
Algorithms and Data Structures

CSCI 4041

Session 1

Insertion sort

insertionSort(Array A):

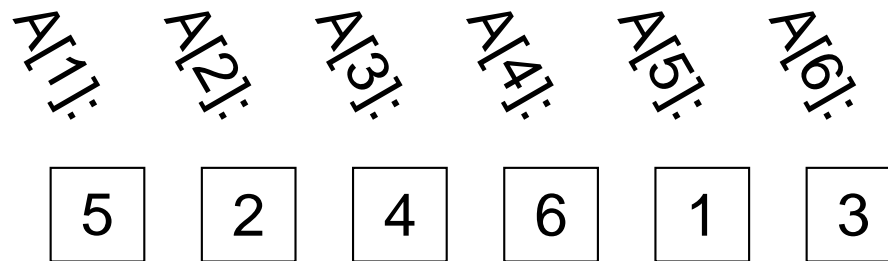
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (1)

insertionSort(Array A):

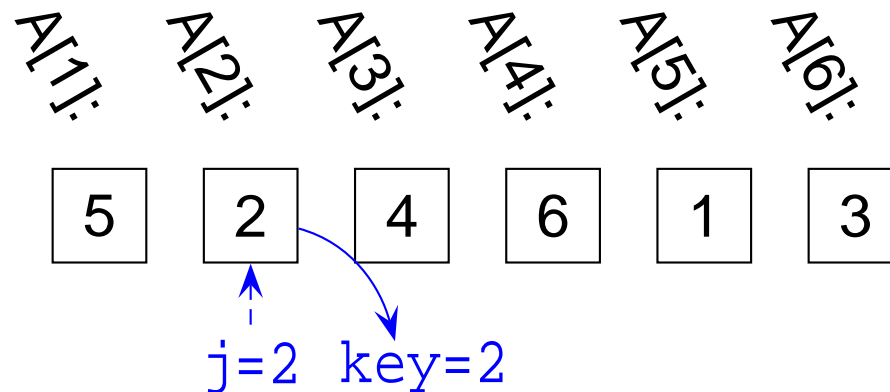
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

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$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (2)

insertionSort(Array A):

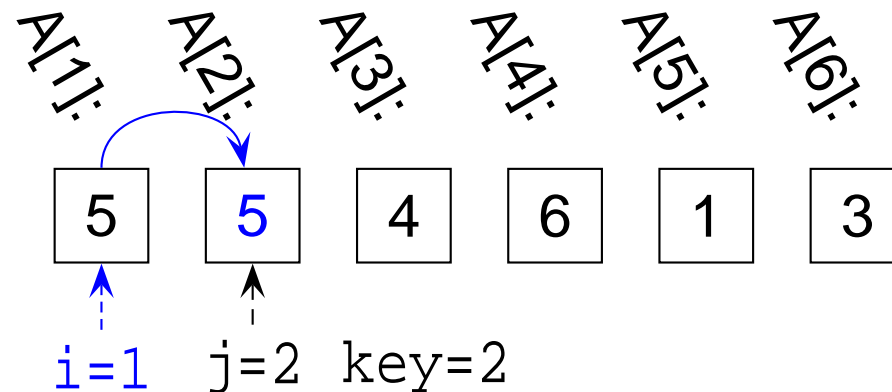
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (3)

insertionSort(Array A):

