本考科禁用計算機

Data Structures

(1) (10%) Transfer the infix expression $A/B - C + D * E - A * C$ to the postfix expression.

(2) (10%) Consider the collection of edges selected by Dijkstra's algorithm as the shortest paths to the graph's vertices from the start vertex. Do these edges form a spanning tree? Do these edges form a minimum spanning tree?

(3) (15%) For a full binary tree with n internal nodes, let I be the sum of the depths of all internal nodes and E be the sum of the depths of all leaf nodes. Prove that $E = I + 2n$ for $n \geq 0$.

(4) (15%) Build the max-heap step by step for the following values stored in an array:

$$7, \ 5, \ 8, \ 3, \ 2, \ 1, \ 4, \ 6$$

(5) (15%) A common problem for compilers and text editors is to determine if the parentheses in a string are balanced and properly nested. Give an algorithm that returns **true** if a string contains properly nested and balanced parentheses, and **false** otherwise.

(6) (15%) Write an algorithm to determine whether an undirected graph of n vertices and m edges contains a cycle. What is the time complexity of your algorithm?

(7) (20%) Which of the following operations are best implemented by first sorting the list of numbers? Briefly describe your reason for each operation.
　(a) Find the minimum value.
　(b) Find the medium.
　(c) Find the value that appears the most times.
　(d) Compute the arithmetic mean.