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Fall 2003

Technology Branches Out to Many Fields of Study

New Tech Minor and Major Crop Up for Undergrads

Technology management is a valuable, if not vital skill for those in the science industries, and thanks to the UC Davis Graduate School of Management, it's now an undergraduate minor. The technology management minor (http://www.gsm.ucdavis.edu/techminor), which kicked off this fall with two new classes, is specifically designed for engineering, biological, and physical sciences majors to gain a business perspective of the disciplines they are studying. "The minor gives students an extra skill set in the business arena," says Holly Bishop-Green, the programming director for the undergraduate minor. "It provides them an extra context for the environment in which they will be working."

Mandeep Singh, a computer science major who had previously worked in the private sector and who recently changed his minor from economics to technology management, also notes the value of the project management skills that the minor emphasizes. "This minor has the potential to provide its students with a strong business edge," says Singh, who is taking both of the technology management classes offered this quarter. "It gives employers the option of picking a smart employee versus picking a smart employee who is also business savvy."

Michael Maher, one of Singh's professors, agrees. "There's no doubt they'll have a real leg-up when they go into the market," he says.

Singh happens to be a computer science major, but the tech management minor is open to students with majors in a variety of scientific disciplines. For example, exercise biology, food biochemistry, and geology majors are invited to apply, along with many others in the Colleges of Engineering, Biological Sciences, and Physical Sciences (see the tech minor Web site for a complete list of eligible majors).

Statistics show that about 40 to 50 percent of undergraduates — regardless of major — work in private industries at some point in their career, according to Paul Griffin, a professor and associate dean in the Graduate School of Management. Thus, the new minor benefits non-business students by providing them an understanding of the way private industry works. "Technology management is not just working with computers and building bridges," Griffin says.

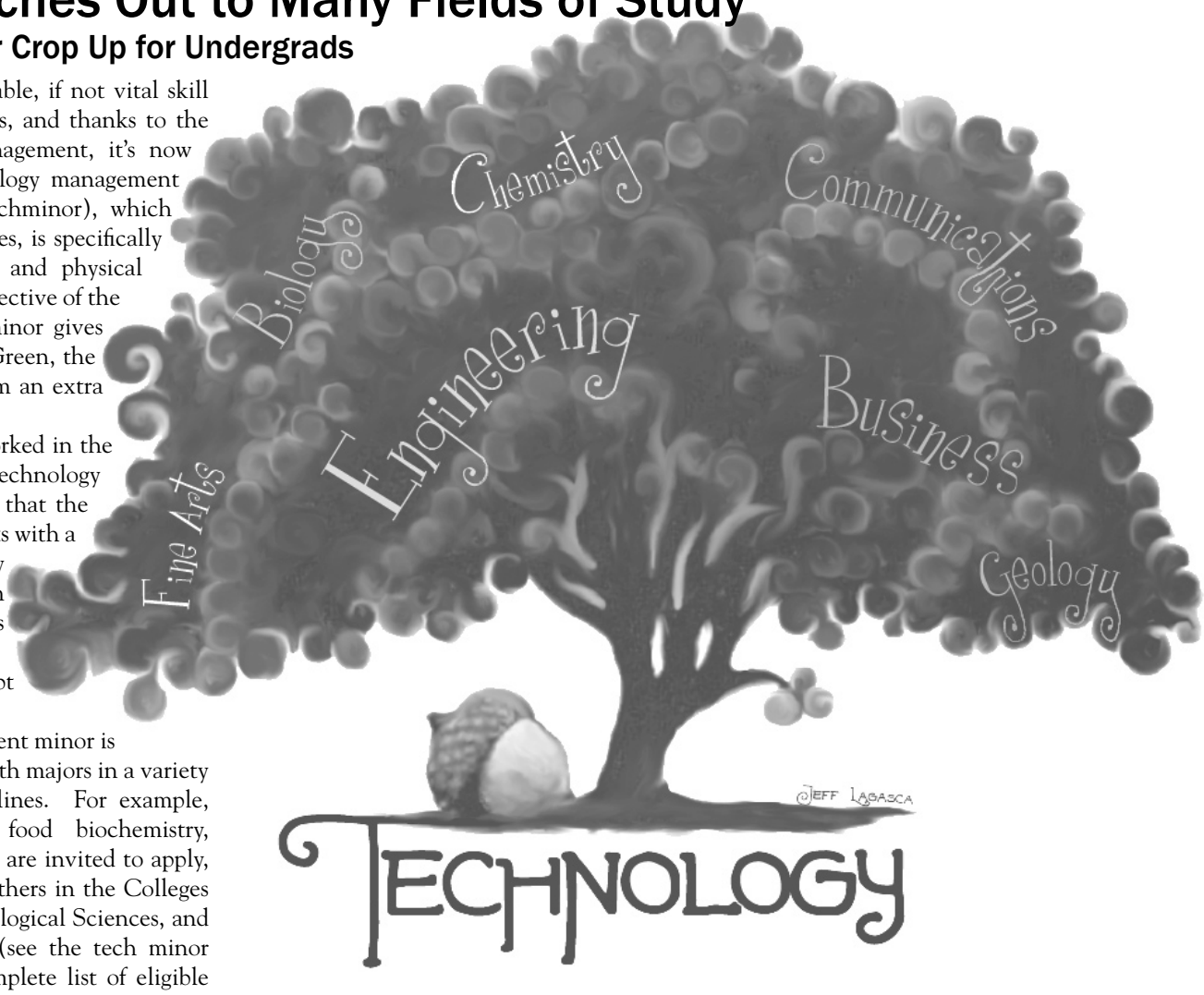
In order to enroll in the program, students must first take prerequisite classes including accounting, calculus, and statistics. Courses for the minor include "Financing New Business Ventures," "Marketing for the Technology-based Enterprise," and "Supply Chain Planning and Management," among others. Maher, a GSM professor who teaches a Cost and Quality Management class, says he completed a great deal of research and talked to faculty around the country to prepare the course; he even co-authored the textbook with a former classmate of his, combining their respective management and technology expertise.

