

Data Structure - Problem Set #4

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Problem 6.16

```
/**
 * find tree node that is at implicit position i
 */
Node<AnyType> TreeNodeAtI(Node<AnyType> root, int i, int index) {
    /**
     * if i equals to the index of the current node in the array representation,
     * the current node is the required node and thus return the current node.
     * Also, if the current node is empty, return null.
     */
    if(i==index || root==null) {
        if(root!=null) {
            return root;
        }
    }
    /**
     * if current node has right child.
     */
    if(root.right != null) {
        //call recursively TreeNodeAtI
        //where 2*index+2 is the index of the right child of current node
        Node<AnyType> right = TreeNodeAtI(root.right, i, 2*index+2);
        if(right != null) {
            return right;
        }
    }
    /**
     * if current node has left child.
     */
    if(root.left != null) {
        Node<AnyType> left = TreeNodeAtI(root.left, i, 2*index+1);
```

```
        if(left!=null) {  
            return left;  
        }  
    }  
    return null;  
}
```

The above algorithm takes the root node of Binary Heap tree, implicit position i of tree node to be found and the index of current node as input. It first call to `TreeNodeAtI`, `index=1`, since the root node will always be at index 1.

The algorithm compares whether the implicit position i and index of current node are equal or not.

Problem 6.18

a

The root is the minimum element.

The maximum element can be find out by comparing the two child of the two root.

The bigger element between the two child nodes of the root is the max element.

b

Insertion in minmax heap

To add an element to a Min-Max Heap perform following operations:

Insert the required key into given Min-Max Heap.

Compare this key with its parent. If it is found to be smaller (greater) compared to its parent, then it is surely smaller (greater) than all other keys present at nodes at max(min) level that are on the path from the present position of key to the root of heap. Now, just check for nodes on Min(Max) levels.

If the key added is in correct order then stop otherwise swap that key with its parent.

The following algorithm is used to insert a new node in to the min-max heap:

Step 1:

Create a function to insert the new node in the min-max heap.

Function min_max_insert(element heap[], int n, element item)

```
/* insert item into the min-max heap */
int parent;
n++;
```

Step 2:

Create an if statement to check the max size of the node

```
if(n == MAX_SIZE)
{
    print("The heap is full");
    return;
}

parent = n / 2;
if(!parent)
/* heap is empty, insert item into first position */
    heap[1] = item;
```

```
Else switch(level(parent))
```

Step 3:

Create an if statement to find the min element in the node.

```
case FALSE:
    /* min level */
    If item.key < heap[parent].key
        heap[n] = heap[parent]
        verify_min(heap, parent, item)

    Else
        verify_max(heap, n, item)
        break
case TRUE:
    /* max level */
    If item.key > heap[parent].key
        heap[n] = heap[parent]
        verify_max(heap, parent, item)

    Else
        verify_min(heap, n, item)
```