Non-deterministic Communication Complexity with Few Witnesses

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Abstract
We study non-deterministic communication protocols in which no input has too
many witnesses. Define $n_k(f)$ to be the maximum complexity of a non-
deterministic protocol for the function $f$ in which each input has at most $k$ witnesses. We present two different lower bounds for $n_k(f)$. Our first result shows that $n_k(f)$ is bounded below by $\Omega(\sqrt{c(f)/k})$ where $c(f)$ is the deterministic complexity. Our second results bounds $n_k(f)$ by $\log(rk(M_f))/k-1$ where $rk(M_f)$ is the rank of the representing matrix of $f$. As a consequence, it follows that the communication complexity analogue of the Turing-complexity class $Few P$ is equal to the analogue of the class $P$. 