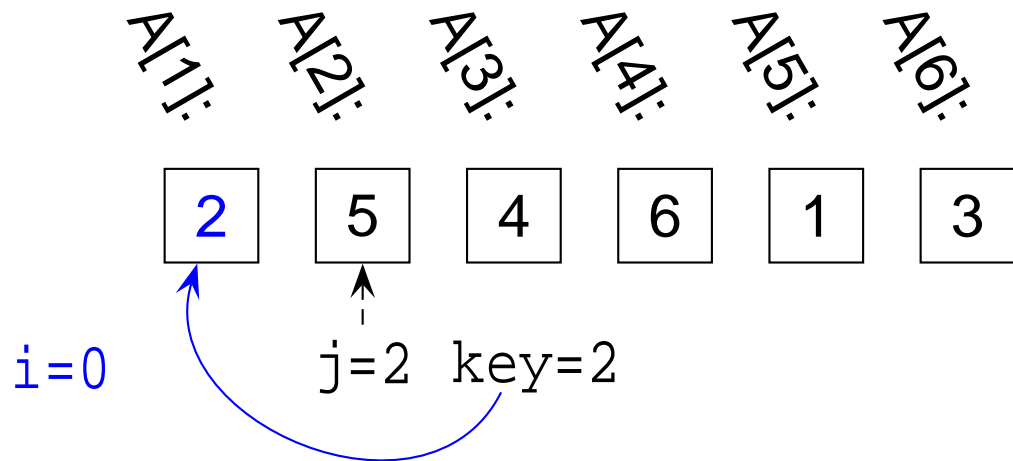
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$a[i+1] \leftarrow \text{key}$



Insertion sort (5)

insertionSort(Array A):

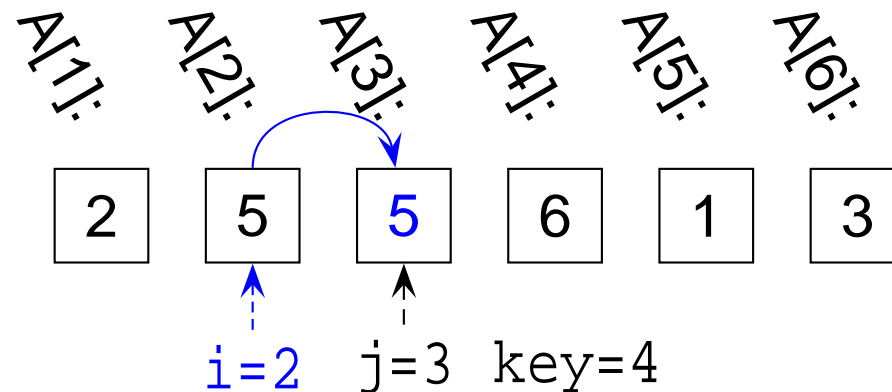
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (6)

insertionSort(Array A):

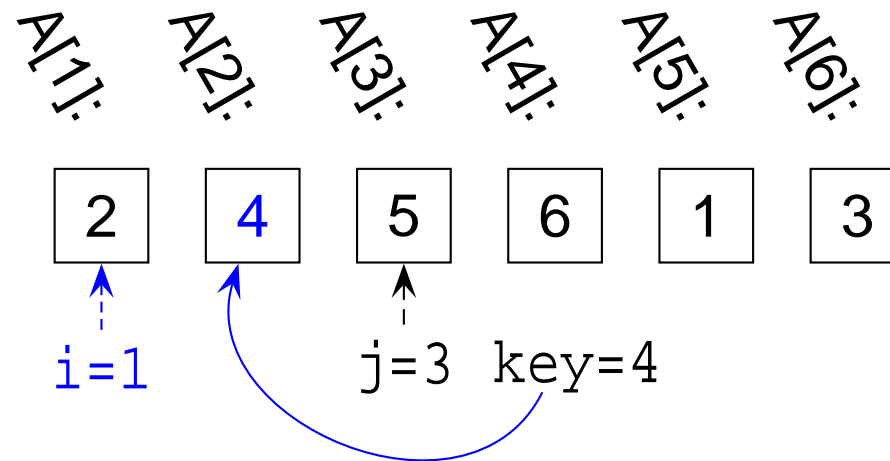
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (7)

insertionSort(Array A):