"Students are performing well," Maher says, adding that students are sticking around a fifth year just to take the new classes. "They're tuned in and asking very, very good questions. So far I'm happy."

The idea for the minor grew out of an initiative to place more emphasis on the undergraduate business education, and it came to fruition when campus administrators gave the GSM a budget and asked them to put a program together. Once GSM received the final go-ahead to organize the minor, it took about six months to put together, during which informational meetings took place for faculty advisors and the first applicants began applying for the fall quarter.

Enrollment is currently limited and selective; admission will take place on a quarterly basis. Although Maher says that it will take some time for the minor program to get off and running more solidly, the program is expected to grow in the near future. Two hundred students—more than double the current number of enrolled students—will eventually be accepted into the program in a phase-in process. Faculty and staff say they hope to bolster their outreach efforts to students in order to encourage them to enroll. Singh, the tech management student, says in the future he hopes to see more practical business projects as a part of the classes and more interaction between the undergraduates and MBA students. (Singh, like many technology management minors, is thinking about pursuing an MBA himself.)

"I recommend this minor to all eligible undergrads as an excellent first step in their aspiration to stand out in a crowd and become the stuff that leaders are made of," Singh says. For questions and more information, email TechMinor@gsm.ucdavis.edu. ¤



Introducing the Technocultural Studies Major at UC Davis

Technology has become so intertwined with everyday life that the humanities are now integrating technology theory into their curricula. The new technoculturalstudiesdepartment will kick off winter quarter. Students will eventually be able to major in Technocultural Studies, but they can immediately begin taking courses such as "History of Sound in the Arts" where they will examine audiophonic and audiovisual technologies. Other courses include "Topics in Virtuality," "Parallels in Art and Science," or "Technoculture and the Popular Imagination," according to the program's site (www.rocketmedia.com/TCS).

Online Chemistry Lab Sparks National Attention

It's not often that a chemistry course is up for a technology award in the same ranks as a popular TV commercial or video game. But with the new online introductory chemistry (Chem 2C) lab formats at UC Davis, this has become a reality. The project was a finalist for the prestigious Macromedia MAX award, presented at a Macromedia conference in Salt Lake City in November. The purpose of the award is to recognize "excellent, innovative and result-proven projects built with Macromedia technology," according to the Macromedia Web site.

In addition to being a featured nominee, the online lab received special attention as it was exhibited at the conference. The creators of the Chem lab, IET-Mediaworks and the chemistry department, were selected as one of only two finalists in the "Educational Experiences" category.

