An Overview of the JHU EPP Computer Science and Information Systems and Technology Graduate Programs

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As a cornerstone of JHU’s Graduate Programs for Professionals, the Computer Science (CS) and Information Systems and Technology (IS&T) programs have evolved in response to rapidly emerging technologies and the global economic environment. Both programs offer a mix of foundation and applied courses that enable students to develop a deep understanding of information technology. As the more traditional program, CS emphasizes underlying theoretical principles, while the newer IS&T Program encourages students from a wide range of backgrounds to pursue a more eclectic and applied course of study.

INTRODUCTION

For more than four decades, technical professionals seeking to continue their education have turned to JHU and the Whiting School’s Engineering and Applied Science Programs for Professionals (EPP). Although computer science (CS) was just emerging as a discipline when JHU first developed it in The Evening College, which supported part-time education, the CS Program has since become a leader in EPP graduate programs. With outstanding faculty, an extensive curriculum, excellent facilities, and a strong student body, the CS Program has continually reinvented itself to keep pace with a rapidly evolving technology base and changing demands. EPP has also responded to the changing global environment in computing and networking through the creation of the Information Systems and Technology (IS&T) Program to meet the burgeoning need for experts in applied areas of information technology (IT).

Although CS has been the largest of the EPP graduate programs for nearly two decades and IS&T has developed into a robust program in the last decade, much has changed in the past several years. Areas associated with IT have evolved significantly, and most universities now offer both graduate and undergraduate CS degrees as well as a variety of degrees associated with information systems. Courses that once served as a part of the graduate core curriculum have become undergraduate prerequisites, courses previously characterized as advanced now serve as foundation courses, and new fields of study have emerged both within CS, such as bioinformatics, and from CS, such as IS&T.

In this article, we present an overview of EPP’s CS and IS&T programs. After providing a short history in the next section, we focus on key activities of the past decade. Current offerings and requirements are described, and an overview of the program committee, faculty, and advisors is provided. A brief analysis is given of enrollments, indicating some past and recent trends, and new approaches are described for enhancing student
opportunities based on partnerships and online courses. Finally, we highlight a few recent achievements before making concluding remarks.

THE COMPUTER SCIENCE PROGRAM

A Brief History

Courses in CS were initially offered in JHU’s part-time program in Numerical Science (now Applied and Computational Mathematics) in the 1966–1967 academic year. In recognition of the emergence of CS as a discipline and the increasing popularity of the CS courses offered at JHU, a separate part-time CS program was established in 1971, with Bob Rich serving as the first Chair. The program rapidly grew into the largest program within EPP, and by the early 1980s, more than 80 sections of 34 classes were offered in areas ranging from traditional topics in operating systems and compiler design to cutting-edge topics in graphics and networking. Students were required to take two classes in the areas of languages, algorithms, and computational theory, and the remaining classes were divided roughly into the areas of architecture and software. Of the faculty at the time, approximately 10 continue to serve, providing both continuity and a sense of tradition.

In 1985, Vince Sigillito was appointed Chair, guiding the CS Program during the evolution of the Whiting School’s Part-Time Programs in Engineering and Applied Science.1 By the late 1980s, CS as a field of study had evolved, and some of the lower-level and introductory courses then offered in the program were converted to undergraduate prerequisites, increasing the rigor of the program and making it more appealing for the increasing number of incoming students that held bachelor’s degrees in CS. In addition, CS was one of the initial programs to offer courses in Montgomery County, which has led to its strong presence today at the Montgomery County Campus (MCC).

By 1990, more than 70 courses were offered at APL and MCC, with strong interest in the areas of artificial intelligence, data communications, and software engineering. All of these areas had numerous course offerings with large enrollments each semester. CS students could also choose an option in Telecommunications, which was offered jointly with what was at the time the Electrical Engineering (EE) Program. This option enabled students to take a variety of telecommunications courses from both CS and EE.