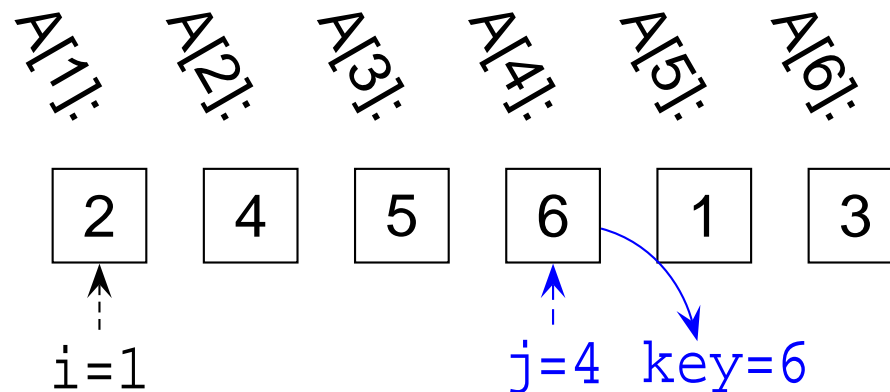
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (8)

insertionSort(Array A):

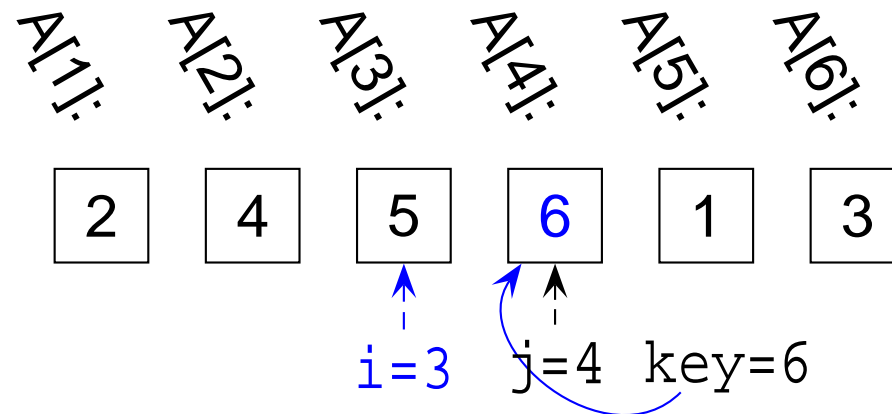
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$a[i+1] \leftarrow \text{key}$



Insertion sort (9)

insertionSort(Array A):

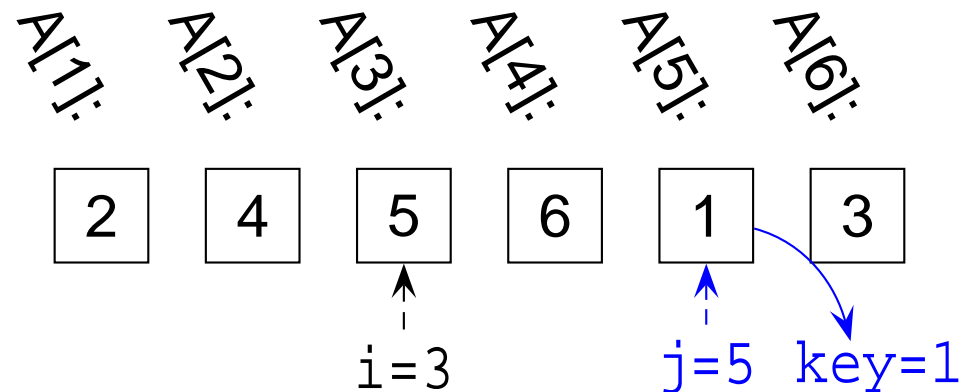
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (10)

insertionSort(Array A):

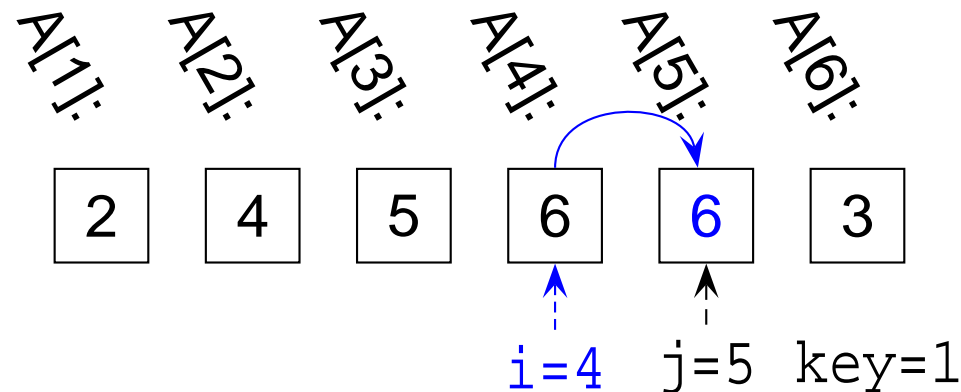
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (11)

