Reversible Computing as a Special Case of Quantum Computing

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Abstract

Reversibility is one of the important features of quantum computing, because evolution of a quantum system is described by a unitary operator and hence it is reversible. Since Bennett (1973) proposed a reversible Turing machine, various models of reversible computing have been proposed and investigated. In this talk, after giving remarks on the relation between quantum and reversible computing, we focus on a problem how universal computers can be built from primitive elements with very simple reversible rules. Especially, we consider a new universal reversible logic element called a “rotary element” proposed by Morita et al. (2001). It is an element with 1-bit memory, and thus not a pure logic gate. We show that any reversible Turing machine can be realized as a circuit composed only of it. We also discuss simple reversible two-dimensional cellular automata in which any reversible counter machine can be embedded compactly. Such reversible systems suggest possibilities of new architectures of computing that are very different from the ones using logic gates of a conventional type.

Slides of this talk will be available at: http://www.iec.hiroshima-u.ac.jp/˜morita/equis/

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