Case Studies: How Faculty Leverage UB's Robust IT Infrastructure to Advance Research, Instruction and Service

UB has strategically invested in building its core technology infrastructure to advance its missions. UB faculty are using this ubiquitous and advanced IT infrastructure to

- Transform instructional programs and prepare students for work in the 21st Century
- Enable researchers to tackle previously unsolvable problems and participate in national collaboratories and global collaborations
- Share UB technology and expertise with other institutions and the private sector in Western New York and New York State

The following examples show just a few of the ways faculty leverage IT at UB.

RESEARCH & DISCOVERY

	Goals	**Infrastructure**
NEESgrid – NSF Network for Earthquake Engineering Simulation Research – A National Collaboratory NEES is a national, shared use, experimental resource (collaboratory) for advancing knowledge & technology to improve the design and performance of the nation's civil infrastructure when subjected to earthquakes and tsunamis. With an investment of $81.9M in NSF Funding, a nationwide network of 15 advanced engineering facilities has been created. The largest investment made by NSF is in the UB laboratory ($21M). High definition video and high-performance Internet connect the 15 facilities allowing for both operation and viewing of NEES tests from remote locations Funding: NSF $21M	o Enabling pioneering work in integrated real-time physical and computational simulation testing o Enable participation by researchers, educators, students, industrial partners who have access to the equipment, data, models, and software being developed	o High-performance Internet connecting the 15 facilities o IT staff – software tool developers; network engineers; database, modeling and visualization specialists o High definition video
COMPUTATIONAL MECHANICS: Finite element tools, simulation and visualization tools, High Performance Computing (HPC) environment and tools Faculty and students in Mechanical & Aerospace Engineering are applying finite element technologies to study a wide range of problems in engineering, including volcanic flows and risk mitigation, dental implant design, and child safety set design. The work on landslides has received a $1.9M ITR award. External Funding: ITR	o Use of computation-based science research to study a range of problems o Increase the level of discovery	o Finite element tools o Simulation & visualization tools o HPC. Environment

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BUFFALO CENTER FOR BIOMEDICAL COMPUTING: NIH Pre-Center Award – Faculty participating in this NIH Pre-Center award are integrating computational & biomedical research efforts, merging HPC, genomics, proteomics, and bioimaging to make critical scientific contributions in biomedical research. This multidisciplinary research involves 4 partners: UB, RPCI, the CCR, and the BCEB, and several departments: CSE, Pharmaceutical Sciences, Math, Biology, Molecular and Cellular Biology, Social and Preventive Medicine. Benefits: Enhanced research & discovery, enabling critical breakthroughs in tackling common diseases; development of advanced data mining algorithms Funding: NIH Pre-Center Funding > $1M	o Integration of computational & biomedical research efforts to study common diseases, including cancer, multiple sclerosis, coronary artery disease o Integration of genomic & clinical data to tackle common diseases o Leveraging UB's advanced data mining infrastructure to create knowledge and new treatments for common diseases o High performance computing	o High-end visualization o Advanced data mining algorithms o High end data storage and management
CENTER FOR HIGH-THROUGHPUT STRUCTURAL BIOLOGY: Hauptman-Woodward Medical Research Institute (HWI) – Stanford Synchrotron Research Laboratory (SSRL) Collaboration HWI received a five-year $16.9 M grant from NIH to fund the center, one of 10 nationally funded centers that are part of the National Institute of General Medical Sciences Protein Structure Initiative (PSI). HWI runs diffraction experiments at a synchrotron beamline at SSRL from their Buffalo location. They ship samples from Buffalo to Stanford, where live video feed from multiple cameras allows HWI scientists to control the experiments and SSRL provides back the raw data from the samples. Video and control of the experiment is in real-time.	o The PSI is a national effort to assemble a large collection of protein structures in a high-throughput operation. o Make atomic-level structures of most proteins easily obtainable from DNA sequences o Advance protein structure research & discovery	o High performance network (high bandwidth, high quality of service) to move very large datasets of images (HWI collects low resolution images every 2 sec; high res images every 20 sec.

