The awards are summarized below with links to their webpage.

In their Expedition to Understand, Cope with, and Benefit From Intractability, Sanjeev Arora and his collaborators at Princeton University, Rutgers University, New York University and the Institute for Advanced Study will attack some of the deepest and hardest problems in computer science, striving to bridge fundamental gaps in our understanding about the power and limits of efficient algorithms. Computational intractability, a concept that permeates science, mathematics and engineering, limits our ability to understand nature or to design systems. The PIs hope to better understand the boundary between the tractable and the intractable. This has the potential to revolutionize our understanding of algorithmic processes in a host of disciplines and to cast new light on fields such as quantum computing, secure cryptography and pseudorandomness. The research team plans to draw on ideas from diverse fields including algorithms, complexity, cryptography, analysis, geometry, combinatorics and quantum mechanics.

In the Expedition Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society, Carla Gomes and her colleagues at Cornell University, Bowdoin College, the Conservation Fund, Howard University, Oregon State University and the Pacific Northwest National Laboratory will explore the development and application of computational methods to enable a sustainable environment, economy and society. By tackling challenges that have not traditionally been addressed by computational approaches, Gomes and her team hope to create a new field of computational sustainability--much like computational biology has arisen in past decades--that will stimulate new research synergies across the areas of constraint optimization, dynamical systems, and machine learning. The research team is highly interdisciplinary, bringing together computer scientists, applied mathematicians, economists, biologists and environmental scientists.

In the Open Programmable Mobile Internet 2020 project, Nick McKeown and his colleages at Stanford University address fundamental issues emerging in the forthcoming broadband wireless mobile revolution. It aims to create an "open" alternative to mobile ubiquitous computing and communication that can spur innovations, which will have a dramatic impact on the choices users will have in the way their data and information is computed, stored and communicated. Their architecture will enable: identity-based computing that frees us from managing a large number of physical and digital keys and enables the development of an integrated security infrastructure; a fluid computing experience that provides seamless access to data and applications anywhere and on any available network; an open, programmable and secure environment, where it is easy both to write and deploy applications on devices that are secure and to enable remote services and backup storage in the cloud; and fast radio access networks where new radio technology mitigates interference, exploits diversity at all levels and improves transmit channel knowledge.

In the Molecular Programming Project, Erik Winfree and his colleagues at the California Institute of Technology and University of Washington will develop fundamental computer science principles for programming information-bearing molecules like DNA and RNA polymers and demonstrate their application experimentally. Inspired by the biomolecular programs of life--from the low-level operating system controlling cell metabolism to the high-level code for development, the process by which a single cell becomes an entire organism--Winfree and his colleagues are working to create analogous molecular programs using non-living chemistry. The objects of their study, molecular programs, are collections of molecules that may perform a computation, fabricate an object or control a system of molecular sensors and actuators. The project aims to develop tools and theories for molecular programming--such as programming languages and compilers--that will enable systematic design and implementation of technological and biotechnological applications that require information processing and decision-making to be embedded within and carried out by chemical processes.