CSCE 221
Checkpoint 4 Revision

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Problem 3

The first submission did not answer part b. Although the algorithm may be optimized by having the queue reload itself (using size() to keep track of position), the previous algorithm will be analyzed for time complexity. $Q1, Q2$ will be used as predeclared queues.
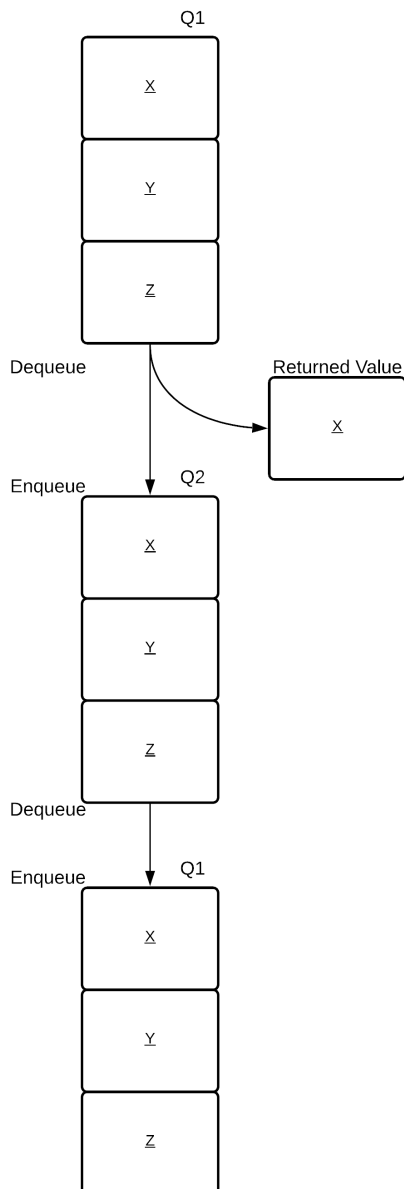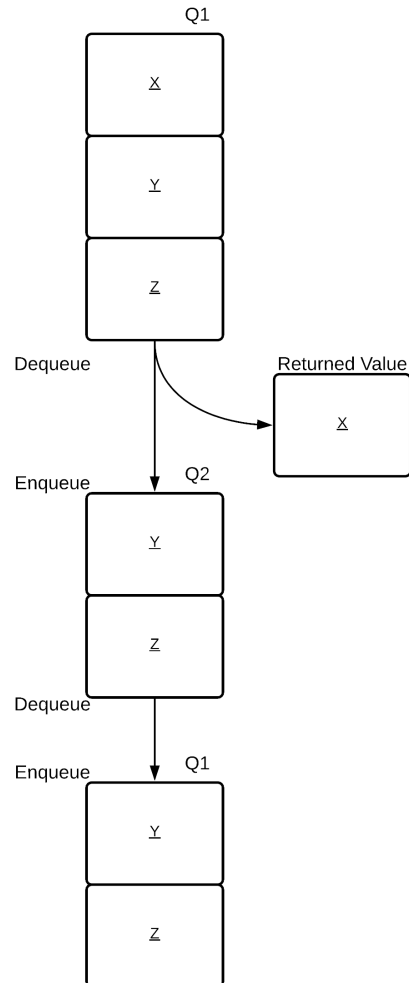
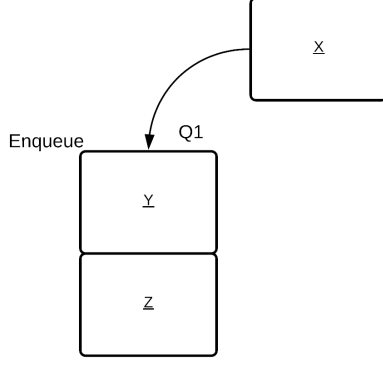Fig. 1. peek() operation sequence.

Fig. 2. pop() operation sequence.

Fig. 3. push() operation sequence.

Algorithm 1 Object peek()

Require: $Q1, Q2$
  $initialize\ temp = 0: \ O(1)$
  $initialize\ return\ object = 0: \ O(1)$
  for $i = 0$ **to** $Q1 \rightarrow size() - 1: \ O(N)$ **do**
    $Q1 \rightarrow dequeue \rightarrow temp: \ O(1)$
    if $i = Q1 \rightarrow size() - 1$ **then**
      $temp \rightarrow return\ object: \ O(1)$
    end if
    $Q2 \rightarrow enqueue \rightarrow temp: \ O(1)$
  end for
  for $i = 0$ **to** $Q2 \rightarrow size() - 1: \ O(N)$ **do**
    $Q2 \rightarrow dequeue \rightarrow temp: \ O(1)$
    $Q1 \rightarrow enqueue \rightarrow temp: \ O(1)$
  end for
  return $return\ object$

Algorithm 2 Object pop()

Require: $Q1, Q2$
  $initialize\ temp = 0: \ O(1)$
  $initialize\ return\ object = 0: \ O(1)$
  for $i = 0$ **to** $Q1 \rightarrow size() - 1: \ O(N)$ **do**
    if $i = Q1 \rightarrow size() - 1$ **then**
      $Q1 \rightarrow dequeue \rightarrow return\ object: \ O(1)$
      $break\ loop$
    end if
    $Q1 \rightarrow dequeue \rightarrow temp: \ O(1)$
    $Q2 \rightarrow enqueue \rightarrow temp: \ O(1)$
  end for
  for $i = 0$ **to** $Q2 \rightarrow size() - 1: \ O(N)$ **do**
    $Q2 \rightarrow dequeue \rightarrow temp: \ O(1)$
    $Q1 \rightarrow enqueue \rightarrow temp: \ O(1)$
  end for
  return $return\ object$

Total runtime of $peek()$ would be

$$O(1) + O(1) + 3O(N)O(1) + 2O(N)O(1)$$

$$lim_{N \rightarrow \infty} 2O(1) + 5O(N) \rightarrow O(N)$$

$\therefore peek() \in \boxed{O(N)}$.

Total runtime of $pop()$ would be

$$O(1) + O(1) + 3O(N)O(1) + 2O(N)O(1)$$

$$lim_{N \rightarrow \infty} 2O(1) + 5O(N) \rightarrow O(N)$$

$\therefore peek() \in \boxed{O(N)}$.

Total runtime of $push()$ would be

$$lim_{N \rightarrow \infty} O(1) \rightarrow O(1)$$

$\therefore push() \in \boxed{O(1)}$.

Algorithm 3 void push()

Require: $Q1, value\ to\ push\ (X)$
  $Q1 \rightarrow enqueue \rightarrow X: \ O(1)$