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The complexity of short two-person games.

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This paper answers an open problem due to Cook; namely, is there a "natural" problem which is complete for the class of languages AC^1? If $k \geq 1$ is an integer, then AC^k is the class of languages recognizable by alternating Turing Machines [cf. *A. Chandra, D. Kozen* and *L. Stockmeyer*, "Alternation", J. Assoc. Comput. Mach. 28, 114-133 (1981; Zbl 0473.68043)]. It is shown that a source of problems that are complete for AC^1 is a class of short (i.e., $O(\log n)$ moves) two-person games of perfect information. The authors define a specific two-person game of perfect information called Shortcake after a fashion of a game termed Cutcake of *E. Berlekamp, J. Conway* and *R. Guy* [see "Winning ways for your mathematical plays" (1982; Zbl 0485.00025)], which is an alternating move game on an $m \times n$ Boolean matrix between two players: H and V. If an $m \times n$ Boolean matrix is generically denoted by M, then informally, Shortcake=$\{M : H$ has a winning Shortcake strategy on $M\}$. For NC^1 reduction defined by computations from a uniform family of founded fan-in circuits of $O(\log n)$ depth, the following is the main theorem of the paper: Theorem. Shortcake is complete for AC^1 under many-one NC^1 reducibility. Other games and variants for P- completeness are also formulated and discussed. *A.Lewis (Irvine)*

Keywords: two-person games of perfect information; P-completeness
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