The recommendations of the 1972 and 1973 ACM Curriculum Committee on Information Systems programs have been influential in the development of degree programs at the bachelor's, master's, and doctoral levels. The earlier curriculum has been revised and updated based on advances in the field over the past nine years. The report discusses the continuing need for education related to the definition, analysis, design, construction, and management of information systems in organizations. The structure of both bachelor's and master's level programs are described and courses are defined. Course outlines include rationale for the course, course objectives, instructional modes, and a list of topics. Each topic is weighted in terms of suggested percent of time devoted to the subject.


General Term: Management

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Preface

This report contains curriculum recommendations prepared by the ACM Curriculum Committee on Information Systems (C2IS). The recommendations are based on earlier work of the ACM Curriculum Committee on Computer Education for Management and the ACM Curriculum Committee on Computer Science. The basic structure provided by earlier curriculum efforts has remained intact.

After C2IS completed the survey of information systems (IS) programs in 1979, the Committee started discussing a revised curriculum with representatives of business, government, and educational institutions. Many people assisted the C2IS group in its work on this report. An initial meeting on the project was held in New Orleans in November 1979. The group from the New Orleans meeting was divided into three subgroups to work on detailed course outlines. During July 1980, the subgroups held meetings in Atlanta, Dallas, and Colorado Springs. The results of the subgroups were presented at a workshop held in Tucson in November 1980. The results of the Tucson workshop were discussed with individuals representing both business and government at a March 1981 meeting in Dallas.

Many suggestions and constructive comments resulted from the review process and the comments from various meetings have been incorporated. The Committee is grateful to the reviewers and to the meeting participants. The names of those who assisted the Committee appear in the Acknowledgments at the end of the report.

The Committee undertakes full responsibility for the substance of the report and the conclusions and recommendations contained in it.

Committee membership during the preparation of this report was

J. F. Nunamaker, Jr., Chairman, University of Arizona
J. D. Couger, University of Colorado
William Cotterman, Georgia State University
Gordon B. Davis, University of Minnesota
Benjamin Diamant, IBM
Andrew Whinston, Purdue University
Marshall Yovits, Indiana-Purdue University at Indianapolis

1. Historical Review

The need for an information systems (IS) curriculum is greater today than when it was first outlined in the position paper by a committee of the ACM 10 years ago [1]. The ACM Curriculum Committee on Information Systems and its predecessors have been very active in the establishment of guidelines and objectives for a curriculum in information systems, and the efforts of the committees over the past 10 years have resulted in the publication of a number of significant documents [1–9]. This report is a revision and update of the 1972 and 1973 ACM information systems curriculum reports.

The ACM curriculum efforts for information systems (as contrasted with computer science) began with the ACM Curriculum Committee on Computer Education for Management. This committee, supported by a National Science Foundation grant, was established to evaluate the state of the art and to develop a series of recommendations for improving computer education for management. To provide the committee with material for its study of curricular needs, five regional meetings were held in the United States in 1970. At each meeting a broad section of invited academicians and practitioners considered the state of curricula in business schools. Three topics were covered: curricula for the general manager; computer-related material in required and functional courses; and curricula for students concentrating on computer-based information systems.

An analysis of the minutes of the meetings revealed a common set of experiences which raised similar pedagogic and economic issues. A paper [1] by two members of the committee, J.L. McKenney and F.M. Tonge, provided a summary of the discussions, a condensation of the pedagogic and substantive concerns raised, and a consideration of the resource allocation issues involved. This report was preliminary to the committee's recommendations for improving computer education for management; it provided the participants and the administrators of institutions with background information for the ongoing task of course development.

The McKenney and Tonge report was followed by the Teichroew report [2]. The latter documented the need for education in administrative information systems and the need for appropriate college curricula and courses. The educational roles of professional societies and organizations using computers also were discussed, and the plans of the committee were outlined.

Significant parts of the Teichroew report were descriptions of the education necessary for the effective use of computers in organizations, a classification of the positions for which education is required, and a survey of educational programs available at that time. The Teichroew report made a useful distinction between the functions of an information analyst and a systems designer.

The curriculum guide for graduate programs in information systems [3] was published in 1972 with Robert L. Ashenhurst as editor. This report explicitly recognized the educational requirements for two types of graduates: (1) technically trained systems designers, and (2) managerially oriented information analysts. The curriculum report includes

- discussion of the need for education related to information systems in organizations
- proposed curriculum and degree programs in universities at the master's level
- curriculum materials and course descriptions
- program organization and implementation questions.

A complementary report on curriculum recommen-
Motivation for the Revised Curriculum

The motivations for the revised curriculum built upon those that motivated earlier curriculum efforts, expanded to take into consideration changes in the importance of information systems, advances in technology, improvements in information systems analysis and development processes, and an increased need for information systems management skills.

The need for increased organizational productivity is a major motivation for improved information systems and improved education for information systems analysts and designers. The direct and indirect influence of information technology is viewed as a major aspect of productivity growth.

Labor economics and skill requirements in the private and public sectors have resulted in increasing demand for more information systems and broader application of the information systems technology. The interest in information systems solutions to business problems is growing at a rapid rate, well exceeding the capabilities of the information systems community to satisfy these demands. In addition to the increase in the total number of systems in use, an increase in average complexity compounds this problem. New graduates today should be better prepared than their predecessors to handle the ever increasing complexities of design.

In order for the information systems community to face the current and future demands, the curriculum should address the basic goals of

1. people needs
2. skill needs
3. tool needs.

Concepts of data and resource sharing are becoming increasingly important. Complex internal and external forces face the public and private sectors. The curriculum must address new skill demands related to these developments and should prepare the IS student for greater involvement in organizations.

The major changes of this report relative to the 1972 [3] and 1973 [4] reports focus on the following:

- integration of management skills; the communications, writing, and behavioral skills have been integrated into the sequence of courses dealing with organizational concepts and concerns
- inclusion of data management and data communication courses
- inclusion of the AACSIB common body of knowledge as a major component of the curriculum
- introduction of the MIS policy course as a capstone to the program.

Related Curriculum Efforts

There are three major curriculum efforts that relate to the IS curricula: (1) the IEEE Software Engineering Proposal; (2) the IFIP curriculum efforts; and (3) the DPMA Computer Information Systems Proposal.
IEEE Software Engineering

The Institute of Electrical and Electronic Engineers produced a draft report on software engineering. The IEEE Committee has not adopted the recommendations in the report [10].

IFIP Curriculum

The International Federation of Information Processing published its curriculum for information systems designers in 1974 [11]. The TC3 Committee of IFIP is in the process of updating that curriculum.

DPMA Computer Information Systems Proposal

The general objective of the Data Processing Management Association's effort is to develop a model curriculum for undergraduate computer information systems education for the 1980s. The DPMA model curriculum committee has identified its target as the computer information systems programs of community colleges and universities, with secondary interest in high school programs.

A complete description of the DPMA Model Curriculum is described in [12]. Professor William Mitchell has provided a critique and evaluation of the Cal Poly/DPMA Model Curriculum for Computer Information Systems [13].

2. Curriculum Requirements

The Philosophy of the Information Systems Curriculum Structure

The basic philosophy of the IS program is based on the premise that graduates of the program will be employed for major segments of their careers in positions involving organizational information systems. They will

• assist in defining and planning information systems
• elicit information requirements for applications and assist in designing the systems
• implement information systems applications
• manage information system development and operation.

Information systems graduates should not be limited to these four functions in their career path, but should be qualified by their educational orientation to take positions both in functional areas in organizations and in general management.

