Science & Tech

UMBC's Vandana Janeja aims to boost high-performance computing know-how to tackle environmental science challenges with a $1 million NSF grant

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Fast computers, such as these at the Nanoscience High-Performance Computing Facility at Argonne National Laboratory, can advance important scientific research. (Image credit: Argonne National Laboratory, used under CC BY-NC-SA 2.0 DEED)

The discovery of the **Higgs boson**. The **first picture of a black hole**. The Covid-19 vaccine. Many recent scientific advances, such as these, owe much to a largely unsung hero: high-performance computing.

Yet the use of high-performance computing is generally limited to a niche group. “Some researchers are very sophisticated in the use of these tools, but many are not,” says **Vandana Janeja**, a professor of information systems at UMBC.

Janeja is on a mission to spread advanced computing know-how far beyond its current borders. “It’s not just for the elites,” she says.

She was recently awarded **a nearly $1 million grant** from the National Science Foundation (NSF) that will help further that mission. The grant is part of a **larger NSF collaborative award** with the University of Maryland Center for Environmental Sciences (UMCES).

Janeja and her UMBC and UMCES colleagues will work to connect a wide range of students and faculty with high-performance computing experts, creating and

nurturing what has been called the cyberinfrastructure pipeline. The ultimate goal is to facilitate the flow of knowledge.

“Once one person gains experience, they can turn around and help someone else,” Janeja says. “It’s about supporting and connecting people with resources and not just about setting up the hardware and software.”

Vandana Janeja (Marlayna Demond ’11/UMBC)

Building a high-performance computing workforce

The need for fast computers in research is driven in part by a modern deluge of data. For example, NASA estimates that it will soon have accumulated **hundreds of petabytes of Earth science data**, from sources such as satellites flying overhead and sensors installed on the ground. Making full use of all that data requires new approaches to computing. While traditional computers generally perform calculations one at a time, **high-performance computing** facilities break up the work between multiple computing nodes and run processes in parallel.

UMBC has its own **high-performance computing facility**, which houses computing equipment that can process data significantly faster than a standard laptop. University researchers have employed the fast computers to study topics as diverse as weather modeling, cancer treatment, and flight dynamics.

“Learning how to use high-performance computing is not straight-forward,” says Janeja. Users have to gain a good understanding of the infrastructure of the computers, and also hone their skills in identifying the best techniques to take full advantage of that infrastructure.

People with a good understanding of how these machines and their software work will be in high demand, Janeja adds.

Many modern AI algorithms, which are used by scientific researchers and big tech companies alike, require high-performance computing to operate. “While everyone is running toward the shiny object of AI, many don’t realize that there is a backbone, called cyberinfrastructure, that runs AI,” says Janeja.

Part of Janeja’s goal with the new grant is to educate students who may pursue careers building, maintaining, utilizing, and improving that cyberinfrastructure backbone. She also cares deeply about ensuring diverse groups of people have access to these roles.

“We are trying to democratize the use of cyberinfrastructure and make it accessible to people who have never used it,” Janeja says.

Jack Suess, ‘81, M.S. ‘94, UMBC’s vice president of information technology, says he is excited for his division to play a key role in the award, helping shape best practices and build a national cyberinfrastructure support structure. “I look forward to watching how this work informs not just how we support faculty, but how we train and support advanced undergraduates and graduate students to evolve into these roles,” he says.

Tackling environmental challenges

While there is no shortage of scientific questions that might be tackled with high-performance computing, Janeja and her colleagues on the new grant will test-run their collaborative initiatives with projects in environmental science.

Changes to the ice and snow in Greenland could contribute to sea level rise. (Image credit: NASA)

Janeja is also director of **iHARP**, an NSF-funded institute that aims to harness big data and advanced computing tools to better model how climate change will affect the polar regions. As part of the new grant, iHARP and UMCES researchers will partner with cyberinfrastructure professionals to explore environmental science questions, such as in iHARP investigating how to predict the rate of snow melting in Greenland.

Scientists increasingly rely on big data and high-performance computing to understand and predict changes in the environment. As human activities continue to put pressure on natural systems, it will be more important than ever to forge collaborations between researchers and computing experts that advance the science.

“I’m excited to leverage high-performance computing to solve real-world problems and make it accessible to students and researchers of all backgrounds,” Janeja says.

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