Prime Clocks

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Abstract: Physical implementations of digital computers began in the latter half of the 1930's and were first constructed from various forms of logic gates. Based on the prime numbers, this paper introduces prime clocks and prime clock sums, where the clocks utilize time and act as computational primitives instead of gates. The prime clocks generate an infinite abelian group, where for each n, there is a finite subgroup S such that for each Boolean function $f : \{0,1\}^n \to \{0,1\}$, there exists a finite prime clock sum in S that can represent and compute f. A parallelizable algorithm, implemented with a finite prime clock sum, is provided that computes f. In contrast, the negation $\neg$, conjunction $\wedge$, and disjunction $\vee$ operations form a Boolean algebra. In terms of computation, Boolean circuits computed with logic gates `NOT`, `AND`, `OR` have a depth. This means that a completely parallel computation of Boolean functions is not possible with these gates. Overall, some new connections between number theory, Boolean functions and computation are established. [1]

[1] An excerpt: Autonomous Systems 2017. Proceedings of the 10th GI Conference. **10**(857). 142–158, VDI Verlag 2017.

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