what is the *what is it?* series and what is it for?

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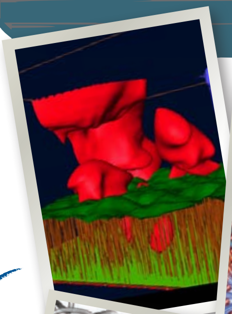

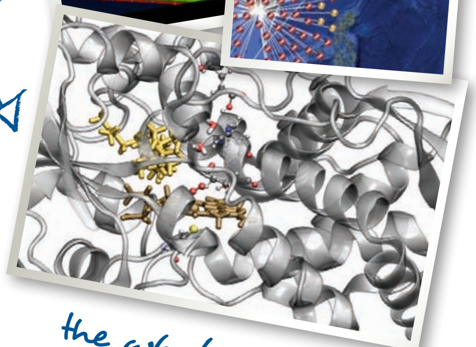

the what is it? series helps students and the public learn about supercomputing!

what is it series no. 0
I saw it on the Internet!

***Related Ohio Academic Content Standards:** Technology*

A short time back, a reporter covering a story at The Ohio Supercomputer Center (OSC) asked if the communications team had any materials that explained, in language the general public would understand, how a supercomputer worked. The center didn't have anything like that at that time, and we spent several hours searching the Internet to see if any of our peer organizations had anything — we couldn't find anything.

During the summer months, OSC hosts Summer Institute for high school sophomores, juniors and seniors, and Young Women's Summer Institute, for sixth- and seventh-grade girls. Both initiatives are meant to stimulate academic and career interest and skills in the STEM fields (science, technology, engineering and math). It seemed a natural fit to develop a series of fact sheets that could speak to the insitute participants, as well as the general public, whether through the media or directly from the OSC web site.

what is it? topics

The first topic covered in the series seeks to answer the original question (***what is a supercomputer?***). From there, we considered other related hardware, and tried to answer a question about where researchers store the data from their projects (***what is mass storage?***). We also thought that there should be an answer to one of the hottest new trends in supercomputing that leverages the speed of video game chips (***what is a GPGPU system?***).

Next, the team sought to explain how modeling, simulation and analysis can be combined with other subjects (***what is computational science?***) and used to improve manufacturing (***what is Blue Collar Computing?***).

We also thought it might be interesting to explain how computer graphics transformed the filmmaking and video game industries (***what is computer animation?***).

And, someone at the center also suggested describing how supercomputers and advanced networks could be used to operate very sophisticated scientific instruments (***what is shared instrumentation?***). Finally, we decided to explain how researchers are developing new and amazingly intuitive ways for people to interact with supercomputers (***what is a computer interface?***).

Academic Content Standards

Once most of the content and design of the series was completed, the communications team thought it might be helpful to show teachers and others how these popular topics are related to the framework the state's K-12 school system uses to teach students about technology. A simple review revealed several that the topics covered in the ***what is it?*** series could be used to address a number of specific areas outlined in the Ohio Academic Content Standards. Some of those related standards are listed at the top of each fact sheet. You're not from Ohio? Check with your state's department of education to see if they have similar guidelines.

What else?

While we focused on a handful of topics that seemed fairly obvious, there isn't necessarily any limit to the topics that the series could address. If you have any additional topics related to supercomputing for which you'd like to see a ***what is it?*** fact sheet, please let us know!

for more info, visit www.osc.edu/press/media/

what is a supercomputer and how does it work?

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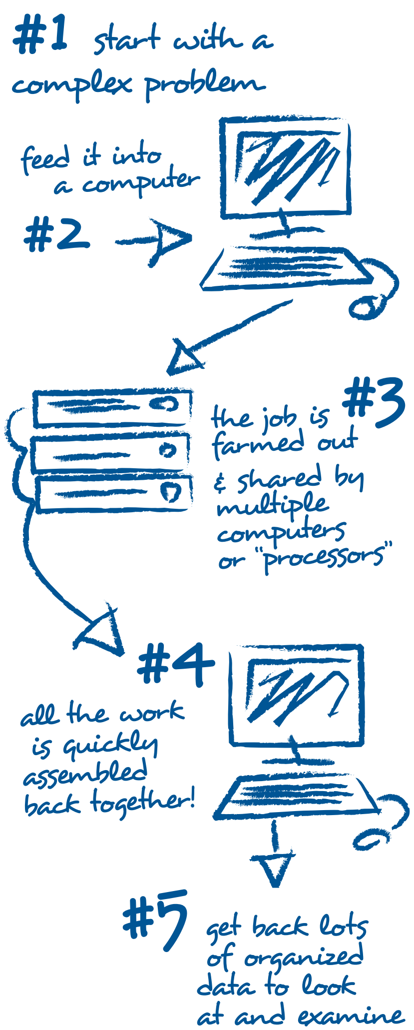
***Related Ohio Academic Content Standards:** Technology ▸ Nature of Technology ▸ Technology Assessment / Technology and History*
Technology ▸ Technology for Productivity Applications ▸ Understanding Operations