How the Lab Works

In the general chemistry series, which is a requirement for most science majors, there are two components: the lecture (taught by a lecturer or faculty member) and the laboratory (taught by a teaching assistant). In the traditional lab, the teaching assistant (TA) must preface each lab exercise with a 30-minute introduction to the guidelines and safety procedures. The students would then do the lab exercise and go home to write up a report. Now, with the online Chem 2C program, the TAs no longer deliver the pre-lab monologue, and students don't have to use their handwritten lab manual to write up their lab reports.

Instead, students log onto the course Web site and enter a virtual pre-lab (made by Mediaworks programmers with Cold Fusion and Flash design programs). The pre-lab includes an overview of safety procedures, video of people demonstrating how the lab exercise works, and graphical representations of chemical formulas and concepts. As evidence of completing the pre-lab, students must take an online quiz at least one hour prior to physically showing up for the lab. The students are allowed two attempts to answer quiz questions correctly. If they fail both attempts, the TA reviews the lab experiment with the student to determine if they understand enough to proceed with the in-person lab.

The online pre-lab puts both students and TAs at an advantage. Students now have the assurance that presentations and grading will be consistent among TAs;

Chem Lab
continues on p.4

Q: How can I listen to or download music online without breaking the law or getting sued?

If you're asking this question, then you are probably starting to get the caustic message coming from the Record Industry Association of America (RIAA) which has brought 1600 lawsuits against illegal file-swappers. Fortunately, there are lots of options for finding legally-available music on the Internet. The bottom line, however, is that most of them will cost you money.

Legal but Brief: 15-20 Second Tune-Teasers

At the very least, you can legally listen to music through your favorite artists' Web sites. Most popular artists will offer 15-20 second previews of their songs to encourage you to purchase their CDs. You can also listen to and download entire songs from selected featured artists (which change from week to week) on the Web sites of popular music channels, such as the Country Music Television (www.cmt.com) and MTV (www.mtv.com).

Listen Only: Internet Radio

Many mainstream artists offer their songs to Internet radio stations for listening only. LAUNCH Music on Yahoo (www.launch.yahoo.com) offers an online radio station that streams music from the genres you select as your favorites. Live365 (www.live365.com) allows you to listen to a more eclectic variety of music. Like LAUNCH, the music is organized by genre; however, Live365 is unique since its music is not programmed by the site owners, but plugged in by listeners just like you who post their own playlists. Of course, neither of these radio options permit downloading, but they do offer free exposure to new music and serve as an alternative to traditional radio, which tends to play the same songs over and over again.

Songs a la Carte

If you're willing to open your wallet, the Internet has many great services that allow you to purchase music by popular artists for very low prices. To get started, check out Bumbles MP3s (www.bumblesmp3s.com) which provides a guide to over 40 legal MP3 download sites on the Web today.

Most services offer songs for under a dollar, with Napster, iTunes and MusicMatch charging ninety-nine cents per song. Some sites, such as BuyMusic.com (www.buymusic.com), allow you to preview a 15-20 second clip of the song before you download it.

An important caveat for a la carte buyers who transport files to a digital music player, such as an iPod: make sure your music files are compatible with your player. Mp3 is not the only file format (there are others, such as .wma and .aac), and not all players support all formats. MusicNow (www.musicnow.com) claims that its downloads are compatible with 40 different digital music players.

Musical Buffet: Monthly Subscription Services

For a small price per month, subscription services like Rhapsody (www.listen.com) provide the option of streaming music for only $9.95 per month. You get access to a large legal collection of albums and can select the songs you want to hear, but you can't download them to your computer. You can, however, save your playlists and access them from other computers. Even better, a majority of the songs can be burned onto a CD for just ten cents per song. Rhapsody offers a 7-day free trial.

As you're choosing which option best meets your needs and your finances, just remember that all of these choices are a lot cheaper than hiring a lawyer or paying a $12,000 settlement to the RIAA. ¤

Reminder: Campus Email Servers to Undergo Upgrade

What You Need to Know and Do Before Late December

At 10 a.m. on December 29, Information and Educational Technology (IET) will upgrade the campus email servers in preparation for a project to secure email passwords. Here's a brief recap of what you need to know and do:

Who will be affected by this upgrade:

- You will NOT be affected if you check your campus email using only the Web-based email program in MyUCDavis (or if you access your email directly from http://geckomail.ucdavis.edu). Users of email clients set to the IMAP protocal will not be affected, either.
- You WILL need to take some steps if you use a version of Eudora older than 5.2.1, or Outlook, or similar email client. See below to find out how to prepare and make sure you can still receive and send email messages after the server upgrade.