In 1994, Sigillito retired, and long-time faculty member and Vice Chair Robert Grossman became Program Chair. Then in 1996, Ralph Semmel assumed program leadership, and Grossman continued on as Vice Chair.

The Program Today

Interest in the focal areas of the early 1990s began to wane, but with the growing popularity of the Internet, the advent of the World Wide Web, and the dot-com boom there emerged an immense interest in communications systems, networking, and distributed computing. The Telecommunications option ultimately evolved into the Telecommunications and Networking option that continues to be jointly offered with what is today the Electrical and Computer Engineering Program. Richard Nieporent of MITRE has long served as the CS Coordinator for this option and has played an instrumental role in developing a robust set of offerings and attracting key faculty.

In 1996, Marty Hall, who had been one of the CS Program’s principal artificial intelligence instructors, developed and offered a new course, Distributed Development on the World Wide Web. The course was hugely successful, and Hall went on to write a best-selling book based on the materials he developed for the course.2 The book has been translated into multiple languages and adopted by universities throughout the world.

Hall joined the Program Committee in 2001 and played a key role in winning a multi-year award through the Maryland Applied Information Technology Initiative that supported the development of new CS courses. He then teamed with Hash Malik, a fellow Program Committee and faculty member, to guide the creation of a concentration area in Distributed Computing that today includes nine courses. Significantly, Hall later prepared a second edition of his best-selling book with another EPP CS faculty member, Larry Brown.3 Hall and Brown have also written a two-volume follow-on book set, which is in its second edition, that is used in some of the advanced distributed computing classes.4,5

The CS Program has also developed comprehensive offerings in other areas of emerging importance in recent years. For instance, a Bioinformatics concentration area was established to enable students to develop expertise in computational biology. Ed Addison, a successful entrepreneur with a strong interest and significant expertise in bioinformatics, assumed leadership of the initiative and established the Bioinformatics concentration area which now has eight courses. In addition, a separate Advanced Certificate for Post Master’s Study in Bioinformatics was established that enables students to focus intensely in the field and take related courses outside the Whiting School of Engineering. Moreover, in 2002, EPP and the Krieger School of Arts and Sciences teamed to create a joint Master’s Degree Program in Bioinformatics consisting of CS and biology courses from both schools. Finally, in 2005, JHU’s Academic Council approved an online version of the degree program.

A recent initiative in CS stems from recognition of the increasing vulnerability of computing systems and the significant economic and productivity impacts due to information systems succumbing to malicious attacks. As a result, a new concentration area in Information
Security was established in 2002. This area was coordinated with Gerry Masson, who at the time served as Chair of Homewood's CS Department and now serves as Director of JHU's Information Security Institute (JHUISI). There are now nine courses offered in Information Security, and JHUISI students can take many of them.

EMERGENCE OF THE INFORMATION SYSTEMS AND TECHNOLOGY PROGRAM

At the height of the dot-com boom in the latter part of the 1990s, the demand for IT courses of all types was high. Students with diverse backgrounds were seeking to enter the IT field, even if they did not have technical degrees. In response to the growing national demand for IT education, many universities established IT departments, and sometimes even schools. Students flocked to these programs, but many were seeking deeper technical insights and less emphasis on the business-oriented courses that were often core to those programs.

While students from all technical disciplines have always been welcome to join the CS Program, the prerequisites in math and CS can be daunting for those with degrees in disciplines such as education or business. EPP recognized the need for a program that would be technically rich while appealing to a broader student body than that comprising CS. Consequently, in 1997, EPP established a new Master's Degree Program in IS&T.

Semmel and Roger Westgate, who had been Associate Dean responsible for part-time engineering education and then acting Dean of JHU's Whiting School of Engineering, gave a detailed description of the inception of the IS&T Program in an earlier Technical Digest article. Given the program's initial leveraging of applied CS courses, Semmel served as the first Chair. He turned over Chair responsibilities to Bruce Coury in 1998 but continued his association as CS Coordinator for IS&T.

