An Information Systems-Centric Curriculum
ISCC ’99

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Abstract- The ISCC ’99 (Information Systems-Centric Curriculum) is unique in that it was specifically to meet the needs of business and industry. The curriculum was cooperatively developed by a group from industry and academe and has been reviewed by a large group of reviewers. The review led to some revisions. The curriculum is now available for dissemination at www.iscc.unomaha.edu. This project was funded by several NSF/DUE grants and has been partially implemented in at least two institutions. The implementations seem to be very successful and can be models for curricular reform in many institutions. The lessons learned in the development of the curriculum can be of help to others.

This curriculum is specifically designed to prepare graduates to work on very large, complex systems. There is a great deal of emphasis on students understanding of a systems view and that information is at the center of the system.

Introduction

The Task Force developed the ISCC ‘99 curriculum over a four-year period. The members from business and industry prepared a “Profile of the Graduate” to describe the skills and knowledge they wanted in a new hire. This “Profile of the Graduate” became the specification for the design of the curriculum. This Profile includes the required technical skills, the personal skills deemed necessary, and the desired personal attributes. A modified Bloom’s taxonomy was used to indicate the level of each skill deemed necessary for each knowledge unit. This allowed the Task Force to design the curriculum to take an incoming student and, through the process of the curriculum, develop a student with the desired attributes.

Some of the innovative aspects of the curriculum are: 1) a course in Dynamics of Change, 2) having students begin to look at real computing systems and analyze them in the beginning course, 3) having both a) a comprehensive project which covers all the important aspects of a system design and b) a real-life experience in the development of a part of a system in a business or industrial environment, and 4) integration throughout the curriculum of the development and practice of personal skills. This paper describes these unique aspects.

In addition to course syllabi for each of the eleven recommended course, there are suggested activities to assure that the students have experience with the concepts and attain a level of learning to meet the needs established by the industrial members of the taskforce in their Profile of the Graduate. Further group activities, activities that enhance or develop communications skills are highlighted. Professional and ethical issues are emphasized.

Profile of a Graduate

The personal, interpersonal and technical skills desired in the graduate are outlined below:

Personal Skills

• Systemic thinking
• Problem solving
• Critical thinking
• Risk taking
• Personal discipline
• Persistence
• Curiosity

Interpersonal Skills

• Collaboration
• Oral, written, listening, and group communication
• Conflict resolution

Technical Knowledge and Skills

[The detailed subheadings under this section are quite lengthy and are covered in considerable detail in the course outlines, which are available in the complete publication of ISCC ’99.]

• Information abstraction, representation and organization
• Enterprise computing architectures and delivery systems

1 This work was supported by the National Science Foundation through grants DUE-9455450 and DUE-976243
• Concepts of information and systems distribution
• Human behavior and computer interaction
• Dynamics of change
• Process management and systems development
• Use of computing tools to apply knowledge

ISCC '99 was designed to develop a graduate who will meet the industry profile listed above. In addition the graduate is prepared with the fundamental concepts to pursue life-long learning. The ISCC '99 curriculum does not replace traditional Information Systems (IS '97) or Computer Science Curriculum '91) curricula, but builds upon the foundations of computing, just as these curricula, to produce a new type of graduate. This curriculum is designed to prepare graduates to work as members of a team in developing, deploying and maintaining large, complex computing systems. The emphasis from the first course until the final course is on the entire system, including the software, the hardware, and the people who use the system.

The ISCC '99 curriculum document specifies in detail with the computing courses needed. The Task Force felt that these were the essential courses that would be offered by the department or group responsible for this curriculum. Because of the importance of ethics, just as these curricula, to produce a new type of graduate. This curriculum is designed to prepare graduates to work as members of a team in developing, deploying and maintaining large, complex computing systems. The emphasis from the first course until the final course is on the entire system, including the software, the hardware, and the people who use the system.

