iems
intelligente eingebettete
mikrosysteme

Bioinformatics Group
Prof. Dr. Rolf Backofen
Florian Eggenhofer
Michael Uhl
Rick Gelhausen

# Entwurf, Analyse und Umsetzung von Algorithmen

UNI FREIBURG

## Exercise sheet 11

**Exercise 1** (20 points)

In the lecture it was shown by means of a potential function that the costs for $n$ *insert* / *remove* operations for a $(2, 4)$ tree is $O(n)$. Prove in a similar fashion and with a suitable potential function that the costs for $n$ arbitrary *insert* / *remove* operations for a $(4, 9)$ tree are still $O(n)$.

Pay attention to provide a complete proof. Be especially careful that you consider every event that may occur. Similar cases can be proven together, different cases should be considered separately. For example, when you add a child there is no difference whether the node has 6 or 7 children before (in both cases a split is not necessary, and the potential function does not change, if chosen appropriately). In case of a previous node with 9 children you should consider a different case, as now a split has to happen and maybe the parent node changes as well as the potential function.

A complete proof does not imply much text. A proof may be very short, and a shorter proof with the same information content is always better.

Allocate enough time to write down your proof in a clean way. This is the main work of this task, in addition to the understanding of the proof from the lecture.