Coury, at the time an APL researcher and former professor in industrial engineering, could serve as Chair for only 1 year and transitioned leadership to Allan Bjorkaas in 1999.

Upon being appointed Associate Dean for EPP, Bjorkaas asked Semmel to again assume leadership of the program in 2002. In his second tour as Chair, Semmel appointed John Piorkowski as the IS&T Coordinator. In this role, Piorkowski, an APL staff member who had been teaching and advising in the IS&T Program, assumed responsibility for many of the IS&T planning and operational activities.

By design, IS&T is the most eclectic degree program offered in EPP. Students can take nonelective courses from IS&T, CS, Systems Engineering, and Technical Management as well as two elective courses from up to two additional EPP programs. This eclectic orientation has made IS&T a natural focal point for collaborative efforts with other JHU schools. For example, IS&T has led an effort for EPP in a joint initiative with the School of Professional Studies in Business and Education to offer the five-course Graduate Certificate in Technical Innovation and New Ventures.

PROGRAM HIGHLIGHTS OF THE PAST 10 YEARS

Offerings and Requirements

There are currently nine concentration areas in the CS Program, and more than 80 graduate courses and 5 undergraduate prerequisite courses are offered (see the box, CS Concentration Areas). Students must take a set of three foundation courses in algorithm analysis, computer architecture, and software engineering, and then three courses in a concentration area of their choice. The remaining courses are electives, two of which may be taken from relevant programs outside CS. Highly qualified students nearing completion of the degree may pursue independent study with CS faculty to add depth in a particular area or to pursue specific research interests.

At the undergraduate level, students who are seeking a master's degree in CS and who are entering from fields outside CS are expected to hold a technical degree and have taken courses in Java or C++, data structures, machine organization, and discrete mathematics or other math courses beyond Calculus II. Students who have not satisfied these prerequisites may take the undergraduate courses offered by JHU. Similarly, students entering Bioinformatics but who do not have biology backgrounds must take undergraduate courses in biology and biochemistry. To facilitate the entrance of CS and other engineering students into the Bioinformatics Program, a special CS undergraduate course has been developed that covers the necessary molecular biology needed for graduate Bioinformatics classes.

The IS&T curriculum is structured similarly to the CS curriculum. Students start with three required foundation courses in software engineering, networking and telecommunications, and decision support systems. The course in software engineering is the same foundation course required of students pursuing a graduate degree in CS, while the other two are tailored for the IS&T graduate degree and are not available to CS students. The remaining courses must include at least two advanced IS&T courses. Up to two electives outside IS&T are permitted, with students typically choosing courses in CS, Technical Management, and Systems Engineering.

While IS&T does not have concentration areas, the offerings are being evaluated to create areas that could serve as a basis for a depth requirement similar to that in CS. Currently, 14 IS&T-specific courses are offered (see

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## CS CONCENTRATION AREAS AND COURSES

### Undergraduate Prerequisite Courses
- 605.201 Introduction to Programming Using Java
- 605.202 Data Structures
- 605.203 Discrete Mathematics
- 605.204 Computer Organization
- 605.205 Molecular Biology for Computer Scientists

### Graduate Concentration Areas and Courses

#### I. Software Engineering
- 605.401 Foundations of Software Engineering
- 605.402 Software Analysis and Design
- 605.403 Software Project Management
- 605.404 Object-Oriented Programming with C++
- 605.405 Conceptual Design for High Performance Systems
- 605.701 Tools and Techniques of Software Project Management
- 605.703 Software Reuse
- 605.704 Object-Oriented Analysis and Design
- 605.705 Software Safety
- 605.706 The Software Development Process
- 605.707 Software Patterns
- 605.709 Seminar in Software Engineering

#### II. Systems
- 605.411 Foundations of Computer Architecture
- 605.414 Software Development in the UNIX Environment
- 605.711 Contemporary Computer Architecture
- 605.713 Robotics
- 605.714 System Development in the UNIX Environment
- 605.715 Software Development for Real-Time Systems