Supercomputers are the world's largest, fastest and most expensive computers and are used to solve complex scientific and engineering calculations. Supercomputers, also known as high performance computers, accelerate research in such areas as advanced materials, energy, the environment, biosciences, commodity trading, manufacturing, defense and aerospace. The most advanced supercomputers usually are found at university, government and military labs. Researchers there use them to meet challenges such as tracking infectious diseases and better understanding the universe. Researchers in industry use supercomputers to create new products and study dangerous processes, i.e. turbine engine air flows.

Supercomputer operation

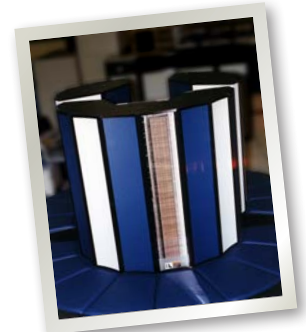
The term supercomputer itself is somewhat fluid, because today's supercomputer tends to become tomorrow's ordinary workstation. Many of today's desktop computers are actually faster than the early supercomputers, which were developed in the mid-1980s.

The parts of a supercomputer are comparable to those of a desktop computer: they both contain hard drives, memory, and central processing units (CPUs), circuits that process instructions within a computer program. Recently, some supercomputers have featured graphical processing units (GPUs), which evolved from video game systems.

Supercomputer speeds are measured in FLOPS, short for "floating point operations per second." A gigaflop is a billion FLOPS, and a teraflop is a trillion FLOPS. In 2008, scientists developed a petaflop supercomputer with a speed of more than one quadrillion (1,000 trillion) FLOPS. To compare, the fastest PC processors perform at about 50 gigaflops.

At most research computing centers, users submit proposals for processing, memory and file storage space. Later, they upload data to a scheduling unit that determines when the supercomputer has space available to run the job. After processing, the results are stored on disk or tape until they are downloaded for analysis.

what does a supercomputer look like?



CrayX-MP

OSC's first machine was a vector-based supercomputer.

Processors

The first supercomputers used scalar processors, very fast CPUs that handle one piece of data at a time. Engineers later developed vector processors, where the CPU handles multiple pieces of data simultaneously. The Ohio Supercomputer Center's first system, a Cray Y-MP, was a vector-based machine capable of operating at just over two gigaflops.

In the 1980s, parallel processing was developed by using hundreds or even thousands of processors at the same time. OSC's newest supercomputer, an IBM Cluster 1350, features more than 9,500 processors and operates at about 75 teraflops. In 2010, a supercomputer at the U.S. Department of Energy's Oak Ridge Leadership Computing Facility in Tennessee achieved a speed of 1.75 petaflops.

IBM Cluster 1350

now, OSC's top supercomputer uses parallel processing!

what is it series no. 1
collect the whole set!

for more info, visit www.osc.edu/press/media/

what is computational science and what does it solve?

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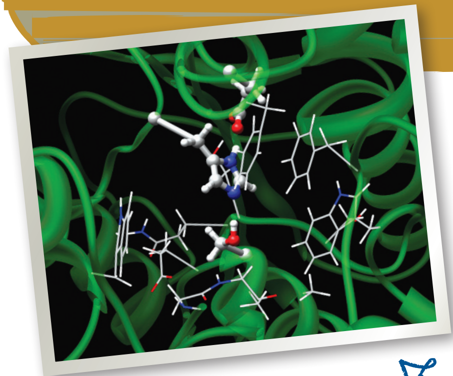
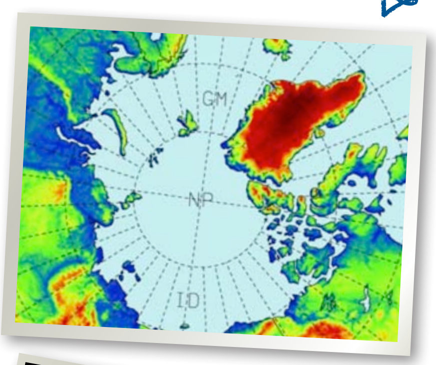
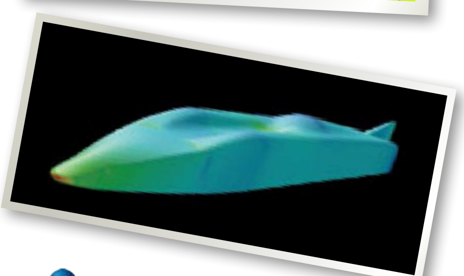
Related Ohio Academic Content Standards: Technology ▸ Nature of Technology ▸ Innovation and Invention / Technology Transfer
Technology ▸ Technology and Societal Interaction ▸ Technology and Citizenship



