НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ КОРАБЛЕБУДУВАННЯ ІМЕНІ АДМІРАЛА МАКАРОВА

Data Structures and Organization

(p.3 – Stacks and Queues)

Yevhen Berkunskyi,

Computer Science dept., NUoS

eugeny.berkunsky@gmail.com

http://www.berkut.mk.ua

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Stacks and Queues

In this lecture we'll see three data storage structures:

- the **Stack**,
- the **Queue**, and
- the **Priority Queue**

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A Different Kind of Structure

- Programmer's Tools
- Restricted Access
- More Abstract

Programmer's Tools

- Arrays are appropriate for the kind of data you might find in a database application. They're typically used for personnel records, inventories, financial data, and so on—data that corresponds to real-world objects or activities.

- The structures and algorithms we'll see here are more often used as programmer's tools.
  - They're primarily conceptual aids rather than full-fledged data storage devices.
  - Their lifetime is typically shorter than that of the database-type structures.
  - They are created and used to carry out a particular task during the operation of a program; when the task is completed, they're discarded.

Restricted Access

- In an array, any item can be accessed, either immediately – if its index number is known – or by searching through a sequence of cells until it's found.
- In the data structures in this lecture, however, access is restricted: Only one item can be read or removed at a given time (unless you cheat).

- The interface of these structures is designed to enforce this restricted access. Access to other items is (in theory) not allowed.

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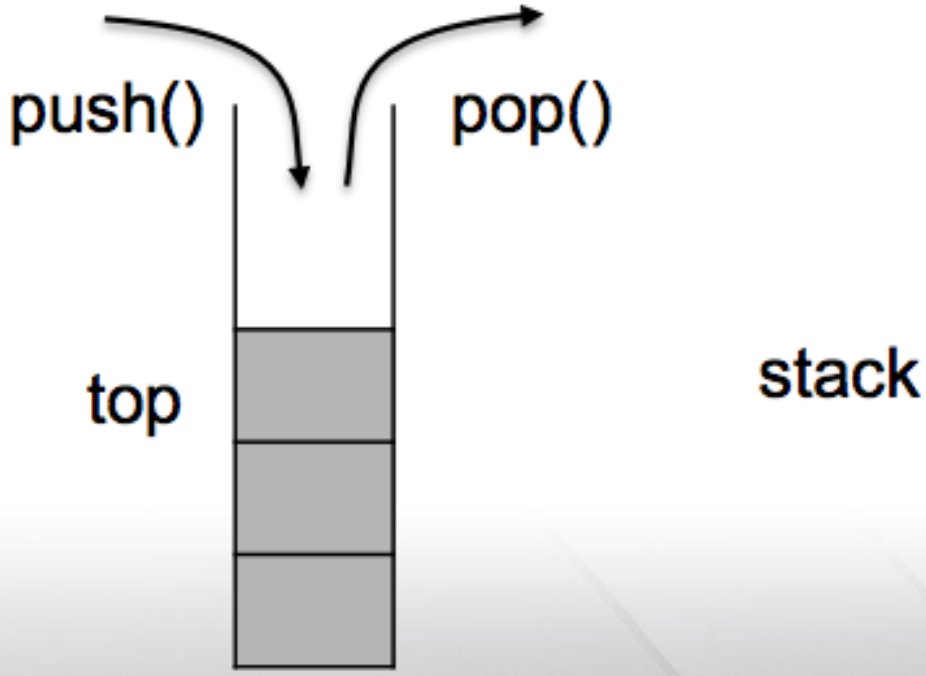
More Abstract

- Stacks, queues, and priority queues are more abstract entities than arrays and many other data storage structures.
- They’re defined primarily by their interface: the permissible operations that can be carried out on them.
- The underlying mechanism used to implement them is typically not visible to their user.

Stacks

- A stack allows access to only one data item: the last item inserted. If you remove this item, you can access the next-to-last item inserted, and so on. This capability is useful in many programming situations.



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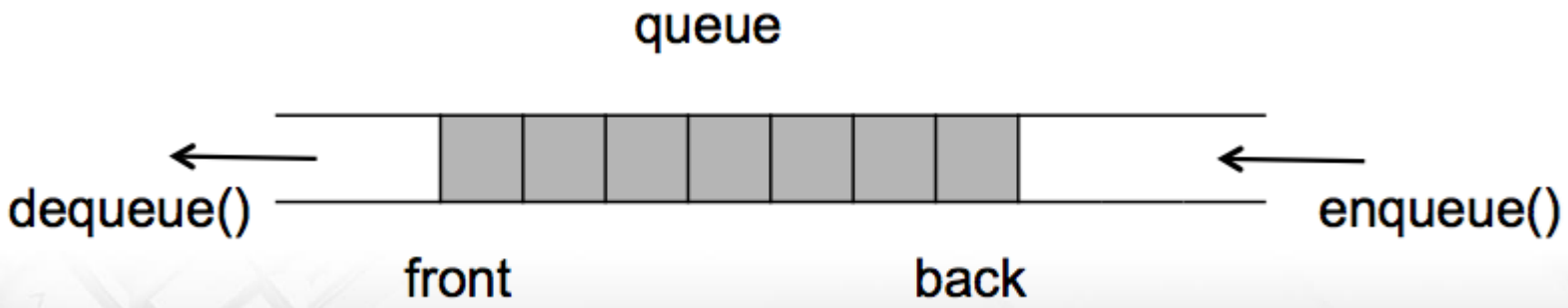
Example