How to prepare:

- Eudora users only: See http://itexpress.ucdavis.edu/upgrade/eudora/ to find out what version of Eudora you're using and to upgrade to version 5.2.1 or above, as needed.
- Users of other email clients (Outlook, Entourage etc) see: http://itexpress.ucdavis.edu/upgrade/pop3/ for how to prepare.

How to reduce duplicate copies of your email:

- Users of all email clients: You'll need to remove your mail from the campus email server, but we recommend not doing this until late December.
- When the email servers are upgraded, your email client will download all messages left on the server. This means you may see duplicate copies of all email messages you have left on the server at the exact time of the upgrade.
- To reduce the amount of duplicate email you receive, remove your email from the server as close as possible to 10:00 a.m. on December 29 (time of upgrade). You can do this by accessing your email via MyUCDavis (log on to http://my.ucdavis.edu/ and clicking on the envelope icon at the top of the page) and deleting messages. Before doing this, make sure you check your email using Eudora or Outlook.

Will I lose email?

- No, you will not lose any mail. Note also that you will still be able to access your email using MyUCDavis (at http://my.ucdavis.edu/) before, during and after the email server upgrade.

How to find out more about this upgrade:

- See the server upgrade FAQ at http://itexpress.ucdavis.edu/upgrade/.

For further assistance:

- Contact your department's Tech Support Coordinator, or call the IT Express Computing Help Desk at 530-754-HELP (4357), email ithelp@ucdavis.edu, or visit 182 Shields Library. ¤

Videoconferencing to the Rescue

Departments Use Technology to Stretch Time and Budgets

Dee Dee Kitterman had a dilemma. As a member of the interview panel for the Executive Director position at the Mondavi Institute for Wine and Food Science, Kitterman received over 40 applications from interested individuals at businesses and universities all over the United States. "We were able to narrow the crowded field down to ten highly qualified candidates," shared Kitterman, the Executive Director for Research and Outreach in the College of Agricultural and Environmental Sciences. "But it became clear that we would need to speak to each of these people in depth to further refine our search." However, the substantial cost and logistics of bringing so many candidates to campus proved daunting, particularly in this era of tight budgets.

"It became clear that we needed to speak to each of these people in depth to refine our search."

The panel looked for alternatives, and ultimately decided upon the videoconferencing services available on campus. In what may be a harbinger of things to come on campuses nationwide, Kitterman and the interview panel were able to use videoconferencing to complete the pre-screening process and realize a significant savings in both time and money.

From the videoconferencing room located in Olson Hall, the members of the interview panel "met" with each of the ten different candidates, whom were located at videoconferencing facilities in their own respective cities. "The videoconferencing staff was very helpful and made the whole process easy," said Kitterman. "They quickly established an IP connection with the candidate's location, and we were able to see and converse with the candidate in real time."

Added to this convenience was the low cost. When taking into account the potential cost of airline tickets, hotel and other travel expenses for bringing ten individuals to campus, "the use of videoconferencing saved the campus a lot of money and kept the candidates from having to take time off from their current positions," said Kitterman.

This time and financial savings also allowed the interview panel to conduct a more thorough search. "Because of videoconferencing, we were able to effectively pre-screen a much larger pool of candidates than would have been possible otherwise," said Dr. Robert Powell, Chairperson of the Department of Chemical Engineering and Materials Science.

In addition to assisting the interviewing process, faculty and staff are using videoconferencing in many other ways. In the Department of Medicine, professors are using videoconferencing to link Davis students with virtual patients at the UC Davis Medical Center. Campus administrators also recently used videoconferencing to participate in a world-wide conference with 34 other universities.

Since Olson's videoconferencing room can hold only twenty people at a time, the Videoconferencing Services group now offers faculty and staff the use of a portable rollaway videoconferencing unit known as the Polycom 4000. The unit includes a camera, two monitors, a VHS and DVD player, and a wireless microphone. Videoconferencing Services also provides a technician to assist with setting up the codec.

