10.1-6.

Show how to implement a quque using two stacks. Analyze the running time of the queue operations.

Answer.

Using two stacks S_1 and S_2, we can ENQUEUE an element to the queue Q by PUSHing it into S_1 and DEQUEUE the tail element by POPing from S_2. Whenever S_1 becomes full or S_2 becomes empty, we transmit as much elements in S_1 to S_2 as possible using TRANSMIT. A queue is said to be empty if and only if both of its stacks S_1 and S_2 are empty. Likewise, the queue becomes full when S_1 and S_2 are both full.

```
QUEUE-EMPTY(Q)
1  if STACK-EMPTY(S_1) and STACK-EMPTY(S_2)
2       return TRUE
3  else return FALSE

QUEUE-FULL(Q)
1  if STACK-FULL(S_1) and STACK-FULL(S_2)
2       return TRUE
3  else return FALSE

ENQUEUE(Q, x)
1  if QUEUE-FULL(Q)
2       error "overflow"
3  else
4       if STACK-FULL(S_1)
5            TRANSMIT(S_1, S_2)
6       PUSH(S_1, x)
7       Q.head = S_1.top
8       Q.tail = S_2.top + 1

DEQUEUE(Q)
1  if QUEUE-EMPTY(Q)
2       error "underflow"
3  else
4       if STACK-EMPTY(S_2)
5            TRANSMIT(S_1, S_2)
6       POP(S_2)
7       Q.tail = S_2.top + 1
8       Q.head = S_1.top

TRANSMIT(S_1, S_2)
1  if STACK-EMPTY(S_2)
2       POUR(S_1, S_2)
3  else
4       T = CREAT-STACK()
5       POUR(S_2, T)
6       POUR(S_1, T)
7       POUR(T, S_2)

POUR(S_1, S_2)
1  while not STACK-FULL(S_2)
```


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2 $\textsc{Push}(S_2, \textsc{Pop}(S_1))$