Chap 4. Linked Lists (2)

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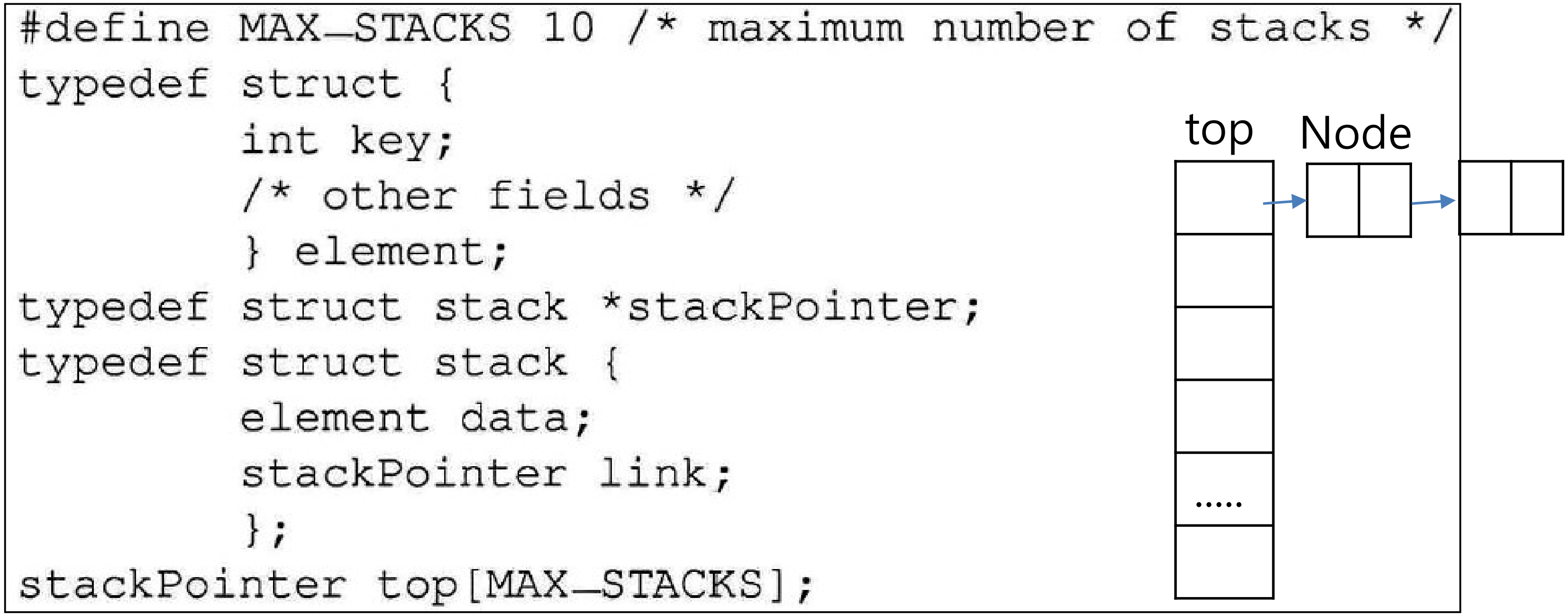
4.3 Linked Stacks And Queues

