NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

SC1007 Data Structures and Algorithms

Tutorial 4: Analysis of Algorithm

Q1 The function subset() below takes two linked lists of integers and determines whether the first is a subset of the second. Give the worst-case running time of subset as a function of the lengths of the two lists. When will this worst case happen?

```
typedef struct _listnode{
  int item;
  struct _listnode *next;
} ListNode;

//Check whether integer X is an element of linked list Q
int element (int X, ListNode* Q)
{
  int found;  //Flag whether X has been found
  found = 0;
  while ( Q != NULL && !found) {
     found = Q->item == X;
     Q = Q->next;
  }
  return found;
}

// Check whether L is a subset of M
int subset (ListNode* L, ListNode* M)
{
  int success; // Flag whether L is a subset so far
  success = 1;
  while ( L != NULL && success) {
      success = element(L->item, M);
      L = L->next;
  }
  return success;
}
```

Q2 Find the number of printf used in the following functions. Write down its time complexity in Θ notation in terms of N.

```
void Q2a (int N)
{
   int j, k;
   for (j=1; j<=N;j*=3)
       for(k=1;k<=N; k*=2)
           printf("SC1007\n");
}
```

```
1   void Q2b (int N)
2  {
3     int i;
4     if(N>0)
5     {
6          for(i=0;i<N;i++)
7              printf("SC1007\n");
8          Q2b(N-1);
9          Q2b(N-1);
10    }
11 }
```

Q3 A sequence, $x_1, x_2, \ldots, x_n$, is said to be cyclically sorted if the smallest number in the sequence is x_i for some i, and the sequence, $x_i, x_{i+1}, \ldots, x_n, x_1, x_2, \ldots, x_{i-1}$ is sorted in increasing order. Design an algorithm to find the minimal element in the sequence in $\mathcal{O}(\log n)$ time. What is the worst-case scenario?