說明：程式部分請以 C 語言或 virtual code 撰寫。

1 (10%) Write a recursive program for binary search. That is, given a list of elements b[0], b[1], ..., b[n-1], you need to search for a particular element X in the list using the binary search strategy.

2 (10%) Answer the following questions about complexity.

    a (5%) Define the "Big-O" notation. What does $f(n) = O(g(n))$ mean?

    b (5%) What is $6*2^n+n^2$ under the "Big O" notation?

3 (10%) Show how to define the data structure of a circular queue using an array. Show how to add an element and how to delete an element from the queue.

4 (10%) You are given the binary expression: a / b - c + d * (e - a * c)

    a (5%) What is its postfix expression?

    b (5%) What is its prefix expression?

5 (10%) Suppose we want to use a linked list to represent a polynomial (for example, $P(x) = 3x^{14} + 2x^8 + 5x^2 + 1$).

    a (5%) Define its data structure.

    b (5%) Write a program to multiply the polynomial by x^2. For example, $x^2 * P(x) = 3x^{16} + 2x^{10} + 5x^4 + x^2$.

6 (20%) Answer the following questions about trees.

    a (5%) Show how to use "left-child-right-sibling" to represent a tree.

    b (5%) What is a complete binary tree?

    c (5%) What is a full binary tree?

    d (5%) How to use an array to represent a complete binary tree?

7 (10%) Define a heap. Show how to insert a node to a heap. Show how to delete a node from a heap.

8 (10%) Show how to represent a graph by an adjacency matrix.

9 (10%) Define "depth-first search" and "breadth-first search".