

國立中央大學101學年度碩士班考試入學試題卷

所別：資訊管理學系碩士班 丙組(一般生) 科目：資料結構 共 2 頁 第 / 頁

本科考試禁用計算器

\*請在試卷答案卷(卡)內作答

1. Please describe the steps of constructing a binary tree. Then, please use the following data, which include 26, 48, 19, 7, 11, to build a binary tree based on the steps you describe. (25 points)
  
2. The elements in a linked list are called nodes, each of which is a structure that contains at least two fields: one for the data and the other for the address of the next node in the sequence. The data field has the useful information (the data) to be processed, and the link field contains a pointer to identify the next node in the list. A pseudocode is part English, part structured code.
  - (a) Write a pseudocode algorithm, called the "createList", to create a linked list which is an empty list. The pseudocode of "createList" must at least consider two metadata entries: the head pointer and the count of elements in the list. Explain your pseudocode in detail. (10 points)
  - (b) Write another pseudocode algorithm, called "insertNode", to insert linked-list node. For the pseudocode, you must consider at least the following conditions: memory overflow, adding before first node or to empty list, and adding in middle or at end. Explain your pseudocode in detail. (15 points)
  
3. Suppose we have two stacks and no other temporary variable. Please "construct" a queue data structure using only the two stacks.
  - (a) describe your idea first for how your queue can operate (5 points)
  - (b) write a pseudo-program to demonstrate your described idea. (10 points)
  
4. Suppose you have an array of  $N$  elements, containing only 2 distinct keys, true and false. Give an  $O(N)$  algorithm to sort the array by describing your idea first, write a pseudo-program to demonstrate your idea, and explain why your program is of  $O(N)$  complexity. (10 points)

注意：背面有試題

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5. The height of an AVL tree  $T$  is 9. What is the minimum number of nodes in  $T$ ? (5 points)
  
6. A tridiagonal matrix is a kind of sparse matrix. In a tridiagonal matrix  $A$  of size  $n$ -by- $n$ ,  $A[i,j]=0$  if the absolute value of  $i-j$  is greater than 1.
  - (a) What is the maximum number of nonzero elements in  $A$ ? (5 points)
  - (b) Suppose that a linear array  $B$ , in the row-major, is used to store  $A[i,j]$  if the absolute value of  $i-j$  is 1 or less. The first element of  $A$  is  $A[1,1]$ , which is stored in  $B[1]$ . Suppose that  $A[i,j]$  is stored in  $B[x]$ . What is the formula for calculating the index  $x$ ? (5 points)
  
7. Let  $T$  be a 2-3 tree of height  $h$ .
  - (a) What is the possible number of leaves? (5 points)
  - (b) Prove your answer to (a). (5 points)

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