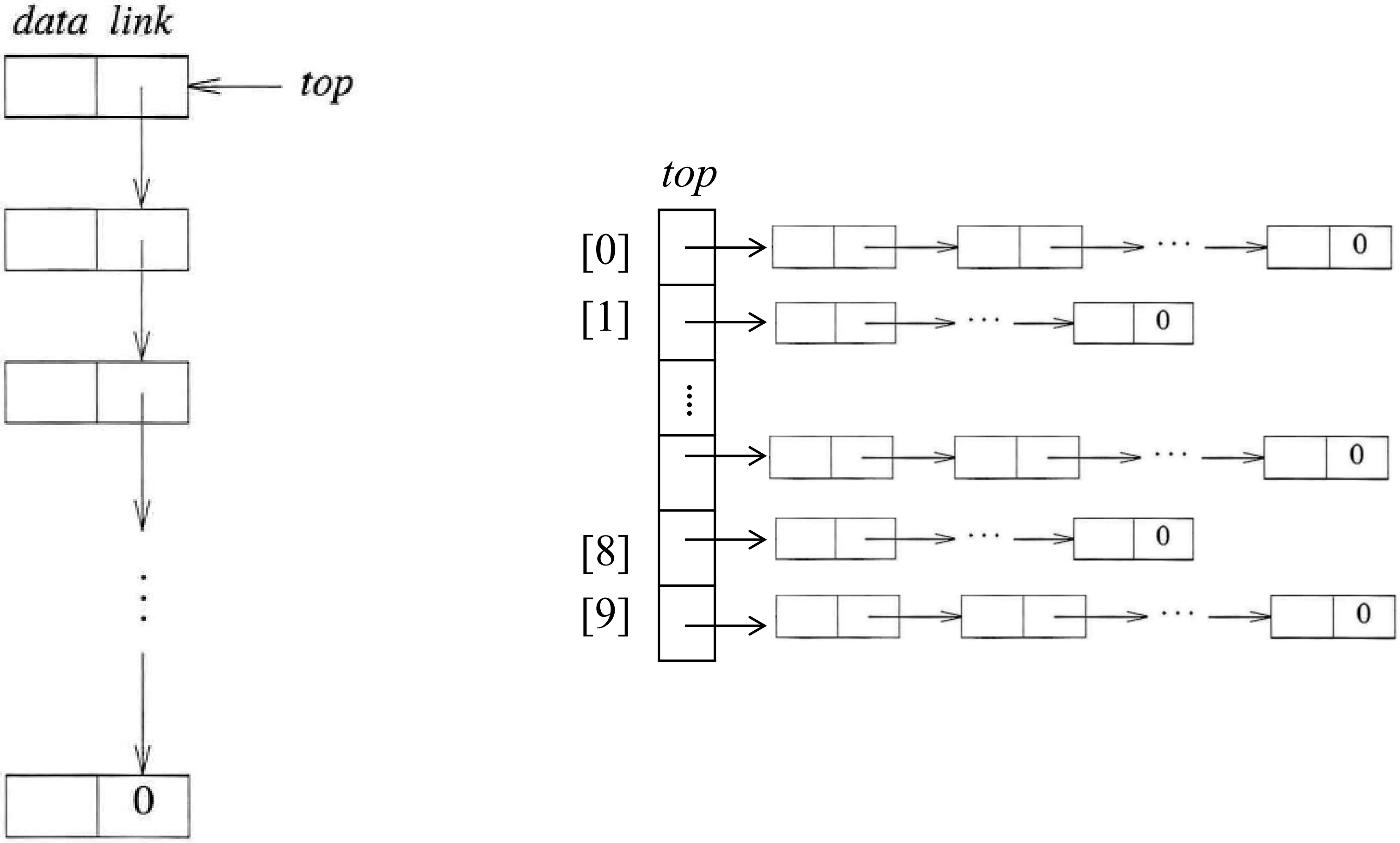
- Representing ***n≤MAX_STACKS* stacks** simultaneously



```
#define MAX_STACKS 10 /* maximum number of stacks */
typedef struct {
        int key;
        /* other fields */
        } element;
typedef struct stack *stackPointer;
typedef struct stack {
        element data;
        stackPointer link;
        };
stackPointer top[MAX_STACKS];
```

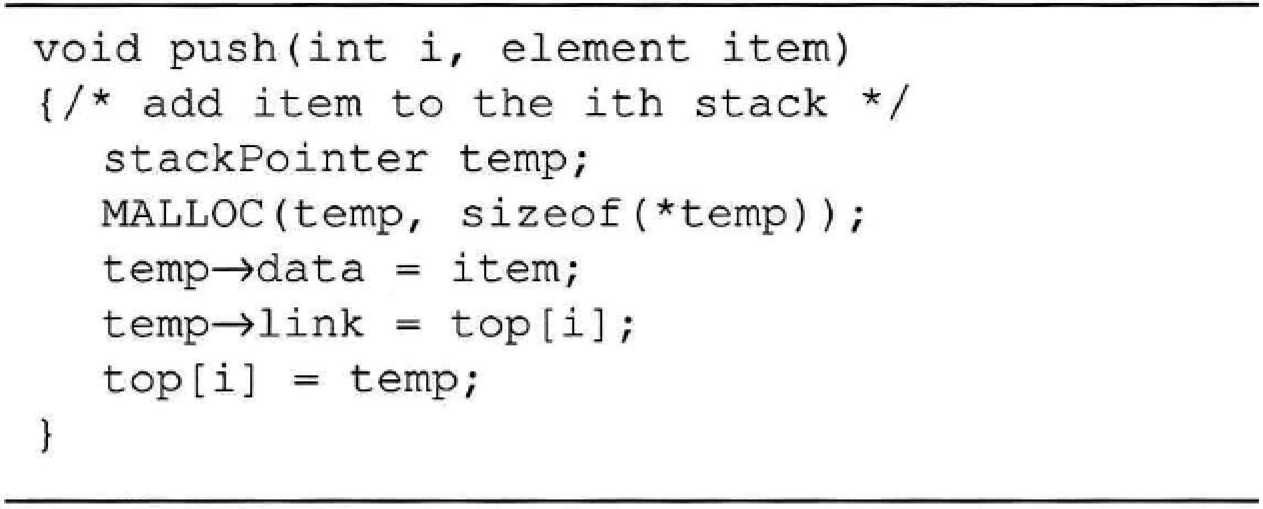
$top[i] = NULL,\ 0 \le i < MAX\_STACKS$ Initial conditions for the stacks

