

**A Proposal for a BS Degree Program in Information Technology (BSIT)
Stage II -- Proposal to Implement**

Submitted by

**The Department of Computer Science and
The Department of Management Science and Information Systems
The University of Massachusetts Boston**

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Proposal Abstract

The Departments of Computer Science (CS) and Management Science and Information Systems (MSIS), and their respective Colleges (College of Science and Mathematics and the College of Management) propose to offer a BS degree in Information Technology (IT).

Guiding Principles

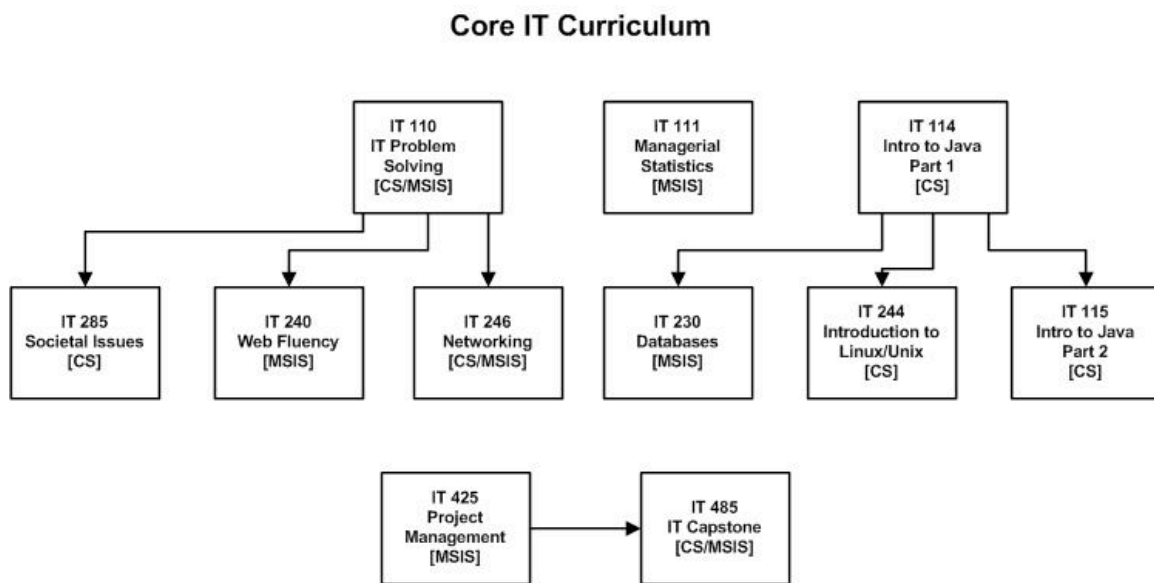
- IT knowledge and skills is a critically important driver in the Massachusetts economy, especially in the Greater Boston area.
- The CS and MSIS Departments, working together, can deliver a top notch degree program that will address the Commonwealth's IT workforce needs.
- The BSIT will provide a pathway from technology related degree programs offered by Massachusetts community colleges into a bachelors level education, and then on to IT positions in the public and private sectors, profit and non profit.
- The BSIT is designed to meet the accreditation standards required of the Computing Science Department and the College of Management, i.e., ABET and AACSB.
- Every exercise assigned throughout the BSIT will be designed to be of the kind that a student might encounter in his or her work: collaboration, competence, and outcomes assessment will be the hallmark characteristics of the program.
- The BSIT is consistent with the University's mission, particularly with regards to access, innovation, and economic development.

The Degree

The BSIT will consist of a *common core* of ten courses, a *track* of four to six courses in a particular area of specialization, a *common capstone* course, and optionally three to five professional electives.

The Core

The core and capstone will foster a community of students who share the same background knowledge, one common to students in other IT programs around the nation.



In the figure, arrows indicate prerequisites and square brackets [...] the department responsible for developing the course: CS for the Computer Science Department (in CSM), and MSIS for the Management Science and Information Systems Department (in CM). Students will take MSIS 425 Project Management after having taken 15 credits in the core, but before taking the capstone.