#### III. Theory
- 605.421 Foundations of Algorithms
- 605.423 Applied Combinatorics and Discrete Mathematics
- 605.424 Logical Foundations of Computer Science
- 605.425 Compiler Theory and Design
- 605.721 Design and Analysis of Algorithms
- 605.722 Computational Complexity
- 605.723 Signal Processing
- 605.725 Queuing Theory with Applications to Computer Science
- 605.727 Computational Geometry
- 605.728 Quantum Computation

#### IV. Information Security
- 605.431 Principles of Enterprise Security and Privacy
- 605.432 Public Key Infrastructure and Managing E-Security
- 605.433 Embedded Computer Systems—Vulnerabilities, Intrusions, and Protection Mechanisms
- 605.434 WWW Security
- 605.731 Network Security
- 605.732 Cryptology
- 605.733 Java and Web Services Security
- 605.734 Information Assurance
- 605.735 Biometrics

#### V. Database Systems and Knowledge Management
- 605.441 Principles of Database Systems
- 605.445 Artificial Intelligence
- 605.447 Neural Networks
- 605.741 Distributed Database Systems on the World Wide Web
- 605.742 XML: Technology and Applications
- 605.744 Information Retrieval
- 605.745 Reasoning Under Uncertainty
- 605.746 Machine Learning and Data Mining
- 605.747 Evolutionary Computation

#### VI. Bioinformatics
- 605.451 Principles of Computational Biology
- 605.452 Biological Databases and Database Tools
- 605.751 Computational Aspects of Molecular Structure
- 605.752 Simulation of Biological and Complex Systems
- 605.753 Computational Genomics
- 605.754 Analysis of Gene Expression
- 605.755 Systems Biology
- 605.759 Independent Project in Bioinformatics

#### VII. Visualization and Human–Computer Interaction
- 605.461 Principles of Computer Graphics
- 605.462 Data Visualization
- 605.463 Image Processing
- 605.465 Natural Language Processing
- 605.761 Applied Computer Graphics
- 605.766 Human–Computer Interaction

#### VIII. Data Communications and Networking
- 605.471 Principles of Data Communications Networks
- 605.472 Computer Network Architectures and Protocols
- 605.475 Protocol Design
- 605.477 Internetworking with TCP/IP I
- 605.478 Cellular Communications Systems
- 605.771 Local Area Networks
- 605.772 Network Management
- 605.773 High-Speed Networking Technologies
- 605.774 Network Programming
- 605.777 Internetworking with TCP/IP II
- 605.778 Voice Over IP

#### IX. Distributed Computing
- 605.481 Distributed Development on the World Wide Web
- 605.482 User Interface Development with the Java Foundation Classes
- 605.485 Electronic Commerce
- 605.781 Distributed Objects
- 605.782 Web Application Development with Servlets and JavaServer Pages (JSP)
- 605.783 Reusable Software Components with JavaBeans
- 605.784 Enterprise Computing with Java
- 605.785 Web Services: Framework, Process, and Applications
- 605.786 Enterprise System Design and Implementation

### Graduate Special Topics Courses
- 605.791 New Technical Ventures
- 605.792 Computer Ethics
the box, IS&T-specific Graduate Courses), 3 of which are cross-listed directly as CS courses. In addition, 25 courses from CS and 4 courses in Technical Management and Systems Engineering are co-listed in IS&T for a total of 42 courses.

Starting with the Spring 2006 semester, IS&T students will be able to enroll in a capstone course. The capstone is designed for those desiring to engage in a major independent project involving a substantial enterprise information system design that incorporates several elements of the IS&T curriculum. The capstone has a broader focus than independent study and specific required components.

