In This Issue:

Supercomputing
Podcasting for Academia
Instant Messaging & e-Books
Blade Servers & Virtualization
Digital Content Management
GIS Technologies in Aphrodisias
Digital & Advanced Media Studios
Welcome to the Fall/Winter 2006 Connect!

The central theme of this issue of Connect is supercomputing at NYU, an increasingly important topic for researchers in a wide variety of disciplines. We are pleased to be able to include the perspective of several scholars in this edition, including Richard Bonneau’s piece on how his biology research is facilitated by grid computing (and how you can help!), and Jimmy Kyriannis and Allen Mincer’s article on how NYU’s new high-speed connections to several research networks support the NYU High Energy Physics Group’s participation in the ATLAS experiment at CERN.

As you explore the issue, you’ll also notice a secondary theme of digital collections management. Several options for storing, organizing, distributing, and studying digital images and files are currently being explored at NYU—including a new Faculty Digital Archive—as discussed in articles by staff from ITS, the NYU Libraries, and NYU’s Institute of Fine Arts. Additionally, this issue features an exploration of Dr. Joshua Young’s experience in producing an academic podcast; a fascinating overview of how geographic information systems technology is facilitating archaeological exploration at Aphrodisias, Turkey; exciting news about enhanced ITS systems administration, new electronic resources and support at Bobst Library; important computer security instructions; and an introduction to the new Digital Studio and ITS Advanced Media Studio facilities. I hope you enjoy this full-color edition of Connect, and continue to send us your feedback and ideas.

- Kate Monahan

About Connect

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Grid computing can mean different things to different people. For the purposes of this article, we'll define grid computing as the use of the collective processing resources of a network of loosely coupled computers to solve large-scale computational problems. The computers in question are not primarily devoted to the grid: they can be anywhere in the world, can belong to anyone (so long as they choose to participate in the grid), and need only communicate with a central server for brief bursts each time a large part of the computational problem has been completed.

This type of grid strategy has resulted in several projects where people throughout the world can devote their computers' processing power to public research efforts during the times when their computers are not in use. One of the best known of these efforts is seti@home (http://seti.org/), a public project dedicated to finding signs of extraterrestrial activity in interstellar radio signals. If the input/output (I/O) needs of the computational problem are small and there is no need for careful timing, these grids can scale to include many hundreds of thousands of computers (as in the case of the project described below) to millions (as in the largest projects such as seti@home). Given that, on average, less than 10% of an office computer's daily processing capacity is used, these grid computing projects are tapping a valuable and underused global resource, enabling much larger scale projects than could otherwise be completed.

This article describes the Human Proteome Folding Project, a grid computing effort currently being carried out by NYU in collaboration with IBM (www.grid.org/projects/hpf/). We're using the computing power of millions of computers to predict the shapes of human proteins about which researchers currently know little. From these detailed shapes, we hope to learn about the functions of these proteins, as the shape of a protein is inherently related to how it functions in our bodies.

The resultant database of protein structures and putative functions will let scientists take the next steps towards understanding how diseases that involve these proteins work. We hope that our work on this project will contribute critical public infrastructure for the biological and biomedical community. Only with the amount of computing power available through the World Community Grid (described below) could we hope to complete this project. The scale of the Grid also allows for better sampling, enabling improved accuracy and gene coverage. I'll describe the project in greater detail below, and then go on to explain how you (via your computer) can participate.

PROTEINS
Proteins are the most important molecules in living beings. Just about everything in your body involves or is made out of proteins. They are structural molecules made up of long chains of smaller molecules called amino acids that act as enzymes and important carriers of biological signals. There are 20 amino acids that combine in different ways to make up proteins. As the chain of amino acids is built, the chain folds (like balling up string) into a more compact mass, ending up in a particular shape. This process is called "protein folding." Many of the things that happen in cells are specifically controlled by protein shapes and the functions conferred by those shapes. For example, a protein in a virus or bacterium may have a particular shape that interacts with human proteins or human cell membrane, enabling it to infect cells. This is an oversimplification, but nevertheless, knowing these shapes helps us gain insight into the biology of disease by understanding protein function.

How proteins fold has been a compelling theoretical and experimental research focus since the early 1950s, when Dr. Christian Anfinsen won the Nobel Prize for showing that proteins fold reproducibly. Most proteins fold to a tight ensemble of possible shapes. These ensembles are amazingly reproducible when compared to other polymers, the discovery of which spawned the new field of polymer physics called protein folding. Eventually, methods for folding proteins computationally
came on the scene, one of the more
successful of them being the Rosetta
software program. Less than five years
ago, we (the Rosetta developers com-
munity) reached a critical milestone,
showing that, for small proteins, we
can predict structure well enough
to predict aspects of function. Ever
since, we have been working hard to
improve these methods of extracting
function from structure prediction,
but the computer power needed for
these calculations has been a constant
limiting factor.

**AN EXPANDING PROTEIN UNIVERSE**

In recent years, scientists have
sequenced many genomes, including
the human genome. Between 20,000
and 30,000 genes found in the human
genome encode proteins. The col-
lection of all the human proteins in
the genome is known as “the human
proteome.” It is not, however, a trivial
task to determine from the sequence
of genes their final 3D shape. Protein
structure can help us divide proteins
into functional classes and thus aid in
our organization and understanding
of the protein universe. A protein’s
shape also gives us clues as to the
protein’s function, but there are tre-
mendous barriers to getting structure
for whole proteomes.

**PROTEIN STRUCTURE PREDICTION**

We’ve known for a while that we
can get good enough structure pre-
dictions using Rosetta to predict
function for large numbers of
proteins. For example, as part of my
PhD at the University of Washington
(Baker Lab), I focused on improving
the Rosetta method and then on pre-
dicting the structures of only 500
key proteins. I was terribly limited
by available computer resources,
however, and predicting the structure
of just these 500 proteins made me
somewhat unpopular, as my calcu-
lations monopolized the Baker Lab
computer clusters.

What we’d ideally like to do in the
Human Proteome Folding Project is
attempt to predict the shape of all
proteins of unknown function. Due
to the massive scale of such a project,
this is not possible using existing
supercomputing centers or clusters
here at NYU, or anywhere else that
I know of. One of the features of the
problem, however, is that computa-
tions on different proteins can be run
completely separately, and, in fact,
single proteins can be separated into
hundreds of smaller independent jobs
(a so-called “embarrassingly parallel
problem”). Although the supercom-
puting resources here at NYU are
impressive, they would not be the
most cost-effective solution, since
parallel problems like ours do not
require shared memory or tightly
coupled I/O. An attractive aspect
of our problem is that data sizes can
be kept very small, with large data
volume steps separated from pro-
cessing-intensive steps.

**WORLD COMMUNITY GRID PILOT PROJECT**

The World Community Grid was
started by IBM as a public super-
computing resource; all results are
made public, and research efforts are
carried out on the non-IBM side by
non-profit entities. In 2004, IBM
was looking for a biological appli-
cation they could use to help test their
grid (also with the aim that work on
the Grid would benefit humanity
and help generate positive publicity).
Given the inherent grid-ability of
our project, we were a natural fit
for the World Community Grid.
We proposed the Human Proteome
Folding Project, and were accepted
as the World Community Grid’s
pilot project.

Initial work consisted of defining
the project’s scope by selecting which
proteins were to be folded. In the
initial phase of the Human Proteome

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2. See the following Connect Magazine articles for more about the Max supercomputer: [www.nyu.edu/its/pubs/connect/fall05/ackerman_supercomputer.html](http://www.nyu.edu/its/pubs/connect/fall05/ackerman_supercomputer.html) and [www.nyu.edu/its/pubs/connect/spring06/allison_max.html](http://www.nyu.edu/its/pubs/connect/spring06/allison_max.html).
Folding Project (HPF1), we folded 150,000 proteins of unknown function. In the current, second phase (HPF2), we’re focusing on approximately 10,000 proteins (150 genomes) of high interest, including human secreted proteins, cancer biomarkers, and small secreted plasmodium proteins. Another task was to construct the Rosetta grid-client. This consisted of changing our code to match special grid-client library calls and testing the server-side pipeline (scripts for breaking work into smaller pieces and recollecting the finished work units). Rick Alther and Viktors Berstis were instrumental in the completion of this work. Robin Wilner and Bill Bovermann led the overall coordination of all the other aspects of the Grid beyond the science, such as the public relations efforts needed to persuade people to download the client.

**THE WORKFLOW**

The overall workflow of the Human Proteome Folding Project is shown in figure 1 (p. 3). The preprocessing steps consist of the sequence analysis needed for making the work units. We first exhaust all means of finding sequence matches (the most common way of annotating proteins), and only when we have confirmed that a protein, or a part of a protein, has no matches to known structures do we send it out to the Grid to be folded. This process helps us conserve resources; the Grid is large, but we still need to maximize the utility of the 500,000 CPU years\(^3\) it will give us.

These preprocessing steps are shown in the box at the top left of figure 1. The box at the lower left shows the most CPU-intensive part of the calculation, and the heart of the calculation performed on the Grid. The rightmost boxes depict our meta-database (structure, sequence, localization, and other annotations integrated for proteins in the 150 genomes analyzed) as well as our planned interface to this meta-database.

The large data volumes of HPF1 and the voracious appetite of the Grid for work units posed a challenge, but we were able to complete HPF1 without any downtime, any fake work units, and any data loss on the part of NYU or the Institute of Systems Biology (ISB) in Seattle, due in large part to heroic efforts by NYU, the ISB, and IBM team members.

**THE RESULTS OF THE FIRST PHASE**

Work on HPF1 is drawing to a close, and results from HPF2 (the current

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\(^3\) The CPU, or Central Processing Unit, is a computer component that interprets instructions and processes data in computer programs. CPU years are a unit of measurement for processing time.
Three Grid Collaborations on Disease Research

Following are descriptions of three of the Bonneau Laboratory’s main efforts to transfer the protein information returned from the World Community Grid into the hands of groups working on disease research. In general, the two parts of the Human Proteome Folding Project (HPF1 and HPF2) are providing vital bioinformatic support, helping these groups to understand the structure and function of proteins central to their research efforts. In each case, our lab has tailored tools and databases to suit the specific needs of each research effort, and these collaborations will in turn inform our future development of tools for integration of organism-specific information with our structure-prediction-derived information. For each project below, we explain why we have asked you to join the World Community Grid and help us fold these proteins. We encourage you to explore the websites of each of these three groups to learn more about their efforts.

Malaria Proteins
Collaborators: Patrick Duffy & Paul Shannon  
www.scrii.org/research/duffy.asp
The Duffy Lab at the Seattle Biomedical Research Institute in Seattle, Washington aims to create a pregnancy malaria vaccine. In 2003, Dr. Duffy and a consortium of laboratories launched the Pregnancy Malaria Initiative to identify the necessary antigens for a malaria vaccine to protect women during pregnancy. They are using bioinformatics, microarray, and proteomics tools to characterize the distinct features of these parasite proteins and evaluate those that may be developed as pregnancy malaria vaccines. The proteins identified by the consortium are now being assessed by the Human Proteome Folding project (HPF2) in order to understand their function and structure so that vaccine designs can be improved.

Using the paradigm established in their studies of pregnancy malaria, the Duffy Lab has also launched a program to develop vaccines against severe childhood malaria. With support from the Grand Challenges in Global Health (GCCH) Program, an international consortium led by the Duffy Lab is now studying the immune responses that protect African children from severe malaria. African children may only suffer one or two episodes of severe malaria before developing resistance, and earlier studies showed that antibody purified from the serum of immune adult Africans could cure young children with malaria. The consortium is thus identifying parasite proteins (Plasmodium) that may be targeted by protective antibodies as a key step in developing vaccines for children. As part of the Human Proteome Folding project, we are working with the Duffy Lab to dramatically improve their ability to annotate many of the proteins they have recently found to be important to Plasmodium and its specific interactions with its host.