from biochemical visualizations to climate models to aerodynamic simula-





what is it series no. 2
it's never too late to learn!

Computational science is a fairly new field of study that uses computing to solve complex scientific and engineering problems through modeling and simulation. Computational scientists use powerful computers to create mathematical models that help them visualize and understand natural and mechanical processes.

Why is this field important?

The use of computational science has become essential to modern innovation and discovery. It allows researchers to study phenomena that would be difficult to study by any other means. A familiar example of computational science use is in weather forecasting, where vast amounts of data are combined with sets of mathematical formulas in a computer program called a weather model. The resulting forecasts are far more accurate and timely than were ever before possible.

Computational models also allow researchers in the life sciences to simulate what happens when drug molecules interact with viruses. They also allow car manufacturers to repeatedly simulate car crashes and then see what happens within the parts damaged in the crash.

In business, modeling and simulation makes it possible to try many "virtual experiments" within a computer before a real experiment is conducted or a physical prototype is created. The benefit is that many different alternatives can been modeled in the computer and the best of these can be chosen and physically tested. Because the cost of building expensive prototypes is reduced, businesses can be more creative with their products. They also get new products to market faster because they can reduce the time that would have been required to build and test physical prototypes.

The competitive advantage created by computational science is being widely recognized. According to the 2005 report of the President's Information Technology Advisory Committee (PITAC): "Computational science – the use of advanced computing capabilities to understand and solve complex problems – has become critical to scientific leadership, economic competitiveness, and national security."

The Council on Competitiveness identified computational science as essential to the nation's competitiveness. Through their survey of the Chief Information or Technology Officers of 33 major companies, the Council found that 97% of those firms could not function without high performance computing and computational science.

And this belief is not restricted to the United States. Several leading economic powers in Asia – Japan, Korea and China – have identified computational science as one of the 10 technology fields critical to its competitiveness.

Computational science education

In order for computational science to help transform the way business is done and discoveries are made, we must first have a workforce skilled in modeling and simulation. Ohio's Ralph Regula School of Computational Science is a statewide, virtual school coordinated by the Ohio Supercomputer Center. The school has developed a variety of computational science education programs aimed at students from the middle school levels to graduate school, and at existing workers seeking industry-needed skills. The competencies created by the faculty were reviewed and approved by a business advisory committee, ensuring that graduates learn the specific skills sought by employers.

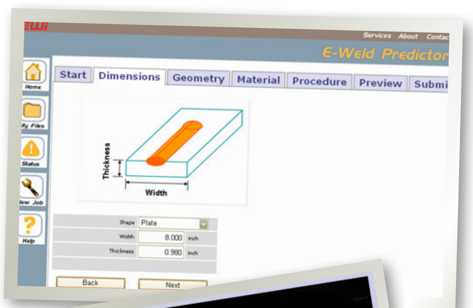
for more info, visit www.osc.edu/press/media/

what is Blue Collar Computing and what is its goal?

Ohio Supercomputer Center

www.osc.edu

businesses can use computer simulation to improve products and save time & money!!



Related Ohio Academic Content Standards: *Technology ▸ Nature of Technology ▸ Commercialization of Technology / Technology Diffusion / Technology Transfer*
Technology ▸ Design ▸ Understanding Technological Systems

Blue Collar Computing™ is a national initiative to help companies gain easy and affordable access to advanced modeling, simulation and analysis. Through this important program, modeling and simulation on computers provide companies with innovative options for the virtual development of new and improved products and services, such as automobiles, prescription drugs and financial forecasting.

