

### Data Structures

1. (Terminology)

Explain the following terms.

- A. (5%) Binary tree
- B. (5%) Kruskal's algorithm
- C. (5%) Static hashing
- D. (5%) B-tree

2. (Bubble Sort)

A. (10%) Give the algorithm of bubble sort to sort an array into ascending order. You may choose to write in C, C++, Java, or pseudo code.

B. (10%) Start with the following initial array. Use the algorithm you give in the above to sort the array.

i. Initial array:

5	7	3	1	9
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ii. After 1<sup>st</sup> iteration:

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iii. After 2<sup>nd</sup> iteration:

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iv. After 3<sup>rd</sup> iteration:

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v. After 4<sup>th</sup> iteration:

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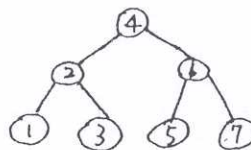
vi. After 5<sup>th</sup> iteration:

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3. (Binary Search Tree)

A. (10%) Give an algorithm to remove a node from a binary search tree. You may choose to write in C, C++, Java, or pseudo code.

B. (10%) Use the algorithm you give in the above to remove the node of key 4 from the following binary search tree.



4. (Data Structures for Polynomial Representation)  
A polynode contains three fields as follows.

coef	exp	link
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For instance, the polynomials  $a = 3x^{14} + 2x^8 + 1$  and  $b = 8x^{14} - 3x^{10} + 10x^6$  would be stored as shown in the following.

- A. (10%) Compute  $c = a * b$ . Show how  $c$  would be stored in this data structure.  
B. (10%) Write a function *operator\** to compute the product of two polynomials. You may choose to write in C, C++, Java, or pseudo code. You may assume the nodes are sorted on *exp* field in descending order.

5. (Min Heaps)

- A. (5%) Draw a diagram of a min-heap that stores keys 1, 2, 3, 4, 5, 6, 7, 8, and 9.  
B. (10%) Give an algorithm to delete the min element of a min-heap. You may choose to write in C, C++, Java, or pseudo code.  
C. (5%) Draw a diagram to show the result after deleting the min element of the min-heap in problem 5A.