Because of the organizational context of the work environment for the IS graduate, the structure of the curriculum assumes an understanding of organizations, organizational processes, and functions within organizations. The information systems designer/implementer is a boundary spanner and a change agent. Therefore, the organizational knowledge should include an understanding of the typical problems encountered by boundary spanners and change agents and the common concepts, strategies, and tools required of the individuals performing such roles.

Finally, organizational knowledge should also include human relations and interpersonal skills for communicating. In addition to support courses in communication, English, and human relations, instruction integrating these skills should be incorporated in the information systems curriculum to prepare students to succeed in the complex environment of information systems.

The nature of the work to be performed by information systems graduates therefore establishes three major knowledge requirements:

1. information systems technology
2. information systems concepts and processes
3. organization functions and management (including interpersonal and organizational behavior).

These three areas of knowledge interact. Information systems technology is applied through information systems analysis and design processes to provide information systems for organizational functions.

Uniqueness of IS Curriculum

The IS curriculum differs from a computer science curriculum in the environment in which the program is taught, the employment environment for the graduate, and the depth of technical expertise required.

1. The IS curriculum teaches information system concepts and processes within two contexts, organization functions and management knowledge and technical information systems knowledge, whereas computer sciences tends to be taught within an environment of mathematics, algorithms, and engineering technology.
2. The IS graduate is expected to work within the environment of an organization and to interact with both organizational functions and computer technology. The computer science graduate has less interaction with organizational functions and more interaction with hardware and software technology.
3. In technical expertise, the IS curriculum places substantial emphasis on the ability to develop an information system structure for an organization and to design and implement applications. There is less emphasis on depth skills in hardware and software design. The computer science graduate typically has less exposure to information requirements analysis and organizational considerations but obtains greater expertise in algorithm development, programming, and system software and hardware.

Output Characteristics of the Graduates

The graduate of a professional IS program should be equipped to function in an entry level position and should also have a basis for continued career growth. The entry level positions for graduates, of course, depend on a variety of factors, such as background and previous work experience. However, in general the entry level positions are:

1. Systems Analyst (entry level). This may be an information analyst working primarily with users to...
Table I. Needed Knowledge and Abilities for Working Effectively in Information Systems

(a) People
Ability to hear others as well as to listen to them
Ability to describe individual and group behavior and to predict likely alternative future behavior in terms of commonly used variables of psychology and economics
Ability to describe and predict task-oriented, time-constrained behavior in an organizational setting

(b) Models
Ability to formulate and solve simple models of the operations research type
Ability to recognize in context the appropriate models for situations commonly encountered

(c) Systems
Ability to view, describe, and define any situation as a system—specifying components, boundaries, and so forth
Ability to apply this "systems viewpoint" in depth to some class of organization—manufacturing firms, government bureaus, universities, hospitals, service providers, etc.
Ability to perform an economic analysis of proposed resource commitments (includes ability to specify needs for additional information and to make a set of conditional evaluations if information is unavailable)
Ability to present in writing a summary of a project for management action (suitable to serve as a basis for decision)
Ability to present in writing a detailed description of part of a project for use in completing or maintaining same

(d) Computers
Knowledge of basic hardware/software components of computer and communication systems and their patterns of configuration
Ability to program in a higher level language
Ability to develop several logical structures for a specified problem
Ability to develop several different implementations of a specified logical structure
Ability to develop specifications for a major programming project in terms of functions, modules, and interfaces
Knowledge of sources for updating knowledge of technology
Ability to develop the major alternatives (assuming current technology) in specifying an information processing system, including data files and communications structures, to the level of major system components
Ability to make an economic analysis for selecting among the alternatives above, including identification of necessary information for making that analysis, and also to identify noneconomic factors

(f) Society
Ability to articulate and defend a personal position on some important issue of the impact of information technology and systems on society (important, as defined by Congressional interest, public press, semitechnical press, etc.)
Ability to perceive and describe several positive and several negative impacts of a specified information system in a specified part of society
Ability, given such specifications of impacts, to perform a rough-cut feasibility analysis of them in terms of behavioral and economic variables

Ability to make "rough-cut" feasibility evaluations (in terms of economic and behavioral variables) of proposed new technologies or applications of current technology, identifying critical variables and making estimates and extrapolations
Ability to develop specifications for the computer-based part of a major information system, with details of task management and database management components

Knowledge of the function of purposeful organizational structure and of the major alternatives for that structure
Knowledge of the functional areas of an organization—operations, finance, marketing, product specification, and development
Ability to identify in an ongoing organizational situation the key issues and problems of each functional area
Knowledge of typical roles and role behavior in each functional area
Ability to identify possible short-term and long-term effects of a specified action on organizational goals
Ability to identify information needs appropriate to issues and roles above
Knowledge of how information systems are superimposed on organizational patterns on the operational, control, and planning levels
Knowledge of techniques for gathering information
Ability to gather information systematically within an organization, given specified information needs and/or specified information flows
Ability to specify, given information needs and sources, several alternative sets of information transfers and processings to meet needs
Ability to make "rough-cut" feasibility evaluations of such alternatives
Ability to develop positive and negative impacts of a specified information system on specified parts of an organization
Ability to develop specifications for a major information system, addressing a given organizational need, and to determine the breakdown into manual and computer-based parts

Define information requirements or an analyst developing designs for information system applications.

2. Application Programmer or Programmer/Analyst (as on-the-job training to be a systems analyst). Some organizations and some graduates feel it is desirable to obtain experience in applications programming prior to becoming a system analyst.

3. Information Systems Specialist. This includes such areas as information systems planning, administration, or resource management.

There is recognition of the limits of formal educational processes in preparing graduates to perform these functions. Some knowledge and experience must be obtained on the job.

A list of needed knowledge and abilities, adapted from the 1972 Curriculum Report [3], is given in Table I. The list is still the most comprehensive available.

The knowledge and abilities necessary to work effectively in this field may be characterized as obtainable by integrating concepts relating to people, models, and systems for the application of computer technology in the context of organizations and society. Thus the requisite knowledge and abilities listed in Table I are conveniently grouped into six categories: (a) people; (b) models; (c) systems; (d) computers; (e) organizations; and (f) society.
The first three categories are fundamental and may be looked upon as providing tools for applications in the last three categories. The last four abilities in the areas of computers and organizations (categories (d) and (e) in Table I) are the key to the information systems development approach presented here. The ability to analyze alternatives and to make "rough-cut" designs is particularly critical in the changing information systems environment of today.

The knowledge and abilities listed are testable in the academic environment—by written or oral examinations, successfully operating computer programs, case discussions, judgment by a panel of experts and/or peers, and other commonly accepted means. Besides attaining knowledge and abilities, however, it is important for the student to have gained some experience in prototypes of work situations, such as

- gathering information in a "real" organization
- working with an operations research specialist to model a complicated situation
- serving as a member of a project team developing a specified application system
- serving as a member of a project team developing a specified information system
- participating in planning and conducting an oral presentation (and selling) the results of a team project.

Inputs

The curriculum does not specify a single prior background for students entering the information systems curriculum; they may come from a variety of backgrounds. Examples are engineering, sciences, technology, liberal arts, and business administration. However, several areas of knowledge are prerequisite to entering the program. They are classified as general and specific prerequisites.

General Prerequisites

(i) finite mathematics, including the fundamentals of formal logic, sets and relations, and linear algebra
(ii) elementary statistics, including the fundamentals of probability, expected value, and construction of sample estimates
(iii) elementary computer programming, including problem analysis and algorithm synthesis, and competence in a higher level language
(iv) elementary economics, including microeconomics and theory of the firm and price theory
(v) elementary psychology, including fundamentals of personality formation, attitudes, and motivation.