According to John Azevedo, Manager of Videoconferencing Services, there is no cost for faculty members interested in using videoconferencing in their teaching (e.g., "bringing in" a guest speaker). Use of the videoconferencing for instructional purposes in conjunction with a class is free, while videoconferences for other purposes are offered on a recharge basis. For more information visit the Videoconferencing Group Web site at http://cts.ucdavis.edu/services/vtc.html or contact them by phone (530-754-8885) or email vtc@ucdavis.edu. ¤

Students Employ New Voting System

ASUCD Technologists Create Software To Handle Online Election

With 135 candidates to choose from, we thought we had a lot of voting options in our recent Governor Recall election. But one month later, on November 12 to 14, UC Davis students found their voting options even more diverse. For the first time on campus, students used the new Choice Voting system in which voters don't just choose their favorite candidate, they can also rank as many other candidates as they choose in their order of preference. With 16 candidates on the ballot (to fill six ASUCD senators seats), this sort of system requires sophisticated software to tally the voting and a smooth integration of that software onto the election Web site, where students cast their votes electronically.

In traditional voting systems, the candidate with the most votes wins, regardless of whether he or she has a majority of the vote. For instance, the well-known winner of the recent California Recall election actually garnered less than a statistical majority, bringing in only 49% of the vote. Last winter, however, UC Davis undergraduates voted to pass an amendment to the ASUCD constitution, making choice voting the official voting system for ASUCD elections. Choice voting stipulates a candidate must receive a majority of the vote (or a threshold of the votes in multi-winner elections) in order to take office, and it ensures majority support by taking into account voters' second, third, and fourth choices.

Choice Voting Demystified

Called 'Instant Run-Off Voting' when one winner is being elected and 'Single-Transferable Voting' when multiple winners are elected, choice voting seems like a mathematical puzzle at first.

UC Davis voters log on to the secure elections Web site where they can view candidate's pictures, read candidate bios and cast their vote (ASUCD elections have been entirely online for several years). Voters click on candidate pictures to rank them in order of first choice, second choice, third choice and so on. It should be noted, however, that voters are not required to rank all the candidates; they can rank as many or as few as they wish.

In single-winner elections, if no single candidate receives a majority of the vote, the candidate with the fewest votes is eliminated from the race. The losing candidate's votes are then re-distributed among the remaining candidates based on voters' next available choice indications. The tallying continues through rounds of elimination and re-tallying until one candidate receives a majority of the votes.

When electing more than one person, as in the case of the recent ASUCD election, winning candidates must achieve a threshold of the vote, in this case roughly 14% or 350 votes. If none of the candidates receive the threshold, elimination rounds begin. On the other hand, if a candidate exceeds the voting threshold, a portion of his or her excess votes over the threshold are divided among the voters' next choices. Sound confusing? Check out the ASUCD election results page at http://asucd.ucdavis.edu/elections/ to get an idea of how the votes and fractions-of-votes transfer from candidate to candidate through the tallying rounds.

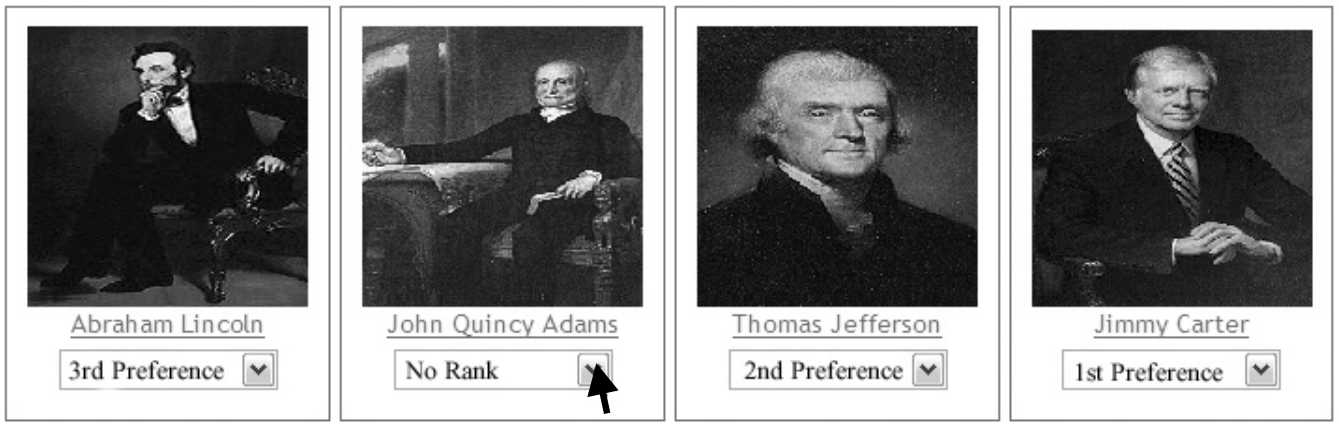
With all this cascading of votes through multiple rounds, the tallying process can seem a bit dizzying. According to mathematics graduate student Chris Jerdonek, one of the students who helped raise campus interest in choice voting, Cambridge, Massachusettes and UC Berkeley began tallying their choice voting elections by hand, using nothing more than a pen, paper and good old-fashioned mathematics. When UC Davis adopted choice voting, the decision to use a computer for vote-tallying was a no-brainer. The only question was what software to use.