insertionSort(Array A):

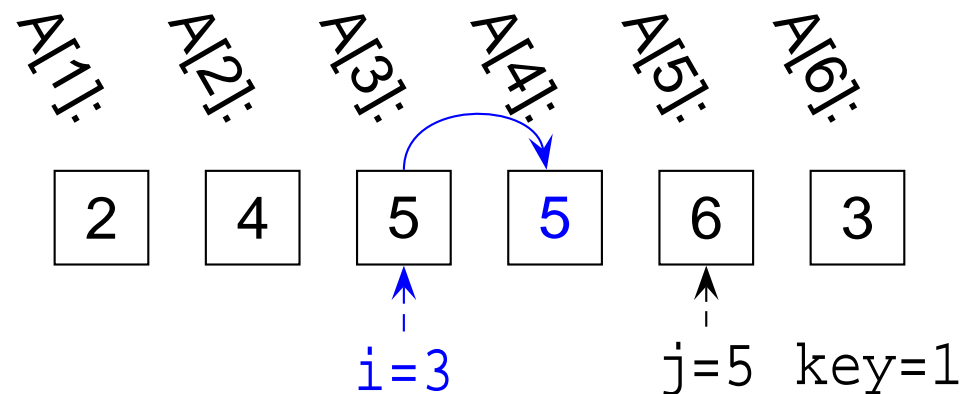
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (12)

insertionSort(Array A):

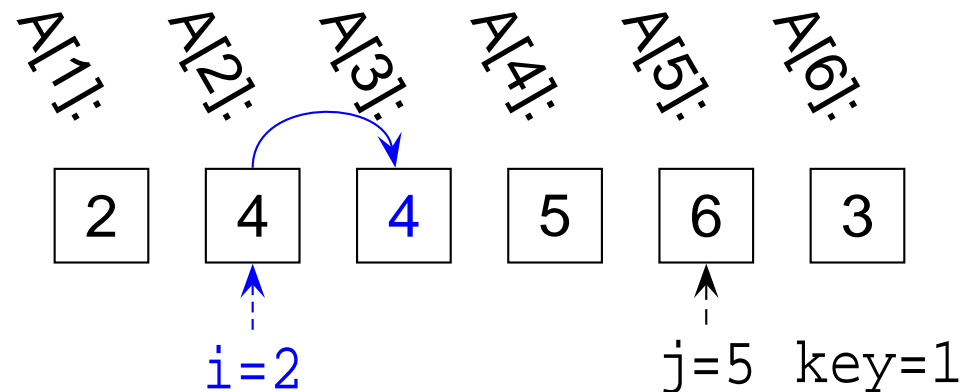
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (13)

insertionSort(Array A):

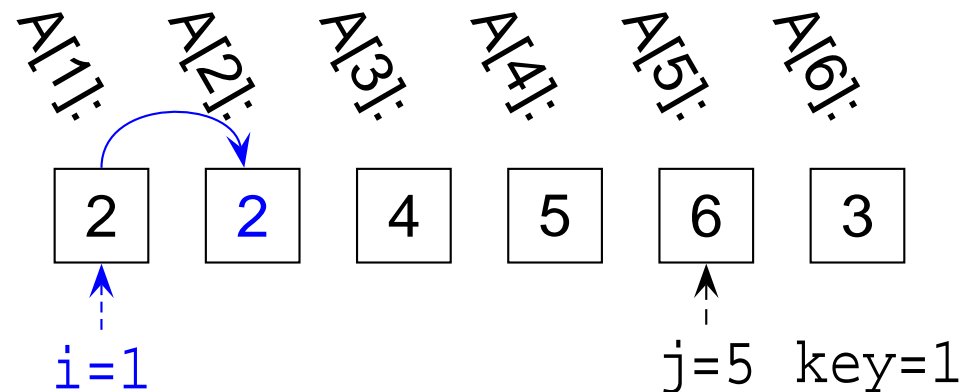
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (14)

insertionSort(Array A):

