

Priority Queue

An Introduction

Md Awsaf Alam ¹
Ahmed Nafis Fuad²

¹Department of CSE
BUET

²Department of CSE
BUET

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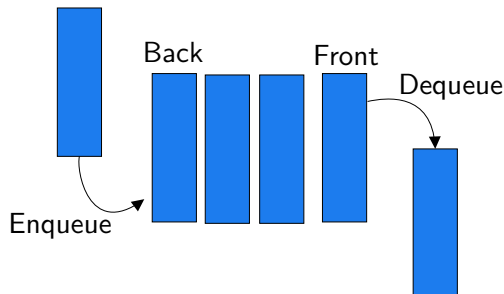
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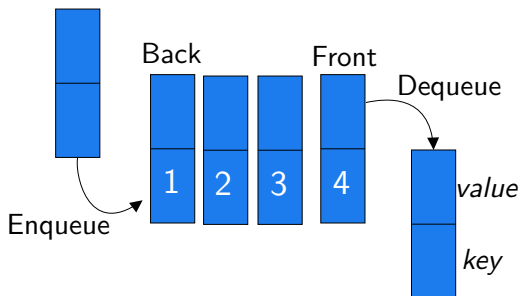
What is a Queue?

A queue is an example of a linear data structure, which works on the basis of "**first-in-first-out**" (FIFO).



What is a Priority Queue?

A priority queue is like a regular queue or stack data structure but where additionally each element has a "**priority**" associated with it. In a priority queue, an element with high priority is served before an element with low priority.

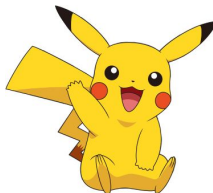


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Application of Queue

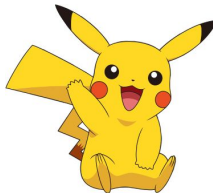


Application of Queue



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Application of Queue



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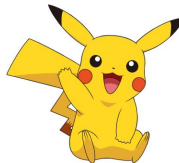


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Application of Queue



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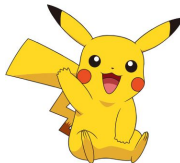


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Application of Queue



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Application of Queue



Application of Queue



Application of Queue



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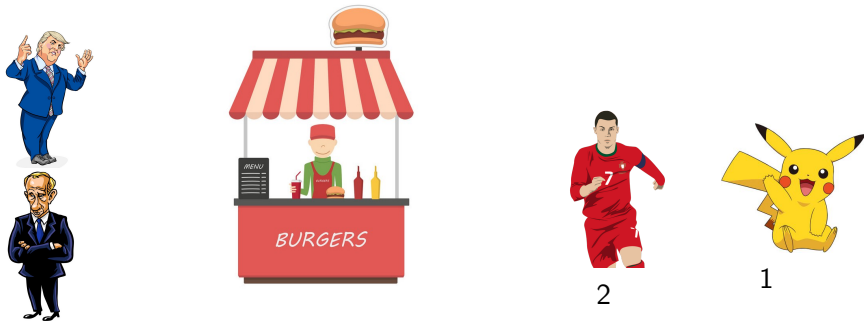


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Application of Queue



Application of Queue



Application of Queue



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Applications

- Dijkstra's Shortest Path Algorithm using priority queue: When the graph is stored in the form of adjacency list or matrix, priority queue can be used to extract minimum efficiently when implementing Dijkstra's algorithm.
- Prim's algorithm: It is used to implement Prim's Algorithm to store keys of nodes and extract minimum key node at every step.
- Data compression : It is used in Huffman codes which is used to compresses data.