Preparing the Technology for Election Day

ASUCD called upon its media and technology staff early in the summer to begin designing vote-tallying software and a user-friendly voting Web site for the upcoming fall election. The elections Web site and vote-tallying software were developed by ASUCD Creative Media student employees Tom Burnett and DJ Davis and staff programmer Alex Park. The ASUCD-created system is double-checked by professional choice voting software, ChoicePlus, which is used at a handful of other universities around the country.

Burnett, who did most of the programming to create the vote-tallying software, said that it took three revisions to get every aspect of the Cold Fusion and Oracle-backed program correct. There were many challenges that came along with the project, including making the Web site compatible with all the different Web browsers in use by student voters, and ensuring that the program's voting sessions wouldn't time-out on voters before they had a chance to select all their preferences.

"We had a mock election with a few hundred people in order to give our software a trial run," says Park. The programmers also posted a sample ballot –featuring past American presidents posing as candidates– on the site in the weeks prior to the election so that students could get a feel for the new voting process ahead of time.



No, Jimmy Carter didn't run for ASUCD senate; he simply appeared on ASUCD's sample ballot so that students could take a crack at choice voting before the big election day. To get a look at the recent ASUCD election process, visit their site at http://elections.ucdavis.edu/.

Student Voters Adjust to New System

Using the choice voting system for the first time, most voters failed to take advantage of the chance to rank all 16 candidates, generally logging on, voting for their six slate candidates, and logging off. Election Committee Chair Mary Ball feels it will "take a while" for people to get used to the system. Some students, such as geology undergraduate Dierdre Williams found the process of marking multiple preferences a bit "tedious." However, Dan Reilly, an undergraduate studying classics felt the extra pointing-and-clicking was worth it since "choice voting allows the voter to split votes into a more realistic and accomodating ranking system instead of the black/white voting of previous years."

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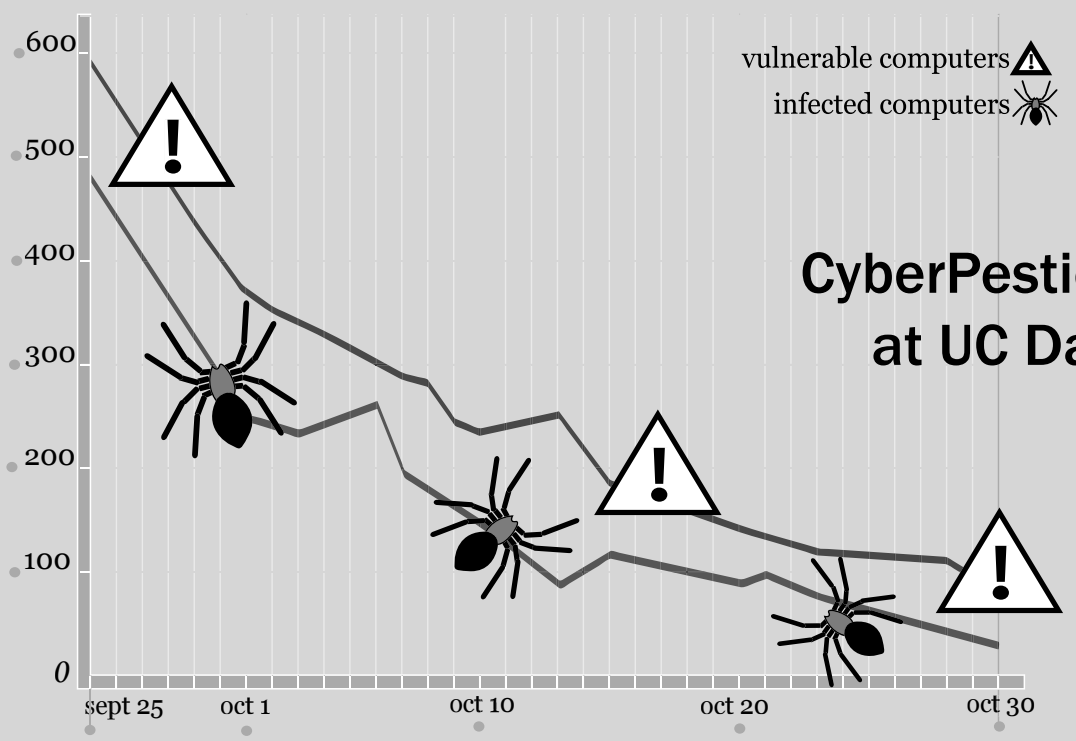

