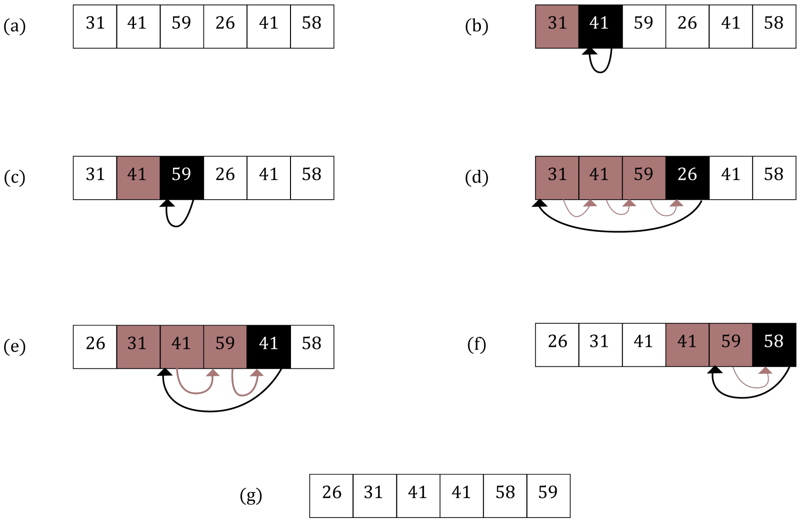
Chapter 2 Part 1 Exercises

2.1-1

The steps are the following:



2.1-2

The new instertion-sort will be the following:

```
REVERSE-INSERTION-SORT($A$)
for $j = 2$ to $A.lenght$
    $key = A[j]$
    $i = j - 1$
    while $i > 0$ and $A[i] < key$
        $A[i+1] = A[i]$
        $i = i - 1$
    $A[i+1] = key$
```

2.1-3

The linear search algorithm will be:

```
Linear-Search$(A, v)$
while $i \leq A.length$
    if $A[i] == v$
        return $i$
    $i = i + 1$
return NIL
```

If the linear search finishes, then v has not been found in the array, so we return NIL. Otherwise, the loop stops when the first occurance of v is found.

The **loop invariant** of the algorithm is:

At the start of each iteration of the loop, the subarray $A[1..i-1]$ does not hold the value v.

Let us see now how the loop invariant properties hold now.

Initialization: We start by showing that the loop invariant holds before the first loop operation, when $i = 1$. The subarray of A is empty, so by definition it does not contain v.

Maintenance: Informally, the body of the while loop compares v with $A[i]$ and exits the loop if they are equal. The subarray $A[1..i]$ consists of elements that are not equal to v, as otherwise the loop would have ended.

Termination: We examine what happens when the loop terminates. When the loop terminates the value of $i = A.lenght + 1 = n + 1$. Then, the whole array A is the left subaray $A[1...i]$, so we have gone through the whole array and not found the value v, so we return NIL.

2.1-4

Stating the problem formally:

Input: Two arrays A, B of size n containing binary digits.

Output: An array C, which is of size $n + 1$ and contains the binary sum of A and B.

Code:

```
BINARY-ADDITION($A, B, C$)
$carry = 0$
for $i = A.length$ downto $1$
    $C[i+1] = A[i] + B[i] + carry$
    if $C[i+1] == 2$
        $C[i+1] = 0$
        $carry = 1$
    elseif $C[i+1] == 3$
        $C[i+1] = 1$
        $carry = 1$
    else
        $carry = 0$
$C[1] = carry$
```