Computer Science Foundation Exam

December 16, 2006

Computer Science

Section 1A

Q1	8	KNW	
Q2	12	CMP	
Q3	12	CMP	
Q4	8	KNW	
Q5	10	CMP	
Total	50		

SOLUTION KEY

1. [8 pts] It takes 72 ms for an O(N log N) algorithm to execute a task for 8 data elements. How much time would it take when the data size is increased 8 times?

72 = c 8 log 8
x = c 64 log 64 **[3 pts for this step]**

72 = c 8 (3)
x = c 64 (6) **[3 pts for this step]**

x / 72 = 64 (6) / 8(3)

x /72 = 8(2)

x = 72 (16) = 1152ms **[2 pts for this step]**

2. [**12 pts**] Transform the following infix expression into its equivalent postfix expression using a stack. Show the contents of the stack at the indicated points 1, 2 and 3 in the infix expressions.

1 2 3

P / (B + S * T) + M – N / R * K – A * F

+		
(		*
/	+	–
1	2	3

[3 pts for each stack outputs]

Resulting Postfix Expression :

P	B	S	T	*	+	/	M	+	N	R	/	K	*	–	A	F	*	–	

[3 pts for correct post fix expression, partial credits may be awarded]

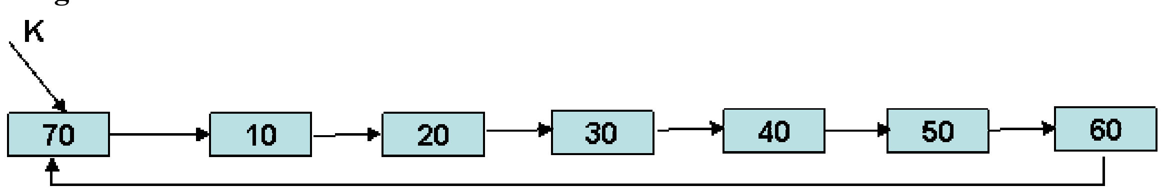
3. [**12 pts**] K is a circular linked list, with following node structure:

```
struct node {
     int value;
     struct node * link;
};
```

Assume K contains the elements 70, 10, 20, 30, 40, 50, 60 with K pointing to 70. Further assume A to be an array of size 10 to hold integers, whose every element is initialized to zero. Draw the linked list K and show the contents of the first 10 positions of the array A after the call *K = transfer (K, A, 0);* is made. The function *transfer* is defined below.

```
struct  node * transfer( struct  node *p, int A[ ], int j){
        struct  node  *s, *x;
        s = p -> link;
        x = s -> link;
        if ( p != s)
        {
                s-> link = x -> link;
                A[j] = x -> value;
                free( x );
                j++;
                p =transfer ( s->link, A, j);
                }
        return p;
}
```

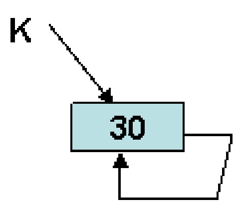
Original Linked List



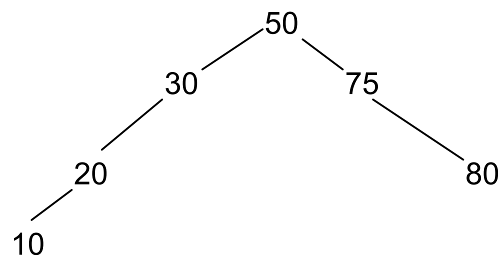
Show the contents of the array : **[6 points for 6 array entries]**

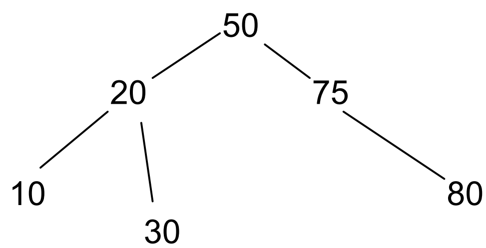
20	50	10	60	40	70	0	0	0	0

Draw the final linked list : **[6 points for correct linked list drawing]**

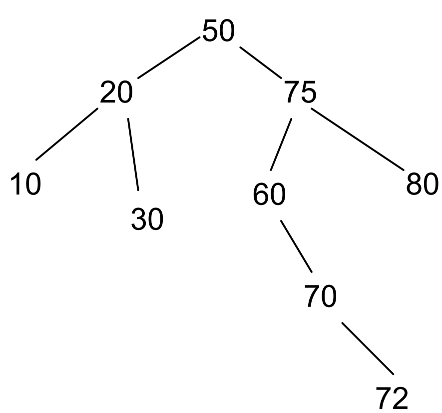


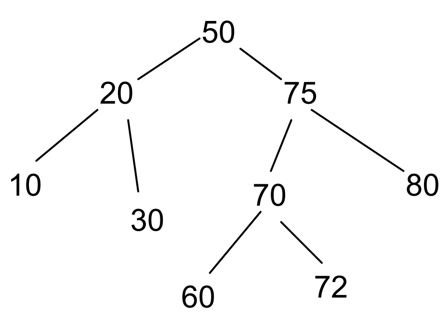
4. [8 pts] Insert the integers 50, 30, 75, 80, 20, 10, 60, 70, 72 to an initially empty AVL tree in order. Draw the state of the AVL tree before and after each necessary rotation.





[4 points]





[4 points]

5. [**10 pts**] Use the Quicksort method on the following array to sort it in increasing order. Choose the first element as the pivot, and show how the pivot helps in partitioning the array in two parts. Write down the two sub arrays that you get after the first partitioning. You do not have to carry on sorting after that.

```
[ 63  80  50  75  42  85  20  89  33  96 ]
      L                                R
                                   R
SWAP
[ 63  33  50  75  42  85  20  89  80  96 ] [3 PTS]
       L                           R
               L           R

[ 63  33  50  20  42  85  75  89  80  96 ]  [2 PTS]
               L           R
                   R
                   L
SWAP THIS WITH THE PIVOT

[ [42  33  50  20]  63 [85  75  89  80  96]] [3 PTS]
```

The two sub arrays are
[42   33   50   20]

and

[85   75   89   80   96]   **[2 PTS]**