MedicalXpress

OHSU teams with Intel to decode the root causes of cancer and other complex diseases

April 22 2013

Oregon Health & Science University (OHSU) and Intel Corp. are teaming up to develop next-generation computing technologies that advance the field of personalized medicine by dramatically increasing the speed, precision and cost-effectiveness of analyzing a patient's individual genetic profile. Through a multi-year research and engineering collaboration announced today, engineers and scientists from the two institutions will develop hardware, software and workflow solutions for Intel's extreme-scale, high-performance computing solutions. This new level of computational horsepower seeks to make strides in addressing one of the biggest challenges in personalized medicine: how to cope with the unprecedented volume of complex biomedical data it generates.

The collaboration combines Intel's strengths in extreme-scale computing capable of handling billions of complex computations simultaneously with OHSU's innovative four-dimensional approach in imaging and analyzing the molecular-level drivers of cancer and other diseases. OHSU's imaging techniques work like a Google map for cancer by providing a highly detailed view of how cells change over time at the molecular level along with a big-picture analysis of how the cells behave as a system.

The team's approach will be to create information tools that can handle the mind-boggling volumes of data generated in the process – doing it more rapidly, more precisely and less expensively than is capable with current technology. The objective is to drive scientific progress in

understanding the genetic origins of illness, starting with cancer, at an individual-patient level and ultimately, to make precision medicine a more routine model of patient care.

An integrated OHSU/Intel team is working on a research data center equipped with an Intel supercomputing cluster. Along with top researchers from the OHSU Knight Cancer Institute, the collaboration will include computer scientists, biophysicists, genomicists, bio-informaticists, biologists and other experts. The team's first projects will be focused on genetic profiling of patients' tumors to look for patterns in how the disease progresses and how to relate this information to how the tumor will respond to treatment.

"This collaboration combines Intel's strengths in developing energy-efficient, extreme-scale computing solutions with OHSU's lead in visualizing and understanding complex biological information," said Stephen Pawlowski, Intel Senior Fellow and Chief Technology Officer, Datacenter and Connected Systems Group, Intel Corp. "We look forward to working together with the goal of improving the efficiency of complex disease diagnosis and personalized treatment."

The science inside

Working side by side with cancer as their first disease target, Intel's engineers and OHSU's biomedical experts are looking to develop a way to create a highly detailed circuit diagram of the genome. By comparing an individual patient's circuitry with the map of a healthy genome, scientists can isolate and study the patient's individual genetic abnormalities to determine which, if any, are linked to cancer. It sounds simple, but the computational demands of this work are intense, requiring clusters of supercomputers and customized algorithms geared to decode the bewildering complexity of human genetic variation.

One of the primary computing challenges is the need to analyze enough disease-causing malfunctions in a sufficiently large population of patients to detect statistically valid patterns in cellular circuitry linked to the progression of disease. Better understanding of how this circuitry works has potential to enable medical researchers to develop detection tools that find cancer at earlier and more treatable stages, diagnosis and staging methods that more precisely guide treatment decisions, and new treatments that more effectively shut down the molecular triggers of illness.

"To make a real difference for cancer patients, we need to know more about how the disease functions over time and within the body's multitude of systems. That represents an enormous analytical challenge that is beyond the capability of current technology," said Joe Gray, Ph.D., Associate Director for Translational Research at the OHSU Knight Cancer Institute, the Gordon Moore Endowed Chair of OHSU's Department of Biomedical Engineering, and Director of the OHSU Center for Spatial Systems Biomedicine.

"By combining Intel's computing expertise with what we know about how to analyze genomes and to create images of how cells change over time, we believe we have the capability to develop the right tools to make significant progress in making the promise of personalized cancer medicine a reality for more patients. This is likely to be a decades-long process, but along the way we expect that what we will learn in studying cancer will also provide insights into other complex diseases," Gray said.

Despite the hotly competitive race to launch new DNA sequencing instruments that can do the job faster, it still takes weeks and many thousands of dollars to analyze just a single patient's cancer profile. The first phase of the OHSU/Intel collaboration will focus on developing systems to accomplish that task in a matter of hours at a cost that is feasible for clinical applications. The data will feed the team's more

complex work of developing systems capable of analyzing how genomic abnormalities cause changes in the molecular architecture of cells and tissues in individual patients. It is hoped that this knowledge will help accelerate drug development and lead to more precise, clinically actionable diagnostic tests.

Cancer's unique computational challenges

Cancer and other diseases with similar origins in molecular abnormalities present scientists with dual, equally stubborn challenges in biology and computation. Cancer is one of mankind's most complex diseases, with more than 12 million new cases diagnosed worldwide each year. That number will balloon as the world's population ages and individual risk factors multiply.

What makes this health challenge so daunting is that cancer is really a collection of rare diseases. In fact, there are no common cancers. There are only common cancer environments in the body, such as the breast. Genetic abnormalities that cause these tumors manifest differently in each individual and are impacted not only by how mutations interact but the location of the body in which they are occurring. Scientists are also realizing that seemingly innocuous biological structures and proteins in the tumor microenvironment also support the growth of cancer cells, adding still more complexity to the equation.

Even more perplexing, a healthy human body creates millions of mutations. Not all of them – in fact, not even most of them – are relevant in disease. The scientific challenge is determining, for each individual, which mutations are relevant.

Why Intel and OHSU are coming together

OHSU's genomic analysis and imaging technologies, if combined with adequate computing power, have the potential to illuminate how billions of genetic mutations are interacting in an individual's body over time to create tumors. The promise of Intel's extreme-scale, high-performance computing solutions is the capability to analyze this data at a cost that will eventually allow for clinical applications, and with lower power consumption than alternative technologies.

The collaboration represents a multi-year commitment with many facets, including plans to educate the next generation of scientists and information technology professionals in the all-new field of quantitative bioscience. As advanced technology and life sciences converge in routine health care environments, a new workforce will evolve with training needs that cannot be fully met by current educational programs. Intel will contribute to OHSU's efforts to develop and implement graduate and undergraduate curricula exposing science and technology students to new high-level knowledge at the interface of computation, biology and medicine.

Provided by Oregon Health & Science University