Specific Prerequisites

The two prerequisites that are specific to the information system curriculum are courses on computer programming and quantitative methods. Suggested descriptions for these courses are included in the course descriptions presented later in the report.

Structure of the Courses

An overall diagram of the degree structure is given in Figure 1. Following the general and specific prerequisites, the degree program in information systems has three components with sets of courses for each:

1. IS technology
2. IS concepts and processes
3. organization functions and management.

The course structure for the graduate curriculum has two courses not proposed for the undergraduate program. These two courses reflect the greater managerial emphasis of the graduate program and the greater depth of instruction for graduate students.

Information Systems Technology
IS1 Computer Concepts and Software Systems
IS2 Program, Data, and File Structures
IS4 Database Management Systems
IS6 Data Communication Systems and Networks
IS7 Modeling and Decision Systems
(graduate program only)

Information Systems Concepts in Organizations
IS3 Information Systems in Organizations
IS5 Information Analysis
IS8 Systems Design Process
IS9 Information Systems Policy
(graduate program only)
IS10 Information Systems Projects

AACSB Common Body of Knowledge

The AACSB accreditation standards specify that degree programs in business and administration include in their course of instruction the equivalent of at least one year of work comprising the following areas:

(a) a background of the concepts, processes, and institutions in marketing and distribution, production, and financing functions of business enterprise
(b) a background of the economic and legal environment of business enterprise along with consideration of the social and political influences on business
(c) a basic understanding of the concepts and methods of accounting, quantitative methods, and information systems
(d) a study of organization theory, interpersonal relationships, control and motivation systems, and communications
(e) a study of administration processes under conditions of uncertainty including integrating analysis and policy determination at the overall management level.

3. Degree Programs

This section recommends ways in which the courses and variations on them can be incorporated into degree programs in universities. Curricula for both undergrad-
Figure 1. General Structure of Information Systems Curriculum (undergraduate and graduate level)

<table>
<thead>
<tr>
<th>Information Systems Technology</th>
<th>Information Systems Process</th>
<th>AACSB Common Body of Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IS_1</strong> Computer Concepts</td>
<td><strong>IS_2</strong> Program and Data Structures</td>
<td>a) Marketing, production and finance</td>
</tr>
<tr>
<td><strong>IS_3</strong> Systems Concepts</td>
<td><strong>IS_4</strong> Data Management</td>
<td><strong>IS_5</strong> Information Analysis</td>
</tr>
<tr>
<td></td>
<td><strong>IS_6</strong> Data Communications</td>
<td>b) Economic, legal and political</td>
</tr>
<tr>
<td><strong>IS_7</strong> Modeling Decision Systems</td>
<td><strong>IS_8</strong> Systems Design</td>
<td>c) Accounting and quantitative methods</td>
</tr>
<tr>
<td><strong>IS_9</strong> Policy</td>
<td><strong>IS_10</strong> Projects</td>
<td>d) Organization theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e) Integration of analysis and policy</td>
</tr>
</tbody>
</table>

Bachelor's Degree Program

The undergraduate version of the IS program contains eight instead of the 10 courses in the graduate program. The two courses omitted are IS7 (Modeling and Decision Systems) and IS9 (MIS Policy). In addition to deletion of these two courses, the contents of six other courses are modified for the undergraduate program. Contents of the other two courses are the same for both degree programs: IS1 (Computer Systems Concepts) and IS2 (Program, Data, and File Structures). The prerequisites are the same for both programs: P1 (Computer Programming) and P2 (Quantitative Methods).

Figure 2 shows the undergraduate level program structure. For the courses common to both programs the principal differences in the graduate and undergraduate courses are (1) time spent on each topic, and (2) level of
instruction. An example of the revision in weighting of time spent on topics is shown in the data communications course. In the graduate level course (IS6) 15 percent of the course weight is assigned to "communication system components." In the undergraduate level course (IS6) the assigned weight is 25 percent. Accordingly, undergraduate level weights were reduced for the graduate level topics: design of communication networks (topic 5), and future networks (topic 6).

In assigning weights to undergraduate curriculum topics there is an emphasis on tools of programming, system analysis, and system design. The supervisory/managerial tools, such as project management, and the advanced techniques, such as network design and computer-aided system design are deemphasized. Only a general understanding of these topics is provided; they are not covered in depth as they are in the graduate level program. For example, in IS5, the information analysis course, weighting of the life cycle management topics is reduced from 25 to 15 percent while the topic on requirement analysis and logical design is increased from 20 to 30 percent.

As an example of varied levels of instruction, students would be assigned projects using the less complicated structured analysis/design techniques at the undergraduate level. At the graduate level, students would be assigned projects that include using the more difficult techniques.

Master's Degree Programs

A four-semester schedule containing the 10 recommended IS courses for a master's level program for systems designers is shown in Figure 3. It assumes completion of the two prerequisite courses, P1 and P2. The shaded areas show how six additional courses required by the MBA or MS degrees can be correlated to the IS courses. The two graduate degree programs are described in more detail below.

MBA Program

An MBA is a fairly broad degree and envisions only limited specialization. The MBA requirements stated by the accrediting agency (American Assembly of Collegiate Schools of Business) are "a minimum of two semesters of academic work beyond the coursework for the common body of knowledge and the baccalaureate degree, in classes reserved exclusively for graduate students." In order to avoid undue specialization, AACSB standards require that a student must take 15 semester hours (or the equivalent) in specified subjects not part of the specialization.

Given the AACSB standards for a common body of knowledge and courses outside the area of specialization, it is impossible in a one-year MBA to have a full IS major as outlined in this report. It is possible with a two-year MBA program. A four-course sequence adequate for preparation of an information systems analyst is shown in Figure 4. The two prerequisite courses would still be required for this area of emphasis.

MBA programs with insufficient time available for a full information systems major of 10 courses may offer an "area of emphasis" with three or four courses. This limited program would not qualify a student to become a system designer. However, students completing this program would have sufficient knowledge to become information analysts—persons who work in a user department performing the liaison between their department and the computer department. The main emphasis in this function is consolidating system requirements for an entire function, such as marketing or production, and determining the feasibility of computerization of the various systems within that functional area. When the system design and programming are complete, the information analyst then assists in the testing and implementation of the system.

MS Program

Although the AACSB common body of knowledge requirements in the MS degree are the same as those of the MBA, most schools use the MS as an in-depth degree as opposed to the "breadth" emphasis in the MBA. The IS program fits easily into the MS programs of most schools.

4. Implementation

Effective implementation of the IS program requires adequate resource levels and judicious use of both faculty resources and hardware/software resources.

Faculty Resources

Although it is difficult to ascertain the minimal number of faculty to properly implement and maintain an IS degree program, some distinctly different disciplines are required. A solid mathematical background is necessary to teach effectively the courses IS6 (Data Communications) and IS7 (Modeling and Decision Systems). A solid behavioral science background is necessary for the courses IS3 (Systems and Information Concepts in Organizations) and IS5 (Information Analysis). Field experience is another faculty prerequisite for some courses. While a recent doctoral graduate could satisfactorily handle the courses IS1 (Computer Concepts and System Software) and IS2 (Program, Data, and File Structures), field experience is important for effective teaching of IS8 (Systems Design) and IS9 (MIS Policy).

