Short citation:

Constantinos Daskalakis is awarded the Nevanlinna Prize for transforming our understanding of the computational complexity of fundamental problems in markets, auctions, equilibria, and other economic structures. His work provides both efficient algorithms and limits on what can be performed efficiently in these domains.

Long citation:

Constantinos Daskalakis has developed a powerful body of results that resolve the computational complexity of some of the central problems in economic theory. These results have also been key to an important emerging theme in computer science, in which algorithms are designed for agents who behave according to their own self-interest.

Daskalakis's early work (with Goldberg and Papadimitriou) showed that finding Nash equilibria is complete for the complexity class PPAD; this implies that it is computationally equivalent in a precise sense to finding Brouwer fixed points, thus establishing a natural converse to Nash's famous construction of equilibria using fixed-point theorems. This computational difficulty in finding the Nash equilibrium in general raises important questions about the role of Nash equilibria as predicted outcomes when players interact in a fashion modeled by a game.

Daskalakis has also made important contributions to the theory of mechanism design, creating algorithms for use by selfish agents. The prior state of the art in this area (including Myerson's Nobel-Prize-winning work on optimal auctions) had been restricted largely to problems where participants' objectives are one-dimensional, described by a single parameter for each participant. Daskalakis (with Cai and Weinberg) provided a general method for transforming multidimensional mechanism design problems to pure problems in algorithm design, in the process developing mathematical tools that he used (with Deckelbaum and Tzamos) to make significant progress on characterizing optimal multidimensional mechanisms, an area that has been open for several decades. The underlying technique relies on a new and powerful geometric interpretation of a collection of large implicitly-defined optimization problems at the heart of the transformation.

In addition to his work on issues at the interface of computational and economic theory, Daskalakis has produced work contributing to an impressive diversity of further areas in the theory of computation. This includes his resolution (with Mossel and Roch) of a fundamental conjecture in the reconstruction of evolutionary trees, and his recent approaches to challenges in the theory of machine learning, including (with Tzamos and Zampetakis) new global guarantees for the well-known Expectation-Maximization heuristic from statistics for mixtures of two Gaussians with known covariances.