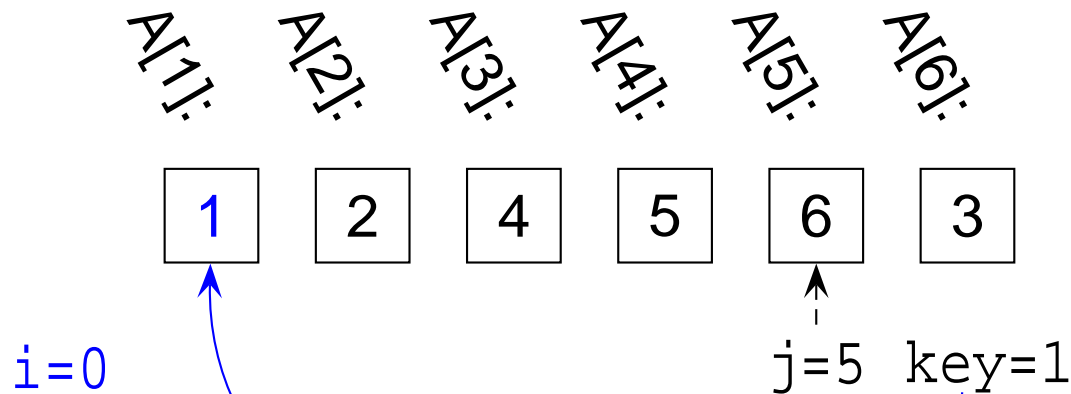
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (15)

insertionSort(Array A):

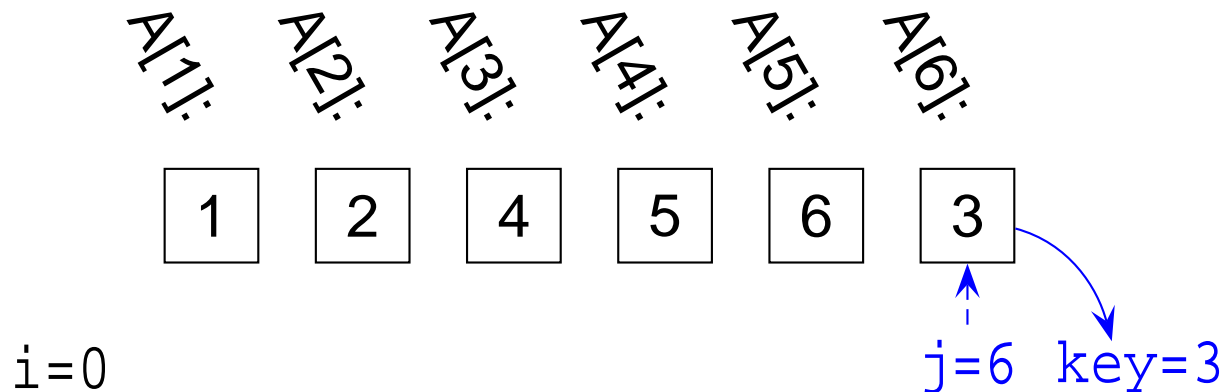
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (16)

insertionSort(Array A):