[redacted] iff the *i*th stack is empty Boundary condition for the *i*th stack

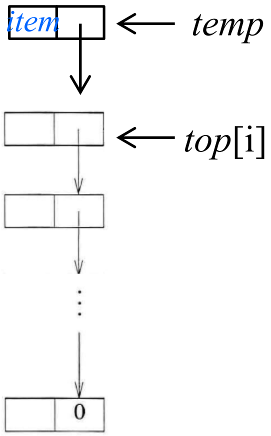


(a) Linked stack

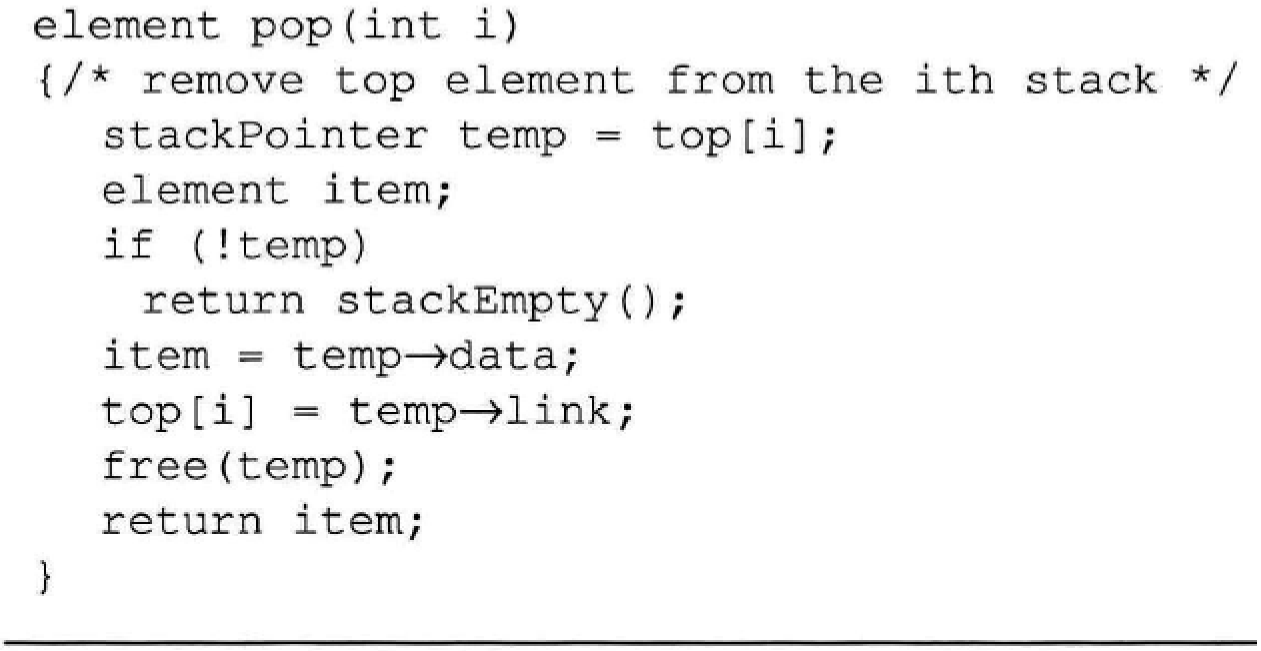
Figure 4.11: Linked stack and queue (1/2)



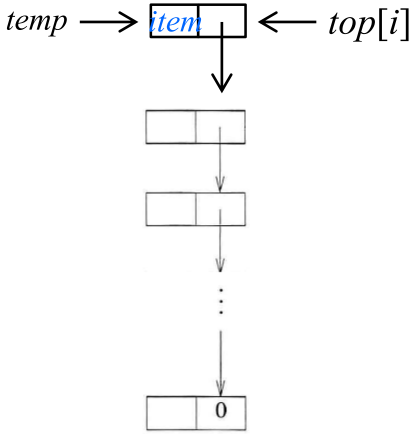
```
void push(int i, element item)
{/* add item to the ith stack */
   stackPointer temp;
   MALLOC(temp, sizeof(*temp));
   temp→data = item;
   temp→link = top[i];
   top[i] = temp;
}
```



Program 4.5: Add to a linked stack *push(i, item)*

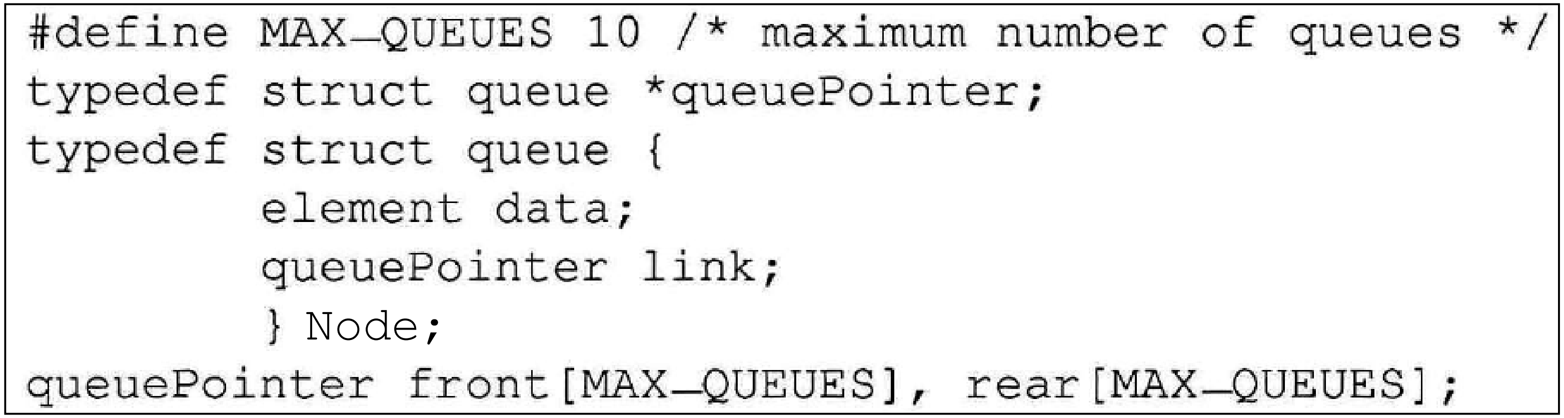


```
element pop(int i)
{/* remove top element from the ith stack */
   stackPointer temp = top[i];
   element item;
   if (!temp)
     return stackEmpty();
   item = temp→data;
   top[i] = temp→link;
   free(temp);
   return item;
}
```