Competitive advantage

Advanced modeling, simulation and analysis supplies companies with a competitive edge through improved manufacturing processes that can reduce the time, labor and cost needed to deliver new products to the market. Simulations make choosing between different manufacturing processes far easier, better data and analysis increase production efficiency, and improved factory designs increase productivity.

Large companies have found a competitive advantage through advanced modeling, simulation and analysis by making large investments in supercomputing systems and sophisticated software. For example, General Motors uses supercomputing to simulate the crash testing of automobiles. GM claims that the crash simulations can reduce the number of full-size, crash-vehicle tests by more than 85 percent, saving the company $500,000 per test. P&G used aerodynamic modeling to redesign their Pringles potato crisps so they don't flutter off conveyor belts during production.

However, many companies do not have the time, money or expertise to invest in vital modeling and simulation resources. Blue Collar Computing provides them with a variety of services to overcome those barriers. A company can either use computer code they have purchased or written and buy time on the supercomputers to run it, or supercomputing experts can work with businesses on a project-by-project basis to help create the software. Finally, the companies can be further assisted by creating easy-to-use web portals or desktop programs for a more user-friendly experience.

National support for BCC

The National Science Foundation established a Blue Ribbon Committee to examine the challenges and potential benefits of simulation-based engineering science (SBES). In its 2006 report, the committee concluded that SBES is "indispensable to the nation's continued leadership in science and engineering. It is central to advances in biomedicine, nanomanufacturing, homeland security, microelectronics, energy and environmental sciences, advanced materials, and product development."

More recently, the National Center for Manufacturing Sciences, along with its partners in the Alliance for High-Performance Digital Manufacturing, have developed a strategy to leverage the power of supercomputing for the estimated 300,000 small- and medium-sized manufacturers in the United States. Once available only to researchers at universities and national labs, access to advanced modeling, simulation and analysis has been called a "game changer on the level of the assembly line," and will drive the manufacturing of the 21st century.

advanced modeling & simulation can help position businesses to better compete in the global marketplace!

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what is computer animation and where did it come from?

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Related Ohio Academic Content Standards: *Technology ▸ Technology and Society Interaction ▸ Technology and History*
Technology ▸ Design ▸ Design Process / History of Design

early digital computer films (Permutations) and digital art (Sine Man) paved the way for effects in today's block-buster movies (Avatar).

Scientists and engineers working at government and industrial labs created the first basic computer graphics tools following in the late 1940s. In 1959, the first computer-aided drawing system, the DAC-1, was created by scientists at the General Motors Research Lab and IBM. In 1960, William Fetter of Boeing Aircraft Company coined the term "computer graphics" to describe cockpit drawings he made with a database of coordinates and a plotter.

Soon after, university researchers and artists began refining these tools for illustration works, creating the first computer-assisted art forms. Much of the nationwide computer research in the 1960s was done through funding from the federal Advanced Research Project Agency, which allowed researchers great latitude in their studies and produced the foundation of today's computer graphics tool sets.

Father of Computer Animation

A traditional film animator, John Whitney Sr. worked in the Lockheed Aircraft Factory during World War II. He quickly realized that targeting elements in bomb sites and anti-aircraft guns also could be used to plot graphics or guide movements, as well as calculate trajectories. He bought some war-surplus computer mechanisms and used them to construct his own "cam machine," which pioneered the concept of "motion control."

Whitney created Motion Graphics, Inc. in 1960 to create films using motion-control and unveiled his first digital computer short film, *Homage to Rameau*, while an artist-in-residence at IBM from 1966-69.

Father of Digital Art

Charles "Chuck" Csuri, an art professor at The Ohio State University became interested in the potential of digital art in 1964, when he decided to turn a huge mainframe – that required the entry of its data through punched cards – into an artist's tool.

The idea of using computers to create art, though, wasn't readily accepted in the early days. Csuri persevered through intellectual isolation, including a rejection from an art critic who wrote that he couldn't image anyone working with electronics and art. Csuri's work now is featured in prestigous art shows and museums around the world.

In 1971, Csuri founded the Computer Graphics Research Group, Cranston/Csuri Productions, the Ohio Supercomputer Graphics Project – a predecessor to the Ohio Supercomputer Center – and the Advanced Computing Center for the Arts and Design – an OSU academic center dedicated to digital art and computer animation.

