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Top Global Award for Young Technologists Goes to Researcher Who Advanced AI with High-Performance Computers

Torsten Hoefler Awarded ACM Prize in Computing for Facilitating Breakthroughs in Research and Industry

New York, NY, March 26, 2025 – ACM, the Association for Computing Machinery, today named Torsten Hoefler, a Professor at ETH Zurich, the recipient of the 2024 ACM Prize in Computing for fundamental contributions to high-performance computing and the ongoing AI revolution. Hoefler developed many of the core capabilities of modern supercomputers and defined key aspects of the algorithms for distributing AI models on them.

The ACM Prize in Computing recognizes early-to-mid-career computer scientists whose research contributions have fundamental impact and broad implications. The award carries a prize of $250,000, from an endowment provided by Infosys Ltd, a global leader in next-generation digital services and consulting.

Overview

High-performance computing (HPC) plays a critical role in AI applications, which require a great deal of computing power. The work of Hoefler and his colleagues to scale network design and programming in supercomputers has revolutionized the capabilities of these large systems. For example, AI algorithms can now be processed on hundreds of thousands of nodes (computers or servers).

Hoefler's advances in interconnection networks, programming, and parallel algorithms broke new ground in facilitating the use of large-scale massively parallel clusters. His numerous innovations across the whole supercomputer stack—including key contributions such as MPI-3 nonblocking collective operations, foundational parallelism strategies for AI models, and high-performance networking systems—have pushed the boundaries of parallel systems design and translated into dramatic improvements in supercomputer performance and scalability. Many of those innovations are incorporated into the largest and most powerful machines today.

Key Contributions

Message Passing Interface 3

Hoefler played a major role in the evolution of the Message Passing Interface (MPI), an informal industry standard for exchanging messages between numerous individual nodes throughout an HPC network. A messaging standard allows synchronization of the activities of each individual computer, sharing data between nodes, and direction and control of the entire parallel network. The MPI-3 standard, in which Hoefler played a leading role, was adopted in 2012 and made possible many of the critical advances in HPC for simulations and AI applications over the past several years.

For MPI-3, Hoefler chaired both the "Process Topologies" and "Collective Operations" working groups. His nonblocking collective operations such as Allreduce, Allgather, Bcast, and their respective blocking versions are included in various collective communication libraries—even beyond MPI-3. These operations power the core of distributed deep learning today.

3D Parallelism

Hoefler was among the first to develop and discover the now well-known notion of "3D parallelism," which drives infrastructure design for the whole AI industry. Subsequently, he and his collaborators continued to develop many innovative techniques for efficient pipelining, sparse communication, model sparsity, and quantization. This work has enabled a cumulative 10-1000x acceleration of AI workloads in modern computers.

Routing Protocols and Network Topologies

The low-level network routing protocols and network topologies that Hoefler and his colleagues developed for networks such as Myrinet and InfiniBand power thousands of AI and HPC supercomputers. These contributions form central pieces of modern high-performance AI systems that are used to train large-language models such as ChatGPT.

"The capacity of high-performance computers has become mind-boggling," said ACM President Yannis Ioannidis. "In just the last two years, we have ushered in the era of exascale computers which can perform a billion *billion* calculations per second. But high-performance computers could do little without the underlying algorithms and standards that allow them to process massive influxes of data. While Hoefler introduced many of these innovations while he was still a student, they remain the definitive way to program massively parallel systems today. The resulting capabilities of these systems have allowed significant advances in AI, the natural sciences, and many other areas."

Salil Parekh, Chief Executive Officer, Infosys, said, "We're in the middle of an exciting era of AI, with great promise for the future. Torsten Hoefler played an important role in advancing

high-performance computing, which in turn, fuelled the current AI revolution. The ACM Prize in Computing is intended to recognize 'early to mid-career professionals,' whose work has depth and impact. With much of his important work being done in his 20s, Hoefler is an example for young people that age is not an obstacle to achievement in computing. Infosys is proud to be the sponsor of this award since it was founded in 2007."

Biographical Background

Torsten Hoefler is a Professor of Computer Science at ETH Zurich (the Swiss Federal Institute of Technology), where he serves as Director of the Scalable Parallel Computing Laboratory. He is also the Chief Architect for AI and Machine Learning at the Swiss National Supercomputing Centre (CSCS). Hoefler received a Diplom Informatik (Master of Computer Science) from Chemnitz University of Technology and a PhD in Computer Science from Indiana University.

Hoefler's honors include the Max Planck-Humboldt Medal, an award for outstanding mid-career scientists; the IEEE CS Sidney Fernbach Award, which recognizes outstanding contributions in the application of high-performance computers; and the ACM Gordon Bell Prize, which recognizes outstanding achievement in high-performance computing. He is a member of the European Academy of Sciences (Academia Europaea), a Fellow of IEEE, and a Fellow of ACM.

Hoefler will be formally presented with the ACM Prize in Computing at ACM's annual Awards Banquet, which will be held on Saturday, June 14 at The Palace Hotel in San Francisco.

About the ACM Prize in Computing

The ACM Prize in Computing recognizes an early to mid-career fundamental innovative contribution in computing that, through its depth, impact, and broad implications, exemplifies the greatest achievements in the discipline. The award carries a prize of $250,000. Financial support is provided by an endowment from Infosys Ltd. The ACM Prize in Computing was previously known as the ACM-Infosys Foundation Award in the Computing Sciences from 2007 through 2015. ACM Prize recipients are invited to participate in the Heidelberg Laureate Forum, an annual networking event that brings together young researchers from around the world with recipients of the ACM A.M. Turing Award, the Abel Prize, the Fields Medal, and the IMU Abacus Medal.

About ACM

ACM, the Association for Computing Machinery, is the world's largest educational and scientific computing society, uniting computing educators, researchers, and professionals to inspire dialogue, share resources, and address the field's challenges. ACM strengthens the computing profession's collective voice through strong leadership, promotion of the highest standards, and recognition of technical excellence. ACM supports the professional growth of its members by providing opportunities for life-long learning, career development, and professional networking.

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