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Title: The existence of an associate subgroup in normal cryptogroups

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Let S be a semigroup. If $a, x \in S$ are such that $a = axa$, then x is an associate of a. A subgroup G of S is an associate subgroup of S if it contains exactly one associate of each element of S. Representing a normal cryptogroup S as a strong semilattice of Rees matrix semigroups, we give necessary and sufficient conditions on S in order for S to have an associate subgroup. Having an associate subgroup is equivalent to admitting a unary operation satisfying three simple axioms. We prove that every maximal subgroup of S is an associate subgroup if and only if S is completely simple. A counterexample shows that the unary semigroups corresponding to two different associate subgroups of (completely simple) S need not be isomorphic. Normal cryptogroups having an associate subgroup are characterized in several ways in the main result of the paper.

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