

Implementation of a stack with an array

Variables

stack: array of elements

top: integer

invariant: $stack[0], \dots, stack[top]$ are the elements of the stack listed from bottom to top

Initialization

$top \leftarrow -1$

Algorithms

size():

output: size of stack

return ($top + 1$)

isEmpty():

output: stack is empty?

return ($top < 0$)

top():

precondition: stack is nonempty

output: top element of stack

return $stack[top]$

push(*element*):

precondition: stack is not full

postcondition: *element* has been added onto top of stack

input: *element* to be added to stack

$top \leftarrow top + 1$

$stack[top] \leftarrow element$

pop():

precondition: stack is nonempty

postcondition: top element has been removed from stack

output: top element of stack

$temp \leftarrow stack[top]$

$top \leftarrow top - 1$

return *temp*

Implementation of a queue with a circular array

Variables

queue: array of elements

front: integer

rear: integer

capacity: integer

invariant: if $front \leq rear$, then $queue[front], \dots, queue[rear - 1]$ are the elements of the queue from front to rear; otherwise, $queue[front], \dots, queue[capacity - 1], queue[0], \dots, queue[rear - 1]$ are the elements of the queue from front to rear

Initialization

$front \leftarrow 0$
 $rear \leftarrow 0$
 $capacity \leftarrow \text{capacity of the array}$

Algorithms

size():

output: size of queue

return $(capacity - front + rear) \bmod capacity$

isEmpty():

output: queue is empty?

return $(front = rear)$

front():

precondition: queue is nonempty

output: front element of queue

return $queue[front]$

enqueue(*element*):

precondition: array *queue* holds less than $capacity - 1$ elements

postcondition: *element* has been added at the rear of queue

input: *element* to be added to queue

$queue[rear] \leftarrow element$

$rear \leftarrow (rear + 1) \bmod capacity$

dequeue():

precondition: queue is nonempty

postcondition: front element has been removed from queue

output: front element of queue

$temp \leftarrow queue[front]$

$front \leftarrow (front + 1) \bmod capacity$

return *temp*