Human Cancer Biomarkers
Collaborators: Leroy Hood & Nathan Price  
www.systemsbiology.org/
Multiple groups at the Institute for Systems Biology in Seattle, Washington are currently involved in a coordinated effort to characterize biomarkers that can be used for early diagnosis and sub-classification of human cancers. In particular, specific efforts are underway in the laboratory of Leroy Hood to find prostate, bladder, and ovarian cancer biomarkers. This project coordinates proteomic, microarray, pathology, and bioinformatics efforts in an attempt to determine reliable and readily-assayable predictors that can be used as markers for diagnosis and selection among alternate therapeutic/intervention regimes.

The Bonneau Lab and the World Community Grid are involved in the functional annotation of putative proteins and proteins of unknown function found in these studies. To date, several hundred putative biomarkers of unknown function have been prioritized and are being processed, along with the other sets of proteins described in this article, on the World Community Grid. The Bonneau Lab has been applying structure-based annotation to elucidate the structure/function of the putative biomarkers discovered using these genome-wide screens.

Gram-Negative Pathogens
Collaborator: David Goodlett  
http://goodlab.mechm.washington.edu/
Dave Goodlett’s laboratory at the University of Washington in Seattle has used Francisella tularensis subspecies novicida (strain U112), a mouse pathogen, as a model to study virulence in Francisella tularensis, a human pathogen that causes Tularemia, also known as “rabbit fever.” Both organisms are extremely virulent to their respective hosts, causing high morbidity/mortality if left untreated by antibiotics. The Bonneau Lab’s primary role thus far has been to carry out genome annotation for the most difficult proteins in these Gram-negative pathogens, using our structure-inclusive pipeline.

The Goodlett Lab was able to verify that many proteins in these genomes with no homology to other genomes are actively expressed at different conditions, increasing our interest in applying the folding methods described in the accompanying article to these genomes. In combination with genome annotation, about 80% of genes are predicted to be expressed. Of predicted genes, approximately 30% had no homology to genes encoding proteins of known function, preventing corroboration of their authenticity. However, observation of gene products validated the authenticity of more than 50% of these hypothetical genes, representing 23.2% of all expressed genes; no pseudogenes were observed. Finally, we are using Rosetta de novo, fold recognition, and homology-modeling to predict structure and infer function for many of the genes of unknown function.
phase, which I’ll describe below) are beginning to arrive at NYU servers. We are now working around the clock—partly due to the fact that the project involves researchers around the globe—to process the results and get them out to the community in our protein domain annotation database.

Alas, predicting the structures is only the first challenge, and current research in my lab centers on integrating the structure-derived data with other sources of protein function (sequence-based, expression and localization measurements, etc.). The beta-release of the database and our release of the results on a model-organism (yeast) are the center of our first paper. Soon after we have debugged the process using the yeast proteome, we’ll release the rest of the 150 genomes folded during HPF1 via our meta-database.

HPF2: HIGH-RESOLUTION PROTEIN FOLDING

The second phase of the project (HPF2) is a refinement, using Rosetta in a mode that accounts for greater atomic detail, of the structures resulting from the first phase, HPF1. The project focuses on human secreted proteins, including proteins in the blood, mucus, tears, and the spaces between cells. These proteins can be important for signaling between cells and are often key markers for diagnosis; they have even been found to be useful as drugs, when synthesized and prescribed to people lacking the proteins. HPF2 also focuses on key secreted pathogenic proteins. This phase of the project dovetails with efforts at the Institute for Systems Biology to support predictive, preventive, and personalized medicine, under the assumption that these secreted proteins will be key elements of this medicine of the future.

This second phase of the Human Proteome Folding Project continues where the first left off. The two main objectives are to: 1) obtain higher resolution structures for specific human proteins and pathogen proteins, and 2) further explore the limits of protein structure prediction by further developing Rosetta structure prediction. Thus, the project addresses two very important parallel imperatives, one biological and one bio-physical. With the second phase, we are aiming to increase the resolution of a select subset of human proteins. Better resolution is important for a number of applications, including, but not limited to, virtual screening of drug targets with docking procedures and protein design. The second phase of the project will also serve to improve our understanding of the physics of protein structure and help us to further develop our state-of-the-art program, Rosetta.

Figure 4. The structure on the left is an example of a Rosetta prediction. The right structure is a structurally similar protein that provides, via structure-structure similarity between the predicted structure (left) and the known structure (right), some clues as to the function of PF0677. (Taken from Bonneau et al., 2001)

We are members of Rosetta Commons, the Rosetta developers’ community (www.rosettacommons.org/).

Figure 4. The structure on the left is an example of a Rosetta prediction. The right structure is a structurally similar protein that provides, via structure-structure similarity between the predicted structure (left) and the known structure (right), some clues as to the function of PF0677. (Taken from Bonneau et al., 2001)

Potentials for Future Protein Grid Computing at NYU

There are a number of ways we can increase the degree to which spare computer processing cycles are used. Making small private grids—NYU-wide or department-wide, for example—can provide more modest but still quite significant resources for many different analysis pipelines (preprocessing protein sequence for the larger grid, analyzing mass spectrometry data, turning cross links into structures, learning tissue-specific regulatory networks, etc). Another option is for an NYU-wide installation of the World Community Grid client, followed by an NYU-wide attachment to the HPF2 project, a much simpler option, in my opinion. To date, only a small fraction of current global CPU capacity is being used, and grid computing projects have lots of room to grow.
The High Energy Physics Group in the NYU College of Arts and Science's Physics Department has recently joined the ATLAS experiment at CERN (the European Organization for Nuclear Research, located in Geneva, Switzerland). The ATLAS experiment is an international collaboration involving 1800 physicists from 150 institutions in 35 countries. The mission of the project is to explore the fundamental nature of matter and the basic forces that shape our universe by searching for new discoveries in the head-on collisions of protons of extraordinarily high energy.

The High Energy Physics Group in the NYU College of Arts and Science's Physics Department has recently joined the ATLAS experiment at CERN (the European Organization for Nuclear Research, located in Geneva, Switzerland). The ATLAS experiment is an international collaboration involving 1800 physicists from 150 institutions in 35 countries. The mission of the project is to explore the fundamental nature of matter and the basic forces that shape our universe by searching for new discoveries in the head-on collisions of protons of extraordinarily high energy.

Slated to begin collecting data sometime in 2007, ATLAS will study the particles created when two protons collide with a total energy of 14 teraelectronvols (TeV)—about 15,000 times the energy equivalent of the proton mass. Among the many studies planned as part of this experiment is a search for the Higgs particle, the one remaining undetected particle predicted by what is now called “The Standard Model” of particle physics. This model has been very successful, agreeing with experiment in the hundreds of tests to which it has been put over the last three decades. However, as it is incomplete and raises some other thorny problems we won’t discuss here, much theoretical work has gone into understanding how to extend this model. ATLAS will therefore also be looking for signs of new particles, predicted to be accessible to ATLAS by these “Beyond the Standard Model” theories.

At CERN, the Large Hadron Collider (LHC) is being built in a tunnel of 27 kilometers in circumference, straddling the French-Swiss border near Geneva. Two counter-rotating beams of protons will be accelerated and then smashed head-on at various points along the collider. As described on the ATLAS website, “the energy density in these high energy collisions is similar to the particle collision energy in the early universe less than a billionth of a second after the Big Bang.”

Four main experiments (see figure, below), one of which is the ATLAS project, will measure the particle debris flowing out of these collisions, which may occasionally include the sought-after particles.

A detector at an LHC interaction region faces many difficulties. Bunches of counter-rotating protons will interact approximately 40 million times a second. A typical event may include 1000 outgoing particles.

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1. http://atlasexperiment.org/
whose type, energy, momentum, and direction need to be measured. Some particle types interact readily, while others pass through a large amount of material with a very small probability of colliding. Particle momenta can be measured by following their paths in a detector-provided magnetic field, but every detector is made of matter, off of which the particles can scatter and therefore change direction.

No single detector type can simultaneously perform all the measurements that are required. The ATLAS detector, which is about the size of a five-story building (see figure 2), therefore consists of several nested detectors surrounding the interaction region, each of which is in turn made of several components. The detector closest to the beam of protons has an inner radius of less than two inches, an outer radius of more than three feet, and a length of more than 20 feet. The outermost detector, designed to measure the highly penetrating muon particles, has an outside length of about 150 feet and a radius of 36 feet. Both of these detectors will measure the position of particles passing through them to a precision of less than the thickness of a human hair.

The high interaction rate of the particles and fine grained multiple measurements by the detectors result in a tremendous amount of data: about 2 megabytes (MB) per event, at a rate of 40 million events per second. In fact, only a small fraction of the events can be kept. A sophisticated three-level trigger system—one part of which is being designed by the NYU group—culls the most interesting events and keeps the rate down to a just-manageable few hundred megabytes per second (MB/s).

ATLAS thus presents many data flow, networking, and computational challenges. Even after being abridged by the trigger system described above, the large amount of data produced is too great to reconstruct and distribute to all collaborating institutions. Rather, a multi-tier computing system has been developed to divide the load of collecting and processing the volume of information being gathered by the ATLAS detector.

On average, data streams from the CERN detector at about 320 MB/s, requiring ten gigabits per second (Gbps) links from the detector for very high performance and reliability. The roughly 10 petabytes per year (1 PB is equal to approximately one billion megabytes) of raw data from the detector flows into a very high capacity CERN storage “Tier-0” facility. It is run through an initial processing step, distributed to ten global Tier-1 facilities around the world for further processing to yield datasets for physicists, and then made accessible to a much larger number of Tier-2 facilities for greater scientific analysis.

The volume of data generated by ATLAS is equal to the computational power necessary to analyze it. Grid systems, for example, use networks to interconnect supercomputers and computer clusters to yield a single system with performance characteristics that exceed those possible with a single computer. The Open Science Grid (www.opensciencegrid.org), in particular, is a distributed high performance computing facility that spans multiple campuses and provides processing resources to support the heavy computational loads of the LHC experiments, as well as other physics and biology research activities.

Transmitting large amounts of data between the ATLAS Tier facilities and research institutions necessitates very high performance networks. Rapid and low-latency remote network access and graphics display are also necessary for research activities and visualization of the analyzed data. In addition, communication among the many institutions and countries requires video transmission and conference capabilities, which also place demands on the network.

LHCNet is a dedicated network specifically designed to support the needs of CERN LHC research projects, such as ATLAS and CMS (Compact Muon Solenoid). The LHCNet network operates at 10 Gbps, spanning CERN, the StarLight communications facility in Chicago, and the Manhattan Landing (MANLAN) communications facility hosted by NYSERNet (www.nysernet.org) in downtown New York City. Participant research institutions then typically establish their connections to LHCNet via StarLight or MANLAN.

In Summer 2006, NYU obtained a 1 Gbps Ethernet connection to the LHCNet network presence at MANLAN, via Dense Wave Division Multiplexing (DWDM) technology on the NYU Metro Optical Network. This connection, in fact, provides the campus with connectivity to two research networks: the United States LHCNet presence (USLHCNet) and the UltraLight network. By its nature, it also provides high-speed connectivity to the CERN facility. A single “DWDM lambda” (optical wavelength) represents the optical link from the NYU campus to MANLAN to establish the gigabit Ethernet connection, while Virtual LAN Network (VLAN) technology over that Ethernet link makes the simultaneous transmission of both LHCNet and UltraLight networks possible.

