time. The final tool is labelled *Submit* and is used to upload the answers at the end of the exam.

Currently, the answer boxes accept only text although we are experimenting with allowing rich text input. Nevertheless, students have not complained that simple text input is a constraint on their ability to express themselves. A few students have commented that they would have liked to enter diagrams and we shall be implementing a simple facility for our next experiment. This raises the interesting problem of how to assess diagrams, which is a research topic in its own right.

An important aspect of many examinations is the rubric – the instructions for the completion of the exam – that often includes rules about the choice of question on offer. We are currently considering the extent to which we should implement such rules. That is, whether or not the system should reject a set of answers that break the rubric. The current feeling is that we should implement a warning system rather than impose restrictions.

During the examination, we keep in touch with the students via the chat room software. This means that we can communicate with students via a text window and using audio. This feature has a number of advantages. First, it enables a student to contact us in the event of a difficulty and allows us to provide information such as the amount of time remaining. We are beginning to use this facility as part of our invigilation procedures.

Once the answers have been submitted and the mock exam period has expired, a copy of the marks is generated automatically and returned to the student. To-date, the electronic marker is equivalent to a very severe human marker so the electronic grades tend to be around 10% lower than for a typical human grader so we are striving to improve its performance. Nevertheless, in our latest experiment the electronic marker was also able to provide simple straightforward feedback on incorrect answers, which was appreciated by the majority of students.

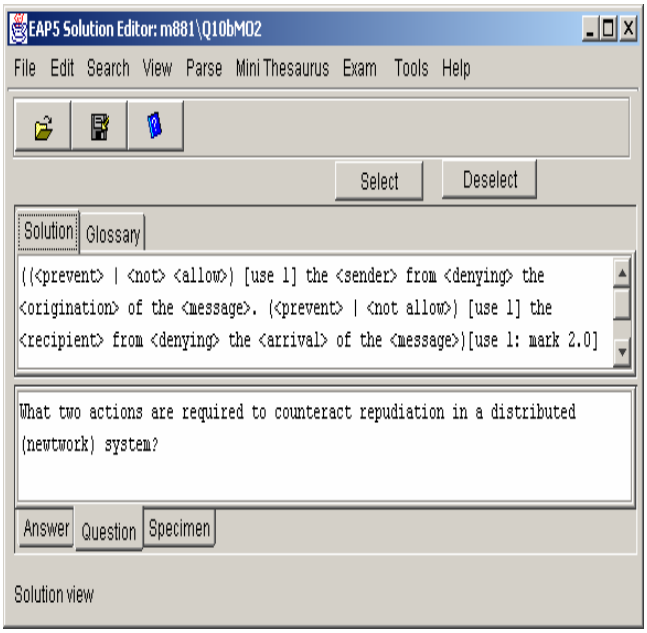
The electronic marker needs input from the teacher in the form of a stylised specimen solution and mark scheme so we have implemented several tools to support this activity. The figure below illustrates our Solution Editor that presents the teacher with a question and a textual specimen solution cum mark scheme from which they develop the 'electronic' solution. If a sample student answer is available, the tool also enables the teacher to test a new electronic solution by using it to mark the answer.

As can be seen from this brief introduction, setting up an electronic examination system can be quite involved, particularly if automatic feedback is to be provided. Further information about our systems can be found on our web site at <http://mcs.open.ac.uk/eap>.

References

[1] Thomas, P. G., B. Price, et al. (2002). "Remote Electronic Examinations: student experiences." *British Journal of Educational Technology* **33**(5): 537-549.

[2] Thomas, P. G., B. Price, et al. (2001). *Experiments with Electronic Examinations over the Internet*. Fifth International Computer Assisted Assessment Conference, Loughborough University, Loughborough, UK.



Community College Corner

Cybersecurity

Robert D. Campbell

The ACM Two-Year College Education Committee (ACMTYCEC) is currently participating in an undertaking to promote the establishment and expansion of workforce development programs in the area of cybersecurity. Following the tragedy of Sept. 11, there has been a great deal of discussion on security issues in general, and clearly, cybersecurity is one category that warrants significant attention. National security and the need to protect the nation's information systems, networks, and infrastructure is an urgent issue that was identified by President Bush in his directive to develop the roadmap document *National Strategy to Secure Cyberspace*.

In June 2002, the National Science Foundation (NSF) and the American Association of Community Colleges (AACC) assembled 90 experts in computer, network, and information security from community colleges, four-year colleges and universities, business, industry, and government to consider how resources at community colleges can be harnessed and expanded to educate a cybersecurity workforce. The workshop, entitled *The Role of the Community College in Educating the Cybersecurity Workforce,* was organized around a set of invited white papers that set the stage for a series of presentations and breakout sessions designed to identify issues and provide recommendations. One of those white papers, "Cybersecurity Education in Community Colleges Across America: A Survey of Present and Planned Implementations," written by two members of the ACMTYCEC, provided details on four prototypical avenues for packaging instruction commonly found in the two-year college environment, and described specific activities in each avenue related to cybersecurity initiatives at several institutions. Other white papers addressed training materials, skills standards, program development, and industry partnerships, all in the context of the community college setting.

The key findings and recommendations that came out of the workshop address the issues of certifications and skill standards; preparation for cybersecurity positions; specification of topics, courses, and curricula; and advancing the role of community colleges in cybersecurity education. The workshop report *Protecting Information: The Role of Community Colleges in Cybersecurity Education* has been published by the AACC; information is available via the website <http://www.aacc.nche.edu/cybersecurity>. This report includes the invited papers as well.