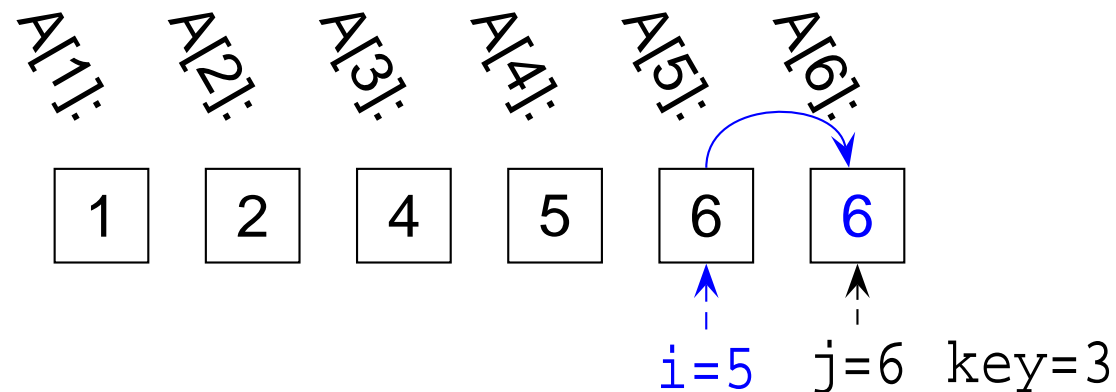
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

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$A[i+1] \leftarrow \text{key}$



Insertion sort (17)

insertionSort(Array A):

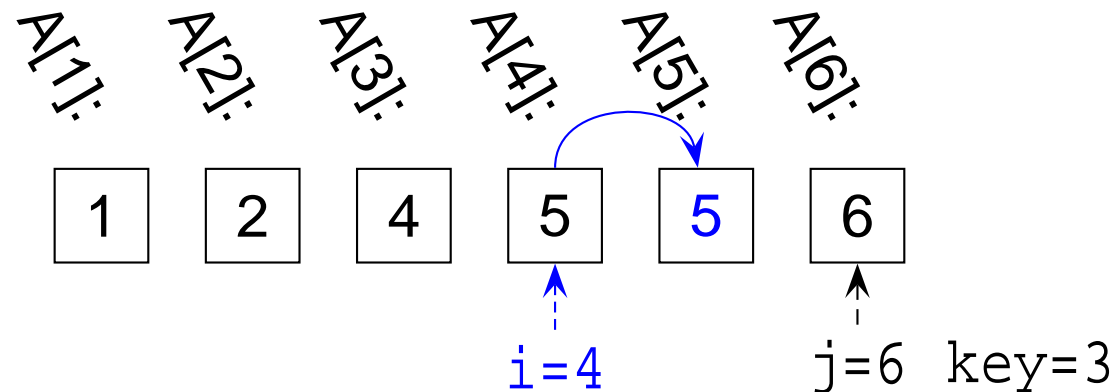
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



Insertion sort (18)

insertionSort(Array A):

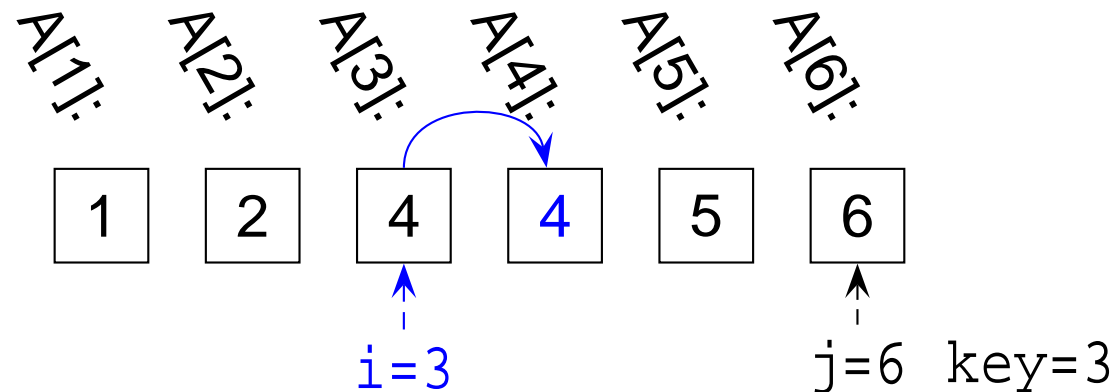
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