4. See “Global Grid Computing at NYU” by Richard Bonneau on p. 2 for more information about these systems.
5. NYU is a member organization of MANLAN and a close collaborator on research and academic-oriented network initiatives.
6. Please see “High Performance & Optical Networks” by Jimmy Kyriannis on p. 31 for more information about DWDM technology and hybrid optical networks.
While LHCNet supports the research needs of NYU’s High Energy Physics Group, UltraLight is an experiment in hybrid optical networks. UltraLight is supported by the California Institute of Technology and CERN for research in hybrid networking, where network devices and Internet-connected computers use both IP (the Internet Protocol) and, simultaneously, direct fiber optic communications. The creation of fiber optic links between sites on a dynamic, on-demand basis is of particular interest to research groups that transmit very large amounts of data and require extremely high-bandwidth performance (at least several Gbps) without congestion or interference from other network communications. Supporting this capability is a design goal for the next-generation Internet2 network, currently known as “NewNet.” The basic building-blocks of this network are hybrid “nodes,” which will ultimately enable on-demand optical connections between institutions on a national scale.

Research projects on the forefront of science continue to place novel demands on technology resources. The design of the computational and network models for ATLAS was a substantial undertaking and has furthered hybrid optical communications, high-speed data transfer techniques, and grid computing technologies through its application, even at this early stage in the project. The requirements for high performance computing technology across the academic disciplines are growing at a terrific rate. The national distributed computing facility, TeraGrid (www.teragrid.org), is similarly receiving quite a bit of attention from universities across the country. Perhaps not unexpectedly, information technology continues to develop and benefit from the research needs of the academic community as it rises to meet that demand.

Jimmy Kyriannis is Senior Technology Architect in ITS Communications and Computing Services. High performance networking and computing are among his focus disciplines. Allen Mincer is a Professor at the NYU Department of Physics and a member of the NYU High Energy Physics Group.


Figure 2. The ATLAS Detector. At the size of a five-story building, weighing 7,000 tons, the detector records the product of protons colliding with each other at very high levels of energy. The resultant data from that collision streams from the detector over high-speed computer networks at approximately 320 megabytes per second.
Aphrodisias, Turkey is an ancient city of major Greek and Roman period archaeological importance. The city lies in Turkey’s central southwestern Maeander River basin, a fertile valley 100 miles southeast of the port of Izmir. Thanks to preservation initiatives, many of the city’s ancient monuments, marble statues, and works of art remain well intact. Aphrodisias’ Roman stadium is arguably the best preserved in the world.

Over the last year and a half, Dr. Christopher Ratté, formerly a professor in the Departments of Classics and Fine Arts (FAS), began an initiative to implement Geographic Information Systems (GIS) technologies in the collection and mapping of archaeological finds in the Aphrodisias valley.

Dr. Ratté enlisted Frank LoPresti, who heads ITS’ Statistics & Mapping Lab (www.nyu.edu/its/labs/third/), and others from ITS to develop plans for a GIS program in Aphrodisias. By the summer of 2006, LoPresti had organized a budding GIS program operated by a small team of students, including Jaime Martinez of the Statistics & Mapping Lab, Jamie Donati of the Institute of Fine Arts, Ian Lockey of the Department of Classics (FAS), and Chris Harrison and Stacey Kuznetzov of the Department of Computer Science. While Ratté, Martinez, Donati, Lockey, Harrison, and Kusnetzov traveled to Aphrodisias to oversee the GIS work, Schuler remained in New York to create and launch a website that uses ESRI’s (www.esri.com) ArcIMS mapping software to display Aphrodisias data.

Once in Aphrodisias, the team focused on geographical data capture and development through the use of Trimble Global Positioning System (GPS)/Mobile GIS units and ESRI software, including ArcGIS, ArcPad, and Spatial Analyst. Trimble GPS/ Mobile GIS units are handheld, ruggedized machines with a high-powered GPS receiver that is capable of determining a location’s latitude and longitude within less than a meter of accuracy. The units also run ArcPad, a robust mobile GIS program created by ESRI that provides two key functions in the data collection process—taking accurate latitude and longitude readings of all significant archaeological finds and creating high quality contour maps through the use of different spatial analysis techniques on elevation points collected in the field.

Throughout the summer, the majority of the team’s time in the field was spent doing high and low intensity surveys of ancient citadel and farmstead sites by creating high quality contour and transect maps. Using the GPS units, the team members were able to capture several thousand elevation points over the entire site. These points were later processed using the ESRI Spatial Analyst tools to create extremely accurate elevation rasters and vector contour lines. With these sites well mapped, high quality transect maps could be produced for the site, which enabled greater accuracy in...
the analysis of pottery shard density survey results of the area. In addition to creating contour maps, the team used GIS modeling technology to aid in the search for citadels, aqueducts, and iron oxide deposits.

**CITADELS**
Several citadels and fortifications had been found around the Aphrodisias survey region prior to this project. Existing information about these structures was used by the team to develop a GIS model for locating other towers and citadels in the region. First, all currently known tower locations were analyzed to determine the elevation range of the known watchtowers. ArcGIS software was used to compute the slope of the terrain on which each of the towers was built. Given the slopes of all known citadel locations, an optimal slope range for ancient watchtowers was selected.

Because the primary function of ancient citadels was to serve as watchtowers, the defining characteristic of all known tower locations is a direct line of sight into the Dandalaz Valley. Thus, a line of sight analysis was performed on the six known tower locations to determine which areas of the valley are least visible to the known outposts. Another line of sight analysis was then performed to determine areas that overlook the less visible parts of the valley. In addition, since ancient watchtowers often have direct line of sight to each other, locations around Aphrodisias were identified that have a line of sight to the known tower locations.

Results of the slope, elevation, and line of sight analysis were combined to identify probable tower locations. Areas that fell within the optimal slope and elevation range were selected, and of these areas, locations that had line of sight to the valley and to other towers were identified. Finally, a GIS map was produced to display areas that satisfied the conditions for probable

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**Connecting NYU & Aphrodisias via Satellite**

In support of the GIS initiative discussed in this article, the Aphrodisias Project Team helped provide high-speed Internet access to the site, so that archeologists working at Aphrodisias could access archeological databases housed on NYU servers in New York. ITS staff member Carlo Cernivani helped Dr. Ratté and other members of the Team research the options, and eventually decided that satellite connectivity was the best solution. It was determined, however, that upgrades to the site’s wireless network infrastructure would be required to take full advantage of this improved Internet connection. ITS and the Aphrodisias program agreed to share the cost of this capital improvement, with ITS paying the up-front cost of the satellite dish, and Aphrodisias paying an Internet Service Provider in the United Kingdom for three months of service during the research season.

The satellite dish was delivered to Aphrodisias in May 2006 and was physically installed by Dr. Ratté’s local contacts. Later that month, Senior Network Engineer Keith Malvetti of ITS’ Communications & Computing Services and Ray Riga of the Institute of Fine Arts traveled to Turkey to configure the dish and implement upgrades to the site’s network and computers. Riga provided storage and memory upgrades to the computers used at the dig, and Malvetti verified that the satellite link was running correctly, built a wired network in the main house, improved the existing wireless network there and in the adjoining buildings, and extended the wireless network to the local museum, where archeologists often went to make database entries. Thanks to this team effort, researchers at Aphrodisias now have a reliable, high-speed connection to the NYU resources they need.
Each year during the field season at Aphrodisias, two of the areas suggested on the map were explored, resulting in the discovery of a fortification and two nearby settlements in the southeast region of the site. Previous research on tower locations (see figure, above).

**AQUEDUCTS**

Several portions of Greco-Roman aqueducts have been found in the Aphrodisias survey region. However, these portions are disjointed and the full paths of the aqueducts are unknown. Previous research on aqueducts, as well as the topographical data of the Aphrodisias region collected with GPS units, were used to predict possible paths connecting the already-discovered aqueduct pieces.

In addition, a cost model was constructed to assign a relative cost of building an aqueduct through each cell of the region’s elevation raster. This cost was assigned based on the assumption that Greco-Roman aqueducts had trivial costs at optimal slope ranges of -1% to 3%. Areas with higher and lower slopes, however, were assigned exponentially higher costs. A cost path algorithm was then performed to map the least costly paths between the known aqueduct portions in Aphrodisias. This aqueduct analysis project is an initial proposal for sites that can be investigated in future years of the survey.

**IRON OXIDE**

Inscriptions found at Aphrodisias suggest the presence of iron mining in the region, but low intensity regional surveys have yet to locate these mines. The large size of the survey area, some 600km², posed a significant challenge—an exhaustive search was simply not feasible. To solve this problem, multispectral satellite data, acquired from the Landsat 7 ETM+ mission launched in 1999 by NASA, was used in con-
junction with advanced GIS spatial analysis techniques. Likely locations for the ancient iron mines were determined, based on the amount of iron in the surrounding area, elevation, and proximity to other known significant sites (see figure, above). One site was determined to be a likely iron mine due to this type of analysis and additional anecdotal evidence, as it is also one of the few sites where slag, a byproduct of the iron smelting process, was found. This iron oxide analysis project is also an initial proposal for sites that can be investigated in future years of the survey.

**ArcIMS**

Through the use of Internet Mapping Services (IMS), data retrieved from the Aphrodisias site can be globally shared in a user-friendly map format. This is made possible through products such as ESRI’s ArcIMS, which enables the delivery of dynamic maps and GIS data and services via the Web, without viewers needing any mapping software.

ArcIMS consists of three applications—Editor, Administer, and Designer—which together provide a relatively easy interface for creating and administering IMS websites. ArcIMS communicates to clients and servers using an ArcGIS extension of the Extensible Markup Language (XML) called ArcXML. Through editing ArcXML documents, ArcIMS designers are able to customize the function, design, and layout of their IMS website. While the highly scalable multi-tier architecture of ArcIMS allows the software and mapping data to be stored on different computers, it can also be completely run off of one simple server computer, as is done in the ITS Statistics & Mapping Lab.

Though still in the early stages of development, the Aphrodisias test website (www.nyu.edu/its/statistics/aphrodisias/) currently allows you to view the discovery location of archaeologically significant finds through the Identify, Query, or Find tools in the toolbar on the left side of the site’s home page. The Identify tool enables

*Jaime Martinez uses the Trimble Mobile GIS units to capture points for the creation of contour maps.*
you to click on a point of interest for information about its archeological category, given name, and historical period. The Query tool allows you to search all artifacts by the same three categories. To use Query, select the question mark tool from the toolbar and choose your field of interest. Clicking “Get Samples” will then allow you to browse points of interest in any of nine archeological categories, by historical period, or by the artifacts’ names. Finally, the Find tool provides the greatest flexibility by enabling you to browse all points of interest that contain a specific string of characters or words.

While the website’s current features provide at least some information on all of the significant finds to date, eventually you will be able to easily access hundreds of photographs and thorough descriptions of all the points of interest within the valley surrounding Aphrodisias. Be sure to check back to the website periodically as it is updated and redesigned over the coming months.

Jordan Schuler is a Master of Urban Planning candidate at the NYU Wagner School of Public Service. He also works in the Statistics & Mapping Lab as a GIS consultant, teaching assistant, and tutor. Jaime Martinez is a Master of Urban Planning Candidate at the Wagner School of Public Service. He currently works as a GIS consultant for NYU, and will be an adjunct professor at the Gallatin School of Individualized Study next semester. Chris Harrison recently completed his Masters degree in Computer Science at NYU. He is currently working at AT&T Labs on new ways for people to interact and communicate while watching television. Stacey Kusnetzov is a graduate student in NYU’s Department of Computer Science.

