

# Data Structures I: Heaps

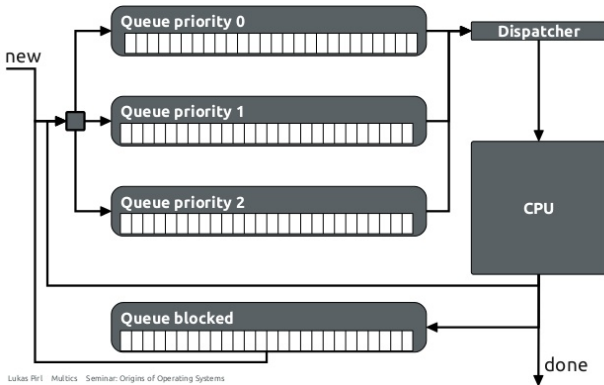


Disclaimer: Keep alcohol out of the hands of minors.

- 10 ml Irish Cream
- 15 ml Vodka
- 10 ml Lime Juice
- 4 drops of Grenadine Syrup



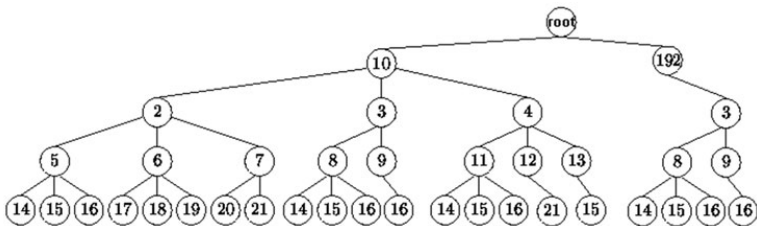
## 1<sup>st</sup> Scheduler – Priority Queuing



Lukas Plri Multics Seminar: Origins of Operating Systems

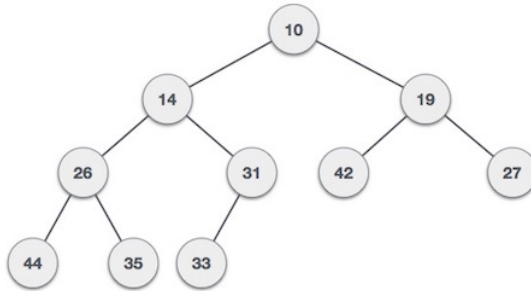
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An **N-ary tree** is a rooted tree in which each node has at most  $n$  children.



```
import java.util.ArrayList;
public class Node {
    public final ArrayList<Node> children;
    public final int data;
    public Node(int d){
        data = d;
        children = new ArrayList<Node>();
    }
}
```

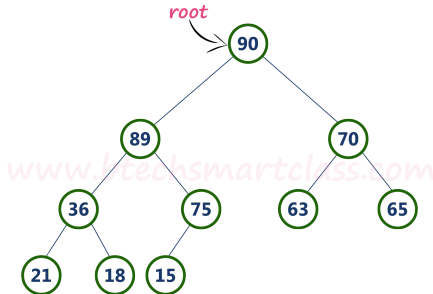
```
public class NaryTree {  
    Node root;  
    public NaryTree() {  
        root = null;  
    }  
}
```



**Figure:** Min heap is a specialized full binary tree in which every parent node contains lower or equal value than its child nodes. And last leaf node can be alone.



- <https://www.cs.usfca.edu/~galles/visualization/Heap.html>



**Figure:** Max heap is a specialized full binary tree in which every parent node contains greater or equal value than its child nodes. And last leaf node can be alone.

- Step 1: Insert the newNode as last leaf from left to right.
- Step 2: Compare newNode value with its Parent node.
- Step 3: If newNode value is greater than its parent, then swap both of them.
- Step 4: Repeat step 2 and step 3 until newNode value is less than its parent node (or) newNode reached to root.

Taken from [http://btechsmartclass.com/DS/U3\\_T7.html](http://btechsmartclass.com/DS/U3_T7.html)

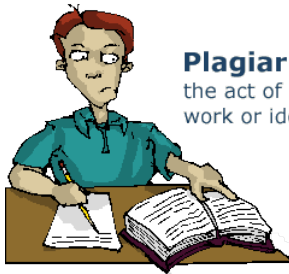
- Step 1: Remove root node.
- Step 2: Move the last element of last level to root.
- Step 3: Compare the value of this child node with its parent.
- Step 4: If value of parent is less than child, then swap them.
- Step 5: Repeat step 3 and 4 until Heap property holds.

Taken from [https://www.tutorialspoint.com/data\\_structures\\_algorithms/heap\\_data\\_structure.htm](https://www.tutorialspoint.com/data_structures_algorithms/heap_data_structure.htm)

- Find max value:  $O(n)$
- Delete max value:  $O(\log n)$
- Insert value:  $O(\log n)$

Taken from [https://en.wikipedia.org/wiki/Binary\\_heap#Summary\\_of\\_running\\_times](https://en.wikipedia.org/wiki/Binary_heap#Summary_of_running_times)

- Please learn how to reference images, trademarks, videos and fragments of code.
- Avoid plagiarism



## **Plagiarism:**

the act of presenting another's work or ideas as your own.

Figure: Figure about plagiarism, University of Malta [Uni09]



University of Malta.

Plagiarism — The act of presenting another's work or ideas as your own, 2009.

[Online; accessed 29-November-2013].