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Intel and National Science Foundation Invest in Wireless-Specific Machine Learning Edge Research

SANTA CLARA, Calif.--(BUSINESS WIRE)-- **What's New:** Today, Intel and the National Science Foundation (NSF) announced award recipients of joint funding for research into the development of future wireless systems. The Machine Learning for Wireless Networking Systems (MLWiNS) program is the latest in a series of joint efforts between the two partners to support research that accelerates innovation with the focus of enabling ultra-dense wireless systems and architectures that meet the throughput, latency and reliability requirements of future applications. In parallel, the program will target research on distributed machine learning computations over wireless edge networks, to enable a broad range of new applications.

> *"Since 2015, Intel and NSF have collectively contributed more than $30 million to support science and engineering research in emerging areas of technology. MLWiNS is the next step in this collaboration and has the promise to enable future wireless systems that serve the world's rising demand for pervasive, intelligent devices."*
> – Gabriela Cruz Thompson, director of university research and collaborations at Intel Labs

Why It's Important: As demand for advanced connected services and devices grows, future wireless networks will need to meet the challenging density, latency, throughput and security requirements these applications will require. Machine learning shows great potential to manage the size and complexity of such networks – addressing the demand for capacity and coverage while maintaining the stringent and diverse quality of service expected from network users. At the same time, sophisticated networks and devices create an opportunity for machine learning services and computation to be deployed closer to where the data is generated, which alleviates bandwidth, privacy, latency and scalability concerns to move data to the cloud.

"5G and Beyond networks need to support throughput, density and latency requirements that are orders of magnitudes higher than what current wireless networks can support, and they also need to be secure and energy-efficient," said Margaret Martonosi, assistant director for computer and information science and engineering at NSF. "The MLWiNS program was designed to stimulate novel machine learning research that can help meet these requirements – the awards announced today seek to apply innovative machine learning techniques to future wireless network designs to enable such advances and capabilities."

What Will Be Researched: Through MLWiNS, Intel and NSF will fund research with the goal of driving new wireless system and architecture design, increasing the utilization of sparse spectrum resources and enhancing distributed machine learning computation over

wireless edge networks. Grant winners will conduct research across multiple areas of machine learning and wireless networking. Key focus areas and project examples include:

Reinforcement learning for wireless networks: Research teams from the University of Virginia and Penn State University will study reinforcement learning for optimizing wireless network operation, focusing on tackling convergence issues, leveraging knowledge-transfer methods to reduce the amount of training data necessary, and bridging the gap between model-based and model-free reinforcement learning through an episodic approach.

Federated learning for edge computing:

Researchers from the University of North Carolina at Charlotte will explore methods to speed up multi-hop federated learning over wireless communications, allowing multiple groups of devices to collaboratively train a shared global model while keeping their data local and private. Unlike classical federated learning systems that utilize single-hop wireless communications, multi-hop system updates need to go through multiple noisy and interference-rich wireless links, which can result in slower updates. Researchers aim to overcome this challenge by developing a novel wireless multi-hop federated learning system with guaranteed stability, high accuracy and a fast convergence speed by systematically addressing the challenges of communication latency, and system and data heterogeneity.

Researchers from the Georgia Institute of Technology will analyze and design federated and collaborative machine-learning training and inference schemes for edge computing, with the goal of increasing efficiency over wireless networks. The team will address challenges with real-time deep learning at the edge, including limited and dynamic wireless channel bandwidth, unevenly distributed data across edge devices and on-device resource constraints.

Research from the University of Southern California and the University of California, Berkeley will focus on a coding-centric approach to enhance federated learning over wireless communications. Specifically, researchers will work to tackle the challenges of dealing with non-independent and identically distributed data, and heterogeneous resources at the wireless edge, and minimizing upload bandwidth costs from users, while emphasizing issues of privacy and security when learning from distributed data.

Distributed training across multiple edge devices: Rice University researchers will work to train large-scale centralized neural networks by separating them into a set of independent sub-networks that can be trained on different devices at the edge. This can reduce training time and complexity, while limiting the impact on model accuracy.

Leveraging information theory and machine learning to improve wireless network performance: Research teams from the Massachusetts Institute of Technology and Virginia Polytechnic Institute and State University will collaborate to explore the use of deep neural networks to address physical layer problems of a wireless network. They will exploit information theoretic tools in order to develop new algorithms that can better address non-linear distortions and relax simplifying assumptions on the noise and impairments encountered in wireless networks.

Deep learning from radio frequency signatures: Researchers at Oregon State University will investigate cross-layer techniques that leverage the combined capabilities of transceiver hardware, wireless radio frequency (RF) domain knowledge and deep learning to enable efficient wireless device classification. Specifically, the focus will be on exploiting RF signal knowledge and transceiver hardware impairments to develop efficient deep learning-based device classification techniques that are scalable with the massive and diverse numbers of emerging wireless devices, robust against device signature cloning and replication, and agnostic to environment and system distortions.

About Award Winners and Project Descriptions: A full list of award winners and project descriptions can be found in "Intel and National Science Foundation Announce Future Wireless Systems Research Award Recipients."

More Context: NSF/Intel Partnership on Machine Learning for Wireless Networking Systems (MLWiNS) | Intel Labs (Press Kit) | Artificial Intelligence at Intel (Press Kit)

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Alexa Korkos
415-706-5783
Alexa.Korkos@intel.com

Source: Intel Corporation