Program 4.6: Delete from a linked stack *item = pop(i)*

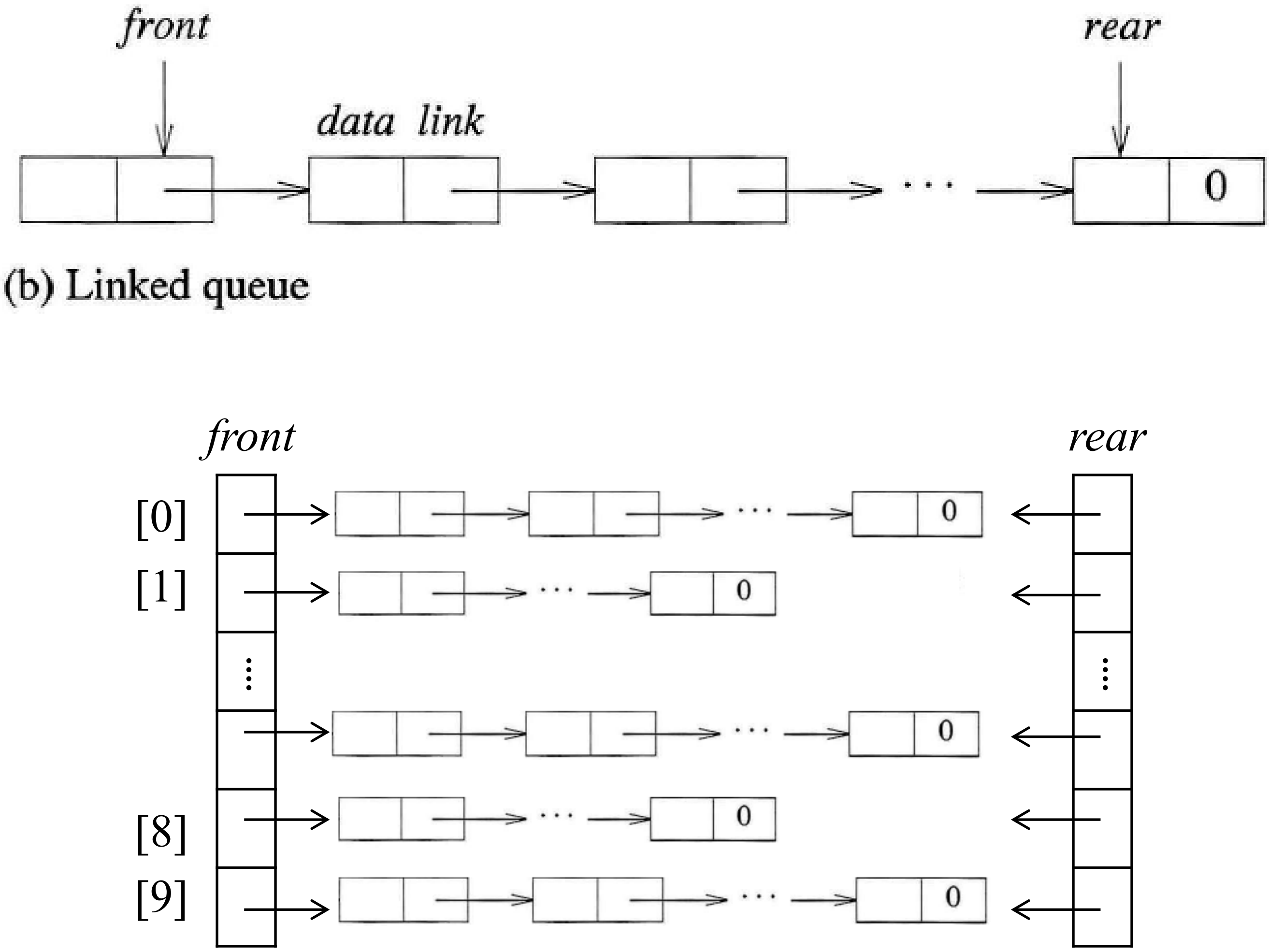
- Representing ***n≤MAX_QUEUES* queues** simultaneously



```
#define MAX_QUEUES 10 /* maximum number of queues */
typedef struct queue *queuePointer;
typedef struct queue {
        element data;
        queuePointer link;
        } Node;
queuePointer front[MAX_QUEUES], rear[MAX_QUEUES];
```