In the workshop, a framework of six core curricular areas was developed with links to hands-on real world activities:

(1) Security Issues
- Survey of computer security literacy issues, awareness, and ethics
- Scope of security in relation to today's technologies
- Need for security policies
- Glossary of terms
- Confidentiality, integrity, availability, authentication, authorization, and non-repudiation
- TCP/IP (Transmission Control Protocol/Internet Protocol)

(2) Business and Economic Issues and Security Policies
- Economic impact and planning
- Business based security including knowing the users and clients
- Business and institutional structures, strategies, and policies
- Know what a security policy is
- Policy, standards, guidelines (e.g., acceptable use, methods and procedures)
- Risk-based assessments

(3) Law, Ethics and Standards
- Legal implications of security measures and breaches
- Ethical aspects of cybersecurity
- Standards and international organizations
- Legal and regulatory aspects including understanding of the judicial system, investigative processes, evidence chain, and incident reporting
- Forensics guidelines and protocols

(4) General Knowledge and Skills
- Accounting
- Written and oral communications
- Telecommunications
- Ethics
- Discipline
- Strategic and tactical thinking
- SCANS skills
  - Planning and allocating resources
  - Working with others as part of a team
  - Acquiring and using information
  - Understanding complex interrelationships
  - Working with a variety of technologies

(5) Internet and Cybersecurity Skills and Knowledge
- Software, Hardware, and Operating Systems
  - Operating systems (need to know more than one)
  - Unix
  - Cryptography
  - Programming
- Network Security
  - Networks (e.g., in telecommunications network security knowledge of networks, servers, systems, databases, signaling networks and gateways, network and element management systems, and network elements)
  - Basic network security, information security, database security, system security, communications security, etc.
- Security Protocols
  - Strong authentication and secure credentials exchange
  - Development and assurance of compliance with HIPAA
  - Installation of centralized antivirus software
  - Fluency with firewalls (IDS, VPN) and installation of firewalls
  - Antivirus, anti-Trojan, scanning, and back-up
- Threat Management
  - Styles of attack
  - Psychosocial aspects of security
  - Identifying threats
  - Access and environmental management requirements

- Policy and procedures security development

(6) Knowledge of Industry Hiring Practices in Cybersecurity

- Run backgrounds checks for malicious hacking history, a history of drug us, and credit ratings. Companies want to make sure cybersecurity workers are not vulnerable to blackmail
- Place a high value on maturity, ethics, and integrity. "No hackers, crackers, or phreakers"

The focus since June has been on disseminating the results of the workshop to the broadest possible audience. The AACC has organized a program of dissemination activities that has included presentations and poster sessions conducted at the Workforce Development Institute 2003, the ACM SIGCSE Symposium 2003, and the Society for Information Technology and Teacher Education International Conference 2003, with several other venues pending as of this writing. In addition, the Chair of the ACMTYCEC was invited to address a directorate of the European Commission currently formulating recommendations on cybersecurity workforce development in Europe, to discuss the status of such efforts in community colleges in the United States and the recommendations from the June workshop. The ACMTYCEC appreciates the opportunity to participate in this initiative of national significance, applauds the support of NSF in this undertaking, and expresses its gratitude for the leadership of AACC (and the outstanding efforts of Ellen Hause) in promoting the implementation of these recommendations.

Upsilon Pi Epsilon

Scholarship, Student Awards, Microbreweries, and Baseball

Jeffrey Popyack

Greetings! Are you wondering what on Earth microbreweries have in common with student awards? Can there possibly be some connection to baseball? Does this really have something to do with computer science? As a small hint, there is a distinct focus on quality in what lies ahead. Perhaps the word "small" is another hint. Let's begin with the awards.

Student Awards

The UPE Constitution [1] states:

> ARTICLE I, SECTION 2:
> The object of this Association shall be the promotion of high scholarship and original investigation in the several branches of the Computing and Information Disciplines

In accordance with our constitution, Upsilon Pi Epsilon supports student achievement in a variety of ways – scholarships for undergraduate and graduate students, founding and continuous sponsorship of the ACM International Collegiate Programming Contest, ACM and IEEE Computer Society awards, and support for student awards from The Consortium for Computing Sciences in Colleges (CCSC). Microsoft has generously provided annual funding for UPE scholarship awards for many years.

Since joining the Association of College Honor Societies, the parent organization for all academic honor societies in North America, UPE has been the member society that returns the highest percentage of its revenues back to students in the form of awards. Over the last several years, UPE has distributed an average of around $28,000 per year in student awards.

For this column, I'd like to take a look at one organization where there have been some exciting developments, and with whom UPE is proud to be associated, the CCSC.

CCSC

If you're not familiar with the Consortium for Computing Sciences in Colleges, you owe yourself a treat. I attended my first CCSC regional conference a few years back, when they were still known as the Consortium for Computing in Small Colleges. Their goal is stated as "supporting quality, cost effective regional conferences and activities aimed at faculty from teaching-oriented, mostly undergraduate colleges" [2]. There are eight regions, each having an annual conference. Attend a conference, and you get an annual membership in the process, which brings you the proceedings of every one of those conferences during the year. In addition to the scholarly papers and presentations, the conferences feature a variety of student-oriented activities, such as student paper sessions, research poster contests, programming contests, and web design contests. At the first conference I attended, I was impressed not only with the quality of the student research posters, but the prominence of the event – a social hour/reception transpired in the center of the room with the posters and presenters at the perimeter, and there was plenty of interaction between presenters and the other attendees. What surprised me was that there were no actual prizes for the students whose posters were named as winners – the conference's cost effective budget precluded that ability. What an obvious match for Upsilon Pi Epsilon's desire to recognize high scholarship and original investigation!

Within months, UPE had formed a sponsorship agreement with CCSC to support student awards on an annual basis. While the amount of funding available was modest (especially when spread among the numerous regions), it has helped in promoting the student activities.