

ACM Computing Review CR137206: "Associative Digital Network Theory",
An associative algebra approach to logic, arithmetic and state machines.
(prof. Harvey Cohn, CUNY, 8 aug 2009):

As a historical fact, mathematics developed from applications in rational mechanics and number theory, for which commutative algebra is most natural. For basic applications from network theory (Turing machines), associative algebra $(ab)c = a(bc)$ would be more natural, with Boolean algebra $aa = a$ and commutative algebra $ab = ba$ as special cases.

Benschop develops this thesis in an idiosyncratic fashion, reinforced by a long career of practical experience. → This book may well be an important historical document, and useful for seminars, though not presented primarily for class usage. There are profuse illustrations in classic number theory, and claims that the outlook sheds new light on classic problems such as those of Fermat and Goldbach, interpreted as machines. As unlikely as it is that this may be practical, it makes for an interesting book.

This book is intended for researchers at industrial laboratories, teachers and students at technical universities, in electrical engineering, computer science and applied math departments, interested in new developments of modeling and designing digital networks (state machines, combinational and sequential logic) in general, as combined math/engineering discipline. As background an undergraduate level of "Modern applied algebra" (Birkhoff-Bartee -1970), and "Algebraic Structure of Sequential Machines" (Hartmanis-Stearns" -1970) will suffice.

Essential concepts with engineering interpretation are given in a practical fashion with examples. Main motivation is: the importance of the unifying associative algebra of *function composition* (semigroup theory) for practical characterisation of the three main computer functions, namely sequential logic (state machines), arithmetic and combinational (Boolean) logic. The *five basic state machine components* are derived (periodic and monotone counters, logic and/or, branch and reset), with natural ways of coupling them into networks. Boolean logic is analyzed with a new spectral method. Based on semigroup structure of *residue closures*, a *residue-and-carry* method yields elementary proofs of conjectures of Fermat and Goldbach.

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Associative Structure of State Machines

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*An Associative Algebra Approach
to Logic, Arithmetic and Automata*

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