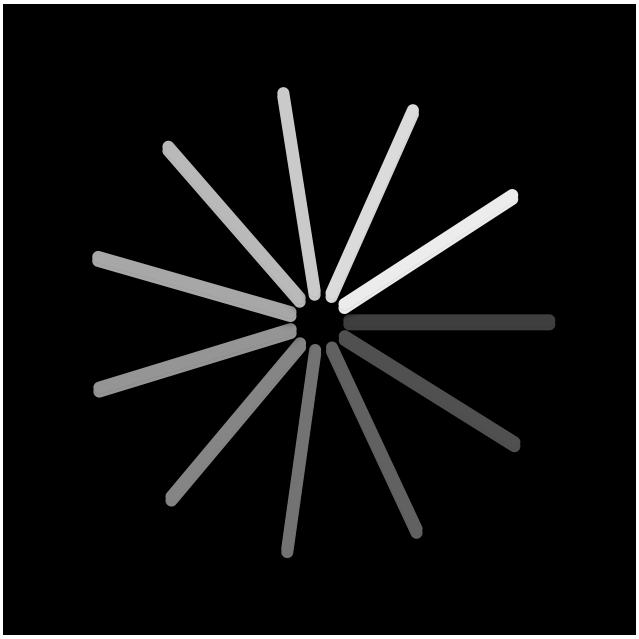
Queues

Let's begin by watching the video "Queues" (2:51).



Python Queue How-To

The simplest example of a queue is the typical line that we all participate in from time to time. We wait in a line for a movie, we wait in the check-out line at a grocery store, and we wait in the

cafeteria line (so that we can pop the tray stack). Well-behaved lines, or queues, are very restrictive in that they have only one way in and only one way out. There is no jumping in the middle and no leaving before you have waited the necessary amount of time to get to the front.

"Waiting Line (https://flic.kr/p/MFBZ8P) " from Alexander Svensson (https://www.flickr.com/photos/svensson/) on flickr (https://www.flickr.com/)

The Queue Data Type

A queue is an ordered collection of items where the addition of new items happens at one end, called the “rear,” and the removal of existing items occurs at the other end, commonly called the “front.” As an element enters the queue it starts at the rear and makes its way toward the front, waiting until that time when it is the next element to be removed.

The most recently added item in the queue must wait at the end of the collection. The item that has been in the collection the longest is at the front. This ordering principle is sometimes called **FIFO**, **first-in first-out**. It is also known as “first-come first-served.”

Below shows a simple queue of Python data objects.

Computer science also has common examples of queues. A computer laboratory has 30 computers networked with a single printer. When students want to print, their print tasks “get in line” with all the other printing tasks that are waiting. The first task in is the next to be completed. If you are last in line, you must wait for all the other tasks to print ahead of you.

In addition to printing queues, operating systems use a number of different queues to control processes within a computer. The scheduling of what gets done next is typically based on a queuing algorithm that tries to execute programs as quickly as possible and serve as many users as it can. Also, as we type, sometimes keystrokes get ahead of the characters that appear on the screen. This is due to the computer doing other work at that moment. The keystrokes are being

placed in a queue-like buffer so that they can eventually be displayed on the screen in the proper order.

The **queue abstract data type** is defined by the following structure and operations. A queue is structured, as described above, as an ordered collection of items which are added at one end, called the “rear,” and removed from the other end, called the “front.” Queues maintain a FIFO ordering property. The queue operations are given below.

- `Queue()` creates a new queue that is empty. It needs no parameters and returns an empty queue.
- `enqueue(item)` adds a new item to the rear of the queue. It needs the item and returns nothing.
- `dequeue()` removes the front item from the queue. It needs no parameters and returns the item. The queue is modified.
- `isEmpty()` tests to see whether the queue is empty. It needs no parameters and returns a boolean value.
- `size()` returns the number of items in the queue. It needs no parameters and returns an integer.

It is again appropriate to create a new class for the implementation of the abstract data type queue. As before, we will use the power and simplicity of the list collection to build the internal representation of the queue.

We need to decide which end of the list to use as the rear and which to use as the front. The implementation assumes that the rear is at position 0 in the list. This allows us to use the `insert` function on lists to add new elements to the rear of the queue. The `pop` operation can be used to remove the front element (the last element of the list). Recall that this also means that enqueue will be O(n) and dequeue will be O(1).

Source: Problem Solving and Algorithms in Python (http://interactivepython.org/runestone/static/pythonds/index.html#) from Bradley Miller on www.interactivepython.org (http://interactivepython.org/runestone/static/pythonds/index.html#).