2006-1398: A NEW FLAVOR OF EET AND CS: BS DEGREE IN NETWORKING AND SYSTEM ADMINISTRATION (NASA) AT UNI

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A new flavor of EET and CS: BS Degree in Networking and System Administration (NaSA) at UNI

Abstract
This paper describes establishment of a new Bachelors of Science Degree program entitled "Networking and System Administration - NaSA" at the University of Northern Iowa. The NaSA major is a cross-disciplinary program supported by electrical engineering technology and computer science majors in the College of Natural Sciences. This paper also reports recently developed curriculum for the NaSA major and lists program requirements in detail. The authors also intend to discuss the curriculum with similar institutions and consider their suggestions for the program enhancement.

I. Introduction

According to the Bureau of Labor and Statistics, computer support specialists and system administrators are projected to be among the fastest growing occupations over the period of 2002-2012 [1]. Due to this reason there are a number of Bachelor of Science in Applied Networking Technologies and System Administration degree programs developed and established all over the U.S. as well as Europe and Asia [2-3]. There are also a number of information technology and networking Baccalaureate degree programs offering in distance education [4]. A list of ABET accredited Computing Programs and Information Technology related institutions can be found at ABET web site [5].

This paper describes establishment of a new Bachelors of Science Degree program entitled "Networking and System Administration - NaSA" at the University of Northern Iowa (UNI). The NaSA major is a cross-disciplinary program supported by electrical engineering technology and computer science majors in the College of Natural Sciences. The curriculum includes mathematics and physical science core, fundamental electrical engineering technology core courses, and computer science classes. A background in the mathematics and physics is very significant for the intended BS degree program. The courses from existing electrical engineering technology major such as electrical circuits, analog/digital electronics, and analog/digital data communications core courses will be excellent flavor for the computer science classes for the NaSA major.

As the first and only major in a state-supported university in Iowa, the Networking and System Administration major is a timely program aimed at preparing graduates for careers and research opportunities in all fields related to reliable and distributed network computing and their corresponding hardware components.

Employment of systems administrators is expected to increase much faster than average as firms will continue to invest heavily in securing computer networks. Companies are looking for workers knowledgeable about the function and administration of networks. Such employees have become increasingly hard to find, as systems administration has moved from being a separate function within corporations to one that forms a crucial element of business in an increasingly

high-technology economy. Also, demand for computer security specialists will grow as businesses and government continue to invest heavily in "cyber-security," protecting vital computer networks and electronic infrastructure from attack.

State of Iowa's Board of Regents has recently approved this new major as a significant need for Iowans. A state-of-the-art Innovative Teaching and Technology Center (ITTC) that will house the classrooms, faculty offices, networking and hardware laboratories for the new NaSA major has been built at the university campus. All the classrooms in the ITTC will include smart boards, multimedia equipment, and wireless internet services. The ITTC is expected to be opened during spring 2006 semester. There are currently about 12 students enrolled in the major and the student enrollment is expected to grow steadily. A new faculty member who has an undergraduate degree in Computer Science and a Ph.D. in Electrical Engineering was hired recently for the program development. There will be more open lines for the new faculty in the future as the program grows.

II. Course of Study and Curriculum

Table I presents the complete course of study for the NaSA major at UNI. A minimum of 127 semester hours are required for graduation with a Bachelor of Sciences (BS) degree. The University requires 45 hours of general education or recently renamed *as liberal arts* classes, and additional 10-13 hours of university electives. The math and science requirements are 16 semester hours including two calculus classes, and two calculus-based Engineering Physics courses as shown in Table 1. The required number of core courses is 65-67 semester hours. This includes Calculus I and II, Physics I and II for Science and Engineering, electrical circuits, analog and digital electronics devices, analog and digital communications, Computer Organization, Computer Science I, II, III, discrete structures, system administration, systems security, operating systems, and networking. Additional two classes in the advanced computer subjects are also required as shown in Table II. Table III indicates required liberal arts core courses. UNI is traditionally a liberal arts college, therefore liberal art core courses have been always significantly more compared with those of engineering colleges. Detailed course descriptions are given on the program web site [6].

