注意事項：

1. 本試題除各題另有限制之外，可使用 Pseudo Code，Java、C 或 C++作答。
2. 請依題號序作答於答案紙。作答時可不必抄題，但請務必將各題之完整題號(例：*(1-A)*或*(2-B)*等等)標示清楚。
3. 本試題共計二頁。配分標示於各題或各小題。不可使用電子計算機。

試題：

(1) Briefly explain the following terms: (本題 15 分，各小題 3 分)

(1-A) Strongly connected graph　(1-B) LR rotation

(1-C) Splay ree　(1-D) Linear open addressing

(1-E) NP-Complete

(2) A palindrome is a word or phrase that reads the same backwards as forwards, e.g. *madam* and *nurses run* are palindromes. Please answer the following:

(2-A) Design an algorithm or program, using only the data structure of stack if needed, to test whether a given ***n***-character string is a palindrome. (本小題 10 分)

(2-B) What is the time complexity of your algorithm or program in (2-A)? Please explain briefly. (本小題 5 分)

(2-C) What is the possible best time complexity of an algorithm that can test whether a given ***n***-character string is a palindrome? Please give your reason. (本小題 5 分)

(3) Given a binary tree T of 16 nodes with root node A, let A_L and A_R stand for the left subtree and right subtree of A respectively. How many different structures can T assume under the conditions given separately in the following?

(3-A) if (i) the height of T is 9, and (ii) the height of A_L is 3 and (iii) the pre-order traversal of A_R gives the same node sequence as the in-order traversal of A_R. (本小題 5 分)

(3-B) if A_L has 3 more nodes than A_R. (本小題 5 分)

(3-C) if A_L is a complete binary tree of height 4. (本小題 5 分)

(3-D) if A_R is a full binary tree. (本小題 5 分)

(4) Solve the following *recurrence equations* by giving a general solution:

(4-A) $T(n) = a_n T(n\text{-}1) + b_n$ (本小題 5 分)

(4-B) $T(n+1) = 2\,T(n) - T(n\text{-}1)$　$n \geq 1$ and $T(0) = 1$; $T(1) = 5$ (本小題 10 分)

(5) Proof or disproof the following: (本題 10 分，各小題 5 分)

(5-A) If $f_1(n) = O(g_1(n))$ and $f_2(n) = O(g_2(n))$, then $f_1(n) \times f_2(n) = O(g_1(n) \times g_2(n))$.

(5-B) If $f(n) = \sqrt{n}$ and $g(n) = \log n$, then $f(n) + g(n) = O(\sqrt{n})$.

(背面仍有題目,請繼續作答)

(6) Answer **True** of **False** for each the following statements on sorting algorithms.
(本題 5 分，各小題 1 分)

(6-A) Shell sort is a stable sorting algorithm.

(6-B) Merge sort is suitable for external sorting.

(6-C) The time complexity for comparison-based sorting algorithm is $\Omega(n \log n)$.

(6-D) Radix sort requires the minimum data space.

(6-E) The conditions of worst case are the same for bubble sort and quick sort.

(7) Answer **True** of **False** for each the following statements on searching.
(本題 5 分，各小題 1 分)

(7-A) When there is duplication among primary keys, binary search can be used.

(7-B) The time complexity of binary search is the same as searching with binary search tree.

(7-C) ISAM guarantees good performance when there is no insertion and deletion.

(7-D) No matter what the size of dictionary is, binary search guarantees better performance than linear search.

(7-E) Hashing is always the most efficient among all searching algorithms.

(8) Given a connected undirected graph $G = (V, E)$ and $|V| > 1$. Let $Path(i, j)$ denote the simple path between node i and node j. The length of $Path(i, j)$ is denoted by $L(i, j)$ which is defined as the number of edges in $Path(i, j)$. Let $BFS(i)$ and $DFS(i)$ denote the outcome of visiting all nodes in a graph G starting from node i by *breadth-first search* and *depth-first search* respectively. Please answer the following based on the further given conditions: (本題 10 分)

(8-A) if G is acyclic and $V = \{ A, B, C, D, E, F \}$ and $BFS(A) = DFS(A)$, give a possible example of G. (本小題 2 分)

(8-B) For the graph shown at right, if $M = \{ v \mid v \in V \text{ and } BFS(v) = DFS(v) \}$, then M = ? (本小題 4 分)

(8-C) Show one example of the possible minimum spanning trees of the graph shown at right. (本小題 2 分)

(8-D) For all $u, v \in V$ and $u \neq v$, let $L1 = \max(L(u, v))$ and $L2 = \min(L(u, v))$, then $(L1 - L2) = ?$ (本小題 2 分)