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HIGH PERFORMANCE COMPUTING (HPC) — Modeling and Simulation: Third Pillar of Science Computational science, enabled by high-end computing power, has become the third pillar of 21st Century scientific inquiry (joining theory and experimentation), enabling researchers to investigate problems that are otherwise impractical or even impossible to address. UB's Center for Computational Science provides the high-end computing power, the software modeling and visualization tools, and the technical expertise and support that enable UB's scientists and other researchers to make discoveries, create knowledge, and perform leading-edge research. UB consistently appears on the Top 500 list of supercomputing sites and has been ranked as high as #38 in the world (2003). Modeling and simulation projects include groundwater flow modeling; computational chemistry models to determine molecular structure; electronic spectra and chemical reactivity with application in drug design, materials science, nanotechnology, and chemical kinetics; protein folding predicative models; x-ray crystallography; computational fluid dynamics, modeling volcanic and mud flows; and accident reconstruction.	o Enable UB's faculty to conduct research and discovery in the physical sciences, social sciences, geosciences, engineering and manufacturing, and biological sciences and health care sciences, and other disciplines o Educate students in scientific and other disciplines in the use of computational science tools so that they can become leaders in their disciplines o Workforce development: Increase the number of students graduating with computational science knowledge/experience.	o High performance computing o Modeling, simulation tools o Visualization tools o Data mining tools

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LARGE SCALE DATA STORAGE/REPOSITORIES — Large Scale Databases, Data Mining and Visualization Tools The huge volumes of data accumulating from the ever-increasing number of sensors and scientific instruments and from initiatives such as the human genome project provide UB researchers with opportunities for major scientific breakthroughs. Large scale data repositories and data mining and visualization tools are needed to enable UB researchers to make these breakthroughs in our strategic strength areas, such as bioinformatics, public health, and other disciplines. The WNY Shared Health Information Project is an example data repository project with the goals of building a secure community-wide health care database and bringing both economic and health benefits to the region. Participants in the project are UB's CCR, School of Informatics, School of Medicine, Health Science Library, the Buffalo Academy of Medicine, Erie County Department of Health, NY State Department of Health, WNY HealthNet, Kaleida, ECMC, Catholic Health System, Independent Health, HealthNow, and Univera Healthcare. Funding: NIH	o Enable UB researchers to use data- mining, visualization and other tools to gain knowledge from large scale data sets o Enable UB researchers to access local and national data repositories, as well as to use data management, mining and visualization tools to make scientific discoveries and create knowledge, and to collaborate with other researchers Specific goals of the WNY Health Information Project include o Developing an electronic patient medical record that follows the patient o Providing care providers with real-time patient info wherever they are, o Providing a tool to aid agencies in community safety, epidemiology, resource allocation, and bioterrorism response o Improving the quality of healthcare while reducing costs.	o Large scale data repositories and storage, o Data management, data mining, & visualization tools o Computer and information security infrastructure
DATA MINING, LARGE SCALE DATABASES — Leading Edge Research: School of Management The School of Management is carrying out leading-edge research on the buying habits of customers at Tops Markets, by using data mining techniques to analyze extremely large Oracle databases of customer purchases over several years. This research, using terabytes of data and leading edge data mining techniques, has become so important and well known that the School is receiving large numbers (more than 1100 applicants) of highly qualified applicants to its PhD program.	o Provide students with learning opportunities that involve the use of leading-edge technologies for scholarship and scientific discovery o Recruit the best and brightest students; attract world class faculty.	o High end data storage at the CCR o Data mining & visualization tools o Technical support and expertise.

