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Algorithms and Data Structures
Summer Term 2019
Exercise Sheet 1

Exercise 1: Bubblesort

The following pseudocode describes the BUBBLESORT algorithm which takes as input an Array A of length n.

Algorithm 1 BUBBLESORT$(A[0, \ldots, n-1])$

```
for i = 0 to n − 2 do
    for j = 0 to n − 2 do
        if A[j] > A[j + 1] then
            swap(A[j], A[j + 1])
```

(a) Assume BUBBLESORT runs on input $A = [27, 8, 19, 5, 23, 12]$. Give A after the end of each iteration of the outer for-loop.

(b) Give an upper and a lower bound for the (worst-case) runtime of BUBBLESORT as a function of n. Explain your answer.

Exercise 2: Insertion Sort

The following pseudocode describes the INSERTIONSORT algorithm which takes as input an Array A of length n.

Algorithm 2 INSERTIONSORT$(A[0, \ldots, n-1])$

```
for i = 0 to n − 2 do
    pos = i + 1
    while pos > 0 and A[pos] < A[pos − 1] do
        swap(A[pos], A[pos − 1])
        pos = pos−1
```

(a) Assume INSERTIONSORT runs on input $A = [27, 8, 19, 5, 23, 12]$. Give A after the end of each iteration of the for-loop.

(b) Give an upper and a lower bound for the (worst-case) runtime of INSERTIONSORT as a function of n. Explain your answer.