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Implementations of Priority Queue

- Fibonacci Heap
- Binary Heap

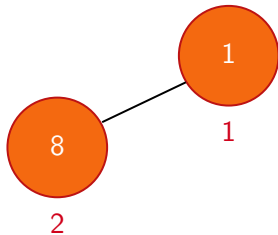
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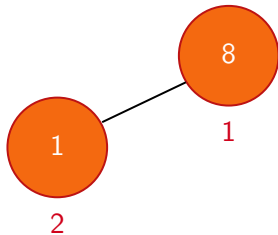
Definition

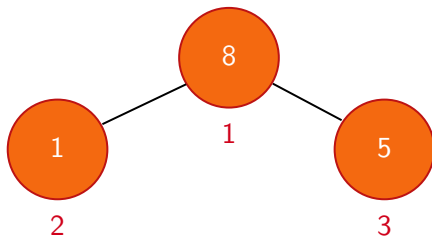
A Binary (Max) Heap is a complete binary tree that maintains the Max Heap property. Binary Heap is one possible data structure to model an efficient Priority Queue (PQ) Abstract Data Type (ADT). In a PQ, each element has a "priority" and an element with higher priority is served before an element with lower priority (ties are broken with standard First-In First-Out (FIFO) rule as with normal Queue). Try clicking ExtractMax() for a sample animation on extracting the max value of random Binary Heap above. To focus the discussion scope, we design this visualization to show a Binary Max Heap that contains distinct integers only.

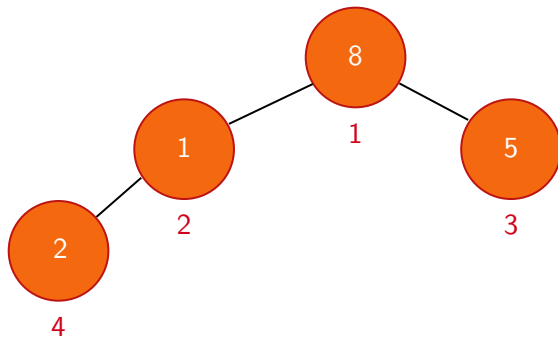


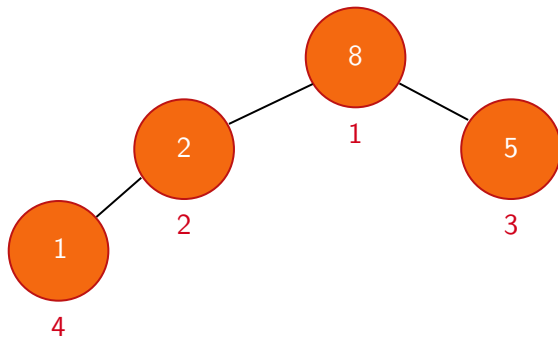
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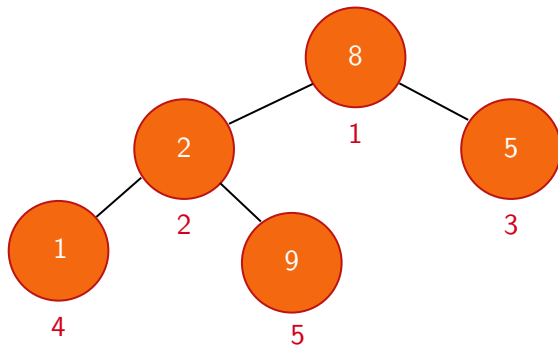


