Review

What is the **variable space** requirement?

$f(n) = n * f(n\text{-}1)$ for $n > 1$

$f(n) = 1$ for $n <= 1$

Given that *n*=*N*, the size of the input parameter=*K*, and the size of return address=*M*.

Q1: • **Iterative**

```
double iterFact(int n)
{   int i;
    double answer;
    if ((n == 0) || (n == 1)) return 1.0;
    answer = 1.0;
    for (i = n; i > 1; i--)
       answer *= i;
    return answer;
}
```

Ans: 0

Q2: • **Recursive**

```
double recurFact(int n)
{
  if ((n==0) || (n==1))  return 1.0;
  return n*recurFact(n-1);
}
```

n=2,3,…,N: size += K; size += M

n=1: size += K; size += M

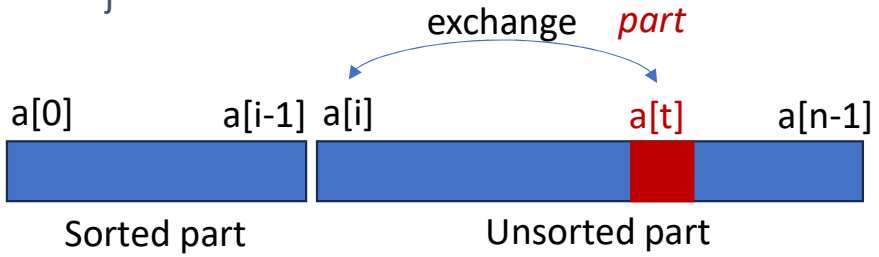
Total: N*(K+M)

What is the time complexity?

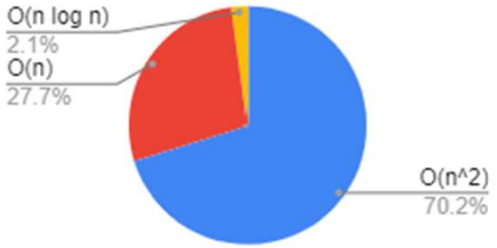
- **Selection sort**

```
for (i = 0; i < n-1; i++)
  {  /*Find the minimum element in a[i:n-1]*/
     int t = i;
     for (j = i+1; j < n; j++)
        if (a[j] < a[t])
           t = j;
      /* Swap the minimum element with the a[i]*/
     if(t != i)
        swap(&a[t], &a[i]);
  }
```

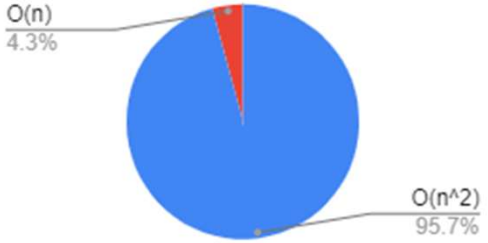
Select the minimum element in unsorted part



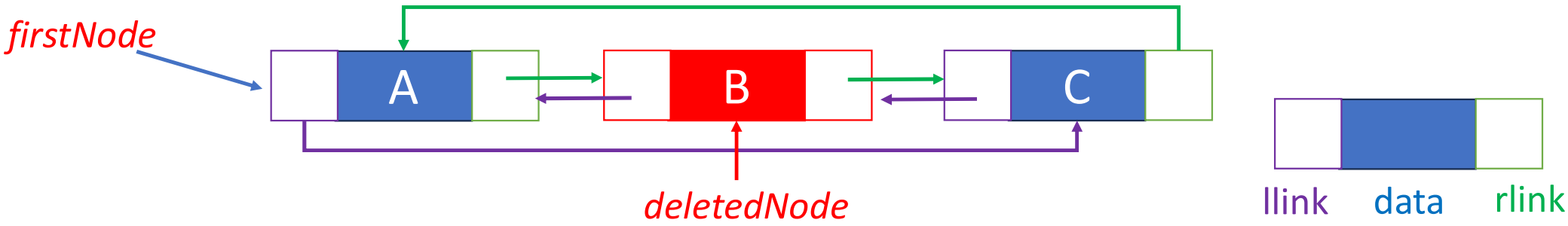
- Q3: Given a list in **increasing** order, what is the time complexity of selection sort?