New ITS Website & Ask ITS Support Area in NYUHome

This fall, ITS collaborated with NYU’s Web Communications to release a redesigned version of the ITS website at www.nyu.edu/its/. New features include a News blog, expanded content, enhanced NYU Blackboard support, and an improved navigation structure. We also launched a new “Ask ITS” support area in NYUHome (http://home.nyu.edu), available via the Home tab, which provides one convenient location for you to request help from ITS, read important security and technology news updates, and link to helpful software and instructions. We encourage you to explore these new sites, and to send us your feedback: its.website@nyu.edu.
Podcasting for Academia

By Joshua Young
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Podcasting is an audio and/or video program that can be loaded directly onto a computer or digital audio player (such as an iPod). Typically, listeners subscribe to podcasts through providers’ websites and podcast directories (virtual libraries), such as iTunes. After a listener registers for a podcast, each new episode is automatically loaded onto his or her computer or digital audio player. The listener need not revisit the provider’s website to download new episodes.1

Early podcasts emulated radio and were designed to appeal to a broad audience. But it is now clear that the great potential of podcasting lies not in addressing large audiences, but in catering to small ones. The power of the Internet is in its ability to serve, indeed to create, communities with niche interests. Podcasting has introduced a novel system for circulating information to dispersed audiences, and the ease of targeting and distributing podcasts is proving to be an especially useful feature for the specialized communities of academia.

Advantages for Academia

My profession is ophthalmology, a relatively small field in medicine dealing with medical and surgical management of eye disease. Ophthalmologists represent a fraction of one percent of the population at large and an insignificant market segment for traditional mass media. Although our area of study is small, its claim to our time is not. Physicians, like most academics and successful business people, have little disposable time. Audio and video presentations have been available online for some time, but all share the requirement that their audience view their material on a computer. Podcasts, however, can be loaded onto portable players and listened to or viewed at any convenient time: while commuting, exercising, doing chores, etc. Another advantage of podcasts is that they are available on demand (in contrast to “webcasts” or radio programs, which are usually distributed at a particular time) and easily accessible to colleagues dispersed over many time zones.

In February of 2005, I launched an ophthalmology podcast called As Seen From Here (http://asseenfromhere.com). Podcasting was still a relatively new medium at the time, and there was no template for academic podcasts. I modeled As Seen From Here after Terry Gross’s Fresh Air (http://freshair.npr.org/), a daily program broadcast on National Public Radio. It was my good fortune to obtain the help of an expert, Sue Spolan, a director of Fresh Air.

As Seen From Here episodes consist of a single lengthy interview. Although the tone is conversational, I speak very little and nearly all of the airtime is given to the guest. Guests are mainly ophthalmologists and vision researchers who have published significant research in peer-review journals within the previous few months. Publication of an article represents the culmination of a project, and researchers are inevitably eager to discuss their work. Where possible, I interview authors whose manuscripts are in-press, so that these podcasts circulate contemporaneously with the publications.

An engaging interview unfolds as a kind of a story, but since some guests are better storytellers than others, it is essential to prepare an outline for each interview and to be ready to improvise, as needed. Careful reading of an author’s manuscript can pay substantial dividends towards this end. The introductory section of an article lends insight into the way that a guest frames his or her own work. Such information enables me, at the beginning of each interview, to help the guest establish context in the way he or she feels most comfortable. Typically, the end of a manuscript addresses questions peer reviewers have raised, and these can often make for interesting conversation during the interview.

The interview format has two advantages over a simple review of the published manuscript. First, guests are generally willing to describe

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their subsequent work as well as the responses their publications have received. Second, interviews give authors an opportunity to describe the significance of the research for their own professional work.

Professional Accreditation

As Seen From Here broke new ground, not only as the first podcast for physicians, but also as the first to obtain professional accreditation from the Accreditation Council for Continuing Medical Education (ACCME). Each year, practicing physicians must obtain a certain number of credit hours, usually 50. In order for As Seen From Here to meet ACCME requirements as a source of credit hours, a peer review board was established at the NYU School of Medicine. Each program is reviewed by members of this board to ensure that academic goals have been met and that no commercial bias has been introduced. Indeed, meeting the ongoing requirements of ACCME accreditation represents a significant portion of the labor expended in producing As Seen From Here. Listeners obtain credit by downloading and printing out a quiz from the NYU School of Medicine website and mailing it back to us; in the future, we hope to migrate to a fully electronic format.

A Two-Way Conversation

One challenge I have encountered in my use of podcasts is their intrinsic lack of interactivity. Academia is discursive by nature, and, from the start, I was interested in finding a means to introduce participation into As Seen From Here. Since the interviews are not broadcast live, it is impossible to include a call-in segment. Instead, I set up two VoIP (Voice over Internet Protocol) telephone lines, in New York and in London. Since these lines capture voicemail digitally, content is easily recorded and accessible from any computer.

The audience of each episode is encouraged to call the telephone lines with questions for guests they have just heard. Their questions are recorded and then emailed to the relevant guest. The guest then calls and records his or her response using the same arrangement. The entire process of question and answer can take several days, but this is not apparent to listeners of As Seen From Here; recordings of the questions and answers are combined and included as an addendum to the next podcast. This arrangement resembles an academic symposium, in that the initial presentation, the questions from the audience, and the speaker’s response are all accessible to the As Seen From Here audience.

On August 14, 2005, for example, I podcast an interview with Elias I. Traboulsi, M.D., the Director of the Center for Genetic Eye Diseases and Chairman of Graduate Medical Education at the Cole Eye Center at the Cleveland Clinic. Dr. Traboulsi had just published an article on the genetics of age-related macular degeneration in the American Journal of Ophthalmology. Among the several hundred ophthalmologists who listen to As Seen From Here, one, in Leesburg Florida, had a question about genetic screening. Several days after the podcast of the interview was released, this ophthalmologist called in his question to the New York telephone line. The question was recorded and forwarded, the next day, by email to Dr. Traboulsi. A day or two later, Dr. Traboulsi called his response into the same telephone line, and his comments were recorded. Finally, the recordings of the question and Dr. Traboulsi’s answer were combined and included in the following week’s podcast, for all of the ophthalmologist-listeners to hear.

Production Tips

In my experience with As Seen From Here, I’ve learned a few lessons that might be helpful to others who wish to produce a podcast.

Recording

It is possible to record a podcast on the internal microphone and/or video camera of a relatively new, well-equipped computer. However, the production quality is far superior when recorded with professional equipment. NYU provides a variety of podcasting production resources for use by faculty, staff, and students on campus; see www.nyu.edu/podcast/ for details. Alternatively, a stationary recording ensemble designed for use with a personal computer can be bought for about $500, or, for an additional $500, a field recording ensemble with a digital recorder.

Editing

Radio is a medium that we all understand and this familiarity has

2. Such lines can be purchased inexpensively from Skype: http://skype.com.

3. Note that some practice is required to achieve good results with a professional microphone. Although superior clarity is possible, altering one’s position relative to the microphone produces widely varying results.
created expectations that extend to radio-like media, such as podcasting. The absence of radio-like production standards in these media is distracting. Next time you listen to an on-location (as opposed to in-studio) interview on NPR, try to pick out where editing has been done. It’s usually impossible to tell. Listen for silence between questions: there isn’t any. This is because NPR is particularly adept at incorporating ambient sounds into their stories and has been jocularly described as “radio that crunches.” While I do not advocate including ambient sound in every interview, podcast producers should keep in mind that audible edits can really distract the audience. It is standard practice to introduce a bit of ambient sound into the silences that are occasionally created by adding pauses during editing. Nothing stands out like dead air.

In addition to ambient sounds, the participants in the interview often breathe audibly. While the listeners may not consciously register these breaths, if one is cut short in an edit, it will become immediately apparent. Indeed, much of the finer work of editing involves adding ambient sound or copying a breath from one portion of an interview to another. The object is always to make the editing inaudible so that the listener can concentrate on the podcast’s content.

**Expansion & Globalization**

Six months ago, I was approached by Dr. Kazuo Tsubota, Chairman of the Department of Ophthalmology of Keio University in Tokyo. A faithful listener of *As Seen From Here*, Dr. Tsubota wanted to introduce its contents more widely within the Japanese ophthalmic community. At that time, the audience of *As Seen From Here* was international but concentrated in the English speaking world. Dr. Tsubota’s idea was to preface each English language podcast with a Japanese language summary covering the gist of the podcast. His contention was that, while most Japanese ophthalmologists spoke some English, many would feel too intimidated to listen to an entire interview exclusively in English. With a Japanese language summary at the beginning of the program, many would feel comfortable enough to stay on for the English interview.

I saw great value in this approach and have since established collaborations with Peking University, Yonsei University, and Rajavithi Hospital to produce editions of the podcast with summaries in Mandarin, Korean, and Thai for release this fall. In addition, based at least in part on the success of *As Seen From Here*, the NYU School of Medicine has had the foresight to create an office to take full advantage of podcasting technology. Called The New Media Project, it is, to my knowledge, the first office in any medical school devoted to the production and dissemination of podcasts. Our work includes replicating the ophthalmology podcast in other medical fields and producing both audio and video podcasts for graduate and undergraduate medical education.

The long term effects that the powerful and versatile medium of podcasting will have on the dissemination of scientific, educational, and business material are not yet apparent, but are certain to be substantial.

Joshua Young, M.D., is a practicing ophthalmologist, Director of the New Media Project at the NYU School of Medicine, Producer of *As Seen From Here*, and Director of Podica (www.podica.com), a podcast consulting and production service for business.

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**How to Participate in the Grid**

Don’t be left out of the satisfying fun that is grid computing! Anyone wishing to participate should visit www.worldcommunitygrid.org/ to download the free software. Thanks to IBM and United Devices, installing and managing the software is secure and easy. We also have mechanisms for helping whole institutions push out installations; interested parties should contact IBM via the “About Us” form within the “Become a Partner” section of the World Community Grid website.

Once the United Devices or open source BOINC client is installed, whether on Windows, Macintosh or Linux, the next step is to attach your client to HPF2 by typing in the following project URL when prompted: www.worldcommunitygrid.org/projects_showcase/viewHpf2Research.do. If you wish, you can also join a team by creating your own or selecting an existing one, the New York University team, for example. Another Grid project of note is working to dock small molecules into HIV protein structures in a search for possible new HIV drugs. I encourage anyone reading this article to convince multiple friends to download the client, as well!

For more information about the Human Proteome Folding Project, select the project name from the list in the “Research” section of the World Community Grid website: www.worldcommunitygrid.org/.

Dr. Richard Bonneau recently joined NYU’s Departments of Biology and Computer Science as part of a joint initiative of Computation in Science and Society and NYU’s Center for Comparative Functional Genomics. He has played a critical role in the development and deployment of Rosetta, the state-of-the-art protein-folding program described in this article. See http://cs.nyu.edu/~bonneau/ for more about Dr. Bonneau’s research efforts.
**e-Books & Digital Images for Teaching & Research**

By Tom McNulty
tom.mcnulty@nyu.edu

**EBRARY**
For decades, researchers have had access to an ever-growing body of digitized periodical literature (newspapers, magazines, and journals) and reference works. Articles in these publications generally have one thing in common: they are short. Rarely does one read a reference work or a complete journal volume cover-to-cover; rather, readers select those portions that pertain to the research question at hand. The traditional book, by contrast, typically is read cover-to-cover, which might account for its relatively late appearance in the digital world.

Librarians see in the electronic book (which is generally distributed online) an opportunity to solve some of the challenges facing the modern library—particularly, physical space constraints and the need for multiple copies of certain titles. The electronic book, or “e-book,” obviously has the benefit of requiring no shelf space, but, perhaps more importantly, numerous readers can simultaneously “check out” an e-book.