Game and Film Applications

The first consumer graphic game console, the Magnavox *Odyssey*, was released in 1972. Computer-generated imagery (CGI) was first used in movies in 1973's *Westworld*, a science-fiction film about a society in which robots live and work among humans. The first use of 3-D Wireframe imagery was in its 1976 sequel, *Futureworld*, which featured a computer-generated hand and face. One of the most successful films of all time – *Avatar* – required over a petabyte of digital storage for its visual effects, and each minute of the final footage used 17.28 gigabytes of storage.

what is a computer interface and what does it improve?

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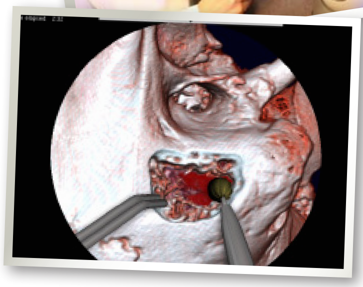

advanced input devices allow people to see, hear and touch objects in a new and more productive way!

Related Ohio Academic Content Standards: *Technology ▸ Nature of Technology ▸ Technology Diffusion / History of Technology*
Technology ▸ Technology for Productivity Applications ▸ Understanding Operations

Not long ago, technically oriented people working with basic interface devices, like keyboards and punch cards, dominated computer usage. Researchers often refer to the set of characteristics provided by an interface device as the human-computer interface or HCI. Today's desktop and notebook computers feature what is called a graphical user interface (GUI) to distinguish it from earlier, more limited interfaces such as the text commands that used a command line interface (CLI).

Today, significant segments of the general population control computers with advanced, somewhat more intuitive interface devices, such as extended and ergonomic keyboards, touch screens, smart phones, joysticks, game controllers and remotes. Yet, for many people and organizations, the benefits of a seamless interface with computers still remain beyond their grasp.

"The goals of most organizations include increased employee and organization productivity, decreased employee training costs, decreased employee work errors, and increased employee satisfaction," according to a report from The National Academies. "These are also exactly the benefits of achieving high usability in user interfaces."

In recent years, the Nintendo Wii video game system introduced a controller with a revolutionary form of user interface, one that lets it sense various degrees of tilting, rotation and acceleration. This system and others like it require large degrees of bodily interaction and now are being used in physical therapy and exercise programs at hospitals, nursing homes, senior centers and fitness clubs.

Interface research

The staff of OSC's Interface Lab researches the potential impact of these interfaces on usability of human/computer interaction through scientific studies of visual, aural and touch interfaces. These studies have led to many exciting developments, such as surgical simulations so that medical students get plenty of practice on delicate procedures, virtual environments where training on powerful farm equipment can be done in complete safety, and a training program for first responders and health professionals

modern computer interfaces allow users to explore new environments through various multi-sensory devices

what is it series no. 5
get 'em while they last!

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what is a GPGPU system and how is it useful?

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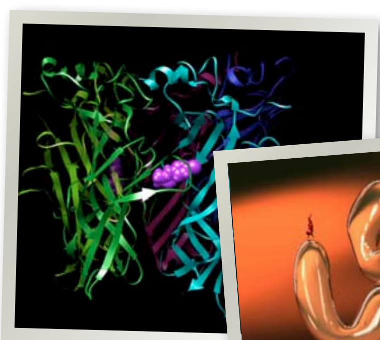
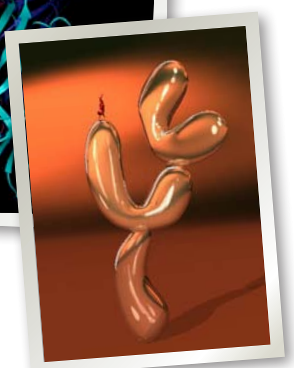
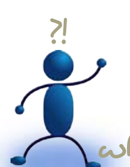
GPGPUs lend gaming power to scientific modeling and digital art!







what is it series no. 6
great for trivia games!

Related Ohio Academic Content Standards: *Technology ▸ Nature of Technology ▸ Technology Transfer*
Technology ▸ Technology for Productivity Applications ▸ Productivity Tools

Early video games utilized a computer's central processing unit (CPU) processor – the part of a computer that carries out the computer's functions – to generate the shape, color and texture of graphic images. In the early 1990s, graphics processing units (GPUs) were developed to help display faster and more physically realistic action sequences, taking the burden off the CPUs.

The earliest GPUs were intended to simply decide what color each individual pixel on the gaming screen should be, but the ability to do this in parallel allowed them to control thousands of pixels each second. The streaming design of GPUs made them very good at making millions of small decisions very quickly. Later on, these GPUs evolved into even faster graphics cards that were incorporated into the computer systems. This new feature relieved the CPU of the bulk of the image processing burden, freeing it to focus on other complex operations.

