題號： 257
科目：資料結構(A)
節次： 4

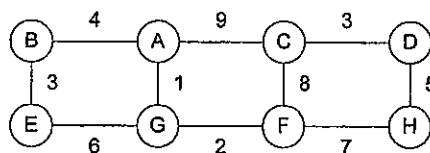國立臺灣大學 103 學年度碩士班招生考試試題

題號： 257
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1. **(15 %)** Write a recursive C/C++/Java program that will check if an array A of integers contains an integer $A[i]$ that is the sum of two integers that appear earlier in A, i.e., $A[i] = A[j] + A[k]$ for $j, k < i$. (10 %)   What is the running time of this function? (5 %)

2. **(10 %)** For a tree T, let n_I denote the number of its internal nodes, and let n_E denote the number of its external nodes.   Show that if every internal node in T has exactly 3 children, then $n_E = 2n_I + 1$.

3. **(10 %)** Let T be a tree with n nodes.   Define the lowest common ancestor (LCA) between two nodes v and w as the lowest node in T that has both v and w as descendants (where we allow a node to be a descendant of itself).   Given two nodes v and w, describe in pseudo code an efficient algorithm for finding the LCA of v and w.

4. **(15 %)** Write a C/C++/Java function that swaps (exchanges) two nodes in a singly linked list.   The nodes are identified by number and are passed as parameters.   For example, to exchange nodes 5 and 8, you would call $swap(5, 8)$.   If the exchange is successful, the algorithm returns 1.   If it encounters an error, such as invalid node numbers, it returns 0.

5. **(10 %)** The binary search tree shown below was created by starting with a null tree and entering data from the keyboard.   In what sequence were the data entered?   If there is more than one possible sequence, identify the alternatives.
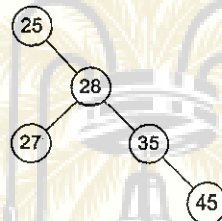
6. **(15 %)** Give a sequence of integers in an array shown as follows:

   9 4 19 6 1 12 7 3

   Show each step of sorting as the array is sorted into ascending order using:
   a. Mergesort sorting. (6 %)
   b. In-place heapsort. (9 %)

7. **(10 %)** Draw the following 2-3-4 tree after execution of the operation insert(30).
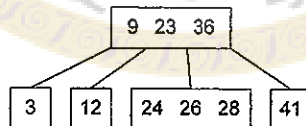
8. **(15 %)** For the weighted graph shown below, answer the following questions.
   a. Find all noncyclic paths from A to H. (5 %)
   b. Give the adjacency matrix representation of the graph. (5 %)
   c. Find the minimum spanning tree of the graph. (5 %)

試題隨卷繳回