Perpetuities in the Analysis of Algorithms for Order Statistics

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Abstract

We analyze algorithms for finding order statistics and show that "perpetuities," which are entities that appear in mathematical finance, play a central role. Two one-sided algorithms for finding order statistics are considered: Quick Select (a variant of Quick Sort) and Radix Select (a variant of Radix Sort). We analyze these algorithms when they work to find an element with a randomly selected rank. This kind of grand average provides a smoothing over all individual distributions for specific fixed order statistics. We show in both cases that the number of swaps (suitably scaled) is a perpetuity. In the case of radix Select we detect a phase change between biased and unbiased data.

The tool for this proof is contraction in the Wasserstein metric space, and identifying the limit as the fixed-point solution of a distributional equation.

Biography

Hosam Mahmoud earned a Ph.D. in Computer Science from the Ohio State University (in 1983). He is an elected member of the International Statistical Institute. He currently serves as an Associate Editor of the Annals of the Institute of Statistical Mathematics (Japan) and as an Associate Editor of Methodology and Computing in Applied Probability. He has research interests in the areas of probabilistic analysis of algorithms, searching and sorting, random structures and algorithms, randomized algorithms and statistical computing.