At the undergraduate level, IS&T students, like their counterparts in CS, are expected to have completed courses in Java or C++ and data structures. They are also expected to have taken a year of college mathematics, but courses such as finite mathematics may be substituted for the calculus sequence required of CS students. The goal is to minimize the entry prerequisites for students coming from nontechnical disciplines while ensuring that students will have sufficient underpinnings to complete the IS&T-specific courses and the selected set of applied CS courses. The prerequisites also serve IS&T students well when they take systems engineering and technical management graduate courses as part of their core curriculum.

For students wishing to continue in formal education programs once their degrees are complete, an Advanced Certificate for Post Master’s Study in CS or IS&T is offered and may be completed by students who hold a master’s degree in CS, IS&T, or a closely related discipline. Students take six courses, five of which come from either CS or IS&T and one of which can be taken from other programs.

In both the CS and IS&T programs, faculty members and students are expected to focus on underlying fundamentals in courses rather than specific applications or commercial systems. While several courses also enable students to develop expertise in particular application-oriented topics (e.g., programming languages), the intent is to impart foundation knowledge that will enable students to work with a wide range of existing and emerging information technologies.

Program Committee and Advisors

The CS and IS&T programs are led by a Program Committee with 12 members. Half of the members are from or have close affiliations with APL, and the other half are drawn from industry, government, and academia. The committee meets annually to discuss the state of the programs, evaluate initiatives, and propose and endorse objectives for the next year. At the annual faculty meeting held each spring, the Program Chair presents a summary of Program Committee discussions and decisions.

To help students in developing plans of study, the CS and IS&T programs have 11 advisors. Advisors evaluate and approve student program plans, assist with registrations and open houses, and answer student questions on

### IS&T-SPECIFIC GRADUATE COURSES

- 635.411 Foundations of Networking and Telecommunications
- 635.412 Local and Wide Area Network Technologies
- 635.413 IP Networking and Applications
- 635.421 Foundations of Decision Support Systems
- 635.431 Information Systems Architectures and Methodologies
- 635.476 Information Systems Security
- 635.482 Web Site Development
- 635.483 Electronic Commerce
- 635.711 Internetworking: Methods, Technologies, and Devices
- 635.721 Human–Computer Interaction
- 635.731 Distributed Architectures
- 635.781 XML: Technology and Applications
- 635.792 Management of Innovation
- 635.795 Information Systems and Technology Capstone Project

### CS AND IS&T PROGRAM COMMITTEE

Ralph D. Semmel, CS and IS&T Program Chair
Principal Professional Staff, APL

Robert S. Grossman, CS Program Vice Chair
Principal Professional Staff, APL

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Vincent G. Sigillito
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Scott Smith
Professor and Chair, Computer Science, Whiting School of Engineering

J. Miller Whisnant
Principal Professional Staff, APL
an ad hoc basis. Three advisors play special roles. Eleanor Chlan, who was also recently appointed as EPP’s first full-time Senior Lecturer, advises students who do not have degrees in CS or IS&T and who do not satisfy the minimum course requirements for direct admission into the graduate programs. Robin Grasso advises Bioinformatics students. Grasso also has developed a handbook that is used for all CS and IS&T advisors, and she distributes updates to the handbook annually. Richard Nieporent advises CS students enrolled in the Telecommunications and Networking option.

One issue that CS and IS&T advisors face more frequently stems from the nation’s increasingly mobile society. Students are more often applying to the programs after transferring to the area. Many of them have taken graduate courses with other colleges and universities and do not want to lose credit for the work they have done. Similarly, there are students close to completion of their programs at JHU who move from the area and do not want to lose their credit. Advisors work with students in both cases to develop options that will allow them to leverage their work and complete their programs. For incoming students, up to two classes may be waived if a sufficient number of graduate courses have been successfully completed at other institutions. Similarly, students who have left the area can work with advisors to develop a plan for completing their programs through JHU online courses, JHU independent study courses, and approved transfer courses from other institutions.