Table 1. NaSA major required core courses

Required Curricular Core		
Catalog#	Course Name	Hours
330:037	Introduction to Circuits	3
330:039	Circuits and Systems	3
330:041	Intro to Analog Electronics	3
330:103	Analog Communications	3
330:104	Digital and Data Communications	3
330:152	Advanced Analog Electroncis	3
330:156	Advanced Digital Electronics	3
800:060	Calculus I	4
800:061	Calculus II	4
810:041	Computer Organization	3
810:061	Computer Science I	3
810:062	Computer Science II	3
810:063	Computer Science III	3
810:080	Discrete Structures	3
810:140	System Administration	3
810:141	System Security	3
810:143	Operating Systems	3
810:147	Networking	3
810:180	Undergraduate Research	3
880:130	Physics I for Science & Engineering	4
880:131	Physics II for Science & Engineering	4

Table II Additional Advanced Computer Science Courses to be elected

Major Electives		
Catalog#	Course Name	Hours
810:112	User Interface Design	3
810:114	Database Systems	3
810:115	Inf. Storage and Retrieval	3
810:116	Projects in Inf. Science	3
810:118	Topics in Inf. Science	3
810:142	Computer Architecture	3
810:145	Projects in Computer Science	3
810:148	Topics in Computer Science	3
810:153	Design & Anal. of Algorithms	3
810:154	Prog. Lang. & Paradigms	3
810:155	Translation of Prog. Lang.	3
810:161	Artificial Intelligence	3
810:162	Intelligent Systems	3
810:181	Theory of Computation	3
810:182	Forman Languages	3
810:188	Topics in Computer Science	3

The classes are all oriented towards laboratory-based hands-on experiences both in electrical electronics and computer networking, systems administration, and security. The electrical and electronics classes include introductory and advanced levels ac/dc circuits, electronic circuits and devices, digital electronics and systems, and analog and digital communications. All of these areas include a variety of lab and project activities. The study of microprocessors is facilitated by Motorola evaluation boards based on the 68HC11 family of microprocessors.

Table III. Liberal Arts Core Requirements for the NaSA major

Liberal Arts Core (45 Hours):	
Category I. Core Competencies (12 hrs)	
A. Reading and Writing	3
B. Speaking and Listening	3
C. Quantitative Techn./Understanding	3
D. Personal Wellness	3
Category II. Civilizations & Cultures (9 hrs)	
A. Humanities (I, II, III available)	6
B. Non-Western Cultures	3
Category III. Fine Arts, Literature, Philosophy and Religion (6 hrs)	
A. Fine Arts	3
B. Literature, Philosophy, or Religion	3
Category IV. Nat. Science & Tech. (7 hours)	
A. Life Sciences	4
B. Physical Sciences	4
Category V. Social Science (9 hours)	
A. Sociocultural & Historical Perspectives	3
B. Individual & Institutional Perspectives	3
C. Topical Perspectives	3
Category VI. Capstone Experience (2 hours)	2

Table IV. Recommended Course Sequences

Freshman — Fall — 14-20 credits			Freshman — Spring — 15-27 credits		
330:037	Introduction to Circuits	3	330:039	Circuits and Systems	3
800:060	Calculus I	4	800:061	Calculus II	4
810:061	Computer Science I	4	810:062	Computer Science II	4
810:080	Discrete Structures	3		Liberal Arts Core	0-10
	Liberal Arts Core	0-3		University Electives	0-10
	University Electives	0-3			
Sophomore — Fall — 14-20 credits			**Sophomore — Spring — 6-26 credits**		
330:041	Introduction to Analog Electronics	3	330:152	Advanced Analog Electronics	3
810:041	Computer Organization	3	330:156	Advanced Digital Electronics	3
810:063	Computer Science III	4	810:143	Operating Systems	3
880:130	Physics I for Science and Engineering	4	880:131	Physics II for Science and Engineering	4
	Liberal Arts Core	0-3		Liberal Arts Core	0-3
	University Electives	0-3		University Electives	0-3
Junior — Fall — 0-20 credits			**Junior — Spring — 3-25 credits**		
810:147	Networking	3	330:159*	Wireless Networks	3
	Liberal Arts Core	0-14		Liberal Arts Core	0-11
	University Electives	0-17		University Electives	0-11 (*)
			A new experimental course		
Senior — Fall — 7-29 credits			**Senior — Spring — 7-29 credits**		
330:103	Analog Communications	3	330:104	Digital & Data Communications	3
810:140	System Administration	3	810:141	System Security	3
810:180	Undergraduate Research in CS	1-3		Liberal Arts Core	0-11
	Liberal Arts Core	0-10		University Electives	0-11
	University Electives	0-10			

A Networking class (lecture and lab) has been already offered more than three academic years by the Computer Science Department. This class will constitute one of the major classes in NaSA program. A new class on Wireless Networks is being developed by our new faculty. The class comprises topics on mobile Internet Protocol (IP) and wireless application protocol, wireless LAN technologies and standards, and security issues on wireless networks.

