

10.1-4.

Rewrite ENQUEUE and DEQUEUE to detect underflow and overflow of a queue.

Answer.

To rewrite ENQUEUE and DEQUEUE with underflow and overflow detection, we first need to implement QUEUE-EMPTY that tells us whether the queue is empty, and QUEUE-FULL for recognizing full queues.

```
QUEUE-EMPTY( $Q$ )
1  if  $Q.head == Q.tail$ 
2      return TRUE
3  else
4      return FALSE
```

```
QUEUE-FULL( $Q$ )
1  if  $Q.tail > Q.head$  // The queue  $Q$  does not cross the array boundary
2      if ( $Q.head == 1$ ) and ( $Q.tail == Q.length$ )
3          return TRUE
4      else return FALSE
5  else // The queue  $Q$  crosses the array boundary
6      if ( $Q.head - Q.tail == 1$ )
7          return TRUE
8      else
9          return FALSE
```

Using these two auxiliary procedures, augmenting ENQUEUE and DEQUEUE requires merely a minor adjustment.

```
ENQUEUE( $Q, x$ )
1  if QUEUE-FULL( $Q$ )
2      error "overflow"
3  else
4       $Q[Q.tail] = x$ 
5      if  $Q.tail == Q.length$ 
6           $Q.tail = 1$ 
7      else  $Q.tail = Q.tail + 1$ 

DEQUEUE( $Q$ )
1  if QUEUE-EMPTY( $Q$ )
2      error "underflow"
3  else
4       $x = Q[Q.head]$ 
5      if  $Q.head == Q.length$ 
6           $Q.head = 1$ 
7      else  $Q.head = Q.head + 1$ 
9  return  $x$ 
```

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