Faculty Achievements

Between CS and IS&T, there are nearly 100 faculty members, all with graduate degrees and almost 40% with Ph.D. degrees. About 20 faculty members have served with the programs for 20 years or longer. Richard Nieporent enjoys the distinction of the longest affiliation, having taught in the CS Program since 1979.

While it is not feasible to list all faculty achievements from the past decade, several recent accomplishments are representative. John Sheppard and Bunny Tjaden, for example, prepared three papers with EPP students that were presented at conferences in 2004 and 2005. Similarly, Eleanor Chlan presented a conference paper in 2005 based on her dissertation research, which is also serving as a basis for a new CS graduate course she is offering in visualization.

Although such recognition in conferences and journals is welcome and desired, the focus of the CS and IS&T programs has always been on the classroom experience. Thus, faculty members are continually encouraged to enhance their courses. One approach that students particularly appreciate is the incorporation of hands-on labs and demonstrations in classes to augment lectures. Over the years, CS and IS&T faculty have developed a number of special laboratory facilities, with recent ones focused on communications and networking, distributed development, and information security. Jeff Gustin has guided the newest addition in support of his real-time software development class. Gustin is having his students use LEGO Mindstorms kits and a real-time Java development environment to explore concepts based on small robots (Fig. 1).

Enrollments

From its start in the early 1970s, the CS Program grew rapidly. Enrollments peaked in the 1991–1993 academic years at more than 3000 per year and then dipped in response to a drooping national economy. Enrollments picked up again as a result of the dot-com boom and peaked once more in the 1999–2002 academic years. The maximum number of annual enrollments during that period topped 3600 (Fig. 2 provides semester details).

With the passing of the dot-com era, CS enrollments have declined. While the decrease is not surprising, several contributing factors are worth highlighting. First, CS enrollments at the undergraduate level have dropped precipitously nationwide. In fact, recent surveys indicate that the number of newly declared majors in CS declined 32% between 2000 and 2004, and the number of incoming freshmen expressing an interest in majoring in CS dropped by 59% during that same period. Although some anecdotal evidence indicates that undergraduate CS enrollments are stabilizing, and perhaps even starting to increase at some institutions,
there will be a smaller pipeline of students for graduate CS programs, especially large ones like EPP's, for several years to come. A second, related factor is that software development offshoring and outsourcing have discouraged students who would otherwise have pursued CS. This has occurred despite an anticipated demand for IT professionals in the United States that significantly exceeds the expected supply. Finally, many companies have become more frugal with tuition benefits, which has restricted the number of courses that students can take in a given year.

In IS&T, the enrollment picture is still evolving. Starting with 9 enrollments in the spring of 1997, the program has grown steadily and now has more than 300 enrollments each academic year (Fig. 3). Moreover, because of the eclectic nature of the program, in any given semester many IS&T students take courses in other programs. The enrollments in courses outside IS&T are attributed to the supporting program and are not included in the IS&T enrollment numbers. A positive impact is that IS&T has helped bolster enrollments in a number of EPP programs, including CS.

**Partnerships**

An exciting development in the last several years has been the establishment of educational partnerships with industry and government. This has been an EPP thrust, and both CS and IS&T have participated at a significant level. Under the partnership programs, EPP offers a selection of courses at the location of a partner organization. Students benefit from the convenience of the offerings and from the explicit support given by managers and colleagues. Employers benefit from the targeted education that is provided.

In CS, the partnerships have been focused on industry. With Lockheed Martin, for example, CS is supporting the Engineering Leadership Development Program. Three CS courses are offered at Lockheed Martin and have been tailored to satisfy specific company requirements while retaining full academic rigor. The remaining courses are taken at EPP educational centers, in particular at APL and MCC, or online.

IS&T's most significant partnership initiative has been with a coordinating government activity supporting multiple organizations. All required courses are offered at a government site and are drawn from the set of IS&T-specific and applied CS offerings. Significantly, there are on the order of 100 enrollments per year in the IS&T partnership program. In addition, a multi-year schedule has been developed that enables the partnership students to plan complete schedules early in their programs.