- Q4: Given a list in **decreasing** order, what is the time complexity of selection sort?



Deleting the node containing “B” (*deletedNode*)



- Q5: Please describe the procedure to remove *deletedNode* from the doubly circular linked list. The node includes three fields: llink, data, and rlink.

```
deletedNode->llink->rlink = deletedNode->rlink;
deletedNode->rlink->llink = deletedNode->llink;
free(deletedNode);
```

How do we improve these answers?

把要刪除的左邊元素rlink連到右邊元素，
右邊元素的llink連到左邊元素

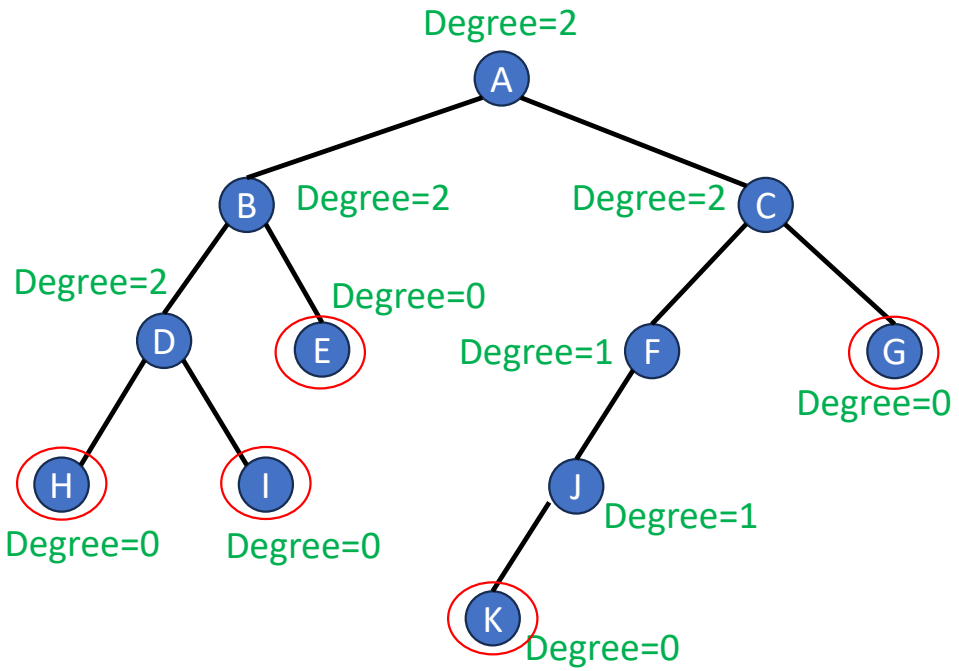
Delete link between AB and between BC.
Link rlink of A to C
Link llink of C to A

前一個的rlink 指向下一個
下一個的llink 指向前一個

C->leftlink=B->leftlink;
A->rightlink=B->rightlink;
free(B);

A=beforeNode
B=deletedNode
beforeNode->rlink=deletedNode->rlink
deletedNode->rlink->llink=beforeNode
free(deletedNode)

Binary tree



LEVEL

1

2

3

4

5

Q6: The degree of the tree 2

Q7: The depth of the tree 5

Q8: List the leaf nodes

H,I,J,E,K,G have degree=0.

Q9: The sibling of node E

D and E have the same parent B.

