CPE 212 - Fundamentals of Software Engineering

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Priority Queues

Outline

- Queue Definition
- Concepts
- Priority Queue Definition
- Implementations
- Coding Examples

Queue ADT

An ordered homogeneous data structure in which elements are added to the rear and removed from the front

FIFO - **F**irst **I**n, **F**irst **O**ut

Example:

Check out line at the grocery store

Queue - Basic Operations

Enqueue - Adds one element to the rear of the queue

Dequeue - Removes and returns item from the front of the queue

IsEmpty - Determines whether the queue is empty

IsFull - Determines whether the queue is full

MakeEmpty - Initializes the queue to the empty state

Enqueue

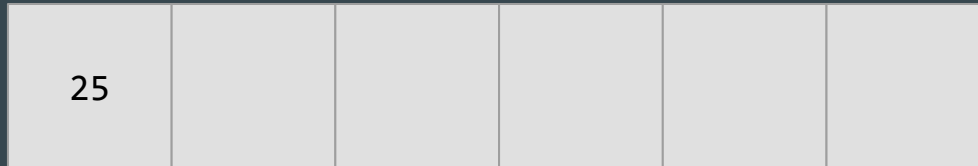Front   Rear

Size = 0

```
Enqueue(25);
```

Front   Rear

25					

25

Size = 1

Enqueue

Front   Rear

| 25 | | | | | |

Size = 1

`Enqueue(16);`

Front   Rear

| 25 | 16 | | | | | ← 16
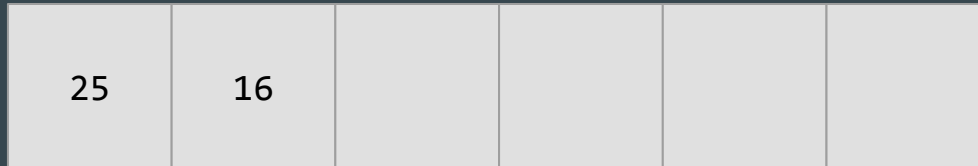
Size = 2

Enqueue

Front   Rear

| 25 | 16 | | | | | Size = 2

`Enqueue(33);`

Front   Rear

| 25 | 16 | 33 | | | | ← 33
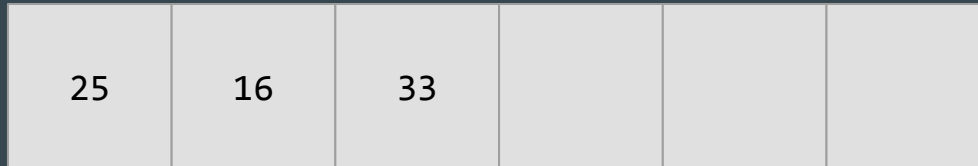
Size = 3

Enqueue

Front   Rear

| 25 | 16 | 33 | | | |

Size = 3

`Enqueue(11);`

Front   Rear

| 25 | 16 | 33 | 11 | | | ← 11

Size = 4

Dequeue

Front   Rear

| 25 | 16 | 33 | 11 | | |

Size = 4

`Dequeue();`

Front   Rear

| 16 | 33 | 11 | | | |
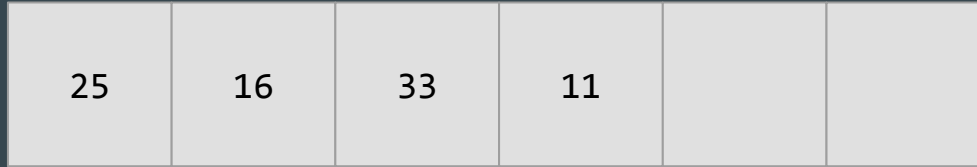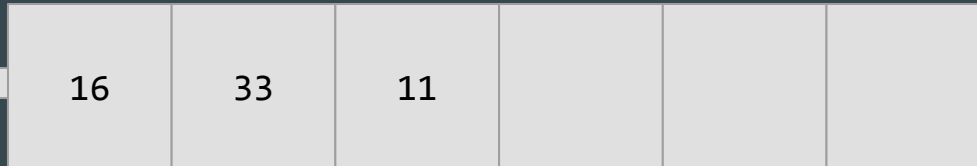
Size = 3

25

Dequeue

Front   Rear

16	33	11			

Size = 3

```
Dequeue();
```

Front   Rear

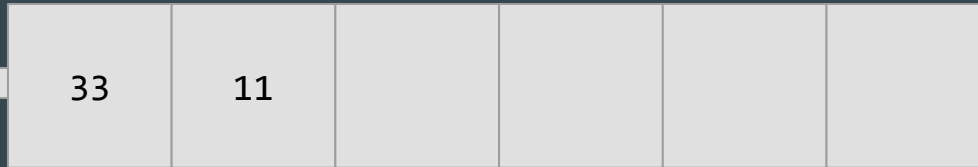|					
33	11				

Size = 2

16

Priority Queue

- A queue that does not have the "first in, first out" logic
- When adding elements to the queue you can retrieve the one with the "highest priority" in constant time O(1)
- Every element has a priority associated with it
- An element with high priority is dequeued before an element with low priority

Questions?

- What happens when items have the same priority?
- When are these useful?
- What data structure has the ability to retrieve the largest element?

Priority Queue Answers

Questions/Answers

- What happens when items have the same priority?

  The item inserted first will be processed first, left node

- When are these useful?

  CPU Scheduling, Ticket or Event registration

- What data structure has the ability to retrieve the largest element?

  HEAP!!!!!!

How would you implement the priority queue?

Priority Queue Other Implementations

N = length of tree

- Linked List
  - Dequeue - O(1) - removes the head
  - Enqueue - O(n) - may have to traverse the entire list
- Binary Search Tree
  - If balanced both Enqueue and Dequeue are $O(\log_2 N)$
  - If skewed the worst case would be O(N)
- Heap
  - Enqueue and Dequeue are both $O(\log_2 N)$

Priority Queue Resources

https://www.geeksforgeeks.org/priority-queue-set-1-introduction/

https://www.fluentcpp.com/2018/03/20/heaps-and-priority-queues-in-c-part-3-queues-and-priority-queues/