A New Undergraduate Program in Information Science

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Abstract

A new undergraduate program in Information Science is described. The program addresses the need for graduates prepared to specialize in the use of computerized information. This is a unique program. It is a technically challenging program that builds on a strong foundation in computing and looks at information as a serious topic of study in its own right. The program shares its first three semesters with a Computer Science (CS) degree program; however it includes five required courses that are not required of the CS majors and boasts a different, albeit overlapping, set of elective courses. The program promises to be exceptionally strong in its coverage of Web related topics and information theory.

Keywords: information science, curriculum, undergraduate, computing, rationale

1. INTRODUCTION

A new undergraduate program in Information Science (ISC) was approved by Villanova University in the fall of 1999 and will begin accepting students as majors in the fall of 2000. The program, offered by the Department of Computing Sciences in the College of Liberal Arts and Sciences, focuses on the challenges and opportunities connected with every aspect of information as influenced by computing devices. The program combines a strong background in computing with a focus on the theory and application of information modeling, acquisition, representation, storage, indexing, manipulation, retrieval and management. Information forms include text, audio, video, image, animation, and hypermedia. Applications of this field include corporate information management, scientific databases, digital libraries, and medical informatics. Research and development topics include new techniques in the effective augmentation of information through computing. This paper describes the rationale and curriculum for the new program, plus how the program relates to our current accredited bachelors program in Computer Science (CS).

2. RATIONALE

We have witnessed a shift in the major use of computers, from number crunching to the storage, retrieval, and transmission of information. An increasing reliance on information resources and the very visible impact of the World Wide Web have led to large numbers of positions for graduates with computing degrees and a corresponding increase in interest in computing programs by incoming students. The Occupational Outlook Handbook lists "computer and data processing services" as the fastest growing industry by a wide margin (U.S. Department of Labor 2000). While abundant opportunities exist for students completing traditional computer science programs, new areas have emerged with requirements of their own. Students completing our new degree program in Information Science will be better prepared for these career choices and advanced study in these areas.

Accordingly, our program was designed to meet the following objectives:
- To address the need for graduates prepared to specialize in the use of computerized information, including the transformation of raw data to information, effective access to stored information, and appropriate presentation of information to those who need it.
- To offer current and future students additional options on the cutting edge of the field.
- To attract additional qualified and well-motivated students to Villanova University.
- To explore interest and opportunities for additional interdisciplinary activities, particularly with the College of Commerce and Finance (MIS), the College of Nursing (Nursing Informatics), and the Law School (co-sponsor of the Center for Information Law and Policy), as well as with specific information-centric activities in individual disciplines

within the Colleges of Liberal Arts and Sciences and Engineering.

- To build upon the existence of one of our university's resources (the archive of the works of St. Augustine) to develop a specialization in retention and use of digitized materials.

3. UNIQUENESS

Other programs concentrating in Information Studies exist, including programs at local universities (Drexel 2000). However, no existing program that we have found addresses the issues at the comprehensive level proposed in this new program. Existing information-centric programs cluster into three types:

- Programs entitled "Computer and Information Science (or Systems)" in which there is very little attention to the information component of the discipline.
- Programs in Information Systems or Management Information Systems found in Colleges of Business. These focus on the management and business aspects of the value of information rather than the theory and technical aspects of information as affected by computing and communications.
- Programs in Information Sciences in schools of Library Science. These programs focus on the organization, indexing, and efficient access to information as traditionally understood in the context of libraries. Much of the material is relevant in a larger context, but the programs are too narrowly focused to meet the needs of the broader community for expertise in information-centric work.

Whereas we did study several valuable information sources and curriculum models (Feather 1997; Gorgone 2000; Lidtke 1998), we believe the program described in this paper is unique. It is a technically challenging program that builds on a strong foundation in computing and looks at information as a serious topic of study in its own right. The graduates of this program will be well qualified for positions requiring expertise in all aspects of information treatment.

We believe that our program can:

- satisfy the industry's needs for well-prepared graduates in its most vital area of growth;
- become, in time, a magnet for a considerable number of new students;
- attract wide attention as a novel alternative to existing attempts to educate computer specialists;
- give an excellent foundation for graduate studies in this and related areas;
- serve, in time, as a prominent research center in this evolving academic discipline.

4. CURRICULUM

The new major, especially in its infant stages, will build on our current strong program in Computer Science. The table below shows the technical requirements of our two programs, side by side, broken down by semester. Differences between the programs are shown in boldface under the Information Science Course column. We use the standard two semester academic year, with each semester lasting 14 weeks plus exams. One credit hour is therefore equivalent to about 14 hours of classroom contact.

Computer Science

Information Science

Sem	Course	Credits	Sem	Course	Credits
1	Algorithms and Data Structures	4	1	Algorithms and Data Structures	4
	Calculus	4		Calculus	4
2	Algorithms and Data Structures II	4	2	Algorithms and Data Structures II	4
	Discrete Structures	3		Discrete Structures	3
	Calculus II	4		Calculus II	4
3	Computer Organization	3	3	Computer Organization	3
	Statistics	3		Statistics	3
	Science	3			
4	Operating Systems	3	4	Operating Systems	3
	Algorithms	3		**Database Principles**	3
	Science/Math	3		**Survey of Information Science**	3
5	Programming Languages	3	5	**Information Retrieval**	3
	Theory of Computation	3		**Theory of Information**	3
	Science with lab I	4		Science with lab I	4
6	Software Engineering	3	6	Software Engineering	3
	CS Elective	3		**Web Application Development**	3
	Science with lab II	4		Science with lab II	4
	Ethical Issues in CS	3		Ethical Issues in CS	3
7	Senior Projects	3	7	**IS Elective**	3
	CS Elective	3		**IS Elective**	3
8	CS Elective	3	8	**IS Elective**	3
	CS Elective	3		**IS Elective**	3

