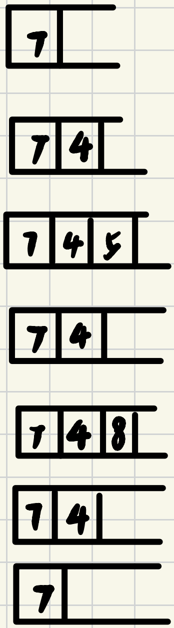
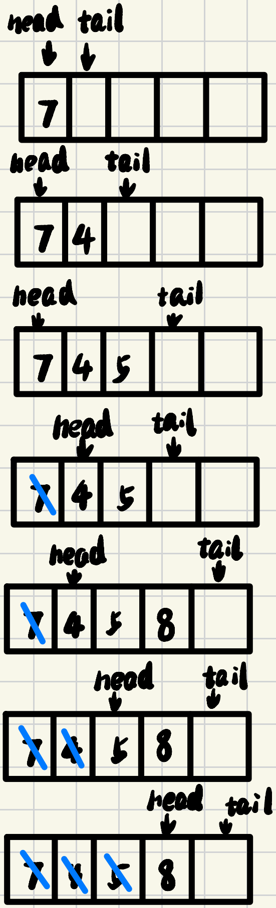
Exercise Sheet 8

Question 8.1

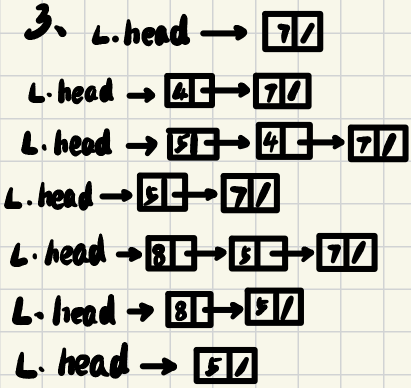
1.



2.



3.



Question 8.2

S_1 starts from left, initially $S_1.top = 0$

S_2 starts from right, initially $S_2.top = n+1$

```
PUSHS1(A, x)
    if $S_1.top = S_2.top - 1$ then
        error "Overflow"
    else
        $S_1.top = S_1.top + 1$
        $A[S_1.top] = x$
```

```
PUSH S2(A, x)
    if $S_2.top = S_1.top + 1$ then
        error "Overflow"
    else
        $S_2.top = S_2.top - 1$
        $A[S_2.top] = x$
```

```
$POPS_1(A)$
if $S_1.top = 0$ then
    error "Underflow"
else
    $S_1.top = S_1.top - 1$
    return $A[S_1.top + 1]$
```

```
$POP S_2 (A)$
if $S_2.top = n+1$ then
    error "Underflow"
else
    $S_2.top = S_2.top + 1$
    return $A[S_2.top - 1]$
```

Question 8.3

```
ENQUEUE (Q, $x$)
if Q.head = Q.tail and Q.head is not empty then
    error "Overflow"
Q[Q.tail] = $x$
if Q.tail = Q.size then
    Q.tail = 1
else
    Q.tail = Q.tail + 1
```

```
DEQUEUE (Q)
if Q.head = Q.tail and Q.head is empty then
    error "Underflow"
$x$ = Q[Q.head]
if Q.head = Q.size
    Q.head = 1
else
    Q.head = Q.head + 1
return $x$
```

Question 8.4

```
ENQUEUE (Q, $x$)
PUSH ($S_1$, $x$)
```

```
DEQUEUE (Q)
while ! STACK-EMPTY ($S_1$) do
    $x = POP_{S_1}(\ )$
    $PUSH_{S_2}(x)$
$k = POP_{S_2}(\ )$
while ! STACK-EMPTY ($S_2$) do
    $x = POP_{S_2}(\ )$
    $PUSH_{S_1}(x)$
return $k$
```

runtime of enqueue : $O(1)$

runtime of dequeue : $O(n)$, n is the number of elements in S_1.