Read-Once Branching Programs for Tree Evaluation Problems

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Abstract:

This talk (although the result itself is a bit technical) should be accessible to general audience including Master-level CS students. The main goal of the talk is to explain how we can prove a complexity lower bound for a combinatorial problem and why it is hard, much harder than proving upper bounds.

Toward the ultimate goal of separating L (Log Space) and P (Poly Time), Cook, McKenzie, Wehr, Braverman and Santhanam introduced the “tree evaluation problem” (TEP). For fixed h, k > 0, FT_h(k) is given as a complete, rooted binary tree of height h, in which each internal node is associated with a function from [k]^2 to [k], and each leaf node with a number in [k]. The value of an internal node v is defined naturally, i.e., if it has a function f and the values of its two child nodes are a and b, then the value of v is f(a, b). Our task is to compute the value of the root node by sequentially executing this function evaluation in a bottom-up fashion. The problem is obviously in P and if we could prove that any branching program solving FT_h(k) needs at least k^{r(h)} states for any unbounded function r, then this problem is not in L, thus achieving our goal. The above authors introduced a restriction called “thrifty” against the structure of BP’s (i.e., against the algorithm for solving the problem) and proved that any thrifty BP needs \Omega(k^h) states. This paper proves a similar lower bound for “read-once” branching programs, which allows us to get rid of the restriction on the order of nodes read by the BP that is the nature of the thrifty restriction. This is a joint work with Atsuki Nagao.

About the Speaker:

Professor Iwama received B.E., M.E. and Ph.D. degrees from Department of Electrical Engineering, Kyoto University in 1973, 1975 and 1980, respectively. He has been a professor with the School of Informatics, Kyoto University since 1997. Professor Iwama’s research interests are mainly in algorithms and complexity theory. He is the editor-in-chief of the Bulletin of the EATCS, as well as Algorithms (an MDPI Online, Open Access Journal). He is Founder and Chair of the Executive Board, Asian Association for Algorithms and Computation (AAAC).

All are welcome!
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