The Myth of Universal Computation

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It is shown that the concept of a Universal Computer cannot be realized. Specifically, instances of a computable function $\mathcal{F}$ are exhibited that cannot be computed on any machine $\mathcal{U}$ that is capable of only a finite and fixed number of operations per step. This remains true even if the machine $\mathcal{U}$ is endowed with an infinite memory and the ability to communicate with the outside world while it is attempting to compute $\mathcal{F}$. It also remains true if, in addition, $\mathcal{U}$ is given an indefinite amount of time to compute $\mathcal{F}$. This result applies not only to idealized models of computation, such as the Turing Machine and the like, but also to all known general-purpose computers, including existing conventional computers, as well as contemplated ones such as quantum computers.