The Tracks

Tracks allow the program to:

- respond quickly to new markets and new technologies as they arise – tracks may come and go, while the core should be more stable, changing only to reflect major shifts in information technology; and

- adapt to student needs – students learn the basics and the important processes in the core, and then learn how to adapt them to an area of interest in their track.

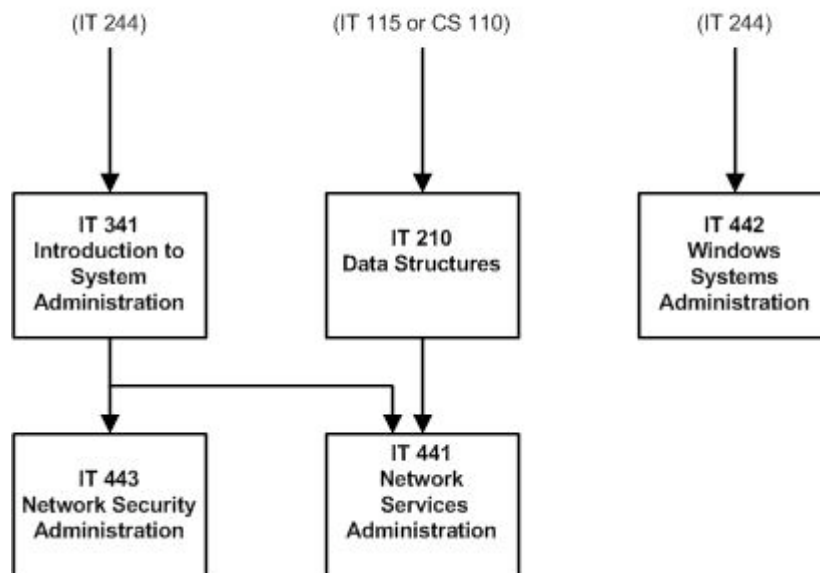
At the start, we propose two tracks: System Administration (offered by the CS Department) and Information Architecture (offered by the MSIS Department).

The System Administration Track

The System Administration track prepares the student for a career in system and network administration. The study of operating systems is a part of this track since networks are normally implemented based on a family of operating systems (e.g. cs.umb.edu implemented using UNIX and umb.edu is implemented using Microsoft Windows).

The CS Department will offer system administration as its first track because it has the expertise and technology platform (department network) to do so. Its success in offering courses in the area is reflected by the fact that CS graduates have gone on to positions as system administrators

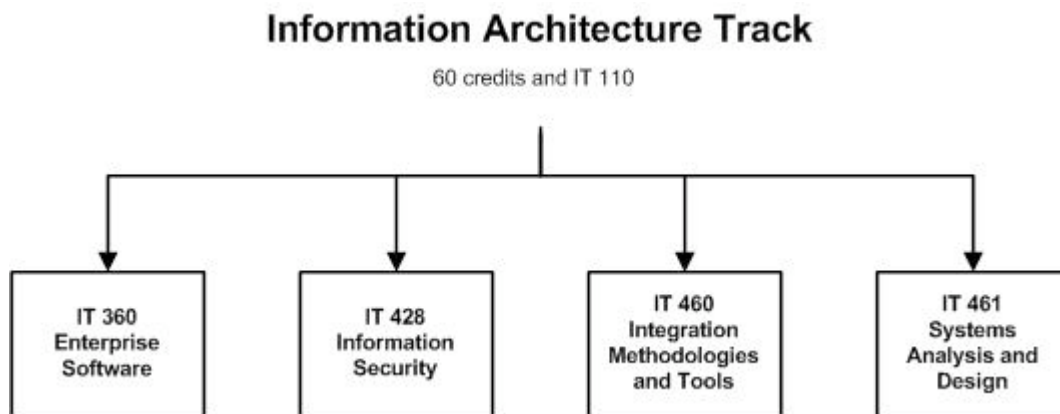
System Administration Track



The Information Architecture Track

The Information Architecture (IA) track prepares the student to be able to specify the requirements and overall architecture of a component-based system. The MSIS Department is well-placed to offer this track drawing upon its expertise in both business principles and technology.