After a summer full of computer security threats, Information and Educational Technology (IET) began scanning all computers connected to the campus network to determine which individual systems might be at risk. Specifically, the scanning looked for the presence of the Welchia worm and a Windows Remote Procedure Call (RPC) vulnerability, which could allow attackers to gain control of individual computer systems and damage the campus network. Users of infected or vulnerable computers were automatically notified and referred to a Web page where repair resources and patches were waiting for them. Within a month's time, the number of Welchia-infected systems and RPC-vulnerable systems were greatly reduced (see graph, above). Due to the effectiveness of scanning, this method will likely be used in the future to minimize the risks of viruses and other security threats. For more info on computer security and viruses, visit http://security.ucdavis.edu.

Photo by Gabriel Unda, IET-Mediaworks

Last Phone Standing

UC Davis student Anne Domenic talks on her cell phone, while using an old friend as a backrest. In October, IET-Communications Resources removed 82 of the 119 campus payphones available around campus. These payphones were not being used much and MCI, the campus phone service provider, had asked the campus to pay the difference between a unit's actual revenue and MCI's cost to maintain the phone. Over the years, the average revenue of campus payphones (currently $25.30 per phone) has been dropping, partly as a result of increased reliance on cell phones. Along with the remaining 37 payphones that survived the phase-out, the campus added 8 emergency phones and 11 courtesy phones in locations where public safety or communications are most critical. For more information on the location of the remaining campus payphones, visit http://cr.ucdavis.edu/payphone.cfm.

New Phone Directory Out On Campus

The 2003-2004 print Campus Directory recently arrived on the desks of UC Davis and UC Davis Health System staff. This year's directory, created by IET-Communications Resources, sports several new interesting features, including a section that lists current faculty and emeriti by academic department.

How To Change Your Listing in the Campus Directories

Most folks know about the online campus directory available from the main UC Davis home page or MyUCDavis (http://my.ucdavis.edu), but a common question asked by faculty and staff is how to update their listing in either the online or print directory. If you recently moved offices, changed your name, or otherwise need to update your personal information, there are a few simple steps to take.

To update your information in the print Directory:

Visit http://cr.ucdavis.edu/forms/dirupdate.cfm or use the form on page 3 of the print directory.

IMPORTANT:

You'll also need to update your information in the online Directory. Changes can made at http://computingaccounts.ucdavis.edu.

For additional information, or to order additional copies of the directory, contact Communications Resources at (530)752-4603. ¤

Chem Lab

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TAs can spend less time on logistics and more time assisting students during the in-person lab. On a broader level, class time is reduced so that more classes can be scheduled. In turn, the large number of students who need to take Chem courses at UC Davis can be accommodated and graduate on time.

"The role of the TA and the role of the student are changing," says Bill Fink, the Chemistry Professor Emeritus who originally helped provide content for the online lab. "The TAs are now much more mentors than evaluators."

In addition to the pre-lab, the post-lab report has also gone online. Students input the data that they collected during their lab exercise and the computer program actually forces them to get their calculations correct by responding to their specific data entries, providing up to three levels of hints to assist them. And since the labs are graded by the computer, there is less room for grading variation among TA's.