GPGPUs in supercomputers

Eventually, the potential of GPUs caught the interest of supercomputing experts. General-purpose computing on graphics processing units (referred to as GPGPU) is an engineering concept that leverages the GPU to perform thousands of calculations in a parallel manner that were traditionally handled as a single thread by the CPU.

However, because GPGPUs are designed to handle multiple streams of data, they are best-suited for types of problems that can be split into many parallel streams, and not for algorithms with streams that must cycle or branch. There also is a high cost in speed for transferring the input data from the CPU to the GPU and back to the CPU, so the problem itself has to be large enough to justify those transfer costs.

Some examples of scientific codes that benefit from multiple parallel stream and small data movements are: biomolecular protein folding done by pharmaceutical companies, simulations of explosions and combat safety features created for the military, and sophisticated climate modeling that supports weather forecasting.

The Csuri Advanced GPU Environment offered by the Ohio Supercomputer Center leverages the unique computing properties of GPGPUs to provide advanced large-scale remote visualization and batch-rendering applications to researchers at universities and in industry. One example of the work that can benefit from the Csuri system is the work of its namesake, Charles "Chuck" Csuri, whose sophisticated digital art involves rendering of thousands of large frames. From his pioneering work in the 1960s, Csuri is known as the father of computer graphics, computer animation and digital fine art.

GPGPUs for ordinary computers

A new breed of computer graphics chips has emerged that has the potential to put a GPGPU-capable chipset in ordinary computers all around the world. Potentially, it can increase the speed of many types of everyday tasks that were once only handled by just the CPU. As this technology fully matures, consumers will see noticable performance increases in areas such as audio and video file conversion, large-photo filtering in image-processing programs, cell phone use of graphics-intensive applications and other tasks.

what is shared instrumentation and what does it accomplish?

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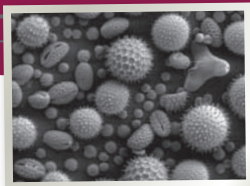


Related Ohio Academic Content Standards: Technology ▸ Nature of Technology ▸ Commercialization of Technology / Technology Diffusion
Technology ▸ Technology for Productivity Applications ▸ Understanding Operations

look at little things from way far away

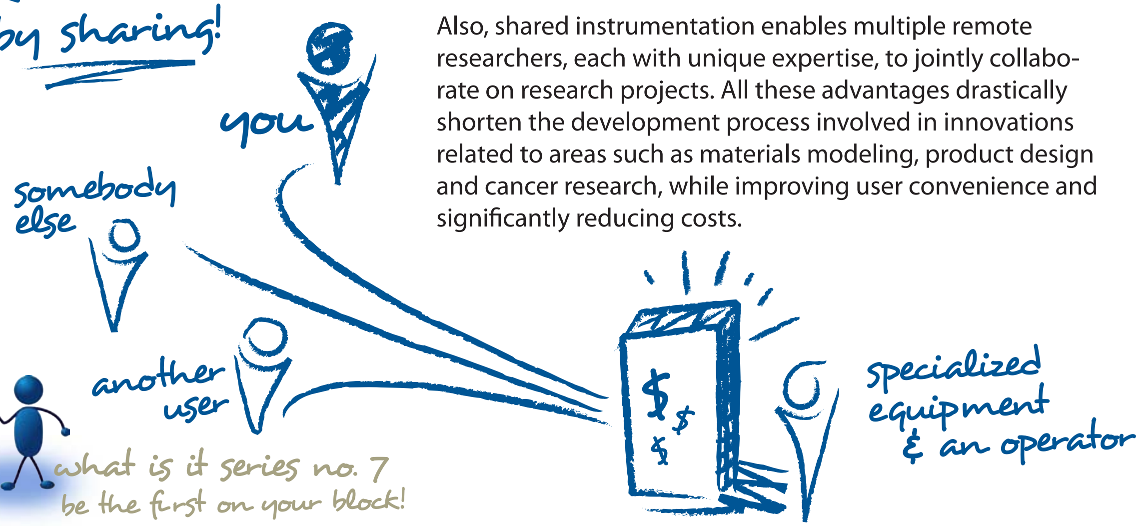
Shared instrumentation is computer software and hardware that researchers and instructors on university campuses and at industrial facilities use to access over the Internet expensive research equipment such as electron microscopes, Raman spectrometers, ion accelerators, telescopes and nuclear magnetic resonance spectrometers.