Information Architecture is concerned with structuring data in proper context, and defining user interactions. IA provides a blueprint that describes how information (not limited to web sites) is organized and structured. It has been described as identifying and leveraging patterns in data that make would-be-complex sets of information, increasingly easier to understand. As such the program will address topics covering concepts such as accessibility, content management, experience design, information findability, information design, interaction design, search engine optimization and marketing, usability, systems user experience, and user interface design. Students will be exposed to common packaged solutions and coached on best practices in adapting these solutions to a wide range of problems.



Additional Tracks

The CS and MSIS Departments expect that there will be a considerable need to continue growing additional tracks to meet workforce needs, including

- computer forensics¹
- game development
- database administration
- web programming, and
- nursing informatics

We expect other academic departments may offer tracks in collaboration with CS and MSIS; these other departments will have the responsibility to advise students in that track, and in identifying capstone projects for that track.

Professional Electives

In addition to completing the core, the capstone, and the specialized track, students will have the opportunity to complete free electives (the exact number which is between 3 and

¹ Xiaogang Deng (Sociology) is working to define this track now.

5 will depend on the number of courses in the track chosen by the student); electives will be selected in an appropriate area outside of IT (e.g. biology, finance, marketing, nursing, etc...) and are intended to support a student's expected career path and interests.

The Capstone Course

After completing the introductory core courses, and a specialized track the students reassemble to take a project-based capstone course. Work on the projects takes place outside class; class time provides a place to share progress reports, ask questions and get advice.

The capstone serves several purposes:

- It gives the student an opportunity to apply what she has learned to one or more real projects, often with a real customer, in her own specialization area.
- It gives the student more exercise in making both oral presentations and written presentations.
- It serves as an *assessment* device: indicating whether or not the student has been adequately trained.
- It brings the community of IT majors back together to share what they've learned in their tracks, and how they may apply it. Students learn from each other some of the material outside of their tracks.

General Education Requirements and Advising

A student may apply to either college (CM or CSM) and will complete the general education requirements of that college. Student advising will be the responsibility of University Academic Advising until the student declares the IT major; thereafter advising is the responsibility of either CS or MSIS.

In particular:

- BS in IT students must meet the First Year – and Intermediate Seminar requirements according to University Requirements. These are the same for the two colleges.
- BS in IT students in both colleges must satisfy the QR requirement and Calculus.
 - Students in the College of Management take Math 134 (Calculus for Managers).
 - Students in the College of Science and Mathematics take Math 140 (Calculus I).
- BS in IT students in both colleges must satisfy a writing proficiency requirement
 - Students in the College of Management take BC 290 (Business Communications).

- Students in the College of Science and Mathematics take the Writing Proficiency Exam or the Writing Portfolio.

In the College of Management:

- BS in IT students in the College of Management will be encouraged to satisfy their social/behavioral science requirement with Econ 101 and Econ 102.
- BS in IT students in the College of Management must take one course that satisfies the Diversity Requirement and one course that satisfies the International Requirement. These two requirements may be satisfied by taking the same course.

Transfer Policy

Students transferring into the BS in IT, in either college, may transfer all 100-level and 200-level core courses, but no more courses in the major. That is, students must complete IT 425 (Project Management) and IT 485 (IT Capstone), and the courses in their chosen track at UMB.

For a full description of the Proposed Program see section 1, Proposal Development and Program Curriculum.

1 Proposal Development and Program Curriculum

The Development Process

Bill Campbell and Robert Cohen² (Computer Science) and Oscar Gutierrez and Jean-Pierre Kuilboer (Management Science and Information Systems) have been working together since the summer of 2005 to design this degree. They have attempted to share all responsibility, and any benefits (e.g. FTE's), on a 50-50 basis. Although there are challenges to two colleges offering a single program, there are also many benefits, to a multi-disciplinary approach.