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Preparing students to work with large systems

The working group’s industry representatives saw a real problem in the development, deployment and maintenance of large systems. The popular press reports many incidents of complex systems failures and the literature is full of cases relating to failures of large systems. The focus of this curriculum is on preparing students to work with large, complex systems. We believe that in most cases this same preparation will also prepare students to work on mid-size systems.

A close collaboration between industry and academia

There are many parts of the curriculum that can only be effective if there is collaboration between the college and local business and industry. The final course is almost entirely dependent upon business and industry since they will provide the actual project for the students. In the two pilot studies of offering this course, industry was very involved. The two pilot projects were Boeing working with the University of Washington and American Express working with Arizona State University. [The Boeing-University of Washington project was reported in ACM SIGCSE Symposium, 1997.] Both of these pilot projects were deemed to be extremely successful by the industry and by the students. In fact, the course at the University of Washington received the highest rating by students of any course in the department.

The first course will be more motivating to students if they have contact with people from business and industry. Students will profit from tours of industry, seeing an information system at work. They will also learn about the field of computing by hearing a number of computing professionals give presentations and answer questions about various applications and careers in computing. Throughout the curriculum, cases studies provided by industry can improve the quality of the projects. Finally, the curriculum will be enhanced by exchange of faculty and qualified people from business and industry. Many people from industry can be very effective teachers, particularly of courses where they have special expertise. Faculty can improve their understanding of enterprise computing by spending a year or summers working in industry.

Curriculum elements

a. A systems view from the beginning
b. Group work from the beginning
c. An emphasis on systems design and software engineering principles
d. A mix of practical applications throughout
e. Two comprehensive courses - an internal project and an external project
f. Dealing with group behavior
g. Dealing with dynamics of change
h. Applications of artificial intelligence

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Innovations in this curriculum

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covered in a technical course dealing with the
documentation, tracking and dealing with change, but also
how the individual, group and organization must deal with
change in this field. Students are seldom aware of how
change may impact them, their group or their organization,
nor are they aware of the typical reactions to such change, so
they are unprepared for the reactions that they and their
colleagues may have to change, be it major or minor. This is
a new course and has yet to be taught.

Content of the Curriculum

It is important to realize that, in addition to the formal
course outlines, many critical skills and practices are
integrated throughout this curriculum and are expected to be
a part of every course. The following should be pervasive
throughout the curriculum:

• The development of individual and team portfolios.
• The development of oral and written communications
  skills for individuals and teams, including listening
  skills.
• The use of available tools for developing and managing
  projects.
• The integration of a work ethic and principles of
  professionalism.
• The repeated use of hands-on practica to emphasize
  concepts.
• The continuous involvement of industry in providing
  experiences that support the curriculum’s philosophy.

Students need to develop analytic capabilities through a
study of probability and statistics, discrete mathematics, and
quantitative methods 1) to provide them with tools to
analyze data trends, 2) to give them the mathematical basis
to understand digital devices and data representations, and 3)
to support quality metrics.

Students need to develop team skills and cultural
awareness. Courses in psychology and group behavior
should help with the development of these skills, but they
need to be practiced throughout the computing curriculum.
Faculty members need to be more aware of the techniques of
fostering good teamwork and should coach their students in
acquiring these skills as well as technical skills.

The industry and business members of the Task Force
clearly support a strong emphasis on computer ethics in the
curriculum. This is interpreted in a broad sense and includes
professionalism in the field of computing.

The course sequence is designed to present a systems
view of an enterprise information system and to introduce
the students to team activities early in the curriculum. As
the course sequence advances the students learn about the
development of individual components in an information
system and the segment of information systems to which
they can contribute. When students have developed
competence in the development of the systems components
they are ready to put them together. Near the end of the
course sequence the curriculum turns once more to the total
systems-centric view of an information system and provides
the conceptual structure and the practical experience to
enable the students to function in a team environment to
design and evaluate an enterprise information system.