To facilitate an expansion of the NYU Libraries’ electronic text collection, we recently introduced ebrary, an interactive, keyword-searchable collection of books that cover all academic subjects. ebrary includes over 30,000 titles from more than 200 of the world’s leading publishers. Individual titles are included in BobCat, the Library’s online catalog.

ebrary does more than simply offer digital versions of traditional books. Using this dynamic system, researchers can create a personal bookshelf, highlight text, add bookmarks, and easily perform other advanced functions. In addition, ebrary’s highly innovative InfoTools allow the researcher to select individual terms and define, explain, or translate them, among other options. Faculty members can even create links to selected chapters in NYU Blackboard (see inset, p. 19).

To facilitate an expansion of the NYU Libraries’ electronic text collection, we recently introduced ebrary, an interactive, keyword-searchable collection of books that cover all academic subjects. ebrary includes over 30,000 titles from more than 200 of the world’s leading publishers. Individual titles are included in BobCat, the Library’s online catalog.

**DIGITAL IMAGES FOR TEACHING & RESEARCH**
While ebrary serves the need for convenient access to e-books, there is also a growing demand at NYU for convenient access to digital image collections. The need for images of works of art, buildings, monuments, and the like was once restricted to art departments, but today it is not uncommon for faculty and students across the curriculum to incorporate images into their teaching and research.

To serve the image needs of the entire University, the Library maintains a subscription to ARTstor—an online image database composed of hundreds of thousands of images, accompanied by descriptive metadata.
Recognizing the fact that no single source can be expected to satisfy everyone’s visual imagery needs, the Library has recently entered into an agreement with ARTstor to host the University’s local collections. A recent addition is the entire Saskia archive, which offers very high quality images of two and three dimensional works of art and the “built environment.” ARTstor provides access to a very large—and growing—collection of visual images through a powerful interface and the Offline Image Viewer.

Many researchers have personal collections of digital imagery. ARTstor has initiated a “personal collections” feature that provides registered individuals with 1000 MB of space for their own digital collections.

To find out more about ARTstor and the NYU Digital Image Collection, browse the ARTstor website at https://ezproxy.library.nyu.edu/login?url=www.artstor.org (also accessible via the Libraries website in the Articles Via Databases section: http://library.nyu.edu/collections/find_articles_title.htm).

Anyone with an active NYU NetID and password may become a registered ARTstor user. Faculty who wish to request instructor privileges should contact Tom McNulty at tom.mcnulty@nyu.edu or 212-998-2519.

[Please also see Greg Schnese’s related article (page 28) on managing digital images with Luna Insight, a suite of tools available University-wide.]

Tom McNulty is the Librarian for Fine Arts at NYU’s Bobst Library.

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1. The phrase “built environment” refers to architecture, landscapes, and other surroundings that are created by humans.
The Digital Studio is a new collaborative facility of the Libraries and Information Technology Services. It is the gateway for NYU faculty to digital services supporting scholarship and teaching. Studio staff offer training, consultation, and assistance with: NYU Blackboard; text scanning, PDF creation, and Optical Character Recognition (OCR); image scanning (including film, slides, and transparencies) and image editing; digital video and audio creation, conversion, and editing; DVD authoring; standards and best practices for digitization; metadata; digital project planning; video conferencing services; streaming services; and primary text collections available online and at the Digital Studio. As described below, our facility boasts the latest software and hardware for digitizing media.

**AUDIO/VISUAL**
The Studio’s digital video stations (below, left) allow instructors to capture video clips from various sources—VHS, DVD, mini DV, Laser Disc—and edit them as needed. The results can be encoded to various formats (including Real, QuickTime, and Windows Media), which can be delivered on the Web via streaming media or download, or on DVD. Instructors can capture audio from cassette, digital audio tape (DAT), or phonograph records. They can then use the audio workstations (below, center) to edit their files, encode them to various formats, including AIFF, WAVE, and MP3, and save them to CD or other media.

**DOCUMENT & IMAGE MANAGEMENT**
Automatic document feeders at the Studio provide a quick and simple method to scan text. Instructors can then save the image that is generated as an electronic PDF or, by using OCR software, convert the image into a digital text document for editing. Several flatbed scanners can be reserved for scanning images or transparencies. The Studio also has a large format flatbed scanner for handling materials up to 12” x 17” and slide scanners with automatic slide feeders (below, right).

**BLACKBOARD SUPPORT**
Faculty who need in-person training using NYU Blackboard can fill out the online help form at www.nyu.edu/blackboard/help/ and select “Instructor and Training” from the pull-down menu. Studio staff will then contact instructors to arrange a training session.

**CONTACT INFORMATION**
The Digital Studio is located in Bobst Library (70 Washington Square South) on the 2nd floor, east wing, and is open from Monday through Friday, 11am to 5pm. To make a reservation to use Digital Studio resources, please fill out our online reservation request form and Digital Studio staff will contact you during regular business hours: www.nyu.edu/its/studio/appointments.php. For more information, please visit www.nyu.edu/studio/ or call 212-992-9233.

Richard Malenitza and Jennifer Vinopal are Co-Managers of the Digital Studio.
As computers become increasingly integrated into our daily lives, the technology that enables them to communicate back to the world becomes ever more advanced. Computer monitors and printers, typical output devices, are limited in their utility and are only capable of creating impressions of the physical world around them. As technology evolves, however, the computer will do more than just represent and calculate ideas or objects; it will build them as well. In fact, the time when your home computer can be used to construct the desk lamp that it sits next to is already here, and the technology that accomplishes this is part of a burgeoning set of technologies known as rapid prototyping (RP).

Although the technology to translate computer data into physical models has existed since the 80s, it has only recently evolved to a level that doesn’t require specialized technicians to operate. Traditionally, RP technology had been reserved for the aerospace industry and the military, but today’s RP equipment is often used by small design and architecture firms to create models, by scientists for visualization, by doctors for implants and prostheses, as well as by artists for sculptures. In the future, RP machines will likely find their way into our homes and will operate in much the same fashion as our current home printer.

**NOMENCLATURE OF RAPID PROTOTYPING**
Rapid prototyping, as it’s most popularly known, is more accurately described as solid freeform fabrication (SFF) and is defined as “a technique for manufacturing solid objects by the sequential delivery of energy and/or material to specified points in space to produce that solid.” Rapid prototyping is not always as rapid as some might imagine—NYU’s Spectrum Z510 three-dimensional printer, for instance, sometimes requires six to seven hours to build an object (though this is often significantly less time than it would take to craft the object by hand)—nor is it used solely for prototyping, as the object is sometimes the final product or piece of art.

Three dimensional printing is one amongst a number of subsets of RP technologies, such as stereolithography (SLA) and selective laser sintering (SLS). In 3D printing, a computer program divides a model into cross sections, which are then built with many layers of powder selectively bonded by a liquid adhesive that is precisely dispensed from an inkjet printhead.

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THE PHYSICAL MODEL

NYU’s ZCorp Spectrum Z510 builds parts from a proprietary plaster-based powder in layers of a few thousandths of an inch thick. Each layer of powder is spread across a piston-supported bed, and is lowered with each pass and then sprayed with binder using traditional inkjet printheads. Binder is applied to the areas of the cross section that are solid—any areas that are left dry will remain as loose powder that will support the model as it’s built but must be removed when the process is completed. The build bed of the Z510 is 10” x 14” and can extend to a depth of 8”, thus is capable of building parts within a 10” x 14” x 8” envelope.

The premier feature of the Z510, however, is its ability to print objects in full color—a feature that is unique among other RP technologies. Parts can be printed with textual labels, colored surfaces, or even with photo-based textures. Also of note is the ability of the Z510 to build models with moving parts. Because parts are separated by loose powder, they can be built up against other parts without joining, so that, for instance, gears can be built onto axles that connect to other gears and axles and form a functioning machine.

THE VIRTUAL MODEL

Before a physical model can be produced on a 3D printer, a virtual computer model must be assembled. Traditionally, computer models destined for rapid prototyping came from computer aided design (CAD) software programs and were usually designed by engineers. At the time, 3D modeling software typically described only surfaces, and did not define the space inside an object any differently from the space outside the object. The complex task of building water-tight models—capable of differentiating inside from outside space—from accurately stitched and oriented surfaces required the skill of a highly trained specialist. Luckily, today’s more user friendly 3D programs and the Z510’s advanced ability to interpolate solid space from geometric surface data have empowered less experienced designers to generate 3D files and build physical parts.

Rapid prototyping systems will not directly print from a 3D program’s native file format. They must first be converted to a triangulated file format, such as STL (Stereo-Lithography) or VRML (Virtual Reality Modeling Language), in which surface geometry is broken down into 2D triangles. Almost all 3D programs have such a feature or will accept a plug-in to perform the conversion. The VRML file format is required when preserving color or texture along with the geometry of the original model, while STL is a geometry-only file format. Neither of these formats, however, preserves the scale of the original model. Scale and orientation within the bed are assigned when the triangulated file is brought into ZCorp’s 3D printing software. Additionally, the printer’s software is used to perform some basic automatic as well as manual
This fall marks the completion of the ITS Advanced Media Studio facility at 35 West 4th Street, within the ITS Multimedia Lab on the second floor (the same location as our previous incarnation as the ITS Arts Technology Group). The space has been significantly expanded and renovated, providing new workstations and self-service equipment, as well as a revamped drop-off Wide-Format Archival Print Service and Rapid Prototyping Service. These state-of-the-art facilities are available to all NYU faculty, as well as students enrolled in any of NYU’s fine arts programs.

The overhauled Wide-Format Archival Print Service now includes three Epson wide-format archival printers printing at 2880 dpi on over a dozen high quality fine art paper stocks, including premium papers selected from among Europe’s finest paper makers. These printers feature the Epson 8-color UltraChrome K3™ ink technology, producing prints that yield higher color gamut than traditional silver-halide prints and with archival ratings of over 100 years.

The AMS’ Universal X2-660 Laser System cuts and etches a variety of materials from digital plan files. A fine laser beam and highly accurate X/Y plotter mechanism achieves highly detailed cuts and etchings across an 18” x 32” laser bed on materials including acrylic plastic, wood, paper, fabrics, and treated metals.

The Rapid Prototyping Service features a ZCorp Z510 3D printer capable of building full color physical models in plaster powder from 3D computer-generated model files (see accompanying article).

The expanded AMS self-service facility includes three new Epson 4800 17” width archival printers set up for both matte paper and photo paper printing, using the same Epson UltraChrome K3™ ink technology used by the Wide-Format Archival Print Service. Printers are driven by the ColorBurst X-Proof RIP program, delivering far superior print quality and control when compared with the standard Epson print driver.

To complement the Studio’s commitment to high-end output, two Imacon virtual drum scanners are available for self-service use. Both scanners provide fast scanning of film up to 4” x 5” with resolutions reaching 8000 dpi. Also available are two 3D modeling stations and a Lasergraphics film recorder for outputting digital files to traditional photographic film. All workstations are equipped with professional grade color management screens, which are calibrated on a weekly basis to provide color consistency from scan to screen to print.

To learn more about the Advanced Media Studio’s services and facilities, visit the AMS website at www.nyu.edu/its/ams/, or send email to ams@nyu.edu.
The System Administration Services (SAS) group within ITS’ Communications & Computing Services has, in recent years, been faced with the challenge of managing a burgeoning server farm in a finite amount of space, while also striving to meet the explosive growth in demand for new applications and services from the NYU community. That challenge is being addressed in two phases.

