Insertion Sort

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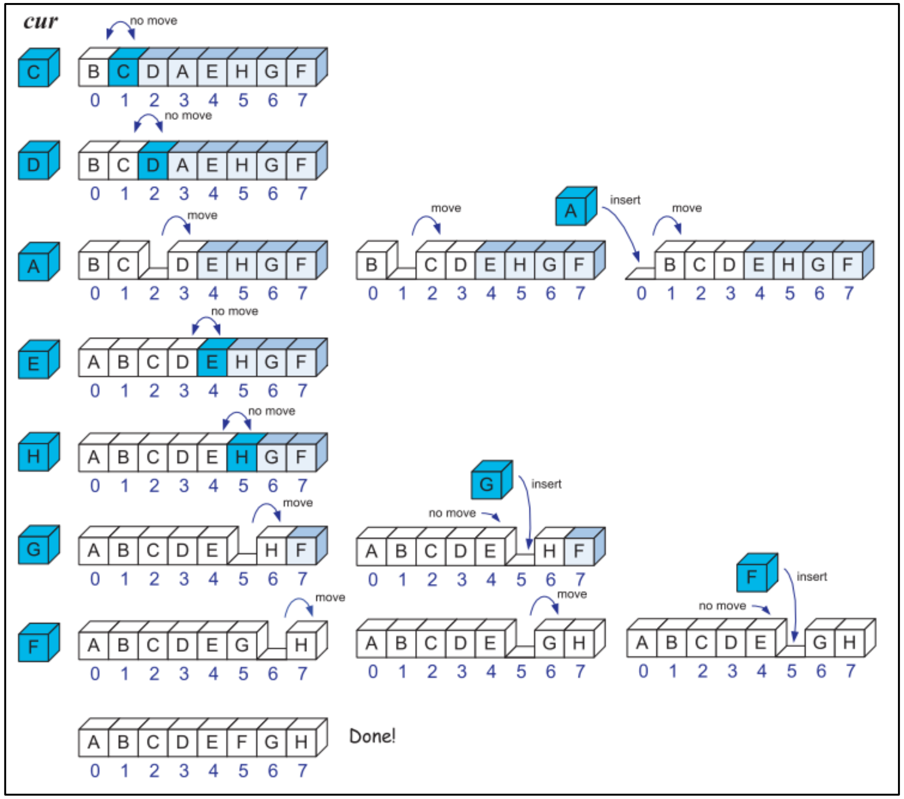
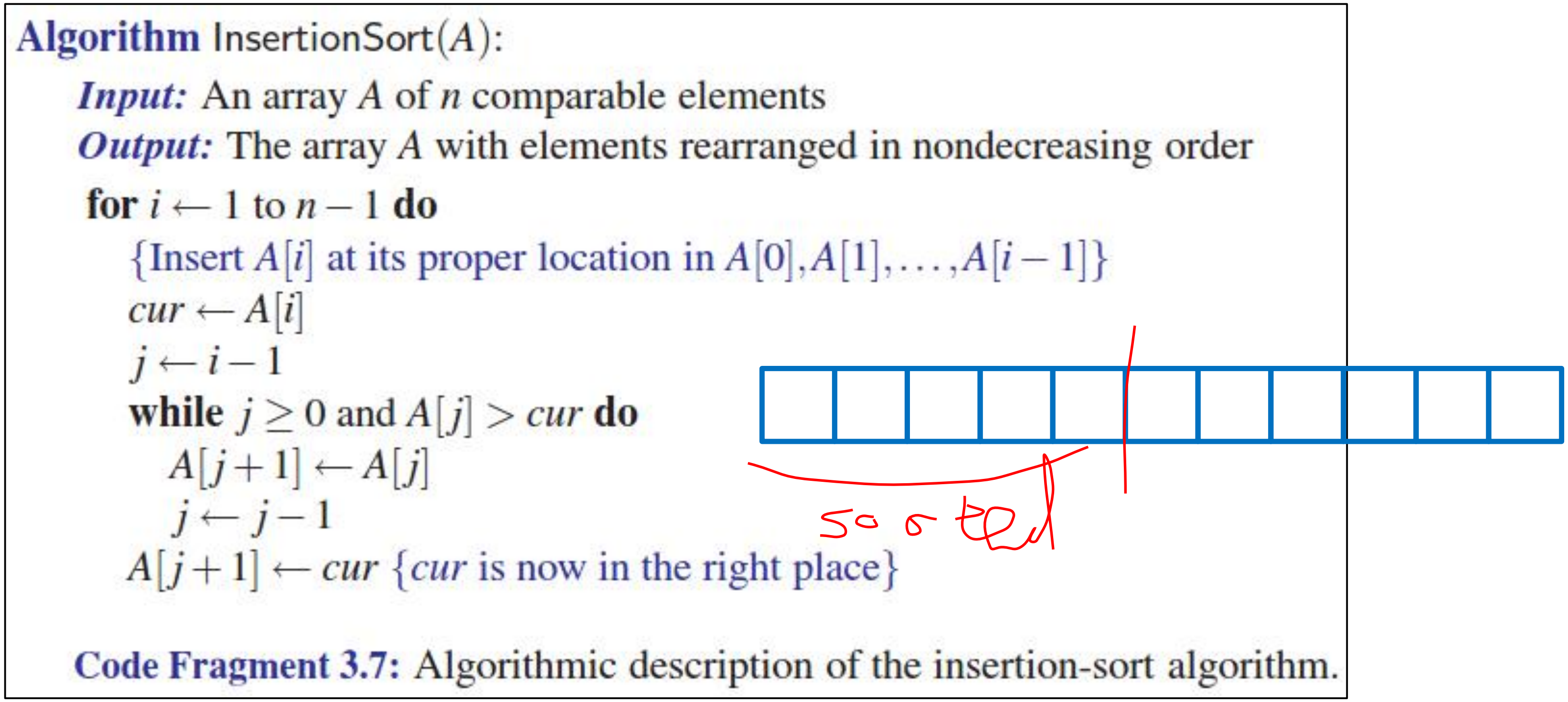
Insertion Sort