A description of the curriculum and its contents are
provided below. The support courses are presented first and
then the central core of the curriculum is described. Figure 1
provides a view of the sequencing of the courses.

Development of Analytical Capabilities

The curriculum includes probability and statistics, discrete
math, and quantitative methods to give a student tools to
analyze data trends, to develop meaningful simulations, to
provide the mathematical basis to understand digital devices
and data representations, and to support quality metrics. The
courses should emphasize the application of the
mathematical concepts and techniques to problems in
computing and information systems.

Development of Team Skills and Cultural Awareness

The computer ethics courses, ISCC-22 and ISCC-52,
[together equivalent to about 3 semester credit hours], in
addition to covering ethical and professional issues, develop
a student’s abilities to understand the implications of their
work as it affects individuals and society. They study issues
related to system security, they become familiar with legal
issues relating to computers and information, and examine
some of the impacts of computing on society.

Critical to this sequence is the effectiveness in
producing information systems practitioners who are
concerned with the organizational, societal and human
impact of their work.

Course Descriptions

The main courses, which are a part of the curriculum, are
listed below, followed by the complete course descriptions:
ISCC-11 Information Systems in Enterprises
ISCC-21 Information Systems Architecture I
ISCC-22 Computer Ethics I
ISCC-31 Information Systems Architecture II
ISCC-41 Information Databases and Transaction Processing
ISCC-42 Human computer Interaction Issues and Methods
ISCC-43 Telecommunications and Networking
ISCC-44 Dynamics of Change
ISCC-45 Applications of AI in Enterprise Systems
ISCC-51 Distributed Systems
ISCC-52 Computer Ethics II
ISCC-53 Comprehensive Enterprise Information Systems
Engineering
ISCC-61 Comprehensive Collaborative Project
Course Descriptions

ISCC-11 Information Systems in Enterprises

Students are immersed in the information system field. They observe information systems used in organizations. They develop rudimentary abilities to critique systems. They begin to develop the vocabulary of the field. Using modeling tools they construct and exercise models of a variety of information systems at a block diagram level. In all of their activities the role of the team is emphasized. Team techniques are practiced from the beginning.

ISCC-21 Information Systems Architecture I

Students are introduced to the hardware and software components of an information system. The course emphasizes problem solving and design paradigms. The students are introduced to beginning programming concepts and object oriented programming. The students are introduced to computer organization and information systems organization. The students practice their programming skills individually and in a small group environment. The place of the software and hardware components in an information system is presented.

ISCC-31 Information Systems Architecture II

The concept of information abstraction is introduced and the role of abstraction in the development of an information system architecture is discussed. The students are introduced to data structures and practice the development and utilization of the data structures in an object oriented environment. A course project is prescribed to assist the students in the development of their design and programming skills. The project involves small teams.

ISCC-41 Information Databases and Transaction Processing

The concepts of data models and data modeling are presented. The design and normalization of data for the database of their choice is discussed. Query processing is presented and students exercise a query processor against a database they have created. Students are introduced to transaction processing with the associated concurrency; integrity and recovery problems of a transaction based system.

ISCC-42 Human Computer Interaction and Methods

The machine information processing components, the human information processing elements and the methods/techniques to adapt them to each other are emphasized. The development process and the design and testing of interfaces are studied. Students not only learn about the principles of good human-computer interaction, they deploy systems that are tested for their effectiveness and accuracy. This course utilizes a lot of small team activity.

ISCC-43 Telecommunications and Networking Issues and Methods

Much of the material covered in current networking courses is contained in this course. Students gain a working knowledge of the connectivity issues, performance issues, and the standards and protocols of a variety of networking configurations. The students experiment with the development and use of networking simulators in configuring and testing networking designs.

ISCC-44 Dynamics of Change

Students are introduced to change as it impacts people, processes, and products. They will learn about designing for change. They employ tools for dealing with and managing software change. They learn about coping with change as an individual, a member of a group and a member of an organization. The student is made aware that, as an information systems professional, he/she is an agent of change.

