Illinois Institute of Technology
Department of Computer Science

Homework Assignment 6

CS 535 Design and Analysis of Algorithms
Fall Semester, 2016

Remember the Honesty Pledge!

Due: Thursday, October 6, 2016

1. We want to determine from which floor of an n-floor skyscraper an iPhone will survive when dropped to the pavement. That is, there is some integer d, $1 \le d \le n$, such that when dropped from floor d or higher the iPhone will be destroyed, but if dropped from a lower floor the iPhone will be undamaged. The problem is to determine d with as few drops as possible, given some number m of iPhones. If we have only one iPhone, for example, we need to drop the phone successively from the first floor, the second floor, and so on until it breaks. Using the van Emde Boas tree idea, design an algorithm to determine d when you have m phones to use with the n-story building.

2. Pages 546–547 in early printings of CLRS3 say "we treat *min* and *max* differently: the element stored in *min* does not appear in any of the clusters, but the element stored in *max* does." This is not really true (they probably corrected it in later printings)—what that sentence should say is "we treat *min* and *max* differently: the element stored in *min* does not appear in any of the clusters, but unless the vEB tree contains just one element (so that the minimum and maximum elements are the same), the element stored in *max* does." Rewrite the code for vEB-Empty-Tree-Insert, vEB-Tree-Insert, and vEB-Tree-Delete so that indeed, *max* does not appear in any of the clusters, just as *min* does not appear in any of the clusters.

3. Problem 20-1, parts (a) and (b) only, on page 557. In part (b), be careful that you do not get snagged by the pitfall described in the middle of page 86 of CLRS3. (*Hint*: For part (b), can you prove, under reasonable assumptions, that $P(u) = u - 2$?) Do not do parts (c)–(g); instead, do the following replacement for part (c):

   (c) We can store all of the array-of-pointers substructures in a single array outside the vEB tree itself. This would change the recurrence (20.5) to

   $$P(u) = (\sqrt{u} + 1)P(\sqrt{u}) + O(1).$$

   Solve this recurrence. Does this idea improve the vEB structure?

4. **PhD Qualifying Exam Section Problem 7.**

   As of September, 2016 the Wikipedia entry for vEB trees says, "This article needs attention from an expert in computer science. The specific problem is: bug in pseudocode." *You* are the expert in computer science; describe the error(s) in the article and how you would correct them.