Theory of Networked Computation

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Workshop Vision

The increasing prominence of the Internet, the Web, and large data-networks in general has profoundly affected social and commercial activity. It has also wrought one of the most profound shifts in Computer Science since its inception. Traditionally, Computer-Science research focused primarily on understanding how best to design, build, analyze, and program computers. Research focus has now shifted to the question of how best to design, build, analyze, and operate networks. How can one ensure that a network created and used by many autonomous organizations and individuals functions properly, respects the rights of users, and exploits its vast shared resources fully and fairly?

The SIGACT community can help address the full spectrum of research questions implicit in this grand challenge by developing a Theory of Networked Computation (ToNC), encompassing both positive and negative results. Algorithms and complexity-theory research has already evolved with and influenced the growth of the Web, producing interesting results and techniques in diverse problem domains, including search and information retrieval, network protocols, error correction, Internet-based auctions, and security. A more general Theory of Networked Computation could influence the development of new networked systems, just as formal notions of “efficient solutions” and “hardness” have influenced system development for single machines. To develop a full-fledged Theory of Networked Computation, researchers will build on past achievements both by striking out in new research directions and by continuing along established directions.

The SIGACT community has identified three broad, overlapping categories of ToNC-research goals:

* **Realizing better networks**: Numerous theoretical-research questions will arise in the design, analysis, implementation, deployment, operation, and modification of future networks.

* **Computing on networks**: Formal computational models of future networks will enable us both to design services, algorithms, and protocols with provable properties and to demonstrate (by proving hardness results) that some networked-computational goals are unattainable.

* **Solving problems that are created or exacerbated by networks**: Not all of the ToNC-research agenda will involve new computational models. The importance of several established theoretical-research areas has risen dramatically as the use of networked computers has proliferated, and some established methods and techniques within these areas are not general or scalable enough to handle the problems that future networks will create. Examples of these areas include massive-data-set algorithmics, error-correcting codes, and random-graph models.

CISE’s NetSE program welcomes proposals in all three categories. More details about the ToNC-research agenda.