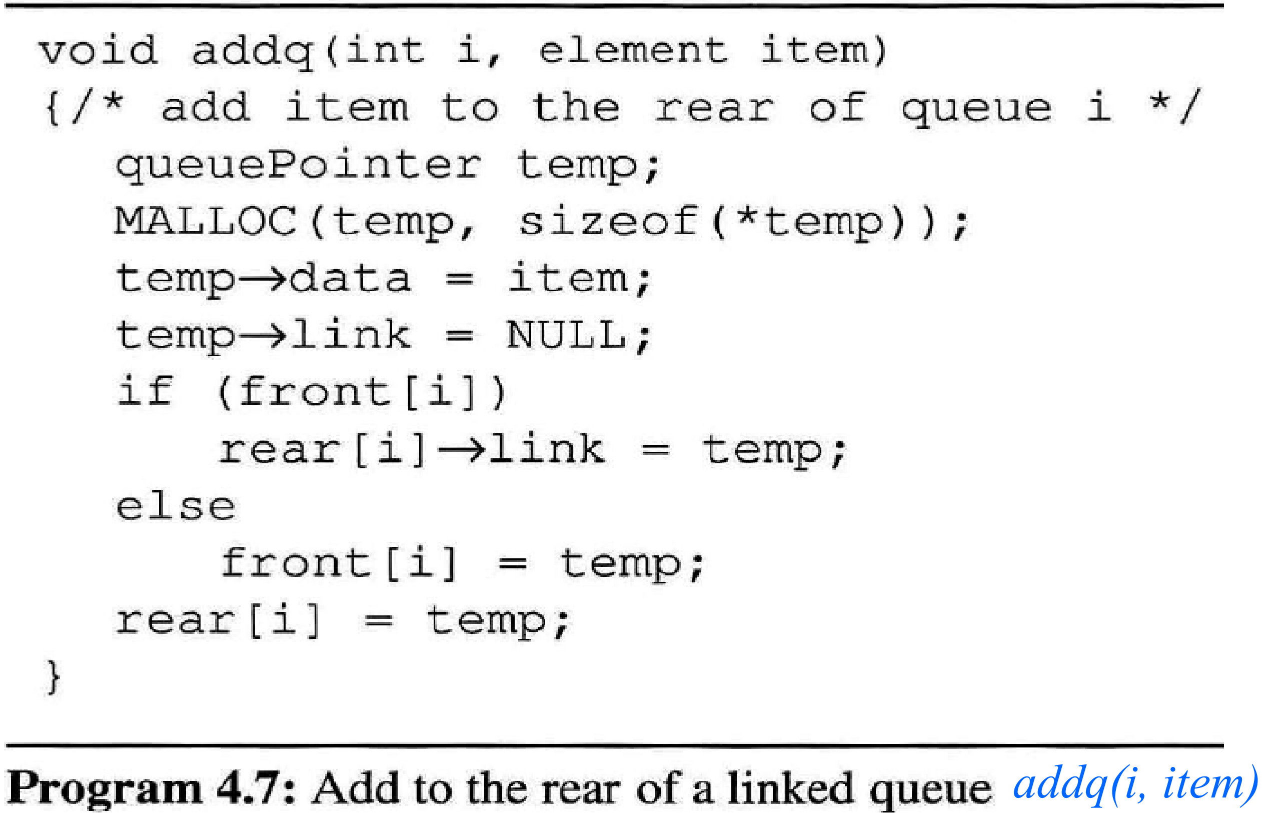
$front[i] = NULL, 0 \leq i < MAX\_QUEUES$ Initial conditions for the queues

$front[i] = \text{NULL iff the } i\text{th queue is empty}$ Boundary condition for the *i*th queue



