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The Associative Law for Groups

Abstract for the Algebra and Combinatorics and Number Theory Seminars 2003 November 4 (Tuesday)

A group without associativity is called a ``quasigroup. (Technically, a quasigroup also has no identity, but that part is not too significant.) Groups can be used to construct a certain combinatorial structure called a ``Dowling geometry of any dimension, but for quasigroups that construction is possible only in dimension 2 or less. The reason is that dimension 3 implies the associative law. This was shown by Kahn and Kung around 1980 by using the combinatorial structure to construct a multiplication operation which, in dimension 3, can be shown to be associative. I will give a new and more natural proof using the axioms for a group in terms of division – an axiomatization that is not as well known as it ought to be.