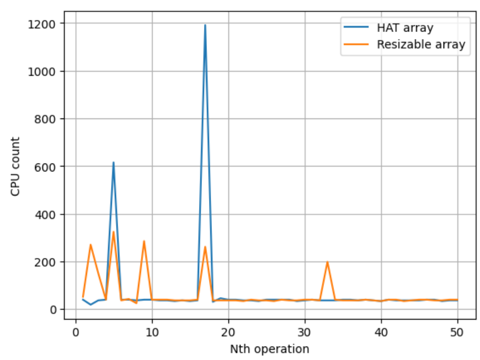


Figure 1.1: Benchmark of each append costs

Figure 1.1 shows the cost of each append out of 50 append operations. Tradditional resizable array shows up to stike CPU cycle more on each operation since the expansion happens more often than HAT array. However, HAT array costs significantly higher cycle because the resizing needs to be done in both levels combine with copying data over.

In conclusion, traditional resizable array takes more cycle to access memory and append new day than HAT array. On the expansion, tradditional resizable array is better than HAT array.

1.3 Access latency

Getting element by index in HAT array is tricky in the way that we need to calculate the block index and the index of element in particular block. This seems to take more cycle than traditional resizable array. Surprisingly, both of data structures take same amount of CPU cycle to access element in the machine memory. Benchmark is finding the average (out of 100,000 times) CPU count on each data structure element access. The result is that both arrays take 18 cycles.

1.4 Scan throughput

1.5 Overall throughput

In section 1.1, I have shown append latency which conclude to have different benefits. For this benchmark, I will test inserting 50 elements to both tradditional resizable array and HAT array. As a consequence, resizable array takes 1153 cycles on average while HAT array takes 1114 cycles on average. Even though the expansion is costly in HAT array, overall throughput of it is around 5 percents faster than resizable array.

Chapter 2

Skip lists

Chapter 3

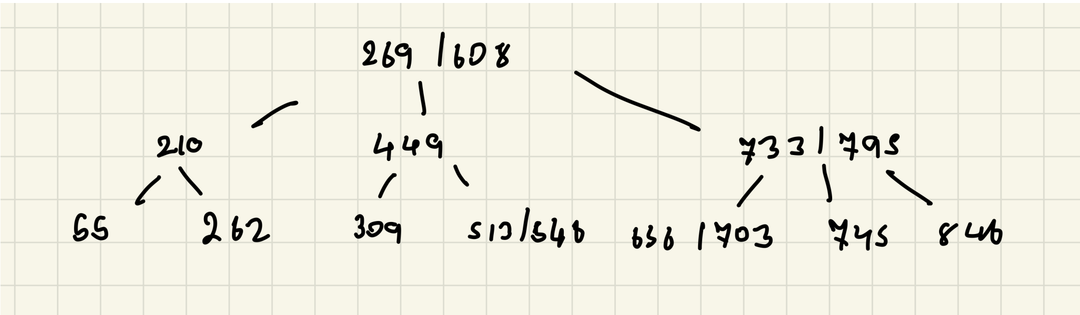
(a,b) tree

3.1 Multiple keys insertion.

Starting with an empty tree, we want to insert the following keys:

733, 703, 608, 846, 309, 269, 55, 745, 548, 449, 513, 210, 795, 656, 262

The result of *(2,3) tree* is



3.2 Key deletion

Suppose that we want to delete 309 in *(2,3) tree*, it falls into case 1 which we need to steal from sibling.

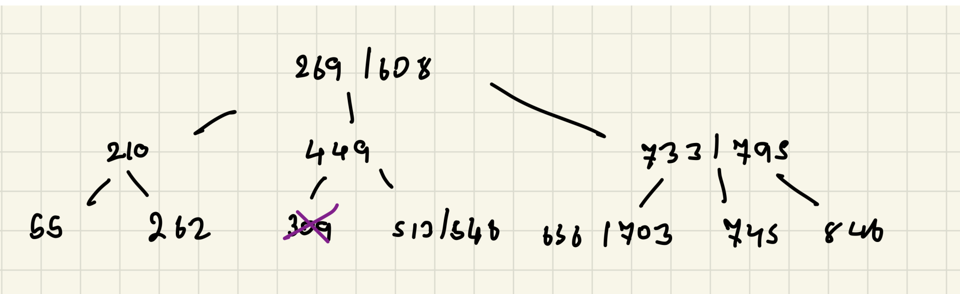


Figure 3.1: Unbalanced tree without key 309

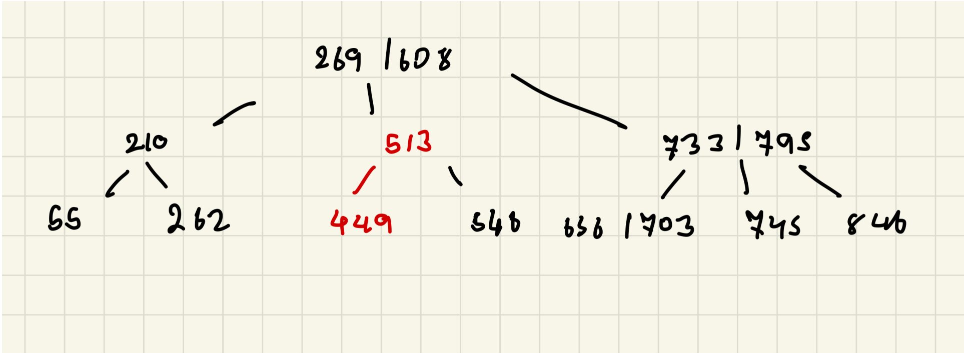


Figure 3.2: Balanced tree after finding replacement by stealing

As you can see in Figure 3.2, the replacements are 513 and 449 which 513 is the new parent node that has 449 and 548 as a child nodes.

$$\alpha_{\mathrm{me}} = a - 1 + 1$$

Chapter 4

B-tree speed