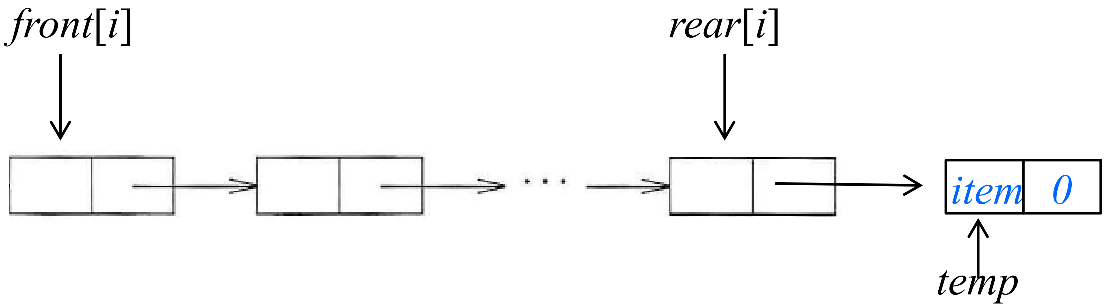
(b) Linked queue

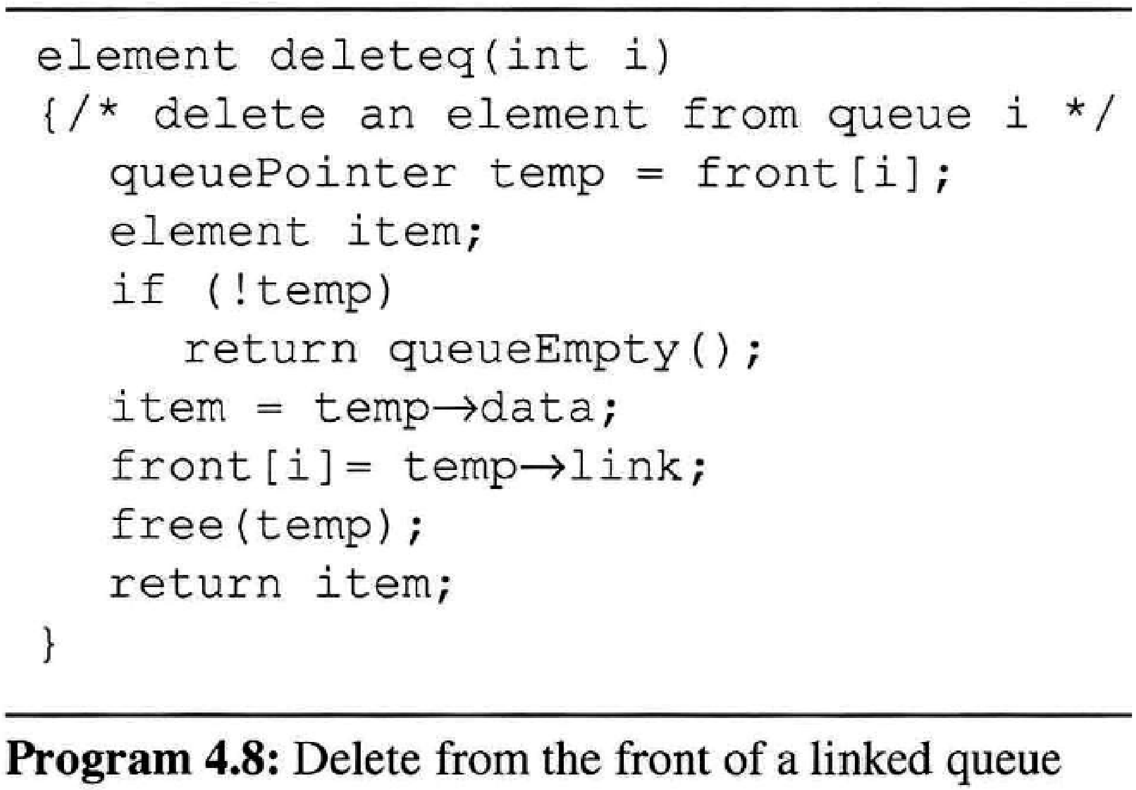
Figure 4.11: Linked stack and queue (2/2)



```
void addq(int i, element item)
{/* add item to the rear of queue i */
   queuePointer temp;
   MALLOC(temp, sizeof(*temp));
   temp→data = item;
   temp→link = NULL;
   if (front[i])
       rear[i]→link = temp;
   else
       front[i] = temp;
   rear[i] = temp;
}
```

Program 4.7: Add to the rear of a linked queue *addq(i, item)*

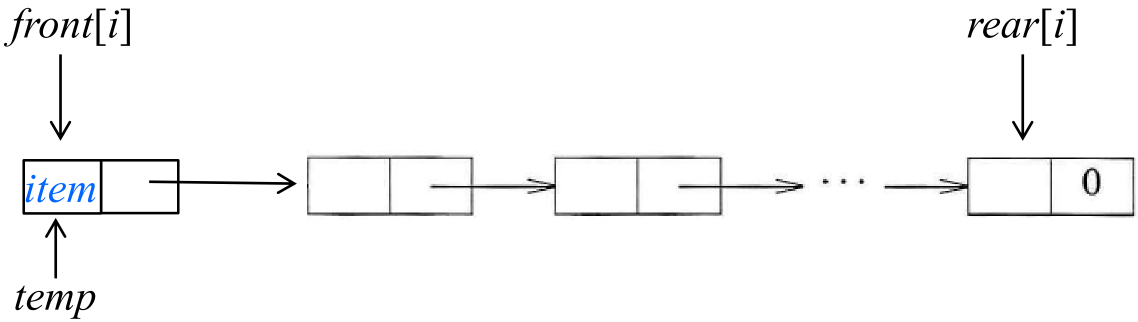




```
element deleteq(int i)
{/* delete an element from queue i */
   queuePointer temp = front[i];
   element item;
   if (!temp)
      return queueEmpty();
   item = temp→data;
   front[i]= temp→link;
   free(temp);
   return item;
}
```

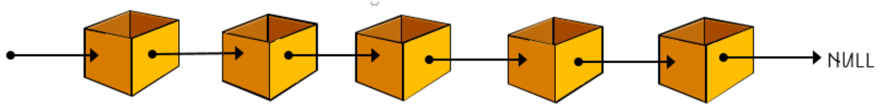
Program 4.8: Delete from the front of a linked queue

item = deleteq(i)