For a school that implements either the master's or the undergraduate program, a minimum of two FTE information systems faculty would be required. This calculation assumes adherence to the AACSB practice of only two course preparations per term and that the eight information systems courses are offered only once a year. Faculty resources for the two prerequisite courses

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Fig. 3. Master's Level Program for Systems Designers
(six course slots are open for MBA or MS requirements)
48-credit-hour master's

<table>
<thead>
<tr>
<th>Semester</th>
<th>IS1</th>
<th>IS2</th>
<th>IS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Computer Systems Concepts</td>
<td>Program, Data and File Structures</td>
<td>Systems and Information Concepts in Organizations</td>
</tr>
<tr>
<td>2nd</td>
<td>Data Management</td>
<td>Information Analysis</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Data Communications, Networks and Distributed Processing</td>
<td>Modeling and Decision Systems</td>
<td>Systems Design</td>
</tr>
<tr>
<td>4th</td>
<td>MIS Policy</td>
<td>System Development Projects</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4. MBA/IS Area of Emphasis

<table>
<thead>
<tr>
<th>IS3</th>
<th>IS2</th>
<th>IS5</th>
<th>IS8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems and Information Concepts in Organizations</td>
<td>Program, Data and File Structures</td>
<td>Information Analysis</td>
<td>Systems Design</td>
</tr>
</tbody>
</table>

are excluded in the above calculation on the assumption that they are already being taught in AACSB accredited schools. However, rarely would two individuals have the breadth of knowledge and experience to teach eight IS courses. Most schools with a limited number of IS faculty use several other faculty members whose teaching expertise includes some of the IS subjects in addition to another discipline, such as accounting or management science.

Since the graduate and undergraduate programs have two courses in common, the IS curriculum would consist of 16 courses in a school which implements both undergraduate and graduate IS programs. A large faculty would be required to support both programs.

Although there are a sufficient number of doctoral programs to prepare faculty [4], the quantity of doctoral candidates is insufficient and is projected to continue to lag demand. Part-time instructors from industry are a viable faculty supplement, but their use is limited by AACSB accreditation standards to 25 percent of full time equivalent academic staff.

The scarcity of qualified faculty is the principal reason that some schools offer only the four course MBA area of emphasis, producing information analysts instead of system designers.

Hardware/Software Resources

Implementation of an IS degree program requires special computing resources that may not now exist in a given school. Although the central campus computing facility may have the capacity needed to support an IS program, it may not have the necessary software. Acquiring a compiler for Cobol or PL/1 presents little difficulty. Acquiring and implementing other software...
packages may be a major undertaking. Minimal special software requirements:

1. data processing language compiler such as Cobol
2. database management system (DBMS) with query language
3. simulation language compiler
4. special purpose packages such as user-oriented financial language
5. system specification language package.

The IS program requires a significant budget for hardware use because student and faculty use of the software described above consume significant amounts of CPU and peripheral device capacity. It is not unusual for the IS department to be one of the top three users of academic computer time on the central campus computer. Micros and small business systems rarely have the capacity and software to meet all IS program needs.

5. Comparison of the Undergraduate and Graduate Programs

Differences Between Undergraduate and Graduate Curricula

There are two differences between the undergraduate and the graduate curricula. First, the undergraduate version of the IS program contains eight instead of 10 courses. The two courses omitted are IS7 (Modeling and Decision Systems) and IS9 (MIS Policy). These courses contain advanced material more appropriate for graduate level instruction. However, the MIS policy course could be used to satisfy the AACSB policy requirement. In that case, it would be reasonable to leave it in the curriculum.

The other difference is that the contents of five courses, IS3, IS4, IS5, IS6, and IS8, are revised for the undergraduate program. The description is the same for each course at both levels; however, the percentage of time devoted to each topic varies for each topic. The percentage of time for the undergraduate version is listed first, and graduate percentages second. The contents of IS1 (Computer Systems Concepts) and IS2 (Program, Data, and File Structures) and the prerequisites, P1 (Computer Programming) and P2 (Quantitative Methods) are the same for both the undergraduate and graduate levels.

The two prerequisite courses, P1 (Computer Programming) and P2 (Quantitative Methods), are available in most business schools because these courses meet the common body of knowledge required for accreditation by the American Assembly of Collegiate Schools of Business.

Rationale for Common Curriculum

System professionals need to have an understanding of each of the topics on the curriculum. Graduate students are prepared to cover some topics in more depth. For example, 20 percent of the course is allocated to network design in the graduate course on data communications, networks, and distributed processing (IS6). Only 10 percent of course time is allocated to that topic in the undergraduate course. Graduates of the master's level program are more likely to be assigned the task of network design. Entry level personnel (BS degree holders) are more likely to be assigned the design of applications programs which utilize the network in designing systems, so topics related to that requirement are weighted more heavily in the undergraduate program.

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Leslie Ball
Stephanie Barrett
Frank Bayer
Izak Benbesat
Robert Benjamin
John Blair
Jim Cash
Mel Colter
J. Daniel Couger
Jim Courtney
Albert R. Crawford, Jr.
Mary Culnan
Al Dale
Gordon Davis
Gary Dickson
Paul J. Dixon
Thomas Dock
Steve Gilbert
Michael Ginzberg
John Gorgone
Nancy Griffith
Richard D. Hackathorn
Thomas Ho
Jeffrey Hoffer
James A. Iverson
Milton Jenkins
Kenneth Kendall
Miles Kennedy
William King
Jeff Kottemann
Kenneth L. Kraemer

Charles Kriebel
Henry Lucas, Jr.
Mike Mannino
Richard O. Mason
William McHenry
Scott McIntyre
James McKenney
Ephraim R. McLean
Alan G. Merten
William Mitchell
Jeff Moore
Al Napier
Mike Quamme
David Risku
John F. Rockhart
Martin Sack
John Schrague
Jim Scott
Alan Sears
James Senn
Ralph H. Sprague
Wilbur A. Steger
Ted Stohr
E. Burton Swanson
Richard Welke
James Wetherbe
Andrew Whinston
Frederic G. Withington
Paul Zeldin
Robert W. Zmud
References


Appendix. Course Descriptions

In the following course descriptions, the weighting of topics varies according to the level of the course. If two percentage figures are given, the first refers to the weighting for an undergraduate course and the second to a graduate level course. The different weights reflect the different emphasis and depth for graduate students compared to undergraduates.

P1 PREREQUISITE: COMPUTER PROGRAMMING

The course follows the outline of CS1 Computer Programming I in "Curriculum 78: Recommendations for the Undergraduate Program in Computer Science."

RATIONALE

The intention of this course is to develop the skill and knowledge necessary to solve problems using a computer. This course develops a basic understanding of algorithm development, programming, and computer concepts.

OBJECTIVES OF THE COURSE

1. To introduce program solving methods and algorithm development.
2. To teach a high level algorithmic programming language that is widely used.
3. To teach how to design, code, debug, and document programs using techniques of good programming style.

INSTRUCTIONAL NOTES

The material on a high level programming language and on algorithm development can be taught best as an integrated whole. Thus the topics should not be covered sequentially. The emphasis of the course is on the techniques of algorithm development and programming with style. Neither esoteric features of a programming language nor other aspects of computers should be allowed to interfere with that purpose.

The language used in the course should be selected such that it supports IS2 and IS10 and the continuity and depth of experience can be achieved. All of the programming syntax and exercises must be illustrated through applications.

The course should stress that the task of writing a program is only one step in the development of an information system application. Programs are developed as part of a system and the course is not involved with all of the aspects involved with making them a part of a system.