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Insertion sort (19)

insertionSort(Array A):

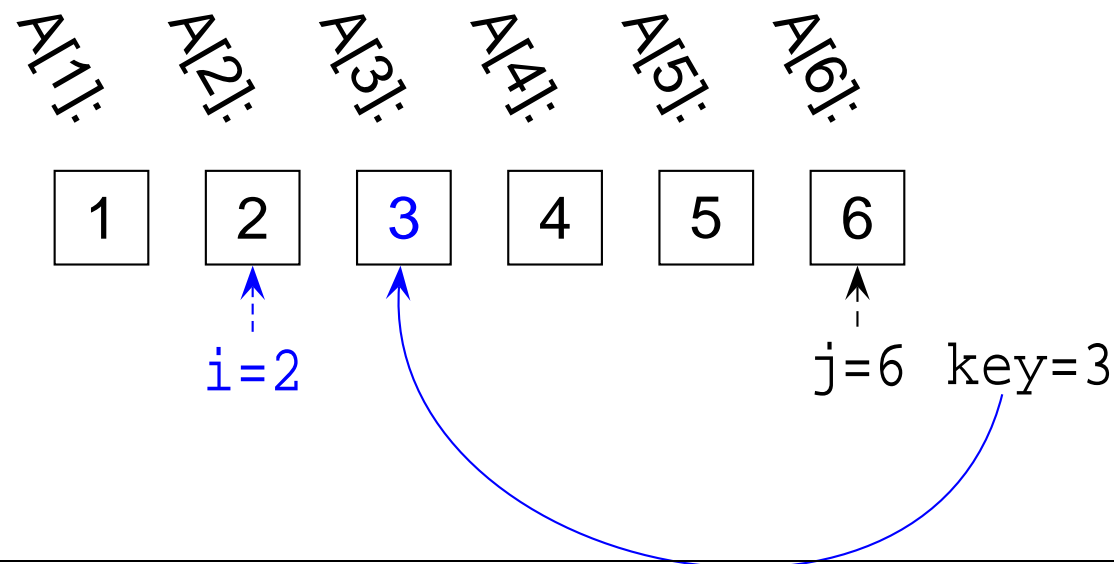
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

$\text{key} \leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

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$a[i+1] \leftarrow \text{key}$



Insertion sort (20)

insertionSort(Array A):

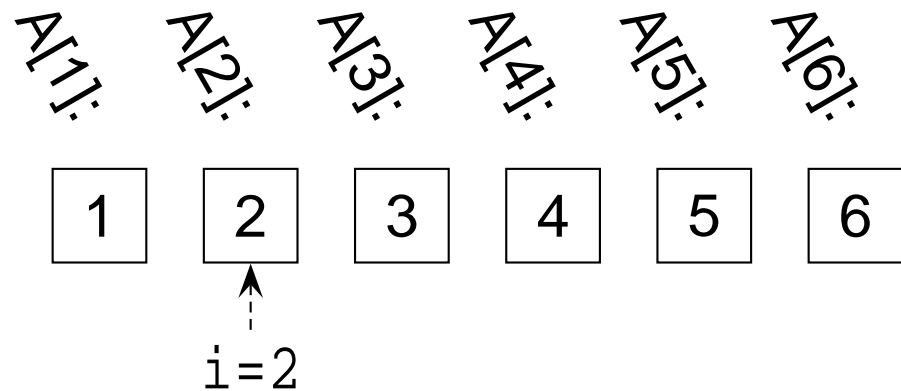
loop from $j \leftarrow 2$ **while** $j \leq \text{length}(A)$ **step** $j \leftarrow j+1$

key $\leftarrow A[j]$

loop from $i \leftarrow j-1$ **while** $i > 0, A[i] > \text{key}$ **step** $i \leftarrow i-1$

$A[i+1] \leftarrow A[i]$

$A[i+1] \leftarrow \text{key}$



$j=7$ key=3