First, a few notes about some of the courses that are common between the two programs. The Algorithms and Data Structures sequence introduces the students to programming with the Java language, object oriented terminology and design approaches, plus algorithms and data structures. The Discrete Structures course covers mathematical structures and techniques that support computer science. The Computer Organization and Operating Systems courses together present the structure of a computer system and the system software that controls it - they include coverage of storage representation and file systems, both of special interest for ISC majors. We are considering revamping our Operating Systems course to include more emphasis on computer security, to better serve both our majors. The Software Engineering course surveys the discipline of software engineering, with a particular emphasis on object oriented approaches. The Ethical Issues in CS course is actually a philosophy course that addresses issues such as software ownership and the social responsibilities of computing professionals.

Let us now address the courses which differentiate our IS program from our CS program, the ones shown in boldface in the table. Two of these courses, Database Principles and Web Application Development, already are offered by our department as CS electives. Both are very popular electives. Their catalog descriptions are:

Principles of Database Systems: Concepts and technology of database management systems; data modeling with an emphasis on the relational model; database querying and normalization; physical data organization.

Web Application Development: Introduction to both the theory behind Internet applications and the practice of building those applications; software engineering issues underlying the development of applications that have a WWW interface; specific problems addressed include effective bandwidth, security, and reliability.

The other three courses are new, and as of this writing have not yet been offered. Their catalog descriptions are:

Survey of Information Science: Brief introductions to several areas in which problems in information use are important. The specific areas will vary, but examples include business, law, bioinformatics, medicine, electronic commerce, and libraries.

Information Retrieval: Theory and practice of location, organization, and rendering of meaningful content in largely unorganized sources.

Theory of Information: Information and coding theory, data compression, and cryptology.

The current identified set of IS electives includes three courses from the CS program (Human Computer Interaction, Information Visualization, and Computer Networking) and the following two new courses:

Data Warehousing and Mining: Tools and techniques, theory and practice for storage and effective use of massive data sets.

Expert and Knowledge Systems: Knowledge representation, uncertainty, automated knowledge acquisition, practical aspects of implement expert systems.

The most visible manifestation of the historic shift of computing from number crunchers to information managers is the explosion of Internet use by industry, government, and people in general. Organization, discovery, transmission, and presentation of information on the World Wide Web is a central theme of the field of Information Science. This prominence will be duly reflected in the new program's curriculum, which will provide students with a unique training in the fundamentals, technology, and applications of information. In addition to the required Web Application Development course we expect many of the other courses to include content related to the Internet and the Web. The Algorithms and Data Structures courses will use Java, the programming language of choice for many Web applications, for the foreseeable future. The Information Retrieval course will include units on intelligent and automated searching on the Web, and will cover aspects of making information available over the Web. The elective course Computer Networking includes units on the architecture and protocols of the World Wide Web and, of course, covers many other network issues such as data compression, encryption, client-server interaction, protocols and security.

Another area where our new program will take a unique approach is theory. Whereas our CS majors will continue to study the theory of computation (Chomsky hierarchy, Church's thesis, NP-completeness) the IS majors will study the theory of information. An initial list of topics for this course includes:

- information and entropy
- instantaneous codes and Kraft's inequality
- Huffman codes
- the Noiseless Coding Theorem
- the Main Coding Theory Problem
- the Noisy Coding Theorem
- linear codes
- other special codes (Hamming, Golay)
- lossless data compression
- elementary methods of cryptology
- RSA algorithm

5.   IMPLEMENTATION

The Information Science program's relationship with the current Computer Science program will help us to efficiently implement it. The ISC majors are required to take eight courses that are already offered by our department. In fact, the first three semesters for the two programs are identical, as you can see from the table above. The overlapping of the two programs in the early stages will allow students to delay their decisions about which program to pursue until after they have had more exposure to the broader discipline of computing.

Creation of the upper level IS electives will be an interesting, but time consuming task. This burden is alleviated somewhat since the list of IS electives, from which IS majors will need to choose four courses, includes three existing courses. We also hope to work with the College of Commerce and Finance to develop one new course to be offered by that college as a service to our IS majors.

Therefore, we will only have to create a total of five new courses to implement the new program: Survey of Information Science, Information Retrieval, Theory of Information, Data Warehousing and Mining, and Expert and Knowledge Systems. The last four new courses will make suitable electives for the current Computer Science majors, which should help us to integrate these courses smoothly into our offerings. A computer science major could take one or two of these new courses within the options of the accredited computer science degree program.

Some Computer Science majors may choose to move to the new program because of the type of work for which it will prepare them. Students with particular interest in the computer system itself and in many kinds of computationally intense applications will choose to remain in the Computer Science program; students with particular interest in applications and systems centered on information will move to the new program. By having both programs available, the department will serve the existing student body better and be attractive to a body of students who currently do not find their interests matched by our offerings.

6.   SUMMARY

Our new program in Information Science will begin accepting students in the Fall of 2000. We have described the goals and plans for the program. We welcome any feedback from interested readers about our plans.

7.   REFERENCES

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