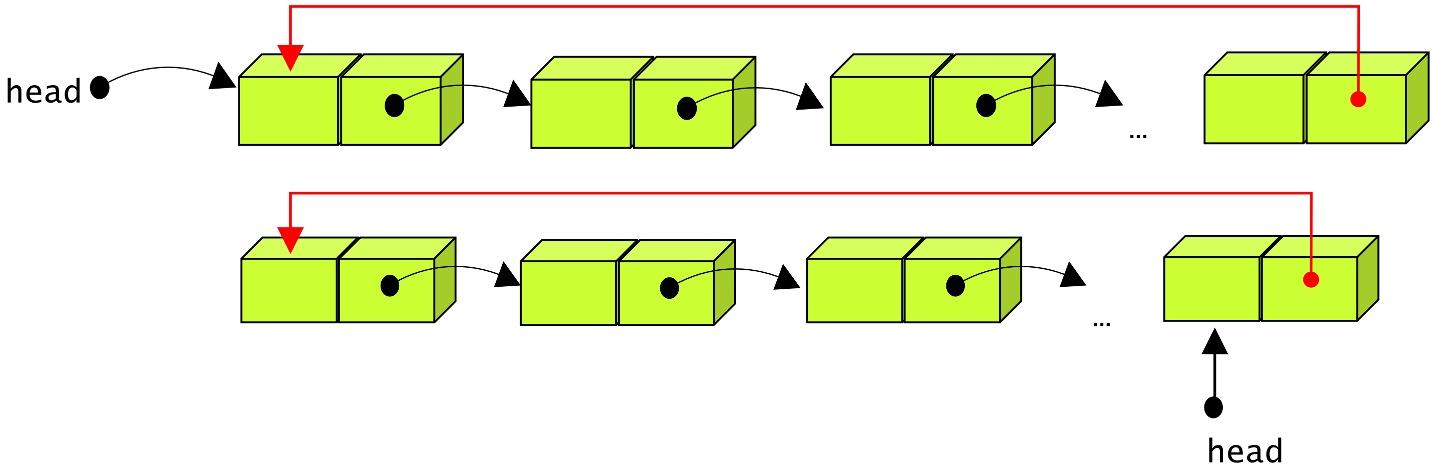


Circular List Representation

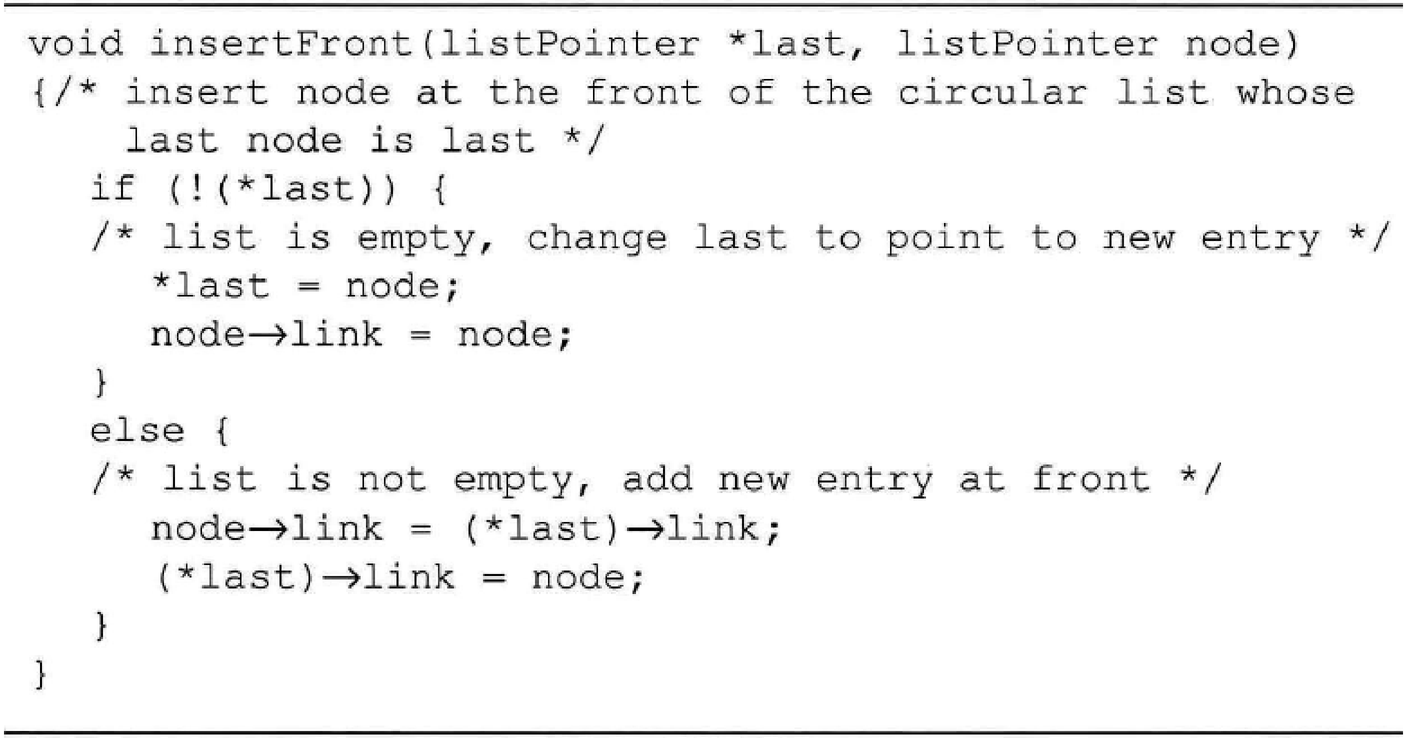
- Chain
  - – A singly linked list in which the last node has a null link



- Circular list
  - – The link filed of the last node points to the first node in the list