In developing the program the design team have been consulting, on a regular basis, with

- College Deans,
- Home departments,
- The Boston Area Advanced Technological Education Connections (BATEC),
- Faculty and administrators of feeder community colleges,
- Faculty and administrators from Boston Public Schools,
- Business leaders in the Boston metropolitan area,
- Internal IT people in the departments and the University,
- SAGE, a national guild of system administrators,
- SIGITE, the ACM Special Interest Group on IT Education,
- Faculty from successful IT programs around the country,
- The University's enrollment management staff,
- The University's Admissions Office,
- The University's Director of Undergraduate Education,
- The University Advising Center,
- Students.

All have been enthusiastic about the program and have encouraged this initiative to succeed.

The Proposed Program

The proposed BS degree in Information Technology will require a total of 120 credits:

- 42 general education credits;
- 45 to 51 credits (depending on the track taken) for the Information Technology Major, including
 - 30 credits for the introductory core IT courses,
 - 15 credits (or 12, or 18 credits) of courses in a specialized track (a track consists of anywhere between four and six 3-credit courses),
 - 3 credits for the capstone course;

² Robert Cohen resigned in August 2007 to teach in one of the Boston high schools where he intends to found a new computer science department.

- 27 to 33 elective credits including professional and general electives. Professional electives are clusters of three courses in an area or field of study. General electives refer to any course at the appropriate level.

Examples of typical four-year schedules are attached. See attachment A for a sample of System Administration track for a student in CSM. See attachment B for a sample of Information Architecture track for a student in CM.

The Core Courses

The core courses are taken by all students in the major. Course descriptions for these follow. Courses marked with an asterisk * are already on the books, but some of these will have to be revised to properly serve the IT core.

- **IT 110 IT Problem Solving**

A wide range of IT concepts are introduced including programming, databases, networking, and web servers and how they work together in a modern system. Students work in groups to implement examples of these systems. The course examines the importance of key issues such as security, privacy, and ethics. Students should leave the course with an understanding of the components of modern systems and the scope of knowledge needed to become an IT professional.

Prerequisites: MA 129 or MA 130

- **IT 111 Managerial Statistics (MSIS 111) ***

Provides the student with the basic statistical techniques needed for business decision making in areas such as operations management, quality improvement, marketing research, finance, and general management. The course examines collection and presentation of data, frequency distributions, basic probability, statistical inference, and regression. Students use statistical software for data presentation and analysis.

Prerequisites: MA 129 or MA 130, co-requisite IT 110 or MSIS 110

- **IT 114 Introduction to Java Part 1 (CS 114) ***

An introductory course in Java programming that exposes students to the concepts involved in using a higher-level, object-oriented programming language. The course will explain the program development process and give students lots of hands-on experience writing small Java programs.

Prerequisites: MA 129 or MA 130.

- **IT 115 Introduction to Java Part 2 (CS 115) ***

A second course in Java programming that exposes students to the concepts involved in using a higher-level, object-oriented programming language. This course is the continuation of CS 114, and covers more advanced Java topics and gives students hands-on experience writing small and medium size Java programs.

Prerequisites: IT 114 or CS 114.

Note: Students may take CS 110 to satisfy both CS 114 and CS 115 as it covers the same material. In this case, students must take an additional programming course, such as MSIS 310 Client/Server Programming or CS 240 C Programming.

- **IT 230 Relational Databases (MSIS 230) ***

This course provides a thorough review of basic relational database concepts and how to apply these concepts to a variety of application problems. The course focuses on the use and properties of relational database management systems. Topics covered include DBMS architecture levels, data modeling, data definition and manipulation capabilities of Structured Query Language programming, and programming techniques for accessing relational databases

Prerequisites: IT 114.

