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On Regular Expression Matching and Deterministic Finite Automata

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ABSTRACT

Given a regular expression R and a string T the regular expression matching problem is to determine if T matches any string in the language generated by R. The best known solution to the problem uses linear space and $O\left(\frac{nm\log\log n}{\log^{3/2} n} + n + m\right)$ time in the worst-case [2], where m and n are the lengths of R and T, respectively. A common misconception is that we can solve the problem efficiently by building a deterministic finite automaton (DFA) for R using $2^{O(m)}$ space and then run it on T in $O(n)$ time [1]. However, this analysis completely ignores issues of addressing into exponential sized data structures. An address in a DFA of size $2^{\Omega(m)}$ requires $\Omega(m)$ bits. Hence, on a standard unit-cost word RAM with word length $\Theta(\log n)$ [3], we need at least $\Omega(m/\log n)$ time to simply write an address in the DFA. It follows that traversing the DFA for R uses at least $\Omega(nm/\log n + n + m)$ worst-case time (note that we do not even include DFA construction time). This bound can only be $O(n)$ when $m = O(\log n)$ and is never better than the above best known bound.

BODY

Even ignoring construction time, deterministic finite automata do not solve regular expression matching in worst-case linear time.

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