BOUNDED ARITHMETIC AND LOGCFL

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The class LOGCFL is defined to be the class of sets LOGSPACE-reducible to some context-free language. This class is equivalent to the class SAC^1 of sets which are computed by some semi-unbounded fan-in, logarithmic depth, polynomial size circuit families.

Using the latter characterization, we define a two-sort bounded arithmetic $V\text{-}Q^{SAC}(\Sigma_0^B)$ [2] which has a bit comprehension axiom for formulae stating that there is a tree certificate of SAC^1 circuit on a given input string. Then we prove that a function is provably total in $V\text{-}Q^{SAC}(\Sigma_0^B)$ if and only if it is polynomially bounded and bitwise computable in LOGCFL.

The main feature of the proof is that $V\text{-}Q^{SAC}(\Sigma_0^B)$ can prove the closure of SAC^1 under complementation. This closure property of SAC^1 was proved by Borodin et.al. [1] using the inductive counting argument and our proof is a formalization of it within the system.

REFERENCES

[1] Borodin, A., S.A.Cook, P.W.Dymond, W.L.Ruzzo and M.Tompa, Two applications of inductive counting for complementation problems. SIAM J.Comput., vol.18, No.3, pp.559–578 (1989)

[2] Kuroda, S., Generalized quantifier and a bounded arithmetic for LOGCFL, to appear in Archive for Mathematical Logic. (2007)

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