Shared instrumentation – also referred to as remote instrumentation – provides easy access to this equipment for colleagues and students who do not have access to such equipment and, in some cases, decreases unnecessary duplication of instrumentation purchases by universities and other labs.

The investments required for such specialized equipment range from tens of thousands to millions of dollars and require significant staffing for operation and maintenance. Reasonable charge-back arrangements with remote users provide laboratories with a return-on-investment opportunity, offsetting some of the initial costs of the equipment.

Also, shared instrumentation enables multiple remote researchers, each with unique expertise, to jointly collaborate on research projects. All these advantages drastically shorten the development process involved in innovations related to areas such as materials modeling, product design and cancer research, while improving user convenience and significantly reducing costs.

Reduce costs by sharing!



What were the challenges?

Internet traffic congestion could make remote operation slow, frustrating, and even dangerous. Communication delays can prevent remote operators from knowing exactly what is happening with an instrument at a particular moment, and that can lead to making the wrong decisions as a result. When that happens, expensive physical components in the instrument could damage one another, and repairs to these components can cost over $100,000. New software innovations involving "network awareness" were needed to prevent this scenario.

A shared instrumentation project

In Ohio, the Board of Regents funded a shared instrumentation pilot research project to gain a greater return on the large university investments in extraordinary instruments. Ohio Supercomputer Center researchers developed the Remote Instrumentation Collaboration Environment. RICE relies on the principles of supply and demand to utilize network bandwidth and deliver a satisfactory user experience.

Special algorithms take control of the software when a user's commands outweigh the supply of bandwidth being consumed by the video feeds from the instrument. When network congestion causes the video feed to freeze up, RICE blocks commands from the user, who may mistakenly think that the instrument hasn't moved, when it actually has. He or she may even try to correct the mistake by pressing even more buttons. RICE prevents remote researchers from making such mistakes. OSC plans to make the RICE software code publicly available.

what is mass storage and what is its function?

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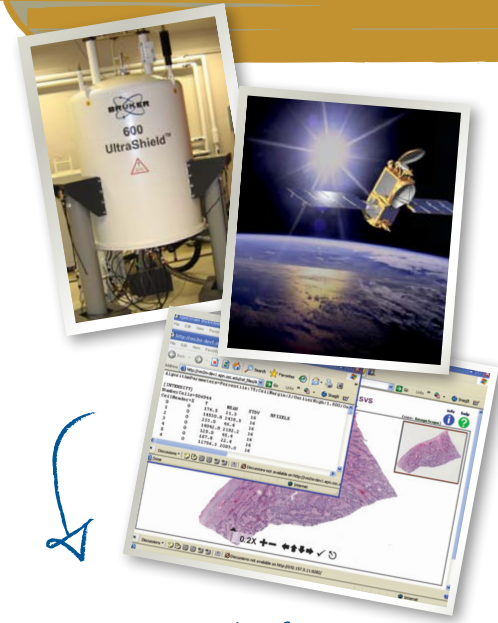


streams of data from powerful scientific instruments fill huge mass storage systems

Related Ohio Academic Content Standards: _Technology ▸ Nature of Technology ▸ Organization & Trade-offs_
Technology ▸ Technology for Productivity Applications ▸ Understanding Operations

With the growth of information technology, the amount of data generated for use in research, business and industry has risen astronomically. Scientists tap the power of supercomputers to collect, manage, process, interpret, present, deliver and secure vast collections of information.

Consider: Powerful instruments, such as telescopes, satellites and sophisticated sensors operate around-the-clock, generating and transmitting a steady stream of scientific data. A team of medical researchers builds an interactive, electronic library of microscopic tumor images in their quest to find a more effective treatment for cancer. And, a scientist combines polar climate data taken from 29-million square miles of atmosphere, sea, ice pack and land to understand the impact of environmental changes or simulate the environment from thousands of years ago.

"With the introduction of space-borne measurements over the last few decades, researchers have been inundated with vast amounts of information," said Dr. David Bromwich, the scientist doing the Arctic climate study. "Today, the trick is to figure out how to effectively use all the diverse information sources."

Mass storage devices

The trick, as Dr. Bromwich sees it, is to find somewhere to store all of the vast amounts of data until he and others can find time to analyze it -- mass storage, in other words. Over the years, people have used "mass storage" to describe various devices, such as tape libraries, RAID systems, hard disk drives, magnetic tape drives, optical disc drives, magneto-optical disc drives and drum memory.