**Online Courses**

During the past several years, online courses have been gaining in popularity, and EPP intends to increase the availability of both online classes and programs. Surveys conducted by JHU have shown that although the direct interactions of a classroom setting are reduced, the convenience of online classes outweighs issues that might be associated with the online format. In particular, many part-time students travel for business and travel schedules cannot always be known at the beginning of a semester. Online courses allow students to continue taking classes regardless of travel requirements. Similarly, students who do not live in the area or who...
may have to move from the area can still take advantage of JHU educational opportunities.

In CS and IS&T, faculty members are given the opportunity to propose new online offerings each year, and both programs are considering whether to offer fully online degrees. Currently, 10 CS and 3 IS&T courses are offered online. While the number of courses offered appears to indicate that students could complete a degree online, not all required courses are yet offered in that format. In particular, CS foundation courses are not online, although the course in foundations of algorithms is under development to support the Graduate Bioinformatics Program that will be offered online in conjunction with the Krieger School of Arts and Sciences. In IS&T, two of the foundation courses are offered online.

CONCLUSION

CS is not the program it was more than 30 years ago, nor, for that matter, a decade ago. It has been continually reinvented in response to emerging technologies, student interests, employer needs, and economic demands. Evolving from a set of software development courses in mathematics, it has become a vibrant and comprehensive program that has long served as an EPP pillar. Graduates of the program have both the theoretical foundations and hands-on experience needed to serve as technical and conceptual leaders in the development of complex information systems.

IS&T, a more recent addition to EPP, has evolved into a robust program in its own right. Leveraging its base in CS, IS&T has attracted a new community of students to EPP. In some ways, these students signal the future of IT. Graduates of the program have the appropriate mix of theory, technology, and management to enable them to lead diverse teams in developing solutions to complex information-based problems across a wide range of areas.

Both programs have arrived at a juncture, with the outlook for the future depending largely on perspective. Some say that demand and enrollments will continue to diminish as globalization and outsourcing ultimately displace ever greater numbers of U.S. IT workers. Others contend that with demand for IT professionals strong and growing, there is a need for U.S. colleges and universities to increase the number of CS and IS&T graduates. Moreover, given the currently undersubscribed undergraduate programs across the nation, there will be an even greater need for focused graduate programs to produce highly educated IT professionals. As for us, we see IT playing ever more critical roles in all facets of life and are looking forward to a bright future as we enter the next stage of evolution for both the CS and IS&T programs.

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REFERENCES

Ralph D. Semmel serves as Chair of the CS and IS&T programs in JHU’s Applied Science Programs for Professionals. Dr. Semmel is a member of APL’s Principal Professional Staff and heads the Laboratory’s Applied Information Sciences Department and Info-centric Operations Business Area. His Ph.D. is in computer science, and his research and teaching experience is in the areas of artificial intelligence and database systems.

Robert S. Grossman is Vice Chair of the CS Program, where he has taught software engineering for more than 20 years. Dr. Grossman, who has a Ph.D. in bioengineering, is an electrical and software engineer at APL and a member of the Principal Professional Staff. John A. Piorkowski serves as Coordinator of the IS&T Program. Mr. Piorkowski is a member of the Laboratory’s Principal Professional Staff and Head of the Program Management Office in APL’s Applied Information Sciences Department. He has an M.S. in electrical engineering and a Post Master’s Certificate in telecommunications. Mr. Piorkowski has both engineering and teaching experience in the areas of networking and communications.

Eleanor B. Chlan, whose Ph.D. is in CS, is a full-time Senior Lecturer with JHU, supporting both the CS and IS&T programs. Dr. Chlan’s research and teaching interests are in the areas of information visualization and discrete structures. Further information on the CS and IS&T programs can be obtained from Dr. Semmel. His e-mail address is ralph.semmel@jhuapl.edu.