"Online labs eliminate the human errors and subjectivity that can result from grading, and make the labs generally a less tedious process," continues Rachel Joseph, a Chem 2C student. "If only o-chem [organic chemistry] labs were online!"

Another added bonus, according to Chem 2C TA William Price, is that the online labs "help in organization—all the materials are together in one location and it is a paperless system. TAs no longer have to decipher writing styles in order to grade labs." The system also stores an online gradebook, which the TAs consult throughout the quarter.

Best of all, the online lab provides students with a better analysis of their work to help them understand concepts. With the immediate assistance that the computer provides, students can't help but get the labs done. "Students can ensure immediately that they do not turn in incorrect work and that, additionally, they understand the mistakes they are making, whether logical or technical," Joseph says.

The students' response has been overwhelmingly positive, according to surveys. In fact, 85 percent said they would recommend the online lab program for other chemistry courses.

In addition to the Chem 2C online lab, Chem 2B will have an online component starting this winter, with both 2A and 2B offered concurrently in the spring. Each course averages 1000 students per quarter, but by the time both courses are offered together, they are projected to have 2500 students combined. Eventually Chem 2A will be phased in as well, reaching even more students who need to take the most basic of the Chemistry series courses.

How the Lab was Developed

While the Chemistry department is responsible for the content of the online labs, Mediaworks helped develop and animate the content, drawing from its corps of videographers, photographers, animators, programmers and educational technology experts. Mediaworks also provides continuing technical support once the module gets some use by the students.

A challenge for Mediaworks is that technology is constantly changing, both in the lab and on the network. "There are always upgrades and advances in technology we have to take into account after the initial release of an online course supplement," says Lisa Wilson, Project Manager.

Accessibility is also a major concern. In order to participate in the online lab components, the student must have a computer capable of handling a heavy media load, including movies and sound files, says Earl Schellhous, a Mediaworks programmer. Mediaworks developed a CD version of the lab for those students who have slow modems or poor processing capabilities. If accessibility is still an issue, students are encouraged to take advantage of the campus computer labs, which are equipped with multimedia software and high-speed Internet connections.

The lab exercises are getting smarter and will eventually take advantage of artificial intelligence capabilities.

Though a few other technical problems have surfaced, Mediaworks has been diligently working to smooth out the kinks. "By working out each one of those bugs and problems, we've made it reliable for most students," Schellhous says.

Other UC Davis departments, and even other institutions, have expressed interest in creating similar online programs and using Chem 2C as a model. For example, Fink notes the large interest among microbiology instructors for an online pre-lab exercise, and adds that the chemistry department is working to get other instructors involved. However, Fink is quick to point out, however that instructors should expect to have their work cut out for them, as it takes a great deal of time and effort to get an online program up and running.

The Foundations and the Future of the Lab

Mediaworks is working on formulating the course into a shared content format so that others may use it. Like other popular learning management systems, such as WebCT and Blackboard, Mediaworks' system can serve as a template for other future projects.

In fact, the Chemistry lab benefits from a learning management system concept initially created in the late 1990s when the dean of the chemistry department, Peter Rock, approached UC Davis educational technology pioneer and then Professor Harry Matthews about finding solutions to overcrowded labs and an influx of safety procedures and chemical experiments. At the time, Matthews was knee-deep in research on the effectiveness of hybrid online/in-class courses, thanks to a grant from the Mellon Foundation. His research confirmed that an online supplement might be the answer to Dean Rock's problems. Diane Meador (a Chemistry Lecturer) and Bill Fink then helped provide content for the lab, and the rest is history.

"The project is really an illustration of the power of collaboration, from the Provost and the AC4 [the Academic Computing Coordinating Council] who initially approved Dean Rock's proposal to the students who have adapted their learning behavior to take advantage of new opportunities," says Matthews.

Fast forward eight iterations later, and the online lab is receiving attention from educational conferences such as Educause and garnering accolades from private industry groups such as Macromedia.

Nonetheless, the developers and instructors involved in the project are more concerned with continuing to perfect the Chem 2C lab for the students. Matthews says that the post-lab exercises are getting smarter and will eventually take advantage of artificial intelligence capabilities, making it possible for the computer to individualize instruction for each student, based on his or her specific needs. As for the here and now, Schellhous says current construction plans include expanding the lab with 3-D simulations and finding even more ways of getting those formulas to stick in the students' minds a little more. ¤

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