On the nature and future of the Theory of Computation (ToC)

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Abstract

The great impact of computer technology on our society tends to hide and obscure the intellectual foundations it rests on, especially from laymen but sometimes from experts as well (the same is true for past technological revolutions as well). Even when understood, these theoretical ideas are often viewed only as servants of the technological development. In this talk, I plan to focus and elaborate on the nature of ToC as an independent intellectual discipline, which is summarized below.

The Theory of Computation, since its inception by Turing in 1936, is as revolutionary, fundamental and beautiful as major theories of mathematics, physics, biology, economics... that are regularly hailed as such. Its impact has been similarly staggering. The mysteries still baffling ToC are as challenging as those left open in other fields. And quite uniquely, the theory of computation is central to most other sciences.

In creating the theoretical foundations of computing systems ToC has already played, and continues to play a major part in one of the greatest scientific and technological revolutions in human history. But the intrinsic study of computation transcends man-made artifacts. ToC has already established itself as an important mathematical discipline, with growing connections to nearly all mathematical areas. And its expanding connections and interactions with all sciences, naturally integrating computational modeling, algorithms and complexity into theories of nature and society, marks the beginning of another scientific revolution!