- Animation of insertion sort
  - Simple animation, Romania folk dance, electroacoustic
- Walk-through



Insertion Sort: Pseudo Code

- Pseudo code of insertion sort

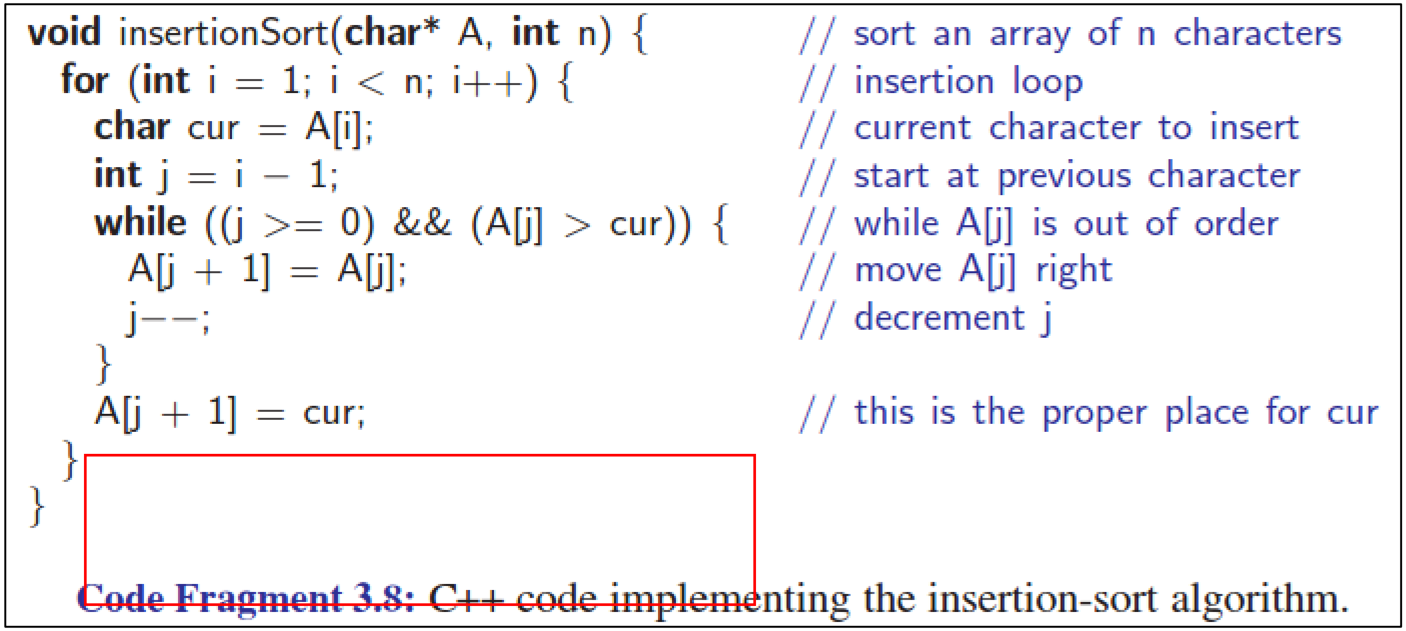


```
Algorithm InsertionSort($A$):
    Input: An array $A$ of $n$ comparable elements
    Output: The array $A$ with elements rearranged in nondecreasing order
    for $i \leftarrow 1$ to $n-1$ do
        {Insert $A[i]$ at its proper location in $A[0], A[1], \ldots, A[i-1]$}
        $cur \leftarrow A[i]$
        $j \leftarrow i-1$
        while $j \geq 0$ and $A[j] > cur$ do
            $A[j+1] \leftarrow A[j]$
            $j \leftarrow j-1$
        $A[j+1] \leftarrow cur$ {$cur$ is now in the right place}
```

Code Fragment 3.7: Algorithmic description of the insertion-sort algorithm.

Insertion Sort: C++ Function

- Real code in C++



```
void insertionSort(char* A, int n) {           // sort an array of n characters
  for (int i = 1; i < n; i++) {                // insertion loop
    char cur = A[i];                           // current character to insert
    int j = i - 1;                             // start at previous character
    while ((j >= 0) && (A[j] > cur)) {         // while A[j] is out of order
      A[j + 1] = A[j];                         // move A[j] right
      j--;                                     // decrement j
    }
    A[j + 1] = cur;                            // this is the proper place for cur
  }
}
```

Code Fragment 3.8: C++ code implementing the insertion-sort algorithm.

- Observations
  - Stable algorithm
  - To reduce comparisons ➔ Use binary search on the sorted part
  - To minimize movements ➔ Use another vector of pointers

Quiz for Insertion Sort

- Show each step of insertion sort on the vector:

3 | 5 1 4 2 7 9 6 8

3 5 | 1 4 2 7 9 6 8

$\underbrace{1\ \ 3\ \ 5}_{\text{sorted}}$ |

3 | 5 1 4 2 7 9 6 8

1 3

1 2 3 5

1 2 3 4 5