**PHASE I: BLADE SERVERS, DYNAMIC STORAGE & BETTER BACKUPS**

In the first phase, which took place over the past year, SAS transitioned the large farm of servers that it manages for various key departments at NYU from a collection of stand-alone and rack-mounted servers to IBM Blade Server technology. Blade Servers are slim units that fit in a single chassis and can be replaced while the computer is operating (known as “hot-swappable”). Each unit is an independent server with its own complement of processors, memory, local storage, network controllers, operating system, and applications. A Blade Server simply slides into a bay within the chassis, like a book in a bookshelf, and plugs into a mid- or backplane, sharing power, fans, floppy drives, switches, and ports with other Blade Servers.

As part of this transition to Blade Servers, the provisioning of disk storage for our managed servers changed significantly. In place of isolated pools of storage allocated to individual servers, ITS put in place a storage area network (or SAN) to which all the Blade Servers are attached. Storage for all ITS Blade-based systems is now provided centrally from a new IBM FastT DS4500 SAN-based shared disk storage array. The move to SAN-based storage not only allows us to more efficiently manage space, but provides our clients with the capability of increasing storage on demand—no further need to worry if your server has enough space to meet your expanding storage needs.

In parallel with the move to Blade Servers and SAN-based storage, SAS has consolidated the backups of all of its managed servers onto the same centralized system that is used to back up all of the ITS-managed “mission critical” systems. Since we adopted this approach, the amount of time it takes to back up the ITS-managed servers has been greatly reduced.

**PHASE II: VIRTUALIZATION**

As important as this first phase has been, it is in a sense only the groundwork for what is to come. In the second phase, which began this past summer, SAS is beginning the implementation of a suite of products from EMC/VMWare that will enable hardware “virtualization,” a process that decouples the physical hardware from the operating system to deliver greater IT resource utilization and flexibility.

Virtualization enables the partitioning of a physical server into one or more “virtual machines.” Each of these machines has its own set of virtual hardware (e.g., RAM, CPU, NIC) upon which an operating system and applications are loaded and run. The operating system sees a consistent, normalized set of hardware regardless of the actual physical hardware components. Virtual machines are encapsulated into files, making it possible to rapidly save, copy, and provision them. Full systems (including

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1. A server farm is a group of networked computers housed in one location and designed to streamline computing processes by distributing work among the various computers (servers).
2. A “backplane” is a circuit board that links several connectors in parallel with each other, forming a computer bus. It is used as a backbone to connect several printed circuit board cards together to make up a complete computer system. (Wikipedia, [http://wikipedia.org/wiki/Backplane](http://wikipedia.org/wiki/Backplane))
3. Random Access Memory, Central Processing Unit, and Network Interface Card, respectively.
fully configured applications, operating systems, Basic Input/Output Systems [BIOS], and virtual hardware can be moved, within seconds, from one physical server to another for zero-downtime maintenance and continuous workload consolidation.

In the virtualized environment being implemented by ITS, hardware management is completely separated from software management, and hardware equipment can be treated as a single pool of processing, storage, and networking power to be allocated and de-allocated on the fly to various software services. Through all of this, ITS clients who use the new virtual infrastructure will still experience resources as if they were dedicated to them, and will continue to enjoy the same high level of performance and reliability they are accustomed to receiving from ITS (with a few added benefits, as described below). On the ITS side, however, we will have the flexibility of operating services in an expandable pool of resources that can be managed globally across the University.

Most important for our clients, the move to a “virtual infrastructure” will enable ITS to offer services that were not possible before. A virtual server can be tailored precisely to the requirements of an application without the need to over-provision memory in anticipation of possible future needs. Should a virtual server require a memory upgrade, all that needs to be done is to shut the server down, change a setting in the virtual machine definition that governs the amount of memory assigned to the system, and restart the server. Further, the virtual hardware presented by a virtual server remains the same no matter how the underlying physical hardware changes. This will make it possible for a client’s “system” to be upgraded to faster, more powerful hardware without the headaches of moving the system to a new hardware platform.

With virtual machines, the testing of new applications destined for production becomes greatly simplified—once licensing issues with the applications are worked out, all that is needed is to shut down the virtual machine and copy the files. Testing new applications can then proceed (with some minimal reconfiguration of the copy), using a fully functional image of the production environment as of the time that the copy was created. This will give SAS the ability to offer either permanent or transient test environments “on demand” to those clients who need it.

The combination of Blade Servers, consolidated storage and backups, and the move to a virtual infrastructure will allow SAS to offer the NYU community a platform for its applications that is flexible, extensible, and as cost effective as possible. For more information about the services provided by ITS Systems Administration Services, contact the ITS Client Services Center at 212-998-3333.

Sherif Samaan is the Manager of LAN Services in ITS’ Communications & Computing Services.

CORRECTION

Correction of any problem areas in the file, such as overlapping vertices, aligned and unconnected surfaces, and inverted normals.\(^3\)

THE ADVANCED MEDIA STUDIO

The Advanced Media Studio (AMS), located at 35 West 4th Street on the 2nd floor, provides three dimensional printing services to all faculty, students of the arts, and visiting artists with approved project proposals (see p. 23). The AMS also offers access to a suite of 3D modeling programs, including sophisticated CAD packages such as: Form•Z, SolidWorks, and Cobalt; the NURBS modeling software Rhino; the 3D animation-oriented package Maya; Mathematica and MATLAB; and SketchUp, an easy-to-learn, conceptually-based 3D modeling program. Clients interested in using this service should note that file inspection and correction is their responsibility, and will involve learning ZCorp’s ZPrint software.

For more information about 3D printing services at the ITS Advanced Media Studio, visit www.nyu.edu/its/ams/, or send email to its.rp@nyu.edu.

Alex Gibbons is a Faculty Technology Specialist at the Advanced Media Studio for ITS’ .edu Services.

\(^3\) A “normal” is a 3D vector that is perpendicular to a flat surface. (Wikipedia, http://en.wikipedia.org/wiki/Surface_normal)

**Figure 4. Sculptural shapes generated by the Z510 printer.**
WHAT IS INSTANT MESSAGING (IM)?
Instant Messaging, or IM, is one of many online communication methods available today. Unlike email or message boards, however, it allows people to communicate with each other synchronously. IM works via a downloadable piece of software that allows users to see if their friends are online; send them a real-time message or share files; and, with the newest versions, even see and hear each other. IM is increasingly the preferred method of communication among students, and many commercial email providers like Yahoo! and Google, recognizing the demand, have bundled IM into their programs and even added functionality for mobile devices like cell phones and PDAs. IM is not a new technology, but it is quickly evolving, and its potential benefits for academia are just beginning to be explored.

HOW IS BOBST LIBRARY USING IM?
In the fall of 2005, a group of librarians at NYU’s Bobst Library hatched a plan to start a synchronous question-answering service using IM technology. There had recently been a resurgence in libraries’ use of IM technology to deliver reference service, and we too wanted to reach out to those individuals who had adopted this technology as their communication mode of choice. We decided to implement a service prototype, and selected a third party IM aggregator product called Trillian to deliver the service. This aggregator allows patrons to reach us regardless of which of the three major IM services—AIM, Yahoo! Messenger, or MSN Messenger—they use. Open source and free for download, Trillian simply acts as a single portal that creates three conduits to the major services, allowing patrons to add the NYU service to their “buddy list” (address book) regardless of their own choice of software.

Anyone serving as the IM librarian at a given time uses the same screen name (“AskBobst”) and the recognizable NYU torch logo, so, once a person adds us to their buddy list, our screen name appears in their IM program whenever one of us is logged in, ready to help him or her when the need arises.

While our IM service was in the initial pilot phase, we decided to limit the amount of overt advertising we did, and we started by just adding a link on our Ask-A-Librarian web page to see what kind of traffic it would generate (see figure, below). As the service evolved, we began to encourage use of the service in the Library’s instruction sessions, mentioning our AskBobst screen name and highlighting the speed and convenience of the service. We also added it to the news banner at the top of the Library homepage. Lastly, we wanted to make sure all of our librarians, even those who were not participating in our pilot project, knew about the service, so we highlighted

The “AskBobst” IM link on the Ask-A-Librarian web page (http://library.nyu.edu/ask/).
it for our own community in open houses and meetings.

**HOW HAS THE SERVICE BEEN RECEIVED?**

So what did our initial users think of the service? After all, the major impetus for the service was to reach NYU community members at their “point of need” via a familiar communication medium. On a deeper level, we also wanted to see how this technology could be deployed to help us meet our educational mission of creating solid, “information-fluent” users and to see if IM could augment our physical services and reach out to people who might not come in to the library. We developed an easy-to-use statistical web form to track the use of the system, as well as any interesting comments that users made during IM interactions. Through this data we have been able to get a good preliminary picture of the use of the service.

One of the first things that became apparent in reviewing these statistics was that adoption of the AskBobst service was relatively fast. We logged nearly 15 chat sessions by the second week, with no advertising and only the small mention on the Ask-A-Librarian page. The service grew noticeably as the semesters passed, and it became common to receive 25-30 queries in a week. We also immediately discerned that the statistics closely corresponded with milestones in the semester, with slight upswings during the midterm and final paper seasons, and precipitous downturns during the Thanksgiving, Winter, and Spring Breaks (see figure, above).

25-30 questions per week is not a massive result, to be sure, but over two semesters of activity, they account for slightly more than 500 reference transactions. There is no clear way to know how likely these patrons would have been to use another form of contact with us, but it stands to reason that at least some of them were drawn to the service because of the medium. Indeed, some of the user reactions seem to bear this out, with comments like: “by the way, I think this is a great system. Really convenient;” “it’s actually really cool that NYU has this service;” and “so nifty…this is great, thanks!” Further cementing this impression is the high number of repeat customers. Librarians have reported receiving multiple queries from a patron over the course of a semester, and because they have added us to their IM “buddy” lists, people appear to be enjoying the ease with which they can return to us for help. Analogous to the tech-help buddy that comes preinstalled in many IM programs, AskBobst gives them a go-to resource for research help.

Whether this service facilitates our educational mission is harder to measure, but two things lead us to believe that it is making a contribution. The first is the nature of the interactions. Where we originally expected that patrons would take advantage of the service to ask quick questions, it has turned out that very often the interactions take significant amounts of time, as librarians help people who are in the middle of doing their research. Many of the sessions involve librarians giving complex instructions about the use and evaluation of information-finding tools, a key skill to possess in the networked world. The second indication was the positive impression of the librarians who staff the service; they noted that they felt better able to promote core information competencies over this medium as compared to email. The longer interactions and dynamic nature of the give and take between librarian and patron has provided us with a service platform that more closely mirrors our traditional physical services. These positive signs speak to the potential power of using IM to promote better information fluency in the library.

**WHAT’S NEXT?**

Our experiences have convinced us that IM is a worthwhile and relatively durable service option, so we will continue to expand on our marketing efforts to further increase its visibility. Based on our positive experience, we think that readers should consider whether they too could make use of this technology in larger educational settings. For instance, how would students react to being able to attend office hours with their professor via IM? How might students’ collaborative work evolve differently if there were an IM component built into course projects from the start? How might students take advantage of the technology to create innovative text, audio, and video presentations or performances? How could IM conferencing options be used to extend the physical classroom?

These are only a few of the many possibilities, and all are simple and reliably available in the current generation of IM; future iterations will no doubt create even broader opportunities. Even setting aside how enamored of IM many students are, there are plenty of good reasons to think about what IM could do for you.

Scott Collard is the Librarian for Psychology & Education at NYU’s Bobst Library. Kara Whatley is the Life Sciences Librarian at NYU’s Bobst Library.
University art departments are undergoing radical changes as digital media gains popularity, raising questions about how best to store and manage growing digital collections. At NYU, we have selected Luna Insight as a promising solution. Insight is a computer program that allows individuals, departments, and institutions to store, manage, and display their digital media. This article briefly describes how Insight works, and how it is being implemented at NYU.