TOPICS

1. Computer Organization (10%)
   - An overview identifying components and their functions, machine, and assembly languages.

2. Programming Language and Programming (45%)

3. Algorithm Development (45%)
   - Techniques of problem solving. Flowcharting. Describing a program using methods such as flowcharting or a program design language. Stepwise refinement. Simple examples. Algorithms for searching (e.g., linear, binary), sorting (e.g., exchange, insertion), merging of ordered lists. Examples taken from business and management applications.

P2 PREREQUISITE: QUANTITATIVE METHODS

RATIONALE

This course will develop skills for the student to recognize real world problems that can be cast in the form of optimization models. The student should develop the skill necessary to characterize problems as scheduling problems, allocation problems, queueing problems, inventory problems, etc., in order to use the appropriate solution technique to understand the internal workings of mathematical programming software and to use intelligently the solutions produced by that software.

OBJECTIVES OF THE COURSE

1. To introduce and exercise a range of analytical modeling techniques useful in decision making in the system design environment.
2. To consider the function of such models as guides for data collection, structures for data manipulation, and as systems for testing assumptions and generating a variety of alternatives.
3. To identify the problems of data collection, maintenance,
and accuracy when using models to assist decision making activities.

INSTRUCTIONAL NOTES

This course is based on the use of analytical models as aids in the formulation and resolution of system alternatives. Emphasis is on problem formulation and resolution relying upon available analysis packages. The discussion of projects should focus on the decision itself and on the use of models to consider alternatives and test assumptions. Problems of data acquisition, preparation, and maintenance should be stressed.

The course deals with mathematical programming algorithms and applications rather than with theory. There are four aspects of the course:

1. study of model formulation and discussion of documented real world applications
2. study of mathematical programming algorithms
3. consideration of the problems involved in implementing mathematical programming algorithms on a computer
4. use of a computer software package to study the behavior of larger models than can be solved by hand.

TOPICS

1. Review (15%)
Real numbers, functions, and graphs, linear functions and linear equations, matrix algebra, quadratic functions, exponential and logarithmic functions, sequences, series, and limits, derivatives, and applications.

2. Analysis of Allocation Problems with Mathematical Programming (20%)
Methods of formulating and solving linear programming problems using packaged computer programs. Linear programming as an aid to planning the allocation of interdependent resources. Value of models in the sensitivity testing of formulations. Evolutionary nature of large models as a decision making aid. Applications to scheduling and computer network design. Optimization of computer networks. Note: particular attention should be paid to the data management requirements of linear programming models allowing examination of the general notions of constraints, objective functions, and optimization in modeling.

3. Linear Programming (15%)  

4. Characterization of Scheduling Situations (20%)  

5. Queuing Models (20%)  
Concept of queuing models and their general applicability to a broad range of situations. Considerations of the many queuing processes within computer systems.

6. Inventory Models (10%)  
Inventory models ranging from simple, single product to multiple product under uncertainty. The database as an inventory control problem. Application of linear programming or dynamic programming analyses to inventory.

Bibliography

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<tr>
<th>Topic</th>
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<tr>
<td>Avriel, M. Nonlinear Programming: Analysis and Methods</td>
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<td>Cooper, R. Introduction to Queuing Theory</td>
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<tr>
<td>Driebeck, N. Applied Linear Programming</td>
<td>3</td>
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<td>Eppen, G., and Gould, F. Quantitative Concepts for Management</td>
<td>1–6</td>
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<tr>
<td>Gordon, G. System Simulation</td>
<td>4</td>
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<tr>
<td>Granger, C., and Newbold, P. Forecasting Economic Time Series</td>
<td>2</td>
</tr>
<tr>
<td>Greenberger, M., Crenson, A., and Crissey, B. Models in the Policy Process</td>
<td>1–6</td>
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<tr>
<td>Martin, M., and Demison, R. Case Exercises in Operations Research</td>
<td>1–6</td>
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<tr>
<td>Orlicky, J. Material Requirements Planning</td>
<td>6</td>
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<td>Raiffa, H. Decision Analysis</td>
<td>1–6</td>
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<tr>
<td>Sasaki, K. Statistics for Modern Business Decision Making</td>
<td>1–6</td>
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<tr>
<td>Wagner, H. Principles of Operations Research</td>
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IS1 COMPUTER CONCEPTS AND SOFTWARE SYSTEMS

RATIONALE

It is important for the student to possess a broad familiarity with fundamental concepts and terminology associated with computer hardware systems and operating systems.

OBJECTIVES OF THE COURSE

1. To introduce computer architecture.
2. To introduce the major concept areas of operating systems principles.
3. To introduce the interrelationships between the operating system and the architecture.

INSTRUCTIONAL NOTES

This course clearly must emphasize breadth rather than depth. Coverage of assembly language must be limited severely. Only those concepts and techniques that are necessary to understand the following concepts in computer architecture and operating systems should be covered. The assignment of programming projects on a specific computer is valuable but these projects should be few in number, small, and carefully constructed to convey the experience of assembly language programming without that experience dominating the course.

The interdependence of operating systems and architecture should be clearly delineated.

TOPICS

1. Computer Structure, Machine Language, and Assembly Language (25%)

2. Computer Architecture and Operating Systems (50%)
Functions of, and communications between, large-scale components of a computer system. Hardware implementation and

3. Operating Environment for Applications Programs (25%) Job control languages, job streams, check points, utilities, systems routines. Discussion of why the operating system exists and the practical consequences.

Bibliography


IS2 PROGRAM, DATA, AND FILE STRUCTURES

P2 is a combination of CS2 (Computer Programming), CS5 (Introduction to File Processing), and CS14, Topic A (Software Design and Development) as described in ACM CS Curriculum 78.

RATIONALE

Because of the emphasis on performance in information systems and the increasing complexity of applications, the user/systems analyst/designer must understand the logical structure and physical structure of both programs and data. The course develops both skill and knowledge relative to program and data structures. This course is a necessity to develop an in-depth understanding of a language such as PL/1 or Cobol. Use of advanced programming techniques and system understanding are necessary in more advanced courses.

OBJECTIVES OF THE COURSE

1. To continue the development of discipline in program design, in style and expression, and in debugging and testing, especially for larger programs.
2. To introduce algorithmic analysis.
3. To introduce basic aspects of string processing, recursion, and simple data structures.
4. To introduce concepts and techniques of structuring data on bulk storage devices.
5. To provide experience in the use of bulk storage devices.
6. To provide the foundation for applications of data structures and file processing techniques.
7. To provide the technical foundation for structured systems design.

INSTRUCTIONAL NOTES

The topics in this outline should be introduced as needed in the context of one or more projects involving larger programs. The instructor may choose to begin with the statement of a sizable project, then utilize structured programming techniques to develop a number of small projects each of which involves string processing, searching, sorting, and data structures. Emphasis on good programming style, expression, and documentation. In order to do this effectively, it is necessary to introduce a high level business data processing language.

The emphasis given to topics in this outline will vary depending on the computer facilities available to students. Programming projects should be assigned to give students experience in file processing. Characteristics and utilization of a variety of storage devices should be covered even though some of the devices are not part of the computer system that is used.

This course presents a formal approach to state-of-the-art techniques in software design and development and provides a means for students to apply the techniques. An integral part of the course is the involvement of students working in teams in the organization, management, and development of a large software project. The team project aspect can be facilitated either by scheduling separate laboratories or by using some of the lecture periods to discuss practical aspects of the team projects.

