

CS 5040: Data Structures and Algorithms
Final Exam, Summer 2017
100 Points

Saturday July 22, 2017
7:00pm – 9:00pm

Name: _____

Please read before you start the test
Terms and Conditions

Answer only 4 out of 5 questions. If you attempts all 5 questions, only the first 4 questions will be graded for credit.

Add your name to the test file name before you upload the file. For example, "FinalExam-SUM17-AndySmith.doc"

The test is closed book, notes, webpages, electronic materials, calculators, electronic devices, etc... only pencil and eraser.

No collaboration with other people is allowed during the test.

Please hand-write or type your answers in the space given under each question.

Please be elaborate and write very clearly.
If I cannot read the answer, it gets no credit!

Any violation will result in an "F" grade for the course.

Q1 (25 points): Given the following set of numbers, show in details how you apply the Quick Sort algorithm we discussed in the class notes to sort the list in ascending order. Similar to what we did in the class notes, show the partitions and split elements (also called pivots) the algorithm generates during the sorting process.

18 2 27 13 5 8 16 22 3

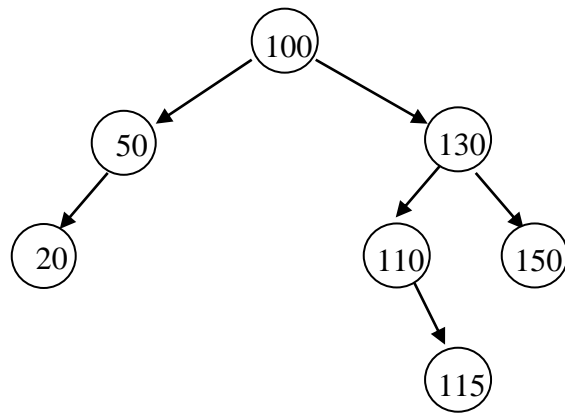
Answer:

Q2 (25 points): Complete the following table for algorithms A, B, and C. The time each algorithm takes to process 10 elements is shown below. For Algorithm C, no need to simplify the answer to its final value. Use the space below the table as work area.

Answer:

Dataset n	Algorithm A $O(n)$	Algorithm B $O(n^3)$	Algorithm C $O(2^n)$
10	5 sec.	10 sec.	5 sec.
30			
200			

Q3 (25 points): Consider the following AVL tree. Show in details how you delete node **50**. Indicate the deletion case number (case 1 or 2 or 3). If re-balancing the tree is required, show in details how you re-balance the tree indicating the re-balancing case number (template) being applied (case 1.a, or 1.b or 2.a or 2.b). Drawing the tree without showing the deletion and re-balancing details receives no points.



Answer:

Q4 (25 points): Consider the following key values:

66 47 87 90 126 140 145 153 177 285 393 395 467 566 620 735

- a) (15 points) Store the key values in a hash table (given below) of size 20 locations (indexed 1 .. 20) using division hashing method and linear probing for collision resolution. Use the table below to store the hashed values. Use the space below as work area.

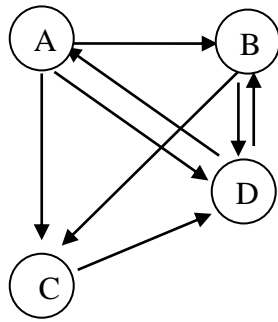
Hash Table:

Index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Key																				

- b) (10 points) Complete the following table showing the number of comparisons needed to find each value using the hash function used in part (a) above.

Value	# of comparisons
66	
467	
566	
735	
285	
87	

Q5 (25 points): Consider the following directed graph G1:



a) (5 points) show the adjacency matrix for graph G1.

b) (20 points) using the adjacency matrix in part a above, show/explain in details (in the space given below) how you manipulate the matrix to determine the following values. Write your answer in the box.

1. (4 points) Total number of paths of length 2 edges (among all nodes).

2. (4 points) Total number of paths of length 1 and 2 edges (among all nodes).

3. (4 points) Total number of cycles of length 2 edges (among all nodes).

4. (4 points) Total number of cycles of length 1 and 2 edges (among all nodes).

5. (2 points) The in-degree of node D?

6. (2 points) The out-degree of node C?

Use space below as work area.