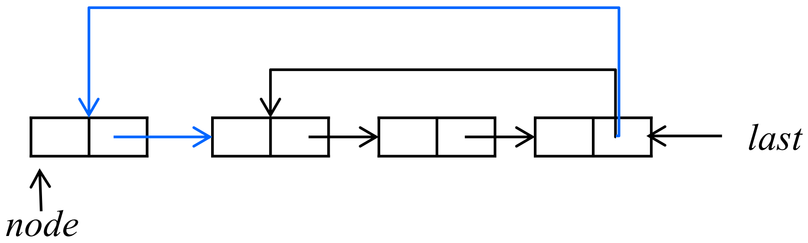


Operations For Circularly Linked Lists



```
void insertFront(listPointer *last, listPointer node)
{/* insert node at the front of the circular list whose
    last node is last */
   if (!(*last)) {
   /* list is empty, change last to point to new entry */
      *last = node;
      node→link = node;
   }
   else {
   /* list is not empty, add new entry at front */
      node→link = (*last)→link;
      (*last)→link = node;
   }
}
```

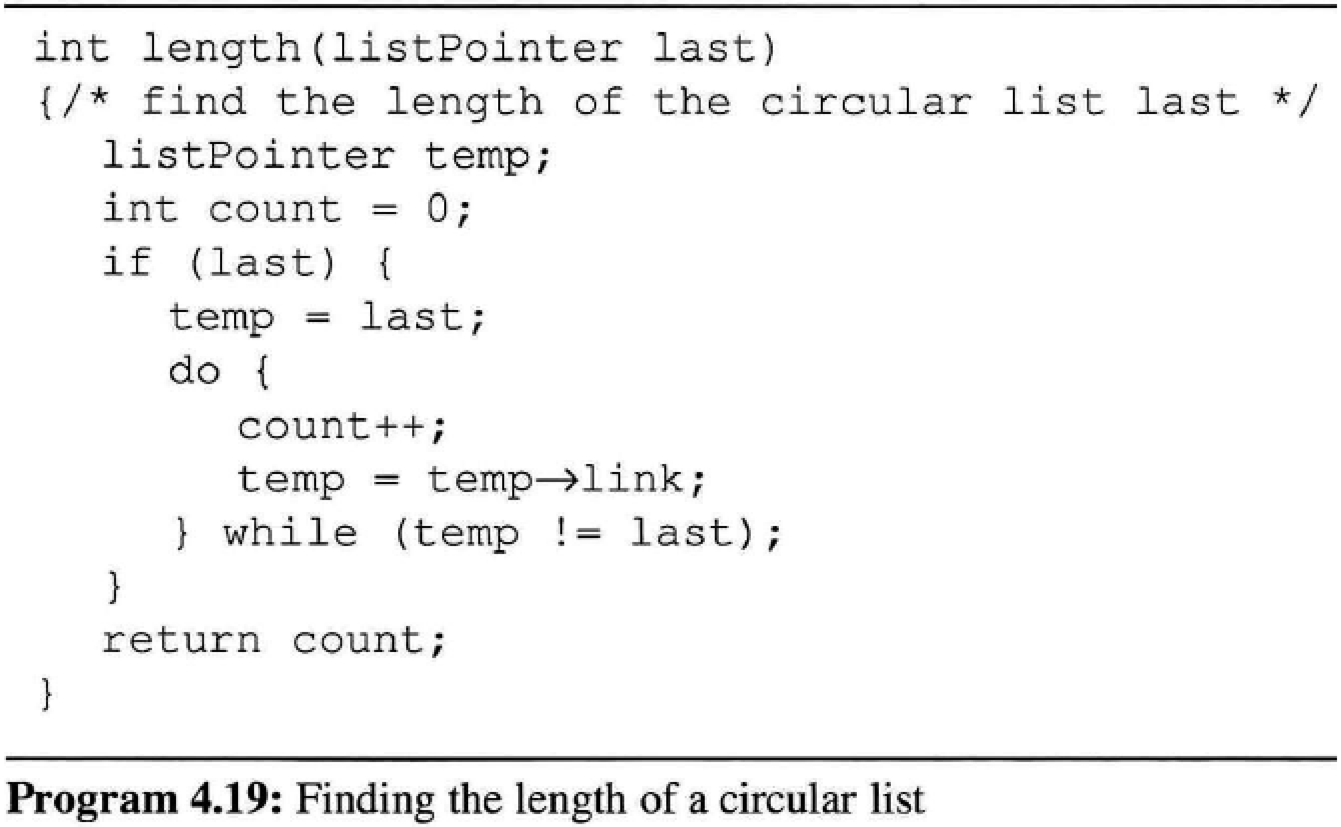
Program 4.18: Inserting at the front of a list



insertFront(&last, node)

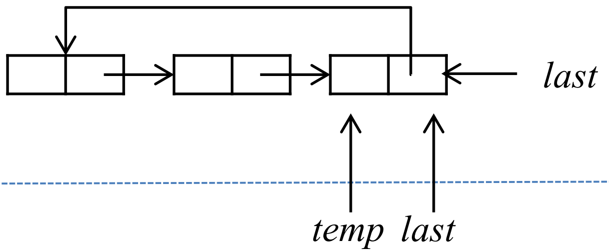
*insertFront(listPointer *last, listPointer node)*

Operations For Circularly Linked Lists



```
int length(listPointer last)
{/* find the length of the circular list last */
   listPointer temp;
   int count = 0;
   if (last) {
      temp = last;
      do {
         count++;
         temp = temp→link;
      } while (temp != last);
   }
   return count;
}
```

Program 4.19: Finding the length of a circular list



length(last)

lengh(listPointer last)

count 0

1