TOPICS

1. Advanced Programming (40%)
   a. Programming Language.
      P1/1 or Cobol syntax. Principles of good programming style, expression, and documentation.
      Control flow. Invariant relation of a loop. Stepwise refinement of both statements and data structures, or top-down programming.

2. Data Organization and Accessing (45%)
   a. Data Structures and Indexing
      Linear allocations (e.g., stacks, queues, deques) and linked allocation (e.g., simple linked lists). Algorithms for manipulating linked lists. Binary trees. Algorithms for traversing and balancing trees. Hash coding.
   b. File Processing Environment
      Definitions of record, file, blocking, compaction, database. Overview of database management system.
   c. Sequential Access
      Physical characteristics of sequential media (tape, cards, etc.). External sort/merge algorithms. File manipulation

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techniques for updating, deleting, and inserting records in sequential files.

d. Random Access
Physical characteristics of disk/drum and other bulk storage devices. Physical representation of data structure on storage devices. Algorithms and techniques for implementing inverted lists, multitlist, indexed sequential, and hierarchical structures.

e. File I/O
File control systems and utility routines, I/O specifications for allocating space and cataloging files.

f. Implementation Considerations
Discussion of the utility of the alternative data organizations. Comparison of logical model of data access in algorithms to difficulties in implementing the data organizations on the machine.

3. Design Techniques (15%)

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IS3 INFORMATION SYSTEMS IN ORGANIZATIONS

RATIONALE
This course establishes a foundation for understanding and analyzing information in organizations. Fundamental concepts of systems and information are explained. The integration of these concepts into the organizational structure ties the curriculum to its environment. Basic tools and techniques for representing systems needed in subsequent courses are introduced and introductory skills developed. The course is the introduction to the curriculum in the sense that it provides a basis for understanding the role of the various parts of the curriculum and provides a broad base for further study. Because the course is a broad, user-oriented introduction, it is also suitable as a general introductory course for nonmajors as well.

OBJECTIVES OF THE COURSE
1. To establish the role of information systems in organizations and how they relate to organizational objectives and organizational structure.
2. To identify the basic concepts that subsequent courses will draw upon: the systems point of view, the organization of a system, information flows, the nature of information systems.
3. To provide students with knowledge of basic techniques and elementary skills in representing system structure.
4. To introduce various types of applications that are part of an information system.

INSTRUCTIONAL NOTES
The teaching method is a combination of a series of lectures and activities. Students utilize modeling and graphical techniques to represent systems. They also apply a user-oriented modeling language or a query language in a problem solving situation. This experience will facilitate understanding of systems from the user point of view.

TOPICS

1. Information Systems and Organizations (30%; 25%)
a. Management Information Systems
Role of information systems in organizations. Alternative taxonomies of information systems, such as modes of processing and management levels. Structure of a management information system. Human–machine information systems.
b. Relating Systems and Information to Organizational Objectives
Matching the information system plan to the organizational strategic plan. Identifying key organizational objectives and processes and developing an information system development. Identifying organizational information needs. Approaches to development of an organizational information system. User role in systems development process. Establishing a portfolio of information system applications. Importance of auditability, maintainability, and recoverability in system design.
c. Information Systems and Organizational Structure and Management

2. Representation and Analysis of System Structure (20%; 15%)

3. Systems, Information, and Decision Theory (10%; 10%)
a. Systems Concepts
plex/conflicting/multiple objectives: methods of resolution, suboptimization.

b. Information Concepts

c. Decision Processes
Identifying information needed to support decision making. Human factors, problem characteristics, and information system capabilities in decision making.

4. Information System Applications (35%; 45%)
a. Transaction processing applications. Basic accounting applications.
b. Systems to support operational processes. Production, marketing, finance, logistics, etc.
c. Transactions to support management control.
d. Applications for budgeting and planning.
f. Other use of information technology: work place automation, word processing, electronic mail, personal computers, remote conferencing, and graphics.

c. Applications for budgeting and planning.
f. Other use of information technology: work place automation, word processing, electronic mail, personal computers, remote conferencing, and graphics.

5. System Evaluation and Selection (5%, 5%)
Identification and generation of alternatives. Evaluation and selection of alternatives. Establishing priorities and allocating resources: cost/benefit, organizational power, centralized versus decentralized allocation mechanisms.

Bibliography
The omission of specific Topic Numbers signifies that the reference applies to the course material generally.


Canning, R. C. What information do managers need? EDP Anal. 17, 6 (June 1979).

Carlson, E. D. (Ed.) Proceedings of a conference on decision support systems. Data Base 8, 3 (1977). Issue contains a number of general articles plus examples of decision support systems.


Driver, M. J., and Mock, T. J. Human information processing, decision style theory, and accounting information systems. Accounting Rev. (July 1975), 490-508.


IS4 DATABASE MANAGEMENT SYSTEMS

RATIONALE

Because of the emphasis on data in information systems and the increasing complexity of data management, the systems analyst must understand the application, logical structure, and physical implementation of database systems. The fundamental purpose of this course is to increase student understanding of how data resources can be managed to support effectively information systems in organizations.

OBJECTIVES

To develop an appreciation of the data resource and the issues in managing data. In order to achieve this purpose, the course provides technical background on computer system management of data. Within the context of the technical background, the course provides instruction in defining data needs, functions on data, user-oriented data languages, and management of data within organizations. Understanding of data structure and storage. Analysis of file organization techniques. Sequential, indexed sequential, multilist, and inverted files. Operating system topics related to data such as dynamic storage allocation and virtual memory. Database management functions and database management systems. Logical and physical data models. User-oriented data languages. The management of data as a resource.

INSTRUCTIONAL NOTES

The course content should include definition of data and survey of the needs for data in an organization. This course should emphasize the concepts and structures necessary to use a database management system. The student should become acquainted with current literature. They should be given an opportunity to use a database management system, including user-oriented data languages for query, update, and report generation and their use as tools in building application systems.

TOPICS

1. The Data Environment (25%; 25%)
   Definition of data. Issues in managing data. Uses and needs of data in the organization. Defining data needs. Tradeoffs between utilization of data and control of data.

2. Basic Technical Concepts and System Resources for Data (15%; 15%)
   a. Introduction
      The notion of a data structure, primitive and composite data types, basic machine architecture, character codes.
   b. Data Structures
      Definition, logical structure, physical implementation, applications and operations for strings, arrays, stacks, queues, linked lists, trees, and graphs. Searching and sorting techniques. Data handling facilities of higher level languages.
   c. Operating System Topics
      Dynamic storage management, virtual memory, role of operating systems in data management.
   d. File Organization
      Implementation and tradeoffs of sequential, random, indexed sequential, B-tree, inverted list, and multilist organization.

3. Database Concepts (30%; 30%)
   a. Database Management Systems
   b. Logical Data Models
      Data abstraction, entity-relationship model. Relational databases, normalization, data dictionaries, and directories.
   c. Internal Data Models
      Implementations, CODASYL DSDL, hierarchic models. Physical database support, memory management, relational systems, network systems, hierarchic systems.

4. Use and Management of Databases (30%; 30%)
   a. Database management system facilities in building information system applications. Use of high-level, user-oriented data language facilities for query, update, and report generation.
   b. Database Administration
      Functions, organizational implications, shared access control, security, recovery, query interfaces, performance measurement.
   c. DBMS Evaluation
      Selection, standardization, survey of commercial DBMS, implementation tools.
   d. Distributed Databases
      Minidatabases, microdatabases, very large databases.

