PE424001 Algorithm and Data Structure
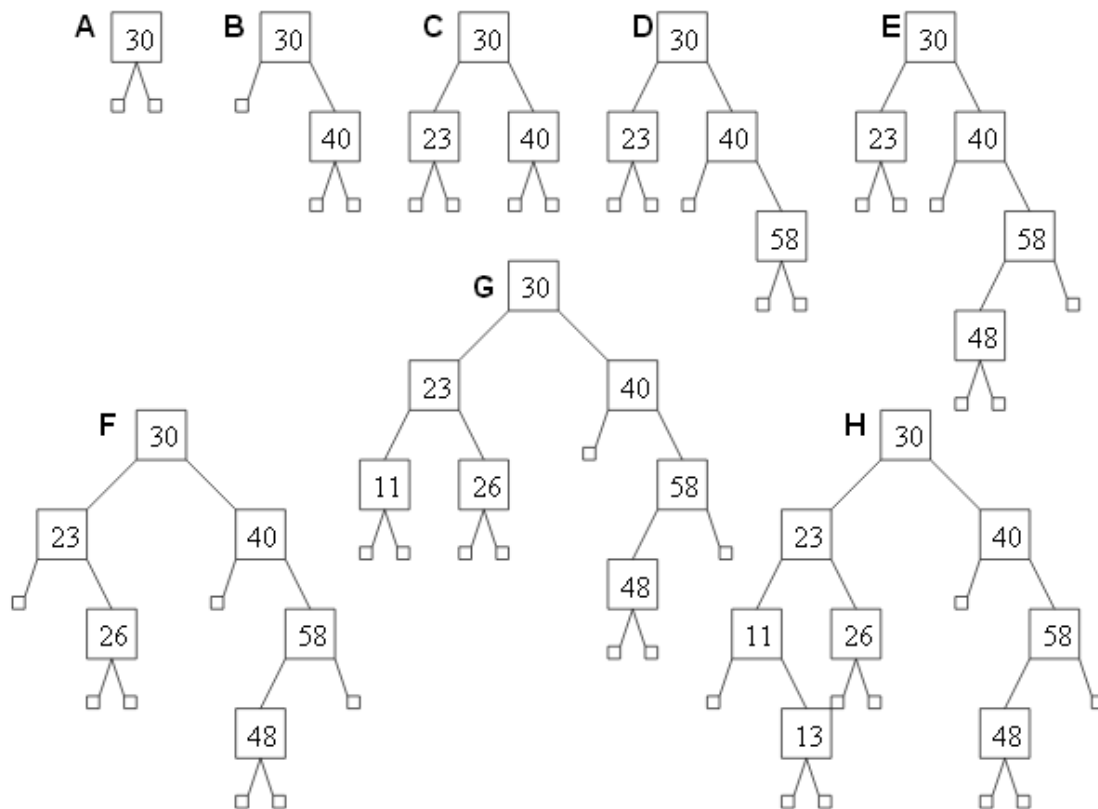# Assignment 1
(25% of the module score)

1. (9 Marks)

   A) Insert into an initially empty binary search tree items with the following keys (in this order): 30, 40, 23, 58, 48, 26, 11, 13. Draw the tree after each insertion. (3 Marks)

Answer key:

B) Remove from the binary search tree (Figure 1) in the following keys (in this order): 65, 76, 88, 97. Draw the tree after each removal. (3 Marks)
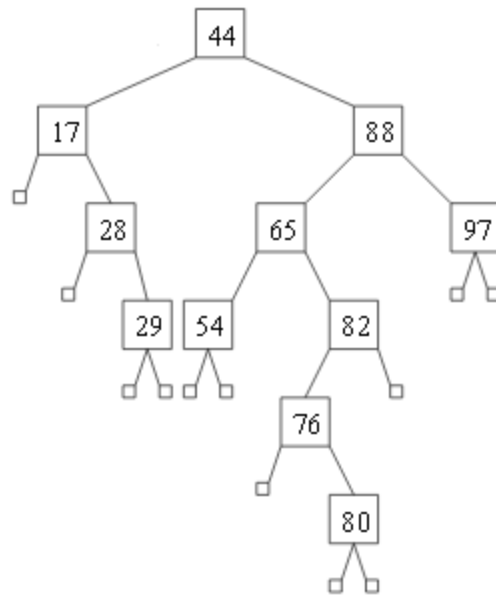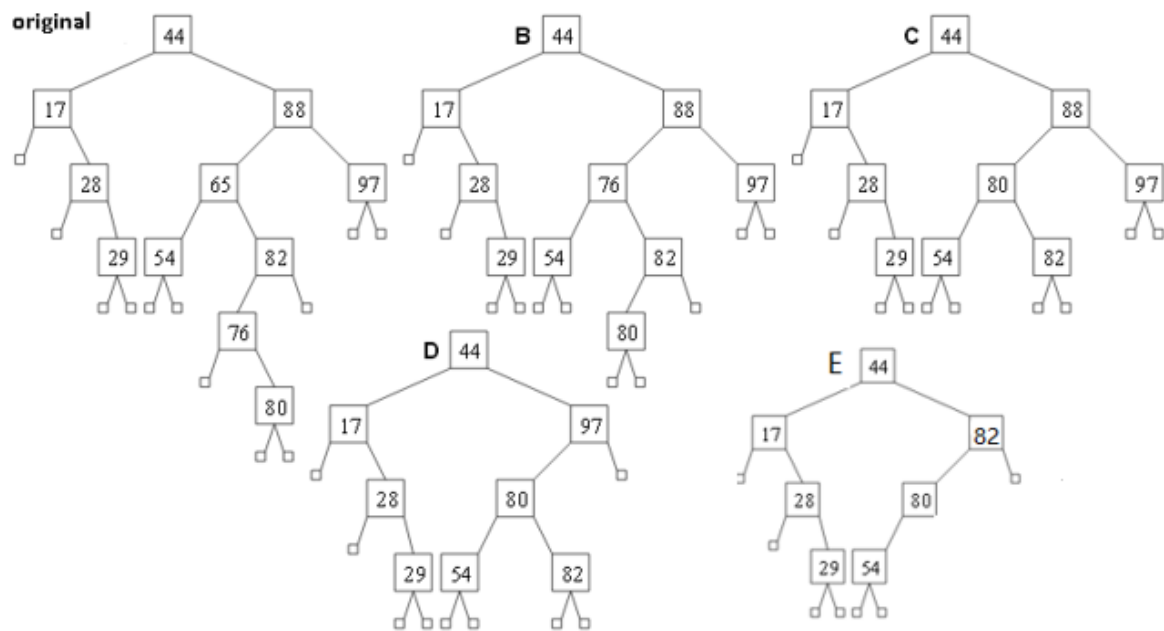
Figure 1 Tree for Q1B

Answer key:

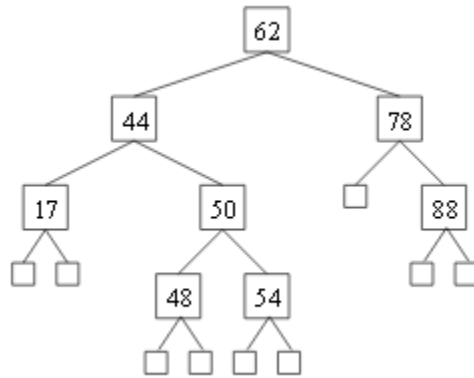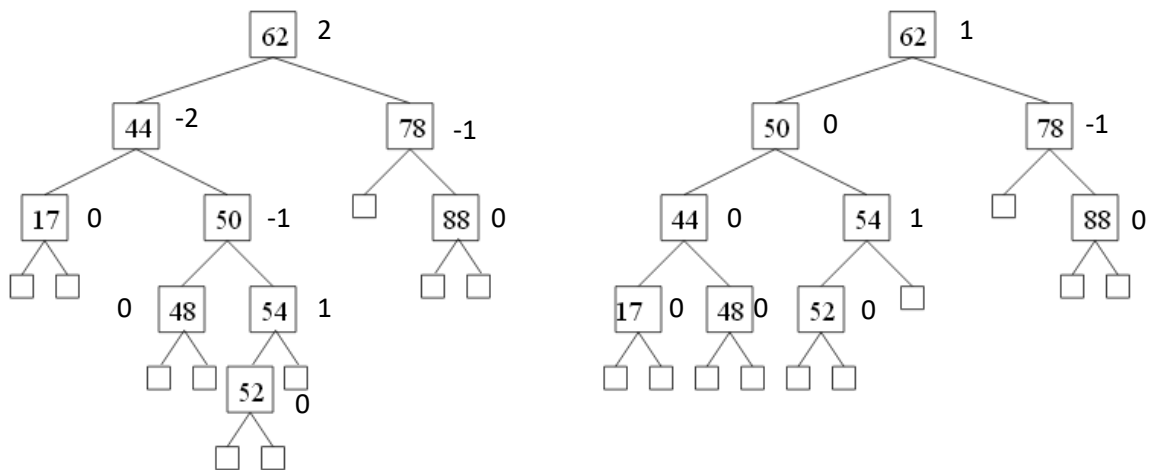C) (3 Marks) Given a tree (Figure 2)

Figure 2 Tree for Q1C

Draw the AVL tree with balancing factors resulting from the insertion of an item with a key 52 into the AVL tree

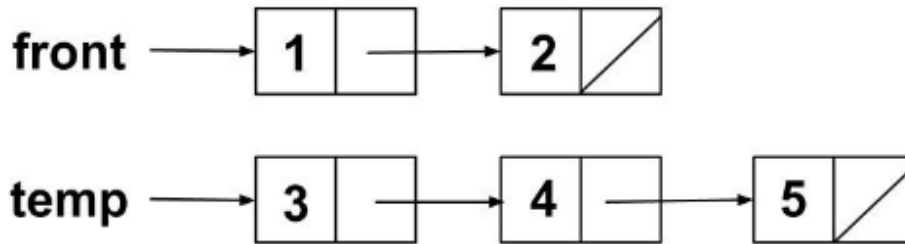Answer key:

2.   (9 Marks)

Before

Figure 3 Two linked list structures

A) Given pointers front, temp and current (not shown in figure) of a linked list data
   structure. Write down the node connection after each of the operation below. For
   example,
   front.next.next=temp the node connection becomes 2 -> 3

   i)   *current = front.next*; (0.5 Mark)
   ii) *front.next = temp.next.next;* (0.5 Mark)
   iii) *temp.next.next = front;* (0.5 Mark)
   iv) *current.next = temp.next;* (0.5 Mark)
   v)   *temp.next = current;* (0.5 Mark)
   vi) *front = temp;* (0.5 Mark)
   vii) Draw the final linked list structure after the above (step i to vi) steps. (2 Marks)

Answer key:
        i) current -> 2
        ii) 1 -> 5
        iii) 4 -> 1
        iv) 2 -> 4
        v) 3 -> 2
        vi) front -> 3

vii)
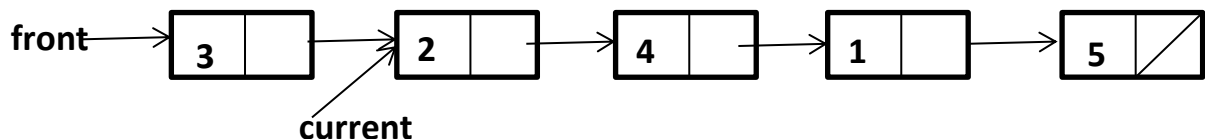
B) Figure 4 shows a linked list data structure with data, address and pointers in each node.
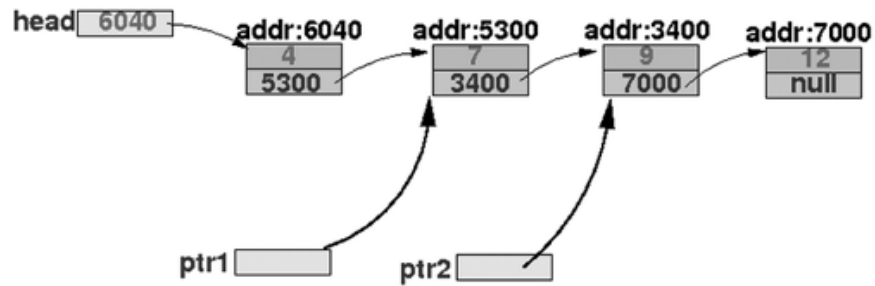
Figure 4 Linked list structure with data and pointers

