On a relationship between non-deterministic communication complexity and instance complexity

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Abstract

We study the relationship between non-deterministic communication complexity of uniform functions and instance complexity. For that purpose, the witness of the non-deterministic communication protocol executed by Alice and Bob is interpreted by Alice as a program p that, for t sufficiently large, "corresponds exactly" to the instance complexity $C^t(\overline{y} : Y_1(\overline{x}))$; in the previous expression $\overline{x}$ and $\overline{y}$ are the parts of the input known by Alice and Bob respectively and $Y_1(\overline{x})$ is the set of all values of y such that $f(\overline{x}, y) = 1$. The main results are $\max_{|x|=|y|=n}\{{C_{\text{Yes}}}^{t(n)}(y : Y_1(x))\} = N^1(f)$ and $\max_{|x|=|y|=n}\{C^{t(n)}(y : Y_1(x))\} = N(f)$. We also present a simple inequality relating individual communication complexity with instance complexity. Joint work with Armando Matos and André Souto.