Bibliography

ACM Comput. Surv. (Special Issue: Database Management Systems), 8, 1 (1976).
Date, C. An Introduction to Database Systems. Addison-Wesley, Reading, Mass., 1975.
TOPICS

1. Application Development Strategies (10%; 10%)
Selection from alternative strategies for application development using, for example, contingency theory. Development alternatives: adoption of packages for new development (outside developer or in-house development). Development methodologies: life cycle, prototyping, etc. Influences on development strategy: master plan, organizational environment, development organization and resources, and information system structure and resources.

2. Application System Development Life Cycle (10%; 5%)
Overview of the phases of application system development life cycle and their interrelationship. Problem identification and feasibility assessments, requirements determination, logical and physical design, planning to accommodate change, program development, implementation, and postimplementation evaluation. Emphasis on phased development approach in planning and completing the study project. Requirements for documentation and auditability.

3. Application System Development Management (5%; 10%)
Project management concepts. Project control for application system development. Responsibilities of project manager, project team members, users, etc. Service level agreements covering management disciplines, management of change, problem resolution, management reporting. Impact of project management on organizational planning cycles.

4. Individual Behavior and Group Dynamics in the Development Process (15%; 10%)
Review of principles of individual, interpersonal, and group behavior. Applications of these principles to the development process. External interactions: interviews with users, job and social group impact analysis, negotiating final inspections, user design reviews and walkthroughs, implementation. Internal interactions: selecting and organizing the development team; interfacing with data entry, data control, computer operations personnel, etc.; reporting progress to data processing management.

5. Problem Need Identification and Feasibility Assessment (15%; 15%)
Sources of problems and needs. Defining the "real" need/problem. Problem analysis: degree of uncertainty, usefulness of information system application, programmability, volatility. Preliminary application requirements determination: variable versus standardized outputs, reporting, data acquisition techniques, application life expectancy, ownership/maintenance responsibility. Preliminary specification: user-system interfaces, mode of operation, input/output, software, hardware. Feasibility assessment: economic, technical, operational, and schedule feasibility; conformance to information system master plan. Justification/approval by allocation mechanism: steering committee, pricing of information services, payback, cost/benefit analysis. Suggested deliverables by students: feasibility analysis report and oral presentation plus general application objectives report.

6. Information Requirements Determination (15%; 25%)
Strategies for obtaining information requirements for an application: eliciting user definition of requirements, studying and modifying information delivered by an existing system, deriving requirements through study of utilizing system, normative derivation from characteristics of utilizing system, iterative discovery of requirements through use of a prototype system. Techniques for information requirements determination: document study, system study, observation, interviewing. Communication skills: listening, writing, presenting. Management/
interpersonal skills: conflict resolution, negotiation. Requirements documentation methods: narrative, graphics, layouts, requirements language. Methods for providing assurance that requirements are correct and complete. Selecting strategies and techniques. Planning the process.

Suggested deliverables by students: (1) live interviews with video tape critique, and (2) detailed requirements specifications report plus oral presentation.

7. Requirement Analysis and Logical Specification (30%; 25%)

Description of system logical data flows, files, and processes by graphical and automated design techniques: top-down design and hierarchical decomposition, tests for logical completeness and consistency. Data dictionaries: content, format, and organization; automated versus manual implementations. Process description methods such as structured English and decision tables. Documenting an existing system. Logical design for target system: data flows, files, and processes; selection of interfaces (automated versus manual); the user interface. User views of data for database design. File requirements: transport volume, response times, integrity, security, etc.

Suggested deliverables by students: general logical design report, documentation plan, walkthrough performance.

Bibliography

The omission of specific Topic Numbers signifies that the reference applies to the course material generally.


Cooper, R.B., and Swanson, E.B. Management information requirements assessment: The state of the art. Data Base (Fall 1979), 5–15.


IBM. Study organization plan documentation techniques. Tech. Rep. C20-8075-0, 1963. The system analysis and design approach advocated by IBM.


National Cash Register. Accurately defined systems. 1967. A forms-driven analysis and design approach that provides documentation of results including data source references.


Taggart, W.M., Jr., and Tharp, M.O. Dimensions of information requirements analysis. Data Base 7, 1 (Summer 1975), 5–13.


Zolliker, M.L. Proceedings of a conference on application development systems. Data Base 11, 3 (Winter-Spring 1980). Contains a number of articles on the implementation of applications.

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IS6 DATA COMMUNICATION SYSTEMS AND NETWORKS

RATIONALE
With the reduction of hardware costs and the increasing sophistication of control software, the inevitable trend toward distribution of heterogeneous processors will accelerate. Systems analysts and their management need to be aware of the data communications technology and its related regulatory environment.

OBJECTIVES OF THE COURSE
To familiarize the student with the concepts and terminology of data communications, network design and distributed information systems. Equipment, protocols and architectures and transmission alternatives, the communications environment, regulatory issues, and network pricing and management.

INSTRUCTIONAL NOTES
This course provides a broad introduction to data communications. Emphasis is on the impact of communications technology on information systems. Major topics include communication concepts, network architectures, data processing versus data communication controversies, data communications software and hardware, distributed information systems, and communication services. Cases are used to involve the student in information system design in a data communication environment.

TOPICS
1. Communications Environment (10%; 5%)
   Communications concepts (sender-receiver, etc.), communications in organizations, communications functions (transmission, interface, etc.), forms of communication (data, message, voice, image).

2. Communication System Components (25%; 15%)
   Transmission media (wire, optic, microwave, etc.), analog-digital, communication devices (modems, multiplexers, concentrators, switchers, front-ends, etc.), line options (dial-up, multidrop, etc.), basic communications software (TPAMs, NCPs, etc.), packet-switching, DP/DC environment, off-loading.

3. Networks and Control (15%; 10%)
   Basic network topologies, equipment configurations, error detection and correction, contention and polling, security and encryption, protocols.

4. Common Carrier Services (10%; 10%)
   Common carrier services, tariffs, regulatory agencies and history, network pricing, value added networks, transborder communication issues, DP versus DC controversies.

5. Design of Communications Networks (10%; 20%)
   Application of communications in organizations, network design evolution, network architectures, protocols (x.25, ISO, etc.), private network design, network control software, topological design algorithms, computer-aided network design software.

6. Network Management and Distributed Environment (20%; 25%)
   Communications requirements determination, performance, monitoring, control, economics, service levels, distributed processes, databases, directories, and control; integrity and economics in distributed environments.

7. Local Area Data Networks (5%; 10%)
   Local networks, office automation, workstation design, gateways.

8. Future Networks (5%; 5%)
   Satellite nets, optic nets, waveguide, etc.; enhanced VANs, future applications, integrated voice and data.

IS7 MODELING AND DECISION SYSTEMS
(Graduate Program Only)

RATIONALE
Many modern decisions involve complex decision-making processes. Modeling, simulation, evaluation techniques and generalized and specific decision-making support systems offer the decision maker valuable assistance in assessing the influence of status data and decision alternatives on the real world environment. The course is valuable to all potential decision makers operating in a complex, technologically rich environment.

OBJECTIVES OF THE COURSE
Study of model formation and solution procedures. To evaluate the use of information systems in decision making and performance evaluation. Distinction between decision support systems and transactional modes of processing information. Study of behavioral aspects of decision making in the decision support environment. Understanding of the tradeoffs involved in the use, design, and construction of decision making systems.

INSTRUCTIONAL NOTES
The course stresses the concept of building models of complex systems operating under uncertainty. Examples from business and government are used extensively in case analysis to instruct the student in systems analysis and design and model building and validation. The students will be required to model and analyze a number of situations, thus developing problem solving capabilities. Real world cases will be used to simulate problem solving activities.

