NEWS RELEASE

Contact: Jim Ormond
212-626-0505
ormond@hq.acm.org

TRANSFORMATIVE INNOVATIONS RECOGNIZED BY WORLD'S LARGEST COMPUTING SOCIETY

ACM Celebrates Individuals Whose Work Has Impacted Datacenter Networks, Software, Algorithms, and AI

New York, NY, May 3, 2023 – ACM, the Association for Computing Machinery, today announced the recipients of four prestigious technical awards. Recognizing these individuals is one way ACM educates the wider public about the science behind technologies we use every day.

Mohammad Alizadeh, Massachusetts Institute of Technology, is the recipient of the **2022 ACM Grace Murray Hopper Award** for pioneering and impactful contributions to datacenter networks.

Alizadeh has fundamentally advanced how datacenters communicate efficiently in transporting data. One of his key contributions is the control of datacenter network congestion and packet loss with a groundbreaking Data Center Transport Control Protocol (DCTCP). DCTCP significantly increases performance in datacenter environments where state-of-the-art TCP protocols fall short.

The theoretical foundation upon which DCTCP is built and the empirical analyses, novel algorithms, and explicit congestion notification techniques it leverages enable data packets to circumvent congestion while using significantly less buffer space. In essence, DCTCP changes the way that network endpoints process congestion signals obtained from within the network, enabling traffic bursts to be tolerated better and leading to reduced transport latency, higher data throughput, and greater network utilization.

The ACM Grace Murray Hopper Award is given to the outstanding young computer professional of the year, selected on the basis of a single recent major technical or service contribution. This award is accompanied by a prize of $35,000. The candidate must have been 35 years of age or less at the time the qualifying contribution was made. Financial support for this award is provided by Microsoft.

Gernot Heiser, University of New South Wales; **Gerwin Klein,** Proofcraft; **Harvey Tuch**, Google; **Kevin Elphinstone**, University of New South Wales; **June Andronick**, Proofcraft; **David Cock**, ETH Zurich; **Philip Derrin**, Qualcomm; **Dhammika Elkaduwe**, University of Peradeniya; **Kai Engelhardt**; **Toby Murray**, University of Melbourne; **Rafal Kolanski**, Proofcraft; **Michael Norrish**, Australian National University; **Thomas Sewell**, University of Cambridge; and **Simon Winwood**, Galois, receive the **ACM Software System Award** for the development of the first industrial-strength, high-performance operating system to have been the subject of a complete, mechanically-checked proof of full functional correctness.

In 2009, the Software System Awardees presented the seL4 microkernel, which became the first ever industrial-strength, general-purpose operating system with formally proved implementation correctness. In subsequent years, the team further added proofs that seL4 enforces the core security properties of integrity and confidentiality, extended the proof to the binary code of the kernel, and performed the first sound and complete worst-case execution-time analysis of a protected mode OS.

The seL4 high-assurance microkernel has fundamentally changed the research community's perception of what formal methods can accomplish: it showed that not only is it possible to complete a formal proof of correctness and security for an industrial-strength operating system but that this can be accomplished without compromising performance or generality. The continuously maintained and growing proofs on seL4 have helped to give rise to a new discipline of proof engineering—the art of proof process modelling, effort estimation, and the systematic treatment of large-scale proofs.

The ACM Software System Award is presented to an institution or individual(s) recognized for developing a software system that has had a lasting influence, reflected in contributions to concepts, in commercial acceptance, or both. The Software System Award carries a prize of $35,000. Financial support for the Software System Award is provided by IBM.

Michael Burrows, Google; **Paolo Ferragina**, University of Pisa; and **Giovanni Manzini**, University of Pisa, receive the **ACM Paris Kanellakis Theory and Practice Award** for inventing the BW-transform and the FM-index that opened and influenced the field of Compressed Data Structures with fundamental impact on Data Compression and Computational Biology.

In 1994, Michael Burrows and his late coauthor David Wheeler published their paper describing revolutionary data compression algorithm based on a reversible transformation of the input. This transformation, which became known as the "Burrows-Wheeler Transform" (BWT), was used as the core of the compressor bzip2. bzip2 achieved compression performance superior to the standard of the time.

A few years later, Paolo Ferragina and Giovanni Manzini showed that, by orchestrating the BWT with a new set of mathematical techniques and algorithmic tools, it became possible to build a "compressed index," later called the FM-index. Before the FM-index, it seemed unavoidable to incur a significant space penalty for achieving efficient queries. With the FM-index, Ferragina and Manzini were able to

disprove this common belief. In addition to being a theoretical breakthrough, the simplicity and effectiveness of the FM-index has made it a premier indexing choice for software tools working on large collections of unstructured data, with the most impressive applications in the field of DNA alignment and Computational Biology in general.

The introduction of the BW Transform by Burrows and Wheeler, and then the development of the FM-index by Ferragina and Manzini, have had a profound impact on the theory of algorithms and data structures with fundamental advancements—first and foremost to Data Compression and Computational Biology, but also to a number of applications in many other areas, including Databases and Information Retrieval at large.

The ACM Paris Kanellakis Theory and Practice Award honors specific theoretical accomplishments that have had a significant and demonstrable effect on the practice of computing. This award is accompanied by a prize of $10,000 and is endowed by contributions from the Kanellakis family, with additional financial support provided by ACM's Special Interest Groups on Algorithms and Computation Theory (SIGACT), Design Automation (SIGDA), Management of Data (SIGMOD), and Programming Languages (SIGPLAN), the ACM SIG Projects Fund, and individual contributions.

Bernhard Schölkopf, Max Planck Institute for Intelligent Systems and ETH Zurich, and **Stuart J. Russell**, University of California at Berkeley, receive the **ACM - AAAI Allen Newell Award**.

Schölkopf is recognized for his widely used research in machine learning, advancing both mathematical foundations and a broad range of applications in science and industry.

Schölkopf has made seminal contributions to kernel methods and causality. His contributions to kernel PCA and kernel embeddings have advanced fundamental statistical methodology in dimensionality reduction and hypothesis testing. Professor Schölkopf and his team have advanced numerous areas of applied machine learning, including applications to astronomy, biology, computer vision, robotics, neuroscience, and cognitive science. Schölkopf's pioneering work in causal machine learning has laid the foundation for a novel understanding of learning causal relationships from data, with implications for all areas of science.

Russell is recognized for a series of foundational contributions to Artificial Intelligence, spanning a wide range of areas such as logical and probabilistic reasoning, knowledge representation, machine learning, reinforcement learning, and the ethics of AI.

Early in his career, Russell defined and studied the concept of bounded optimality, for which he received the 1995 IJCAI Computers and Thought Award. His book, *Artificial Intelligence: A Modern Approach* (co-authored with Peter Norvig), is the preeminent textbook for AI. It has been used for decades to train AI students in more than 1,500 universities all over the world. Russell's work on BLOG (Bayesian Logic) led to the creation of the NETVISA global seismic monitoring algorithm that has the

capability to reliably detect and accurately localize nuclear explosions. In recent years he has also become an influential figure in addressing ethical issues in AI.

The ACM - AAAI Allen Newell Award is presented to an individual selected for career contributions that have breadth within computer science, or that bridge computer science and other disciplines. The Newell award is accompanied by a prize of $10,000, provided by ACM and the Association for the Advancement of Artificial Intelligence (AAAI), and by individual contributions.

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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