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MemComputing: a brain-inspired computing paradigm

Which features make the brain such a powerful and energy-efficient computing machine? Can we reproduce them in the solid state, and if so, what type of computing paradigm would we obtain? I will show that a machine that uses memory to both process and store information, like our brain, and is endowed with intrinsic parallelism and information overhead - namely takes advantage, via its collective state, of the network topology related to the problem - has a computational power far beyond our standard digital computers [1]. We have named this novel computing paradigm "memcomputing" [2, 3, 4]. As examples, I will show the polynomial-time solution of prime factorization, the search version of the subset-sum problem [5], and approximations to the Max-SAT beyond the inapproximability gap [6] using polynomial resources and self-organizing logic gates, namely gates that self-organize to satisfy their logical proposition [5]. I will also show that these machines are described by a topological field theory, and they compute via an instantonic phase, implying that they are robust against noise and disorder [7]. The digital memcomputing machines we propose can be efficiently simulated, are *scalable* and can be easily realized with available nanotechnology components. Work supported in part by MemComputing, Inc. (http://memcpu.com/).

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