ISCC-45 Applications of AI in Enterprise Systems

The fundamental concepts of Artificial Intelligence programming are introduced. The course emphasis is directed toward the development of expert systems and intelligent agents that will enhance user interfaces and will provide intelligent assistance to the users of an information system. The course requires several projects. The course uses a small team environment for project development.

ISCC-51 Distributed Systems

Distributed information systems are explored at the organization level, the functional level, and the user support level. Emphasis is placed on understanding how management, systems organization, hardware, software, and user requirements function together to produce an enterprise information system. Several different configurations for distributed functionality are explored. Data flow simulations are used to test configuration alternatives for satisfying competing requirements such as systems response speed and systems implementation costs. A small team environment is used to develop the projects for the course.

ISCC-53 Comprehensive Enterprise Information Systems Engineering

A systems approach to the design of an enterprise information system is discussed. Required data needed to
develop a quality information systems design is reviewed. Techniques for systems requirement data gathering are presented. A systems requirement specification is developed from provided user interviews. Design techniques for going from the specification requirements to a system configuration are discussed and utilized. A system design is developed and alternative configurations of the design are tested using systems simulation as a tool. The course uses a team approach to systems engineering.

**ISCC-61 Comprehensive Collaborative Project**

This course provides a summative experience for the student, incorporating a range of activities that they have prepared for in their coursework leading up to this course. Ideally this course is a project done in collaboration with industry. The students work as team members on an industry development team that has co-project managers from academia and industry. They will design and implement portions of a complex industrial project.

**Why We Feel This Will Better Prepare Students**

**Meets the Needs Articulated by the Business and Industry Members of the Task Force**

The curriculum has been carefully checked to see that it meets the level of learning for each of the specified technical knowledge skills in the Profile of the Graduate, which is the specification of the representatives from business and industry. In addition, many industry people, with uniformly positive evaluations have reviewed the curriculum. The curriculum attempts to address the development of personal and interpersonal skills by designing learning activities that require group activities and communication.

**Students Have a Better Understanding of Teamwork**

In addition to the practice that students will have in working in different group situations, they will take courses in group behavior, ethics and Dynamics of Change. These courses are designed to hone the skills of each student to function better as a member of a team and to understand the dynamics of group work, even how to be an agent of change within these situations.

**Emphasis on Doing as well as Knowing Prepares Students to be Work-ready**

Students will be introduced to enterprise information systems in the first course through actual visits to observe functioning large information systems or through speakers from business and industry describing such systems. Industry will be encouraged to provide many of the problems for work in the classes. In the final course, students will work as a member of an industry team on some segment of a large enterprise system.

**Conclusion**

ISCC ’99 provides a conceptual foundation for graduates who wish to become involved as members of teams in the design and implementation of complex, enterprise information systems that meet the diverse and complete information requirements of today’s and tomorrow’s industry. This approach emphasizes the systems view, which is introduced early in the curriculum, along with teaming and communications skill building through practice. The systems view is central to the courses in the middle years, as students learn to build and exercise systems components. In the final courses in ISCC ’99 students participate in the design and simulation of enterprise wide information systems.

This curriculum could probably be implemented as a track in an IS or CS program. Such a track would be created from the traditional mathematics and technical courses in the program, adding the systems concepts from ISCC-11 and selected courses from the 40 and 50 level courses in the ISCC ‘99 curriculum. Care would need to be taken in developing the broad view of systems, personal and interpersonal skills which business and industry representatives feel are so important in developing large, complex enterprise systems.

The review copies of this curriculum have been used by several institutions as they develop and revise programs in information science, information technology and information science engineering. Some institutions are planning to submit proposals to the National Science Foundation to adapt or adopt this curriculum. The University of Nebraska at Omaha plans to fully adopt this curriculum. Final assessment of the results of this effort can only be made when the curriculum is adopted or adapted and students have completed the program.

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