

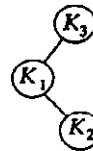
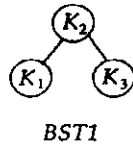
國立臺灣科技大學
八十七學年度碩士班招生考試試題

所 別： 電機工程技術研究所
學程別：

組別： 計算機組

科目： 資料結構

1. Consider three keys K_1 , K_2 , and K_3 , such that $K_1 < K_2 < K_3$. Two of the possible binary search trees, $BST1$ and $BST2$, are shown below:



Let p_i denote the probability of retrieving key K_i , $1 \leq i \leq 3$. Assume $p_2 = 0.3$ and all key retrievals are successful, that is, the probability of any unsuccessful retrieval is zero. Is it possible that $BST2$ is better than $BST1$ in terms of the average number of key comparisons for a retrieval? If the answer is yes, specify the condition for the situation to happen. [14%]

2. A *descending priority queue* is a data structure into which new items can be inserted in an arbitrary order and from which each deletion removes the item with the largest value in the information field. Consider a descending priority queue whose information field consists of an integer. Compare the efficiency, in terms of *time complexity*, of the implementations of the descending priority queue using the following two different types of linked lists: *unordered* linked list and *ordered* linked list. [13%]
3. (a) Describe the fundamental concept of hashing technique. [7%]
 (b) Given a sequence of keys as follows: 18, 28, 36, 75, 15, 26, 47, 24, and a division hash function $f(x) = x \text{ mod } 9$, show the resulting hash table provided that linear open addressing technique is used to handle overflow and each bucket has one slot. [8%]
4. Suppose that *QuickSort* is used to sort a file into nondecreasing order. Analyze the time complexity of *QuickSort* if the file is originally in nonincreasing order. [8%]
5. Show how to implement three stacks in one array. [8%]
6. A full node is a node with two children. Prove that the number of full nodes plus one is equal to the number of leaves in a binary tree. [10%]
7. (a) Construct a Huffman tree from the following set of frequencies. (Always put the smaller subtree to the left. If there is a tie, put the leaf to the left.) [8%]
- | | | | | | | | | |
|-------------|---|---|---|---|---|---|---|---|
| Letters | a | e | i | o | u | s | t | b |
| Frequencies | 1 | 3 | 5 | 2 | 4 | 6 | 7 | 8 |
- (b) Encode the following message, based upon the Huffman tree in part (a).
 Message: betitasisitis [8%]
8. (a) Prove that any comparison-based algorithm to sort 5 elements requires 7 comparisons. [8%]
 (b) Give an algorithm to sort 5 elements with 7 comparisons. [8%]