Mass storage usually does not include random access memory, because memory loses its data with a power loss.

Today, magnetic disks are the predominant storage media in personal computers. Optical discs (CDs and DVDs), however, are almost exclusively used in the large-scale distribution of retail software, music and movies. Because of its portability and low power consumption, flash memory has an established and growing niche in high performance computing facilities, removable storage and on portable devices, such as notebook computers, digital audio players and cell phones.

Security measures

Because of the value of such information, mass storage systems are almost always housed in highly-secure facilities. The buildings usually are designed to ensure uninterrupted service through severe weather and earthquakes, provide very strict climate control and offer tight network and physical security procedures.

Mass storage in research

The mass storage system at the Ohio Supercomputer Center provides its research partners with more than a petabyte of disk storage and a number of storage services through its servers, data storage systems and networks. This large capacity enables researchers, as needed, to store both their raw data and computational results for future collaborations. The system also provides common home directories for users across most of the high performance computing systems at the Center.

what is genomic sequencing and what are its benefits?

Ohio Supercomputer Center

www.osc.edu

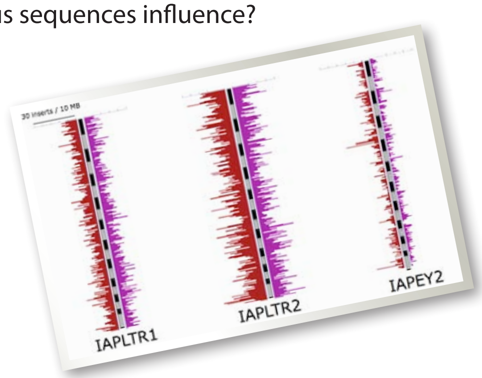
Related Ohio Academic Content Standards: *Technology ▸ Design ▸ Understanding Technological Systems*
Technology ▸ Technology for Productivity Applications ▸ Understanding Operations

Genomic sequencing is the complex scientific process of determining the order of nucleotides that comprise an organism's DNA. The human genome, which required 15 years and about $3 billion to complete, is made up of over 3 billion of these genetic letters. Researchers use high-tech machines and supercomputers to conduct DNA sequencing for large sequencing projects, such as studying an entire genome or searching for a cure for cancer.

data from high-tech sequencers is analyzed on supercomputers to look for ways to treat diseases and cure cancer

Sophisticated sequencing machines "read" a genomic sequence of nucleotides, much as your eyes scan a long series of letters to read a book. Rather than a 26-letter alphabet, these genomic sequences use a four-letter code to represent the four types of nucleotides: A for adenine, G for guanine, T for thymine and C for cytosine.

Scientists sequence entire genomes by first breaking the genome into smaller pieces, sequencing the pieces and then reassembling the pieces in the correct order. Unlocking the sequence of a genomic code, however, is just the beginning of the process. For scientists, the larger issues involve discovering what the sequences – short, medium and long – mean to the organism. How does the genome work? How does it develop? How are different sequences related? What do various sequences influence?



what is it series no. 9
better than bonus miles!

Genomic sequencing applications

There are many different ways in which scientists are using sequencing to better understand genomic processes and help treat diseases.

A next-generation sequencer installed in 2010 at Nationwide Children's Hospital in Columbus, Ohio, is expected to enhance the treatment of patients suffering from infectious diseases, heart conditions, digestive diseases and cancer. The new equipment, supported by computational and storage resources at the Ohio Supercomputer Center, will be able to sequence two human genomes in just over one week. Each eight-day run requires the computational power to align 2,000,000,000 x 100 nucleotide reads, using six terabytes of disk space and 600 gigabytes of storage space.

To treat an aggressive type of brain tumor called blioblastoma multiforme, Dr. Chenglong Li, at The Ohio State University, is working to develop a genetically targeted drug. To help understanding and identifying genomic sequences, Dr. Samuel Shepherd, at the University of Toledo, designed a new algorithm for predicting mid-range sequences.

Another Ohio State researcher, Dr. David Symer, is comparing short sequences of human, mouse and other genomes to determine how genomic elements called retrotransposons, or "jumping genes," move from one location to another, possibly causing cancer and other diseases. And, at Miami University (Ohio), Dr. Chun Liang is studying the genomic processes of diatoms, algae, moss and humans to understand how disparities in RNA development can contribute to cancers and disease.

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