Q10: The children of node C

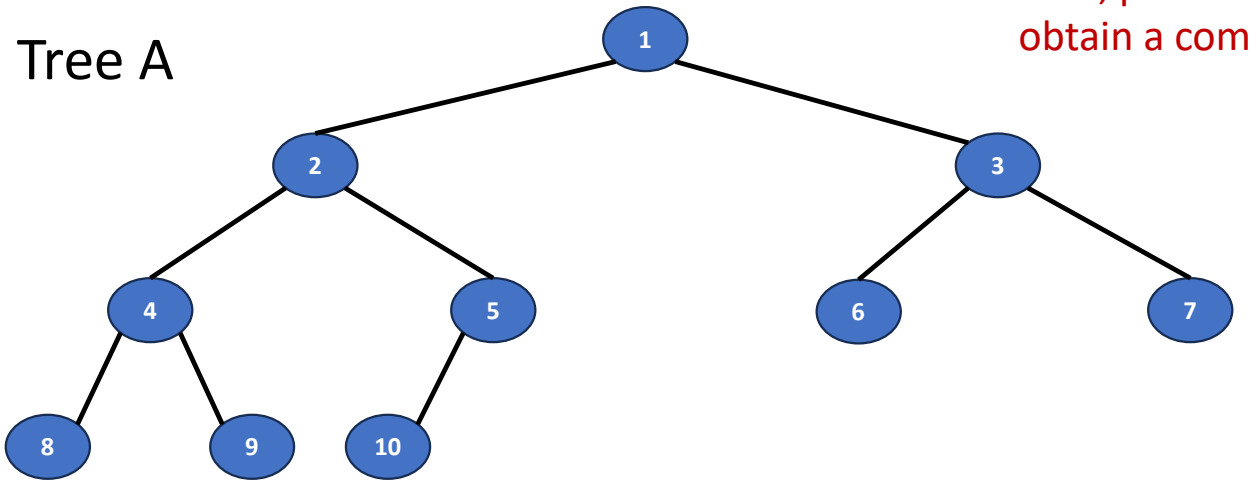
Nodes in the next level of C and linking to C are **F and G**.

Q11: The level of node K 5

Q12: Are Tree A and Tree B complete binary trees?

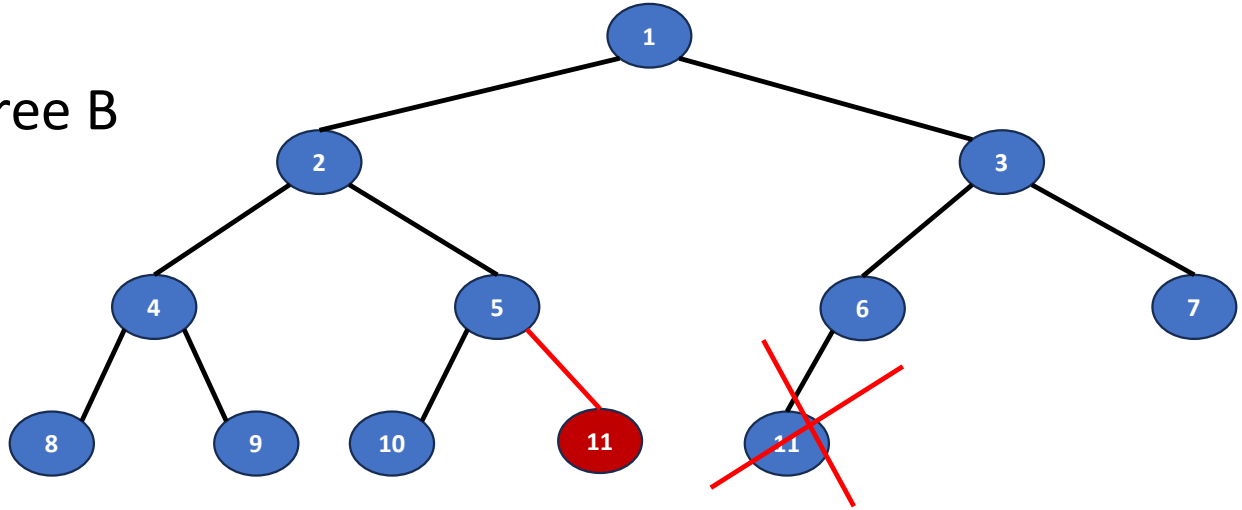
If no, please describe how to modify the tree to obtain a complete binary tree.

- Tree A



YES

- Tree B



NO

1. Remove 11
2. Move 11 to be child of node 5
3. Insert a right child for node 5

Exercise

- Draw the internal memory representation of the binary tree
  1. Using sequential (array) representation
  2. Using linked representation