Queues

- In computer science a **Queue** is a data structure that is somewhat like a stack, except that in a queue the first item inserted is the first to be removed (**First-In-First-Out, FIFO**), while in a Stack, as we've seen, the last item inserted is the first to be removed (**LIFO**)

Queues

- Queues are used as a programmer's tool as stacks are.
- They're also used to model real-world situations such as people waiting in line at a bank, airplanes waiting to take off, or data packets waiting to be transmitted over the Internet.



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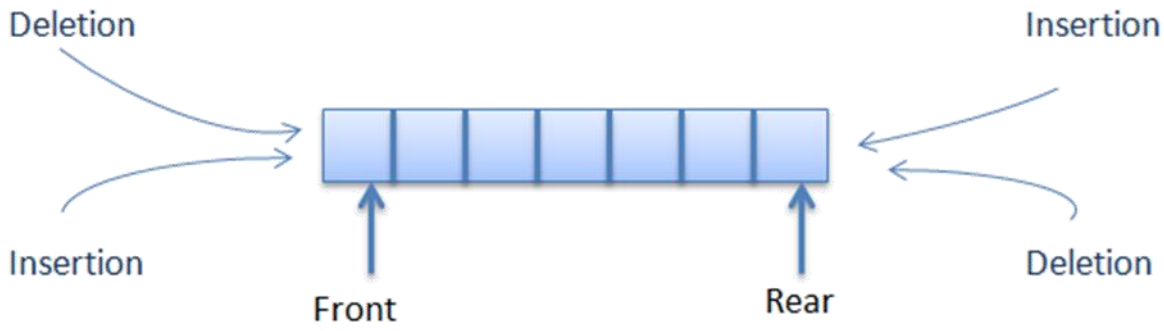
Example

Deques

- A ***deque*** is a double-ended queue. You can insert items at either end and delete them from either end.
- The methods might be called **insertFirst()** and **insertLast()**, and **removeFirst()** and **removeLast()** .



Deques

- If you restrict yourself to **insertFirst()** and **removeFirst()** (or their equivalents on the last), the **deque** acts like a **stack**.
- If you restrict yourself to **insertFirst()** and **removeLast()** (or the opposite pair), it acts like a **queue**.
- A **deque** provides a more versatile data structure than either a **stack** or a **queue** and is sometimes used in container class libraries to serve both purposes.

Priority Queues

- A priority queue is a more specialized data structure than a stack or a queue. However, it's a useful tool in a surprising number of situations.
- Like an ordinary queue, a priority queue has a front and a rear, and items are removed from the front.
- However, in a priority queue, items are ordered by key value so that the item with the lowest key (or in some implementations the highest key) is always at the front.
- Items are inserted in the proper position to maintain the order.

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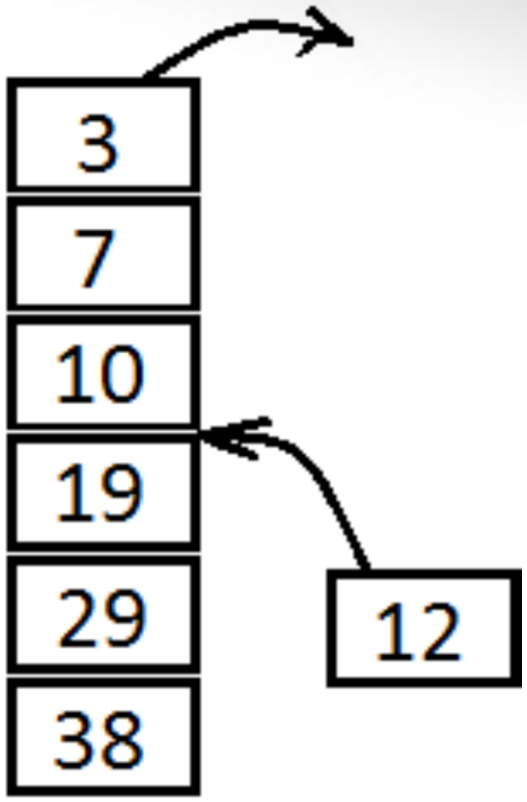
Priority Queues

- In many situations you want access to the item with the lowest key value (which might represent the cheapest or shortest way to do something).
- Thus, the item with the smallest key has the highest priority.
- Somewhat arbitrarily, we'll assume that's the case in this discussion, although there are other situations in which the highest key has the highest priority



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Example

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Questions?

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