Recognizing the gradual shift from analog (non-electronic) media to digital media in the art history field, NYU’s Department of Fine Arts (DFA) began investigating and evaluating potential software solutions, with the goal of ensuring a smooth transition. In 2002, the DFA selected Insight as their preferred solution and installed it on their departmental server. Thomaï Serdari and Tim Donehoo worked with Luna Imaging to create the DFA’s collection. Due to the success of Insight at the DFA, it was presented to the Digital Image Resource Initiative (DIRI), which focuses on the creation of new digital solutions for departments at NYU. The DIRI committee consists of members from the Institute of Fine Arts (IFA), Department of Fine Arts, Information Technology Services (ITS), and Bobst Library.

Insight is part of a four-program suite created by Los Angeles-based Luna Imaging. This suite comprises Insight, Inscribe, Studio, and Administrator Tools. Insight is used at NYU by students, professors, and staff members to view digital images, and is accessible via a Java client or a web browser. Inscribe and Studio allow staff members to upload digital media and data. The final program, Administrator Tools, is used to manage the database itself.

One of the major benefits of Insight is that it not only replicates, using digital media, the traditional side-by-side comparison of images, but also provides several enhanced features (described below). For the individual, Insight makes access to images easy and robust. Departments can manage and grow their own collections, edit information, and display links to outside sources. Institutions may also share their collections with other institutions. The Insight interface allows you to browse image collections at a glance.

Figure 1. The Insight interface allows you to browse image collections at a glance.
information with other departments and institutions.

**IMPLEMENTING INSIGHT**
As described above, the DFA was the first department to begin using Insight at NYU. The success of that collection attracted the attention of NYU’s Institute of Fine Arts, and, as the IFA and DFA have similar collection requirements, it was easily determined that Insight would be a good solution to implement at the IFA, as well.

To support multiple departments, however, a more robust server and additional technical support were required. The eServices department within ITS agreed to host and monitor a new Insight server, as well as back-end software (Oracle) with enough power and memory to support many NYU departments.

With the hardware requirements covered, proper management was now required in order to support the departments. Towards this end, a new position, Digital Collections Assistant, was created to act as a liaison between the IFA, DFA, and ITS. Each department was responsible for developing a workflow that was best suited for their faculty and students. The Digital Collections Assistant supports each department, to ensure that their collections are maintained and available.

The availability of a central Insight server and the success of the joint effort of IFA, DFA, and ITS have encouraged more departments to begin using Insight. The most recent adopters are the Department of Photography and the Imaging Department at the Tisch School of the Arts. It is currently being used for several individual projects, as well.

**BENEFITS & APPLICATIONS**
Insight is a key tool for assisting instructors as they bring digital media into the classroom. It provides a long list of improvements over analog media displays. Faculty can create a slideshow in Insight that not only mimics the traditional technique of side-by-side comparison, but also provides a variety of enhancements not previously available. For instance, instead of being limited to the use of static slides to show a few details of a piece of art, instructors will now be able to zoom-in and pan across images on the fly, enabling the extraction of additional information from the image.

In addition, metadata (descriptive information) associated with each

Continued on p. 36 >>
In this period of rapid technological change, research and communication systems are being transformed and, with them, the process of creating scholarly content. This process is increasingly collaborative, producing new knowledge in dynamic, mobile, and open environments. And each year, more and more scholarship has a digital component or is composed entirely of digital content.

How does one safeguard this scholarship for the future while making it available to the wider world? In the past, individuals or their departments have attempted to do this on their own by posting their work on departmental web servers, but this approach often leads to problems. For example, links to web pages are unstable, changing as documents are moved on the server; servers may not be backed up properly or at all; and the quantity of material may become unmanageable or outgrow the space on the server.

To address this challenge, NYU Libraries and ITS are preparing to implement a digital archive for NYU faculty. Also known as an institutional repository, a digital archive is “a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members.”

A faculty digital archive can provide access to an institution’s research through a single Internet access point. In it, scholars can store many different kinds of digital content, such as digital texts, audio, video, images, and datasets. This versatility allows for the integration of multiple files and formats, so that faculty are able to associate research data, slides, and supporting files with papers.

The centralized framework of a digital archive allows scholars and departments to reliably archive their work without having to concern themselves with the technology and its administration, freeing them to focus on their academic goals. Because the content in a faculty digital archive can, if the depositor wishes, be made accessible to the world, it can increase the visibility of a scholar’s work while providing a permanent link for citation. Scholars can therefore use the digital archive to quickly “pre-publish” materials, either to the world at large, or to a select group of colleagues for collaboration.

Panagiotis Ipeirotis, an Assistant Professor in the Department of Information, Operations, and Management Sciences at the Leonard N. Stern School of Business, is an example of an NYU scholar who has begun to use the pilot Faculty Digital Archive. Working with NYU’s digital library team, Dr. Ipeirotis has indexed content from more than 26 years of Stern research by both faculty and students, concentrated in the area of Information Systems. While most early papers have been published in scholarly, peer-reviewed journals, the most recent works are at various stages of publication.

Making preprint papers available to others, including faculty, students, and research affiliates, is an important part of knowledge creation. In addition, placing content within the Faculty Digital Archive typically raises its visibility in Internet search engine results. The trend toward preprint availability is increasingly common among faculty at most universities. Many faculty are also interested in seeing their papers available on such sites as Google Scholar (http://scholar.google.com/), and storing their research in the faculty digital archive will ensure that links to these materials will remain active over the years.

Additional information about NYU’s new Faculty Digital Archive will appear at http://archive.nyu.edu once the pilot phase is complete.

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NYU’s commitment to academic research has placed increasing demands on NYU-NET, the campus network, to facilitate high-speed access to a variety of resources, including: rich volumes of data sets, high performance compute grids, national laboratories and external research institutions, partner universities, and dedicated research networks. Since 1997, the University’s primary access to such destinations has been our 200 megabits per second (Mbps) connection to the Internet2 Abilene research network (commonly known simply as Internet2). Recently, however, a number of new research networks have been developed, and over the summer, NYU-NET connections were established to several of them. The means by which these connections have been established is new to our network and may present novel network capabilities in the future.

These new research networks have been established primarily to meet a need for access to resources via higher network performance than is conventionally possible with an Internet2 connection. Such resources may require that hundreds of Mbps be dedicated to data transfers to a university campus. In some cases, where very high bandwidth and/or low latency is required, one Gigabit per second (1 Gbps) of bandwidth or more may be called for. (At a data rate of 1 Gbps, the contents of a full CD-worth of data will be transferred in just over five seconds.) Invariably, connections that take place over long distances require fiber optic cable links, which can be costly to implement, and fiber optic cabling between two facilities may not necessarily be in ample supply from intermediate service providers. Technologies such as Wave Division Multiplexing (WDM), however, can improve the utility and capacity of a single fiber optic cable link significantly.

Traditionally, a network communications signal is transmitted between two network devices as a wavelength of laser light over a pair of fiber optic strands (one fiber strand for receiving signal, and the other for transmitting), commonly referred to as a single “fiber optic cable.” The signal “carrier” itself is maintained by rapidly modulating the transmitted light; one common example of this technique is to vary the intensity of the light in a manner which represents a series of binary 0’s and 1’s sent to the receiver. This approach, however, limits a fiber cable to a single network connection and doesn’t offer significant capacity, especially over long distance fiber optic links. Wave Division Multiplexing (WDM), however, addresses this need by transmitting a “rainbow” of colors of light simultaneously on the fiber. Each color of the WDM rainbow is infrared light at a different wavelength, and is able to carry communications independent from all other colors within that rainbow by modulating each wavelength independently. Consequently, the application of WDM enables many network connections, such as connections to Internet Service Providers, external research institutions, video service providers, and telecommunications carriers, to take place simultaneously all over a single fiber optic cable.

Wave Division Multiplexing technology is available in two flavors: Dense WDM (DWDM) and Coarse WDM (CWDM). The primary distinction between the two lies in the characteristics of the optical signal used to provide the communications channels. Each channel corresponds to a different wavelength (color) used by the WDM system. In DWDM, the channels are densely packed to offer a greater number over a single fiber optic connection, while in CWDM many fewer channels are available. For example, DWDM systems available today can offer 128 simultaneous channels, while CWDM is usually limited to 8 or 16. CWDM

1. A compute grid is an interconnected group of computers that act as one. See “Global Grid Computing at NYU” by Richard Bonneau on p. 2 for more information about high performance compute grids.

2. Latency refers to the amount of time it takes a packet of data to move across a network connection.
is commonly used for inter-building or intra-city networks over short distances (one to two kilometers, typically) and with limited bandwidth capacity. DWDM systems, however, make more efficient use of fiber optic cabling and can deliver much more bandwidth. This is often achieved over very long distances (tens of kilometers or more) and can be accomplished as a network in the form of a ring, where a single break in the fiber cabling system will not disrupt communications; data will simply traverse the network to its destination via the opposite and unbroken path. As might be expected, DWDM systems are more costly to implement due to the complexity and intelligence of the devices involved.

DWDM networks are becoming a standard component of network support for research that has need for high performance communications, computing, and data storage. National networks that focus on supporting research and education (R&E) by interconnecting universities, research institutions, and government research laboratories are using DWDM as an enabler, providing institutions with high-bandwidth access to network-based resources through the reduced consumption of costly transcontinental fiber. Both National Lambda Rail (www.nlr.net) and Internet2 (www.internet2.edu) have built high-speed networks that span the United States and provide high-speed connectivity to Regional Optical Networks (RONs), such as NYSENet (the RON for New York State), CENIC, and Merit.

The various RONs, in turn, support R&E networking within geographic regions of the U.S. by providing high-bandwidth connectivity to their subscriber institutions.

NYU and other New York State institutions, for example, traverse the NYSERNet network via its DWDM infrastructure. This connectivity offers high-bandwidth access to other NYSENet subscribers and large-scale research networks such as Internet2, ESnet (the U.S. Department of Energy’s Energy Sciences Network; www.es.net), and MANLAN (the Manhattan Landing network, where international research networks interconnect in NYC; http://networks.internet2.edu/manlan/).

Overall, DWDM technology is enabling service providers to offer an increasing variety of network services. The National Lambda Rail (NLR) currently has a DWDM service offering, called WaveNet, where a customer can purchase a “lambda” (i.e., a channel or wavelength of light) for dedicated communications between two NLR-accessible points within the United States. Internet2 recently announced its WaveCo service, which is a similar and competing lambda service offering. NLR’s PacketNet service, on the other hand, is a competitor with Internet2. Both are national networks which offer IP (Internet Protocol) connectivity between member institutions, essentially creating networks parallel to the Internet and fairly similar in function, although the NLR and Internet2 networks are currently used predominantly by research institutions. Internet2 has been in production service since 1999, and is quite mature, with a very large number of connected participants. PacketNet, on the other hand, is less than a year old, and adoption of the network is not yet widespread.

In parallel with PacketNet, NLR offers an additional service, called FrameNet, which is an Ethernet network that spans the United States. Unlike PacketNet, which has intervening NLR routers that negotiate traffic between organizations, FrameNet has no intervening routers; institutional routers can communicate with one another directly, thereby enabling inexpensive yet direct communications between

3. Information about CENIC, the Corporation for Education Network Initiatives in California, is available at www.cenic.org. Details about the Merit Network are available at www.merit.edu.
Institutions. Since FrameNet is a shared environment, however, the entire nation shares 10 Gbps of bandwidth, and performance issues may arise with its use.

