

# Problem sheet 4

Course 320201 Fundamental Computer Science I, Dr. Holger Kenn  
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This problemsheet's solution is to be handed in either *THURSDAY*, October 2th, 18:00, (as October 3rd is a holiday) clearly readable on paper in my mailbox in Research 1 or *FRIDAY*, October 3rd, 11:15 as a *PDF* file via e-mail to h.kenn@iu-bremen.de.

Midterm: October 10th

## 1.) Stability

- a) Prove that Counting Sort is stable. (1p)
- b) In counting sort, the last **For** loop is replaced with the following code.

```
for  $j \leftarrow 1$  to  $length[A]$  do  
     $B[C[A[j]]] \leftarrow A[j]$   
     $C[A[j]] \leftarrow C[A[j]] - 1$   
end for
```

Would it still work? Would it still be stable? Give a proof for your findings. (2p)

- 2.) What is the worst-case running time of BUCKETSORT? What simple change to the algorithm preserves its linear expected running time and makes its worst-case running time  $O(n \lg n)$ ? (2p)
- 3.) Write an iterative version of RANDOMIZEDSELECT. (2p)
- 4.) In the algorithm SELECT, the input elements are divided into groups of 5. Will the algorithm work in linear time if they are divided in groups of 7? Show that SELECT does not run in linear time if groups of 3 are used. (2p)
- 5.) Show how QUICKSORT can be made to run in  $O(n \lg n)$  time in the worst case. (1p)