



The second exam will cover all material that we covered in class since the class preceding the first midterm through March 29. The major topic categories are:

- AVL tree deletion, and insertion algorithms
- B-trees
- Hashing and hash tables
- Binary heaps

For each topic, performance analysis is included. For example, the running times of the various insertion and deletion algorithms, or results concerning the sizes or heights of trees, are fair questions to expect on the exam.

The format of the exam includes true/false questions, short answer questions, questions that ask you to analyse algorithm performance or carry out algorithms or code on examples, and questions that ask you to write small amounts of code.

Some sample questions of various types are below.

1. Build a heap from an array containing the keys 30, 40, 25, 60, 75, 23, 86, 12, 72 in that order. Show it as an array and as a binary tree.
2. Show the state of a hash table of size 31 that uses the hash function  $h(x) = x\%31$  with quadratic probing, given that the keys are inserted in the order 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. Determine how many collisions take place and how many total probes are needed.
3. What is the expected number of probes using linear probing in a successful search of a hash table?
4. Write a C++ function to implement a hash function using bit shifting using the middle square method if the word size is 8 bytes and the hash table is of size 4096.
5. True or False? The average number of comparisons to insert  $n$  elements into a binary heap is  $O(n \cdot \log n)$ .
6. What is height of the tallest AVL tree with 32 nodes?
7. What is the least number of nodes in an AVL tree of height 8?
8. Perform a deletion on some AVL tree and do the rotation necessary to rebalance the tree.
9. Write a function, that given a string of lowercase letters of length 8, encodes it as a long integer using Horner's Rule.
10. Choose optimal values for B tree parameters, given a disk block size of 1KB, 32-bit addresses, key size of 16 bytes, and dta size of 128 bytes.