

PS Algorithms and Data Structures 2024

Task sheet 3

Task 7

Let $A[1, \dots, n]$ be an array with n numbers. Formulate a recursive divide and conquer algorithm in pseudocode to calculate the maximum of the values in the array A .

Task 8

Formulate an algorithm in pseudocode that determines the maximum number of times the number s appears consecutively in the array $A[1, \dots, n]$.

- The algorithm should have a runtime of $O(n)$.
- Specify a suitable loop invariant to show that the algorithm is correct.

The following examples illustrate how the algorithm works:

<i>Input</i>	<i>Output</i>
$A = [3, 7, 2, 2, 2, 6, 1, 2]$ und $s = 2$	3
$A = [3, 7, 2, 2, 2, 6, 1, 2]$ und $s = 7$	1
$A = [3, 7, 2, 2, 2, 6, 1, 2]$ und $s = 5$	0

Task 9

Consider the following pseudo code, which describes a so-called *linear search* for the element s in the array A .

```
1: LINEAR-SEARCH( $A, s$ )
2:   for  $i = 1$  to  $A.length$ 
3:     if  $A[i] = s$  return true
4:   return false
```

What is the expected number of elements of A that are checked when searching for s ? What is the maximum number of such checks?

Answer each of these questions using the following assumptions about the position of s .

1. The element s is located exactly once in the array A . The exact position of s in A is random and uniformly distributed (over $\{1, 2, 3, \dots, A.length\}$).
2. The element s is not contained in A .