Finally, Internet2 has recently embarked on the development of its second-generation network, called NewNet, which also relies heavily on DWDM. Though NewNet is different from the other services, a hallmark of all these networks is the provision of high-bandwidth network access for institutions at speeds as high as 10 Gbps. Through the adoption of hybrid network technology, NewNet represents a new approach to data networking. Pioneered by such research projects as Internet2’s HOPI, hybrid networking makes use of DWDM and IP technologies simultaneously, and in some cases, extends DWDM capabilities to individual users of the service. In a hybrid network, IP can be used as it conventionally is on the Internet today: email, web services, and network applications all function as they normally do. However, in such a network environment, IP can also be used to signal the optical network to create a point-to-point lambda to a particular destination on an on-demand basis. Similarly, when no longer needed, that lambda can be deactivated and the network resources made available again for the next application.

The applications that might make use of hybrid networks are those which require direct fiber optic communications between two endpoints, such as a processor interconnect between two compute grid nodes, a SAN (Storage Area Network) connection between disk storage systems in different locations, or delivery of an uncompressed high-definition digital video feed. It is noteworthy, however, that hybrid networking technology is still very much experimental and it is not yet clear whether hybrid will be the next evolutionary step in networking. In a hybrid environment, ultimately the applications drive the need; if applications emerge that cannot be adequately supported via IP technology, then a hybrid may present the solution. Hybrid networks, however, are very complex systems that require a great deal of planning and effort to implement, and the underlying control software and networking protocols are still fairly young technologies. Only a handful of hybrid networks have been deployed thus far, and NewNet will be the world’s largest endeavor to date. As ITS is a participant in the Internet2 NewNet design process, we will be following its progress and collaborating with other institutions with similar hybrid interests.

This past summer, high-speed network connections have been established from NYU-NET to a number of these new research networks. As described in the article “High Energy Physics & High Performance Technology Coming Together at NYU” on p. 7, a 1 Gbps link has been established to the USLHCNet network. USLHCNet was designed to support the computing needs of physicists participating in research activities at the CERN Physics Laboratory in Geneva, Switzerland, particularly the ATLAS and CMS projects. through the establishment of a high-speed network supporting the transmission of the vast amounts of data generated by those activities. As a result of this networking initiative, NYU now has 1 Gbps of dedicated network access to CERN.

Through a similar collaboration with the California Institute of Technology and CERN, ITS has also established a high-speed connection to the UltraLight network. UltraLight is a National Science Foundation-funded project designed to advance hybrid networks in support of the high-bandwidth needs of experimental physicists. The network is supported by much of the same staff and infrastructure that operates USLHCNet. The designers of Ultra-Light hope to use hybrid communications to further technologies such as compute grids, disk-to-disk communications for storage of large volumes of data across large distances, and applications that require brief periods of high-speed connectivity on an on-demand basis. UltraLight provides an environment for the development of systems, networking components, communications protocols, and software, all involved in hybrid network communications. Additionally, 1 Gbps connections have been established to the NLR FrameNet and PacketNet networks. Though still fledgling networks, they offer the potential for high-bandwidth connectivity to institutions at speeds that exceed our current performance levels using Internet2.

For the past few years, CWDM technology has been used at NYU to provide access to these and other network resources external to the University, where fiber optic cabling availability has been limited. This semester, that infrastructure is being upgraded to DWDM technology. The expectation is that this new service will support higher levels of external bandwidth, increased service reliability, greater capacity, and academic endeavors requiring access to these and future research networks.

For information about high performance computing at NYU, see www.nyu.edu/its/supercomputing/ or send email to hpc@nyu.edu.

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5. Additional information on HOPI is available at http://networks.internet2.edu/hopi/.
6. A processor interconnect is a connection between computers that enables their CPUs (Central Processing Units) to directly communicate with one another. This is often used in grid systems, where multiple computers are expected to act as one.
7. www.uslhcnet.com

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Jimmy Kyriannis is Senior Technology Architect in ITS Communications and Computing Services. High performance networking and computing are among his focus disciplines.
Secure Sockets Layer (SSL) is a protocol that helps ensure the privacy of documents transmitted over the Internet, including email messages. Once activated, SSL encrypts your incoming messages, ensuring that passwords and other private information cannot be intercepted in transit. If you use an email client other than NYUHome to check your NYU email, activating SSL is quick and easy, and ITS strongly recommends (and will soon require) that you do so as soon as possible.

Once you have configured your preferred email program to access your NYUHome email (see http://home.nyu.edu/help/mail/mailprograms.nyu) follow the instructions below to activate SSL. If you do not see your email client listed below, visit the ITS website for additional instructions: www.nyu.edu/its/email/ssl/.

**WINDOWS XP**

**Eudora 7**

1. Open Eudora, click the Tools menu, and select Options.
2. In the Options window that opens, select the Checking Mail category on the left. Then, on the right, open the pull-down menu below “Secure Sockets when Receiving” and select Required, Alternate Port.
3. Click OK to save the changes, then quit and restart Eudora to ensure that these settings take effect.

**Outlook Express 6**

1. Open Outlook Express and click the Inbox icon on the left to highlight it. Next, open the Tools menu and select Accounts...
2. In the Internet Accounts window that opens, select the Mail tab, then click Properties on the right.
3. In the Properties window that opens, click the Advanced tab. Under Incoming mail, check the box next to This server requires a secure connection (SSL). Do not check the similar box under “Outgoing mail (SMTP)”.
4. Click Apply, then OK. Click Close to exit the Internet Accounts window and save your settings. Quit and restart Outlook Express to ensure that these changes take effect.

**Thunderbird 1.5**

1. Open Thunderbird, select your inbox on the left, then open the Tools menu and select Account Settings...
2. In the Account Settings window that opens, select Server Settings from the options on the left, then, on the right, click the
Important Notes

* If you use the NYUHome email client, SSL has been automatically activated for your NYU email; you do not need to adjust any settings.
* Be sure you activate SSL only for your incoming mail, NOT your outgoing mail (SMTP).
* Make sure that the incoming mail server is set to mail.nyu.edu (NOT imap.nyu.edu, pop.nyu.edu or homemail.nyu.edu).
* Be sure that your email client uses IMAP (rather than POP). If you see Port 995 listed when you follow these instructions, you are using POP and should switch to IMAP. See your program’s help section for details.

MACINTOSH OS X

Thunderbird 1.5

1. Open Thunderbird, then open the Tools menu and select Account Settings...
2. In the window that opens, select Server Settings from the options on the left, then, on the right, click the radio button next to SSL. Do not check the “Use secure authentication” option.
3. Click OK to save the changes and close the window, then quit and restart Thunderbird to ensure that these changes take effect.

Eudora 6.2

Please note: Apple Keychain must be installed on your computer to complete these instructions. SSL is not supported for Mac OS 10.0 or 10.1.

1. Open Eudora, then open the Special menu and select Settings...
2. In the Settings window that opens, select SSL from the menu on the left. Then, in the Secure Settings section on the right, do not check the “Use secure authentication” option.

3. Click OK in both windows to save the changes, then quit and restart Thunderbird to ensure that these changes take effect.
image may be viewed at will (see figure 3). This adds significantly to the educational experience, as all of the collective information that has been recorded for the image will always be available.

One particularly helpful application of Insight has been as a study aid for students. Before Insight was available, websites created to assist students would enable them to view images from within their classes on the NYU Blackboard online course management system. This method, however, would only benefit the particular class with which the images were associated. Now, using Insight, groups of images and virtual collections can be created from existing collections. Insight is already proving to be wildly popular; one class in the Spring 2006 semester received over 22,000 individual logins!

To grow collections within supported departments, a faculty member may request that images be digitized and added to the database for a class. These images can then be arranged by lectures, allowing students to easily view the images at any time. The images are stored in the database, where they can be reused for other classes or for the same class.

NYU departments will enjoy the capability that Insight provides for easily customizing, growing, and backing up their collections. Using Insight, a department may choose to define a template that is customized to its needs. Insight’s versatility potentially broadens its usefulness to many departments, not just those that specialize in art history. Insight accepts a wide variety of digital media including images, audio, and video, with the most common being slide scans and digital photography. Each department that uses Insight can be confident that their collections are routinely backed up by ITS.

Insight is available for students, staff, and faculty to browse NYU’s image collections. To request an Insight account, please visit www.nyu.edu/luna/. For users or departments that wish to add media, please inquire by sending email to luna.help@nyu.edu.

[Please see the related news item on ARTstor, a collection of over 500,000 images for teaching and research, on page 18.]

Gregory Schnese manages NYU’s Insight collection through the Institute of Fine Arts and the Department of Fine Arts.

Apple Mail 1.3 & 2.1
1. Open Apple Mail, select your Inbox on the left, then select Preferences from the Mail drop-down menu.
2. In the window that opens, select Accounts at the top, then select the Advanced tab. Check the box next to Use SSL. Make sure that Password is selected in the Authentication menu.
3. Exit from the Preferences and save your settings, then quit and restart Apple Mail.

See www.nyu.edu/its/email/ssl/ for additional program instructions.
NYUHome v. 6 Coming Soon!

By Robert Brill & Amit Snyderman

A redesigned version of NYUHome will be released early in the Spring 2007 semester. Exciting new features will include:

- A redesigned login screen and seven deluxe new style themes (see screenshot at right for one example), offering amazing colors, beautiful photos, and useful icons, will be available in your Preferences section under “Your Style Theme.”

- The Library channel in the Research tab will offer a vastly improved interface for searching references, databases, and ejournals. In addition, look for the new Library Into quick reference, and Liblink blog.

- A new Student Health & Wellness channel on the NYU Life Tab will provide quick access to information about the Student Health Center, Student Health Insurance, the NYU Wellness Exchange, and much more.

- Expanded content will be available in the Computer Security Alerts and ITS News & Alerts channels on the Home and News tabs.

- All ITS-licensed software and accompanying instructions are now available for download from the ITS Software website: http://software.nyu.edu.

- And, thanks to a Summer 2006 hardware upgrade, NYUHome now offers significant improvements in response time!

Internet Explorer 7 — Tips & Troubleshooting

By Keith Allison

Starting in early November, Microsoft began distributing the latest version of its browser, Internet Explorer 7 (IE7), as a Critical Update via Windows Automatic Update. ITS began updating and testing NYU tools and applications as soon as IE7 was made available. Although current evaluations have not revealed any compatibility problems between IE7 and NYU services such as NYUHome, the Albert Student Information System, administrative applications, and other critical tools, please be aware that testing is still underway, and issues may be discovered as the evaluation progresses.

If you use Internet Explorer and have not updated your browser to the new version, ITS recommends that you continue to use IE6 for the time being. Once testing has been completed and ITS is confident that there are no outstanding complications with using IE7, alerts will be posted to the ITS News blog: www.nyu.edu/its/news/.

If you have already installed IE7, it is unlikely you will encounter any problems. However, if you do, you can remediate the situation by un installing IE7, reverting to IE6, and contacting the ITS Client Services Center (see below). To uninstall IE7:

1. Open the Start menu and select Control Panel.
2. Double-click Add/Remove Programs.
3. Look for “Windows Internet Explorer 7” in the list of programs, and click the Remove button next to it.
4. Follow the on-screen instructions.
5. Restart your computer.

If you need assistance or more information, please contact the ITS Client Services Center at 212-998-3333 or via the Ask ITS support area of NYUHome (available from the Home tab within NYUHome (http://home.nyu.edu).
Help Protect Your Email with SSL

Safer email is just a few clicks away! If you use an email program other than NYUHome to check your NYU Email, you should enable the Secure Sockets Layer (SSL) feature in your email program to help protect the privacy of your messages.

It’s easy to do, and very important.... Don’t delay, do it today! To learn how, see the article on page 34 of this issue.

For more advice on what you can do to help keep your computer and personal information secure, browse the ITS Computer & Network Security website: www.nyu.edu/its/security/.