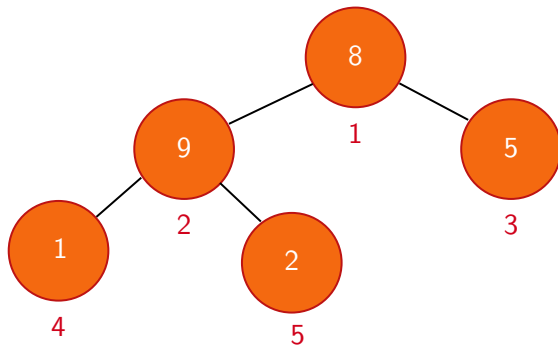


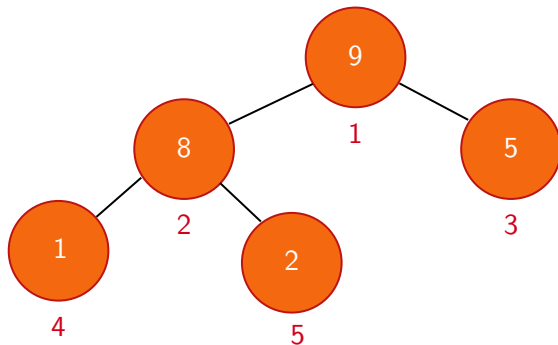


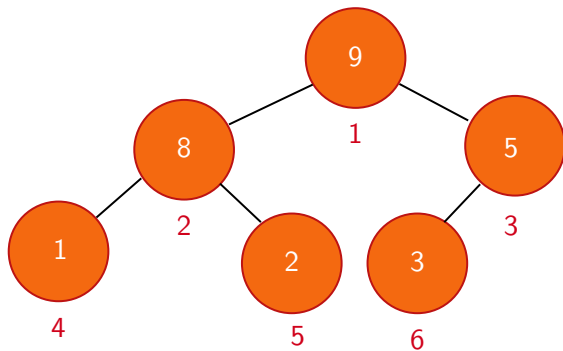


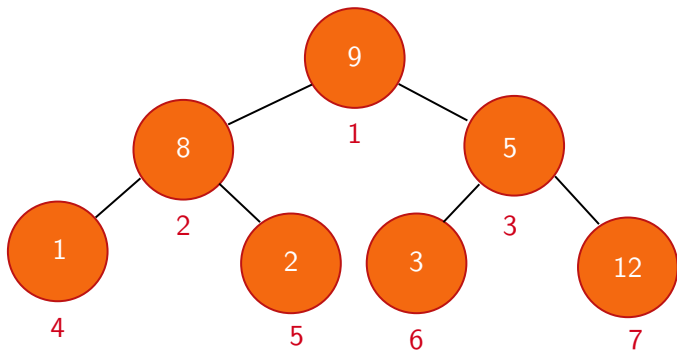


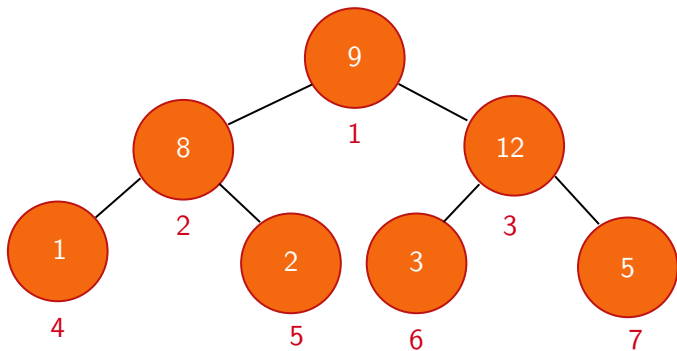


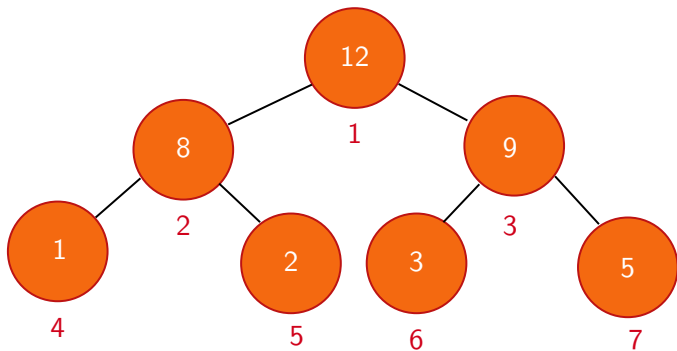












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Max-Heapify Algorithm

```
MAX-HEAPIFY( $A, i$ )  
   $l \leftarrow \text{LEFT}(i)$   
   $r \leftarrow \text{RIGHT}(i)$   
  if  $l \leq \text{heap\_size}[A]$  and  $A[l] > A[i]$  then  
     $\text{largest} \leftarrow l$   
  else  
     $\text{largest} \leftarrow i$   
  end if  
  if  $r \leq \text{heap\_size}[A]$  and  $A[r] > A[\text{largest}]$  then  
     $\text{largest} \leftarrow r$   
  end if  
  if  $\text{largest} \neq i$  then  
    exchange  $A[i] \leftrightarrow A[\text{largest}]$   
  end if  
  MAX-HEAPIFY( $A, \text{largest}$ )
```

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The End

Any Questions?