- **IT 240 Web Fluency**

This course develop an in-depth understanding of how the web works from a technical standpoint, meaning how dynamic pages are created and delivered by web servers, and then used by browsers and other clients. Students demonstrate this understanding by achieving competency by using a current integrated development environment (IDE) to develop web applications.

Prerequisites: IT 110.

- **IT 244 Introduction to Linux/Unix (CS-IT 244) ***

A course designed to introduce students to Linux and UNIX. Students will install, setup, and operate standard tools and learn how they operate together. By course end students will have installed a fully functional Internet server while understanding its structure. Security issues of operating systems will be studied throughout the course.

Prerequisites: IT 114.

- **IT 246 Networking (CS-IT 246) ***

We will study basic data communication and networking concepts for LAN and WAN: network protocols with emphasis on Ethernet, PPP, TCP/IP, and WWW protocols, and mobile and wireless networks. Network applications include Telnet, ftp, email, distributed file systems, and client-server applications. We survey network security issues. We will do hands-on network simulation and network sniffing exercises to see how these technologies work in practice.

Prerequisites: IT 110.

- **IT 285 Social Issues and Ethics in Computing (CS 285, formerly CS 485) ***

Students investigate and discuss with their classmates some of the societal and ethical issues of information technology. The issues include freedom of speech, privacy, security, intellectual property, and the effect computers have on human interaction. Students write papers and make oral presentations on these topics.

Prerequisites: IT 110.

- **IT 425 Project Management (MSIS 425) ***

This course covers techniques and managerial concepts of project management. It prepares students to manage either complex physical projects or complex software development projects. Topics presented in this course include project life cycles, economic analysis of projects, work breakdown structure, cost estimation, and the scheduling, staffing, directing, and controlling of projects. The course also covers the use of management science techniques and computer software for project management.

Prerequisite: 60 credits.

- **IT 485 Information Technology Capstone**

Students will work on a semester-long project, particular to their track and meet together with an instructor and with students from other tracks to discuss each other's projects. Students will deliver a product that is appropriate to their track in the IT program. At the end of the semester, students report on their product, both in oral presentations and demonstrations and in writing.

Prerequisite: IT425 Project Management.

The Tracks

A track consists of four to six courses specializing in some area. The concept of tracks allows us to quickly respond as new areas in technology, and the market appear or recede.

Tracks can be proposed and offered by any department in the University

The System Administration Track

The purpose of the system administration track is to prepare a student for a career in system and network administration. This track is offered by the Computer Science Department and it consists of the following courses.

- IT 210 Intermediate Computing with Data Structures

The design and implementation of computer programs in a high-level language, with emphasis on proper design principles and advanced programming concepts, including dynamic data structures and recursion. Efficient design, implementation and debugging techniques are stressed. The assignments are designed to introduce the student to a variety of topics in computing: data structures and ADTs, Lists, Stacks, Queues, Ordered Lists, Binary Trees, and searching and sorting techniques. The language of instruction is JAVA.

Prerequisite: Fluency in JAVA, established by the successful completion of either IT 115, CS 110 or permission of the instructor. A student who has already taken a programming course at the level of CS 110 in a language other than JAVA will probably not be adequately prepared for CS 210. Since such a student may not register to take CS 110, s/he may petition the department to register for CS 119 in order to complete preparation for CS 210

- IT 341 An Introduction to System Administration

This is an introduction to the process of choosing, installing, configuring, and maintaining UNIX operating systems such as Linux. Topics include user management, file system management, security, networked file systems (NFS), networked information systems (NIS), domain name servers (DNS), mail systems and printers. Students will get practice writing shell scripts. Also, students are introduced to general system administration policy.

Prerequisites: IT 244

- IT 441 Network Services Administration

This course builds on the material in Introduction to Unix System Administration, and covers what is necessary to automate the system administration tasks. Topics include advanced shell programming and scripting, heterogeneous systems,

remote management, the legal issues of system administration, as well as the design and implementation of policies and automated administration regimes.

