Lecture 23
Priority Queue

November 04, 2021
Thursday

PRIORITY QUEUE

- In many situations we can not follow FIFO.
  - Consider elder citizens waiting in the Queue.
  - Fire Brigade waiting in Queue to pass through the toll booth.
  - In a sequence of processes, process P_2 may need to be executed before process P_1 for the proper functioning of a program.
- In such situations, a modified queue termed as **"*priority queue*"** is needed.
- Elements are *dequeued* according to their priority and according to their queue position.

PRIORITIZE BASIS?

- There are multiple choices for prioritizing one item over the others.
  - Frequency of Use
  - Birthday Date
  - Salary
  - Position Status
  - Age
  - Marks in an exam
    - Consider CSS, NTS, GAT etc.

PRIORITY QUEUE OPERATIONS

- Same operations as Queue but with modified implementation
  - clear ( )
    - Clears the queue, with deleting all the elements.
  - isEmpty ( )
    - Returns true if there is no element in the queue, false otherwise.
  - isFull ( )
    - Returns true if there is no space for another element.
  - peek ( )
    - returns the elements with highest priority, without deleting it.

PRIORITY QUEUE OPERATIONS

- Same operations as Queue but with modified implementation
  - enqueue (element, priority)
    - inserts the element having some value v, and priority p.
  - dequeue ( )
    - returns the element with highest priority and removes it from the queue.
  - updatePriority ( )
    - allows to update the priority of any element in the queue.

PRIORITY QUEUE | ENQUEUE

- For enqueue we may choose to insert the element in the array according to its priority.
  - This will cost *O (n)* steps.
  - Priority queue will always be sorted (according to priority) after every enqueue.
- If we want to enqueue as items come.
  - Enqueue will cost *O (1) step.*
  - Priority queue will not be sorted at any moment.

PRIORITY QUEUE | DEQUEUE

- Dequeue on the priority queue which is already sorted for priority
  - will take only one step *O (1).*
- Dequeue on the priority queue which is not sorted
  - We now have to search the top priority element in the unsorted elements queue.
    - This will cost O (n).

TIME COMPLEXITY

- Another way is to have two lists
  - Short ordered list
  - An unordered list
- The elements in the sorted list depends on a threshold priority.
- It may result in an empty list in some cases.
  - Dynamic change in threshold may be required to have some elements in sorted list.
- Another way is always having same number of elements in the sorted list.
  - $\sqrt{n}$ is a good candidate.
  - Dequeuing is immediate and enqueue takes on average $O(\sqrt{n})$