The course offerings of the NaSA major emphasize the *Net-Centric Computing* core of the Joint Task Force on Computing Curricula[7] published by the IEEE Computer Society and the Association for Computing Machinery (ACM). The NaSA major offerings are closely aligned with the Computing Curricula's standards for core content NC1 (Introduction to Net-Centric Computing), NC2 (Communication and Networking), and NC3 (Network Security).

Nationwide there are a number of state-of-the-art networking and digital information technology programs that successfully reengineered electronics engineering and computers science subjects. Bailey et al. applied hardware systems within an information technology curriculum successfully[7]. Similarly, Said et al. developed a summer academy of Information Technology program that recruited many high school students to the science and technology area[8]. One of the first baccalaureate programs in wireless engineering in the US was established within the Samuel Ginn College of Engineering of Auburn University[9]. NaSA program at UNI targets similar developments achieved in the aforementioned institutions to meet needs of telecommunications companies such as Rockwell-Collins Inc. in Iowa, wireless networks service providers, manufacturers of network switching equipment, wireless application developers, and manufacturers of personal wireless communications devices.

Expected career paths for the NaSA majors include Network Administrator, Computer Systems Administrator, Computer Security Specialists, Network Security Specialists, Technical Support Specialist, and Advanced Research on Networking in general. Some research opportunities include High Performance Computing, High Performance Networks, Distributed Environments, Parallel Computing, System Security, Network Security, Data Encryption and Integrity, and the Grid Computing.

III. Future Plans on Community College Articulation Agreements

There are a number of two year associate degree programs offering studies in the information technology and the networking in Iowa Community Colleges. Particularly Hawkeye Community College and Kirkwood Community Colleges are two nearby institutions whose graduates would be expected transferring to UNI for a BS degree in NaSA. There are currently articulation agreements from these institutions to UNI in science and technical majors. We need to investigate community college to UNI transfer opportunities and develop articulation agreements for a smoother transfer process in the Networking and System Administration area.

IV. Conclusions

The Networking and System Administration major is a timely interdisciplinary program aimed at preparing graduates for careers and research opportunities in all fields related to reliable and distributed network computing and digital information technology. The program described in this paper seeks to unite the study of computer science and electrical/electronics engineering technology under the overall scheme of a technological world where a scalability and interoperability of innovative services compete with aspects of security and reliability. Future goals of the program are to enhance recruitment and retention of students, to develop new courses and laboratories in wireless sensor networks, retain and recruit qualified faculty members, and finally to pursue an ABET accreditation.

References

[1] Bureau of Labor and Statistics, http://stats.bls.gov/oco/ocos268.htm

[2] Applied Networking and System Administration Program at Rochester Institute of Technology http://www.rit.edu/~932www/ugrad_bulletin/colleges/ccis/infotech.html

[3] The Bachelors of Science in Network Technologies, DePaul University's School of Computer Science, Telecommunications and Information Systems, http://www.cs.depaul.edu/news/

[4] http://www.worldwidelearn.com/technology-degree/information-technology-degree.htm

[5] ABET accredited Computing and Information Technology related institutions; http://www.abet.org/schoolareacac.asp

[6] UNI Networking and System Administration Program, http://www.cs.uni.edu/NaSA-Web/NaSA.html

[7] "Computing Curricula 2001, Computer Science Volume", December 15, 2001. Published by the *Joint Task Force on Computing Curricula: IEEE Computer Society and Association for Computing Machinery*. http://www.computer.org/portal/cms_docs_ieeecs/ieeecs/education/cc2001/cc2001.pdf.

[8] Bailey M., Helps R., Lunt B., "Hardware Systems within an Information Technology Curriculum", Session 1450, *Proceedings of the ASEE Annual Conference and Exposition 2004,* June 2004, Salt Lake City, Utah.

[9] Said H., Wulf T., "Pathway to Higher Education: Bridging the Digital Divide", Session 3547, *Proceedings of the ASEE Annual Conference and Exposition 2003,* June 2003, Nashville, Tennessee.

[10] Nelson V. P., Chapman, R.O., Jaeger R. C., "A New Baccalaureate Program in Wireless Engineering", *Proceedings of the ASEE Annual Conference and Exposition 2003,* June 2003, Nashville, Tennessee.