Introduction to Computational
Topology
Summer semester 2018

Prof. Dr. Rolf Klein
Barbara Schwarzwald
Institute of Computer Science I

Discussion: 4.07. - 06.07.

UNIVERSITÄT BONN
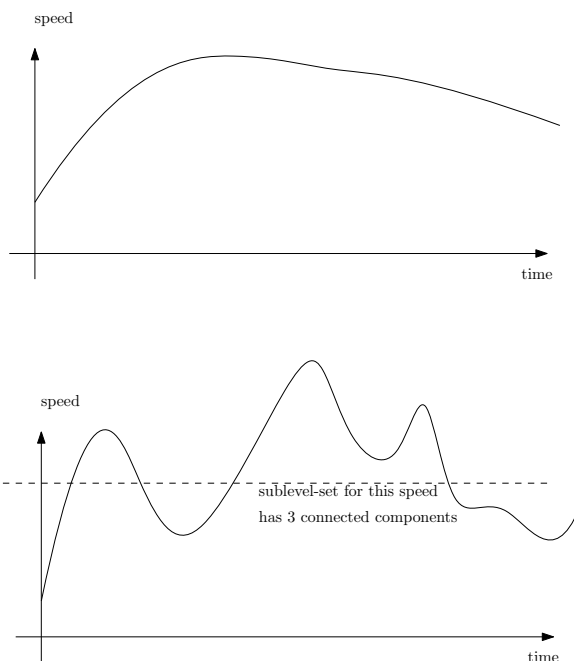
Exercise Sheet 9

Exercise 9.1:   Driver behaviour functions   (4 Punkte)

Analysis of topological filtrations have real-world applications. Consider the following two curves of driving speed over time for drivers on a highway - one of an experienced, relaxed driver and the other of a nervous driver.

Consider the filtration of the sublevel-sets and draw the according merge trees according to the elder rule. How can this be used to classify nervous or relaxed drivers?

Exercise 9.2:   Mini Ball Algorithm   (4 Punkte)

During the analysis of the running time for the MiniBall-Algorithm, we used a double recursive formula to analyse the runtime:

$$t_j(0) = 0 \qquad \text{for all j} \qquad\qquad t_j(n) \le t_j(n-1) + 1 + \tfrac{j}{n} t_{j-1}(n-1)$$

Prove that $t_j(n) \le (j+1)!n$.

Exercise 9.3:   Randomized Backwards Analysis   (4 Punkte)

Consider the standard algorithm for finding the maximum in an array with n integers, which consists of checking every entry in the array in order and keeping a *MaxSoFar* that holds the maximum found so far.

Let's say checking itself is an cheap operation, but updating *MaxSoFar* is expensive. What is the expected number of times *MaxSoFar* has to be updated, if the order of the items in the array is randomized?