

Long Questions

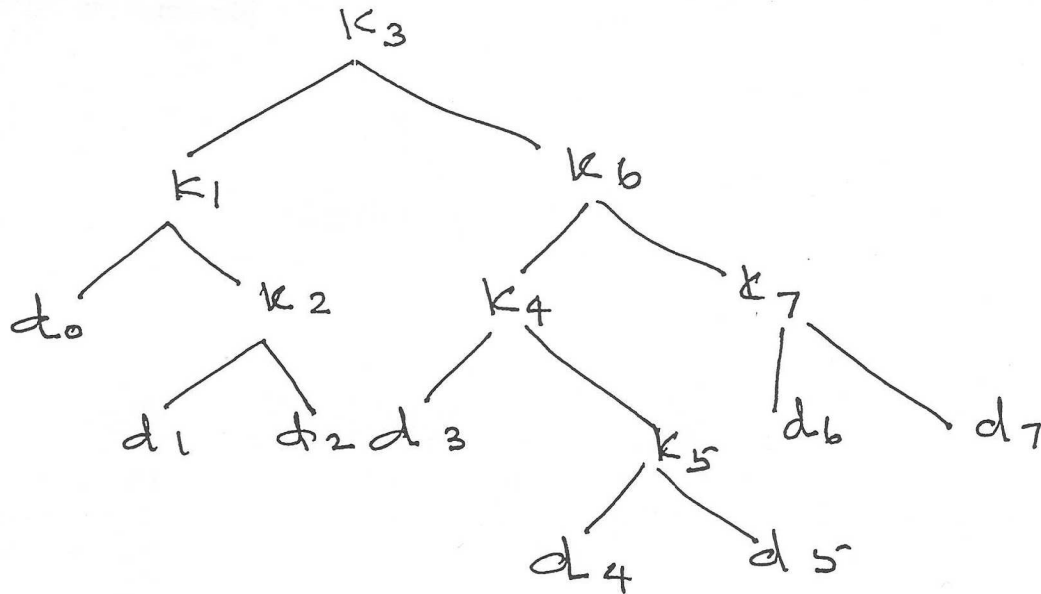
Answer any 3 of 4 questions.

1. a. What is the best tight bound for finding a key k_i out of n keys and what data structure will help you to find such bounds (also state any implicit assumptions if any).

b. Describe how dynamic program is used to construct an optimal binary search tree.

b. Using the following probability of p_i and q_i , obtain the expected cost of searching the binary search tree of Figure 1.

i	0	1	2	3	4	5	6	7
p_i		0.04	0.06	0.08	0.06	0.1	0.12	0.1
q_i	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05



2.A. Explain what do you understand by "principle of optimality"

B. Write down the basic rule that satisfy the principle of optimality and domain related constraints to the following problems.

B1. 0-1 knapsack problem.

B2. Pairwise shortest path problem.

B3. Chain matrix multiplication problem.

3. Compare and contrast P, NP, NP-complete and NP-hard

b. Based on current conjecture, draw a venn diagram to show the relationship among these classes of problem.

c. Suppose there are n clauses and m propositions in a given 3p-sat problem. How many possible interpretations are there? What is the time complexity of testing the satisfiability of a given interpretation? What is the time and space complexity of testing the satisfiability of the clauses.

d. Suppose a single NP-complete problem is solved in polynomial algorithm, what can you state about the entire NP-complete class as well as the NP-hard class.

4. Classify each of the following language as regular, context free but not regular, or decidable but not context free. Prove your answers.

a. $\{ a^{n+1} b^{n-1} c^m : n, m > 0 \}$

b. $\{ a^{2n} b^{2m+1} : n, m \geq 0 \}$

c. $\{ a^{n+1} b^{n-1} c^n : n, m \geq 0 \}$

Algorithm and Theory of Computation

Short Questions

Answer all the questions

1. The time complexity of algorithm 1 and algorithm 2 to solve the same problem is given respectively $O(n^2)$ and $O(n^3)$.
 - a. Which algorithm would you choose to solve the problem.
 - b. If the running time of algorithm 1, and algorithm 2 are respectively $T(n) = 1000 n^2$ and $T(n) = 2 n^3$, which algorithm would you choose. Explain your rationale.
2. Briefly describe when divide and conquer strategy can be applied to solve problem?
- B. Can you effectively apply divide and conquer strategy to solve the following problems (explain why or why not)
 - I. minimum spanning tree
 - II. 0-1 knapsack problem
 - III. Merge sort
3. Find the tight bounds of the following sums.
 - a. $\sum_{i=1}^n i^k$ where k is a constant
 - b. $\sum_{i=1}^n i \log i$
4. a. Briefly describe what is understood by union-find problem?
 - b. How does binomial tree help to solve union find problem.
 - c. How many nodes are there in a binomial tree of order k .
 - d. If you remove a node from a binomial tree of order k , how many binomial trees will be created?
5. Briefly describe priority queue. What is the preferred data structure for implementing priority queue? Obtain the time complexity of building a priority queue of N integers.
6. Briefly describe what is dynamic programming. Can you apply this technique to solve any optimization problem? If yes explain why, if not what particular conditions must be met.
7. What is the strategy behind greedy algorithm? Will it always provide an optimal solution? Explain why and why not.
 - b. What are the differences between Prim's and Kruskal's algorithm in solving minimum spanning tree?