

Report: Computing Poised to Change the Way Science Is Done

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More scientific data has been collected in the last year alone than in all previous years since science began, a Johns Hopkins University scientist says.

Within databases crammed with those observations lie discoveries waiting to be made. If, Alexander Szalay says, researchers develop and learn how to use new analytical tools that will sift those discoveries from a seemingly overwhelming flow of information.

"Computer science has the potential to drastically change the way we do science and the science that we do," said Szalay, Alumni Centennial Professor of Astronomy in the Henry A. Rowland Department of Physics and Astronomy and professor of computer science at Johns Hopkins. "It will play a critical role in tackling the largest challenges facing our world, from medicine and health to energy and the environment."

Every area of science, Szalay said, is inundated with an explosion of data. "It has become increasingly difficult to analyze data as yesterday's gigabytes have grown into today's terabytes," he said. "Soon, data sets will be measured in petabytes."

To effectively analyze such massive amounts of information, Szalay said, will require computing advances that transform the scientific process over the next 15 years.

Szalay was one of 34 members of a "2020 Science Group" that recently published "Towards 2020 Science," a comprehensive analysis of computer science's potential to revolutionize the way science is conducted. Published by Microsoft Research Cambridge, the report challenges the science and computer science communities to partner with policymakers and education leaders to realize that potential.

Szalay has been working with Jim Gray of Microsoft for nearly a decade on a variety of projects relevant to 2020 Science Group concerns about large data collections and their impact on science. In addition, Szalay's group at Johns Hopkins built the multi-terabyte archive for the Sloan Digital Sky Survey (known as the "Cosmic Genome Project") and also played a major role in the National Virtual Observatory, an alliance to construct a system connecting all astronomy data in the world. Szalay also has actively collaborated with experts in mechanical engineering and computer science at Johns Hopkins' Whiting School of Engineering on advanced simulations of turbulence, and with researchers in the Department of Earth and Planetary Sciences on a cutting-edge project to develop tiny wireless sensors for environmental monitoring.

Szalay and other 2020 report contributors say that, although much of the data explosion has happened primarily in the physical and geo-sciences, it promises also to have a profound effect on life sciences. These advances, they say, will accelerate scientists' ability to address some of the modern world's greatest challenges, such as global epidemics and climate change. According to the report, software tools and algorithms that enable far more accurate and powerful modeling of complex systems will allow researchers not only to more clearly map potential epidemics, such as avian influenza, severe acute respiratory syndrome and malaria, but also to potentially avert disaster and improve response to real-time outbreaks.

"Science will be increasingly done directly in the database, finding

relationships among existing data while someone or something else performs the primary collecting role," reads an editorial on the subject in the March 23 issue of Nature, which included a number of articles on the 2020 group's report and its impact. "And this means that scientists will have to understand computer science in much the same way as they previously had to understand mathematics as a basic tool with which to do their jobs."

The 2020 report makes a variety of recommendations, including that society put a priority on science and science-based innovation and that we find new ways to raise public awareness about the importance of research. To that end, Microsoft Research Cambridge will provide 2.5 million euro to the scientific community to support new research that specifically addresses areas outlined by the 2020 Science Group.

Source: Johns Hopkins University

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