i) Write one code segment (see below) so that node with data '9' will be removed. (2 Marks)

//Code segment for Q2 B i)

if ('9' was found in the list)

  {

Ptr1.next = ptr2.next   *// This will delete the node with data '9'*

  }

  else

  {

    // do nothing !

  }

C) What are the advantage and disadvantage of using linked list to store data over array? (2 Marks)

Answer key:
Advantage: Can store multiple data types such as integer, character

3.   (7 Marks) Given an input array

[5 2 6 1 7 9 4 3]

a)   Trace the action of:
   1   Selection Sort (All steps correct 1 Marks)
   2   Bubble Sort (All steps correct 1 Marks)
   3   Insertion Sort (All steps correct 1 Marks)

Answer key:
   Selection Sort

Original	5 2 6 1 7 9 4 3
	1 2 6 5 7 9 4 3
	1 **2** 6 5 7 9 4 3
	1 2 **3** 5 7 9 4 6
	1 2 3 **4** 7 9 5 6
	1 2 3 4 **5** 9 7 6
	1 2 3 4 5 **6** 7 9
	1 2 3 4 5 6 **7** 9

Bubble Sort

Original	5 2 6 1 7 9 4 3
	2 5 6 1 7 9 4 3
	2 5 1 6 7 9 4 3
	2 5 1 6 7 4 9 3
	2 5 1 6 7 4 3 9
	2 1 5 6 7 4 3 9
	2 1 5 6 4 7 3 9
	2 1 5 6 4 3 7 9
	1 2 5 6 4 3 7 9
	1 2 5 4 6 3 7 9
	1 2 5 4 3 6 7 9
	1 2 4 5 4 6 7 9
	1 2 4 3 5 6 7 9
	1 2 3 4 5 6 7 9

Insertion Sort

5
2 5
2 5 6
1 2 5 6
1 2 5 6 7
1 2 5 6 7 9
1 2 4 5 6 7 9

b) Discuss the worst case of Bubble Sort in terms of Big-O. (2 Marks)

Answer key: The worst case of bubble sort is when we need to sort an array arranged in descending order to be sorted in ascending order or vice versa. Consider the case of an array in order 5, 4, 3, 2, 1 and we need to use bubble sort to sort this array in ascending order. In this case the algorithm makes maximum number of comparisons along with maximum number of element exchanges. Hence the algorithm gives its worst performance with complexity in order of $O(n^2)$.

c) Compare the below sorting algorithms **worst** performance in terms of Big-O (All correct 2 Marks)

QuickSort	Selection Sort	Insertion Sort

Answer key:

QuickSort	Selection Sort	Insertion Sort
$O(n^2)$	$O(n^2)$	$O(n^2)$

Submission

- DEADLINE: 22:00:00 29th July, 2021

- Submission method:

1. Zip up all the files and name the zip file to **"[Last name]_[First name].zip".** (E.g. Chan_Peter.zip)
2. Send the zip file to alexng88@vtc.edu.hk
3. Enter "ADS Assignment 1 Submission – [Last name] [First name]" in the subject.
4. Marks will be deducted if you don't follow the submission method.

Marks will be deducted on late submission.

1 week	Your marks x 90%
2 weeks	Your marks x 80%
More than 2 weeks	Your marks x 0%

Marking Scheme

This assignment contributes 25% of the final grade of PE424001
The full mark for this assignment is 25 marks, which break down into:

- Question 1 & 2 contributes 9 marks each.

-Question 3 contributes 7 marks.

- End -