Prerequisites: IT 210 and IT 341

- IT 442 Windows System Administration

This is an introduction to the process of choosing, installing, configuring, and maintaining Microsoft Windows client and server systems. Topics include user management, file systems, network domains and domain management, mailers, and printing. Students get practice in writing scripts for performing maintenance tasks. Also, students learn how these tasks fit into the more general system administration processes.

Prerequisites: IT 244

- IT 443 Network Security Administration

An investigation into the tasks of selecting, configuring and administering services in an internetworking environment. Topics include the TCP/IP protocol suite, service administration including DHCP, DNS, SSH, and Kerberos. Students completing this course will have experience in administering an inter-network of computers with a variety of these services as well as an understanding of the similarities and differences between protocols in the TCP/IP suite (TCP and UDP).

Prerequisites: IT 341

The Information Architecture Track

The purpose of the information architecture track is to train students for careers in the front-end specification (requirements and architecture) of component-based computer systems. This track is offered by the MSIS Department and it consists of the following courses.

- IT 360 Enterprise Software

This course explains the core applications of a typical organization to support their fundamental business functions. It explains the role of IT in attaining competitive advantage and how modern organizations configure commercially available products to satisfy their information needs. The course makes extensive use of collaborative technologies and business applications to demonstrate the work of virtual teams and how they implement their operations.

Prerequisites: IT 110 and 60 credits

- IT 428 Information Security

This course provides a broad overview of the threats to the security of information systems, the responsibilities and basic tools to ensure information security, and the levels of training and expertise needed in organizations to reach and maintain a state of acceptable security. Students will learn and understand the key issues associated with protecting information assets, determining the levels of protection and response to security incidents, and designing a consistent, reasonable information security system, with appropriate intrusion detection and reporting features.

Prerequisites: IT 110 and 60 credits

- IT 460 Integration Methodologies and Tools

This course develops an understanding of applications architecture based on building IT systems out of common parts and a service-oriented architecture. These are collections of information services, modules and functional components that can be reused in a variety of common contexts. The course will apply several tools to exemplify the use of heterogeneous reusable modules to fulfill an information service. An underlying methodology for integration based on BPEL (Business Process Execution Language) will be applied.

Prerequisites: IT 110 and 60 credits

- IT 461 Systems Analysis and Design

This course introduces recent approaches to the analysis and design of computer information systems, including the hands-on use of computer aided software engineering (CASE) tools. The changing role of the systems analyst in both operations and systems applications in today's organizations is examined. The course critically analyzes systems development methodologies, including life cycle models and prototyping; reviews user-led developments and current approaches which facilitate user-developer collaboration; discusses effective diagramming and notational techniques now available to define and document functional requirements and operational business processes; and examines current methods used to test and evaluate the accuracy, completeness, and usability of documented requirements and convert them into efficient systems design or re-engineering processes. Topics include CASE tools, module and transaction design, human-computer interfaces, and system configuration. This course includes practical experience in analyzing and designing an organizational application. It discusses the concept of quality as applied to information systems and business process redesign as well as the role of information systems in managing quality within an organization.

Prerequisites: IT 110 and 60 credits

More Tracks

The Computer Science department could quickly offer additional tracks such as Databases, Web Programming and (general purpose) Programming. Other tracks being considered are Computer Forensics and Nursing Informatics. Any department sponsoring a track will have to play a role in advising students in that track, and in identifying capstone projects for that track. The sponsoring department(s) need not be in either CM or CSM.

Professional Electives

A student will have several free electives depending on the number of courses in their track. Typically students will take three electives in a particular area outside of IT. Lists of appropriate clusters of courses will be provided and, categorized by field (biology, finance, nursing, etc).