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LARGE SCALE DATA STORAGE, HIGH BANDWIDTH NETWORKING ACCESS: 12 access Faculty and students in Informatics are videorecording interview subjects, analyzing their facial expressions for honesty. The work is being funded by the Naval Research Lab (NRL) and requires the transfer of very large uncompressed, videorecorded interview files (15 Tbps) to the NRL weekly. This project requires large scale data storage (SAN) and access to UB's I2, high bandwith connection to move the large volumes of data. External Funding: DOD Naval Research Lab	o Students have learning opportunities involving the use of UB's robust network infrastructure and large scale data storage hardware.	o Large scale data storage o High bandwidth networking access to move Terabits of data
3D VISUALIZATION — Medical Imagery The CCR, working with Children's Hospital and their leading miniature access surgery center team, has been developing software to improve the 3D reconstruction of medical images. The CCR also works with the Buffalo Neuroimaging Analysis Center to improve visualization of MS patient brain scans.	o Improve 3D reconstruction of medical images and visualization of brain scans	o Visualization tools o Software developers o High performance computing environment
GRID COMPUTING — Grid Collaborations: Open Science Grid, NSF Teragrid, NEESgrid, Western New York Grid, NY State Grid, GRID3, ACDC-Campus Grid, Access Grid, HP Labs GridLite, Northeast Bio-Grid Grid computing allows UB researchers to tackle highly challenging problems using distributed computational resources and data systems. UB's connection to the national grid and NSF Teragrid and its grid resources are enabling its researchers to work on problems such as protein folding, earthquake engineering, molecular structure determination, and hydrodynamic circulation modeling (pollution abatement), GIS systems. The CCR coordinates the use of computing resources (e.g., computational resources, imaging instruments, large-scale databases), people, and instruments in a geographically-distributed, multi-institutional environment.	o Allow UB and WNY researchers to use the power of distributed computational and data systems to tackle highly challenging problems.	o High speed network o Middleware o Grid portals and dashboards o Grid application templates and software o Technical support and expertise

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MOLECULAR MODELING & SIMULATION Students and faculty in Chemical & Biological Engineering are using state-of-the-art molecular modeling tools with applications in pharmaceutical formulation and manufacturing, nanotechnology, biochemistry and many other fields where these simulations are useful. Students and faculty in Civil Engineering are using our advanced IT infrastructure to perform groundwater flow modeling, showing the flow of chemical contaminants.	o Students use advanced IT infrastructure and tools to practice 21st Century science o Advanced research and discovery are enabled	o State-of-the-art modeling & simulation tools, visualization tools, o HPC
URBAN NEIGHBORHOOD RESEARCH Faculty and students in Sociology are videorecording urban neighborhoods that are hotspots for crime, and using GPS and GIS tools to chart and analyze results. Students get field experience and are introduced to state-of-the art research tools, leveraging the advanced GPS and GIS infrastructure at UB.	o Introducing students to the tools and techniques of 21st Century sociology research. o Enabling state-of-the-art urban neighborhood research	o Digital Videorecording o GPS and GIS technologies
ACCESS GRID NODES: UB has an access grid room and portable access grid nodes. The Access Grid® is an ensemble of resources including multimedia large-format displays, presentation and interactive environments, and interfaces to Grid middleware and to visualization environments. These resources are used to support group-to-group interactions across the Grid. For example, the Access Grid (AG) is used for large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials, and training. The Access Grid thus differs from desktop-to-desktop tools that focus on individual communication. The Access Grid has issued over 3,400 certificates to users across 47 countries. Each institution has one or more AG nodes, or "designed spaces," that contain the high-end audio and visual technology needed to provide a high-quality compelling user experience. The nodes are also used as a research environment for the development of distributed data and visualization corridors and for the study of issues relating to collaborative work in distributed environments. NSF had been actively encouraging research universities to invest in access grid nodes.	o Enable large-scale global research collaborations o Support studies of collaborative work o Enable UB researchers to "attend" meetings, conferences, etc. without the travel costs o Enable researchers to "meet" with funding agencies	o High-end audio & visual technology to support multicast videoconferencing o Abilene I2 research network access o Technical support staff