A quantum-information-theoretic complement to a general-relativistic implementation of a beyond-Turing computer

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Abstract

There exists a growing literature on the so-called physical Church-Turing thesis in a relativistic spacetime setting. The physical Church-Turing thesis is the conjecture that no computing device that is physically realizable (even in principle) can exceed the computational barriers of a Turing machine. By suggesting a concrete implementation of a beyond-Turing computer in a spacetime setting, István Neméti and Gyula Dávid (2006) have shown how an appreciation of the physical Church-Turing thesis necessitates the confluence of mathematical, computational, physical, and indeed cosmological ideas. In this talk, I will honour István's seventieth birthday, as well as his longstanding interest in, and his seminal contributions to, this field going back to as early as 1987 by modestly proposing how the concrete implementation in Neméti and Dávid (2006) might be complemented by a quantum-information-theoretic communication protocol between the computing device and the logician who sets the beyond-Turing computer a task such as determining the consistency of Zermelo-Fraenkel set theory. This suggests that even the foundations of quantum theory and, ultimately, quantum gravity may play an important role in determining the validity of the physical Church-Turing thesis.