TOPICS
1. Principles of Decision Making (20%)
   Decisions, problem recognition, problem representation, approaches to problem solving, structured and unstructured decision making.

2. Modeling (40%)
   Model formulation, design, construction and evaluation, classes of models, optimization, statistical simulation, scheduling; sta-
Statistical modeling, Monte Carlo techniques, simulation languages, random numbers, verification, distributions and sampling.

3. Tools in Decision Analysis (15%)
Decision making process, decision making under uncertainty, idea generation techniques, delphi, nominal group techniques, risk analysis, cost-benefit analysis, productivity issues.

4. Decision Support Systems (25%)
Cognitive styles, man–machine interfaces, technological tools in support of decision making, evolution of decision support systems, applications.

Bibliography

The omission of specific Topic Numbers signifies that the reference applies to the course material generally.


Little, J.D.C. The concept of decision calculus. Manage. Sci. 16, 8 (1970), B466–B485.


IS8 SYSTEMS DESIGN PROCESS

Prerequisite: IS5; co-requisites: IS6, IS7

RATIONALE

This course is designed to integrate the areas of computer technology, systems analysis, systems design, and organizational behavior to aid the student in designing large scale application or decision support systems. This course provides a strong introduction to the formalization of the information systems design process. The course explores state-of-the-art systems design and specification techniques. It is a must course for those with research interests in software engineering and for those working in an environment where state-of-the-art tools are used. A rigorous approach to information systems design and specification is presented. The course stresses the frontiers of knowledge in the specification, design, implementation, and testing of information systems. The course is also useful for those working in a technically advanced information systems environment.

OBJECTIVES OF THE COURSE

1. To provide the knowledge and skills necessary to develop a physical design and implement an operational system from the logical design.
2. To describe the process of planning for change and the postimplementation reviews and changes. Both technological and managerial aspects of system design and implementation are considered.

INSTRUCTIONAL NOTES

This course is the second covering the system development process. The techniques are utilized in the projects course IS10. A theme to be carried through the course is the iterative nature of the analysis and design process. Implementation and conversion problems are also considered. Case studies should be used as appropriate. Laboratory exercises should include the use of computer-assisted methods for system design. The human engineering aspects of system design should be emphasized.

TOPICS

1. Quality Assurance Review of Logical Design (5%; 5%)

2. Application Software Make or Buy Decision (5%; 5%)
Criteria for software selection. Evaluation process.

3. Planning to Accommodate Change (5%; 5%)
Organizational and individual need for system stability, need for system changes. System design to accommodate change. Monitoring for change. Change management: request and approval, assessing impact, determining effect on existing systems, grouping and scheduling changes. Making changes: testing, acceptance, updating procedures and documentation. Suggested deliverable by student: a system change procedure.

4. Detailed Logical Design (25%; 20%)
Logical software design: modularization control and data flows, process interaction, process organization, module determination, module specifications. Logical file design, data sharing file structure and logical access methods, data representation. Logical database design: alternative models such as the entity-relationship model. Schema levels (conceptual, external, internal). Representation of user views and view integration. Logical access paths. Improvement of logical view: normalization, aggregation, abstraction, etc.
5. Physical Design (25%; 20%)

6. Hardware and System Software Selection (10%; 15%)
Hardware configuration: mainframe and memory, front-end processors, peripherals, etc. Benchmarks, kernels, simulation, vendor selection, scoring techniques, RFP: systems software selection (operating systems, language processors, editors, access methods, communications monitor, etc.). Network architectures. Performance and acceptance criteria. Suggested deliverable by students: scoring sheet with delineation of each item.

7. Program Development and Testing (10%; 10%)

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Lynch, H.J. ADS, a technique in systems documentation. Data Base 1, 1 (Spring 1969), 6-18.


OBJECTIVES OF THE COURSE

1. To understand the overall information needs of an organization and the role of information systems in providing them.
2. To understand alternative structures for matching an organization and their integration with the information system plan. A simulation may also be used to provide the case environment.

INSTRUCTIONAL NOTES

Instruction relative to information requirements of the organization and their integration with the information system plan can be accomplished by a case study in which the students analyze overall organizational information needs, identify an applications portfolio, and develop a master developmental plan. A simulation may also be used to provide the case environment.

The course can benefit from invited speakers from industry who can relate the principles taught to their experience.

TOPICS

1. Planning an Organizational Information System (30%) Information to meet organizational functions, operations, and processes. The information system plan in relationship to organizational strategy and organizational plan. Effect of organizational learning and stage of development. Selection of projects and establishing of development priorities in the plan. Strategies for achieving information system goals.

Suggested deliverables by students: comprehensive case analysis and high-level master plan defining the application portfolio and classes of data needed by an organization and priorities for change from existing information system. Also report
defining effect on organization of new system and change implementation costs and difficulties.

2. Organization of Information System Function (20%)
Alternatives for design and placement of information system organization as part of overall organization: centralization, decentralization, division of functions between users and information systems department. Matching information system organization to host organization. Internal organization of information systems department: job functions, flow of work, alternative organizations. Interaction of information system job functions with other organizational functions.

Suggested deliverables by students: analysis of case on organization considering restructuring of information systems within organization and case on information system organization considering internal restructuring.

3. Computer Center Administration (10%)

4. Management of Information Systems Development (10%)

5. Selection and Development of Information Systems Personnel (10%)

6. The Social and Legal Environment (10%)
Data privacy. Information access policy. Data security. Contracts.

7. The Information Systems Executive (10%)
A review of the role the information systems manager plays in the organization and a general discussion of the challenges and opportunities associated with the position. Managing the relationship between organizational functions and information systems.

Bibliography
The references below do not have specific Topic Numbers because they apply to the course material generally.


OBJECTIVES OF THE COURSE

To provide the student with experience in analyzing, designing, implementing, and evaluating information systems.

INSTRUCTIONAL NOTES

Students are assigned one or more system development projects. The projects involve part or all of the system development cycle. Students work in teams to acquire practical experience in such projects, including the behavioral considerations in systems development.

The work parallels other courses in the final year of the degree program. If possible, the activities should be extended over two semesters. The information analysis portion of the project should begin in the first semester, as soon as the students have sufficient capability to begin applying information analysis techniques. Projects should be completed and documented in the final month of the second semester.

Once a team has completed its project, a team in a subsequent class can expand on it, obtaining experience in the revision and sophistication of existing computer-based systems. The following are possible alternatives for projects.

TOPICS

Alternatives

1. Development of a System for a Local Firm
Under supervision of the faculty and the systems analysis staff, students develop a small application for a computer-based management information system of a local firm. Students might also work as members of established client company teams.

2. Development of a System for a University/College
Under the supervision of the faculty and the university administrative data processing unit, students develop a system to benefit the university. Examples are alumni record and follow-up system, bookstore ordering/accounting, classroom scheduling system.

3. Development for a Hypothetical Application
Students develop an application for a hypothetical firm and prepare system development deliverables.

BIBLIOGRAPHY

The references for the IS3, IS5, and IS7 courses are appropriate for this course. While many excellent cases exist for analysis of subtopics in information systems, there is a shortage of in-depth cases. The few references for in-depth cases:


IS10 INFORMATION SYSTEMS PROJECTS

Prerequisites: IS7 and IS8; corequisite IS9.

RATIONALE

This is one of two capstone courses. By the use of projects the course fits together all of the concepts from previous courses regarding information system development.

OBJECTIVES OF THE COURSE

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