Courses relevant to a business oriented career path include:

MIS:

MSIS 422: Decision Support Systems
MSIS 426: e-business and e-commerce Infrastructure
MSIS 427: Knowledge Management
MSIS 430: International Information Management
MSIS 454: Supply Chain Management
MSIS 455: Decision Analysis

Accounting:

AF 210 Financial Accounting
AF 211 Managerial Accounting
AF 363 Cost Accounting

Finance:

AF 210 Financial Accounting
AF 211 Managerial Accounting
AF 301 Introduction to Financial Management
AF 325 Theory of Corporate Finance

Management:

ACM 299 Analysis and Communication for Managers

MGT 303 Managing Organizations
MGT 470 Entrepreneurship and Innovation in Organizations

Marketing:

MKT 301 Principles of Marketing
MKT 310 Data Analysis for Marketing
MKT 404 Retailing in the Internet Age
MKT 405 Web Page Marketing

Courses relevant to a system administration oriented career path include:

CS 240 C Programming
CS 310 Advanced Data Structures and Algorithms
CS 341 Computer Architecture and Organization
CS 410 Introduction to Software Engineering
CS 430 Database Management Systems
CS 437 Database-backed Web Sites and Web Services
CS 440 Introduction to Operating Systems
CS 445 Real Time Systems
CS 446 Introduction to Internetworking
CS 450 The Structure of Higher Level Languages
CS 451 Compilers I
CS 460 Graphics
CS 470 Introduction to Artificial Intelligence

The Capstone Course

- IT 485 IT Capstone

This is a project-based, capstone course where the student applies what she has learned in one or more projects to be determined by the instructor and the student. Students carry out projects, possibly for customers on campus, under the direction of the instructor, and report back to the class as a whole on their progress. Students will present at least two formal written presentations and at least two formal presentations of their work.

The capstone course serves several purposes.

- It gives the student an opportunity to apply what she has learned to one or more real projects, often with a real customer, in her own specialization area.
- It gives the student more exercise in making both oral presentations and written presentations.
- It serves as an *assessment* device: indicating whether or not the student has been adequately trained.

- It brings the community of IT majors back together to share what they've learned in their tracks, and how they may apply it. Students learn from each other some of the material outside of their tracks.

2 Purpose and Goals

Objectives

The BSIT has the following objectives³:

Graduates will be able to:

- Use and apply current technical concepts and practices in the core information technologies.
- Analyze, identify and define the requirements that must be satisfied to address problems or opportunities faced by organizations or individuals.
- Effectively design IT-based solutions and integrate them into the user environment.
- Address security issues.
- Assist in the creation of an effective project plan.
- Identify and evaluate current and emerging technologies and assess their applicability to address the users' needs.
- Analyze the impact of technology on individuals, organizations and society, including ethical, legal, security and global policy issues.
- Demonstrate an understanding of best practices and standards and their application.
- Demonstrate independent critical thinking and problem solving skills.
- Collaborate in teams to accomplish a common goal by integrating personal initiative and group cooperation.
- Communicate effectively and efficiently with clients and peers both orally and in writing, using appropriate terminology.
- Recognize the need for continued learning throughout their career.

Graduates will be familiar with, and be able to apply, the following core information technologies:

- Programming
- Computer Systems, Networking and Hardware
- Databases
- Web Technologies and Issues
- Human Interface Design

Graduates will have the knowledge and skills in a specialized track:

- System Administration, or

³ Based on The SIGITE's Curriculum Writing Committee's Computing Curriculum -- Information Technology Volume, May 2005. Available at <http://www.sigite.org/content/activities/curriculum/>.

- Information Architecture.

Assessment

Program assessment and improvement activities will include the following:

- Establish an industrial advisory board (IAB). IABs have served the colleges and the CS department well in helping us to decide what we should be teaching.
- Survey students on a regular basis.
- Interview employment counselors and recruiters to gather feedback about our graduates.
- Make use of our advising processes and course evaluation forms to make sure we're meeting these objectives.
- Make use of (current) annual alumni gatherings to survey graduates as to how well we prepared them and what we should be doing next.
- Use the capstone course (and feedback from any customers) as an assessment tool.

3 Mission Context

Relationship to the Computer Science Degree Program

The current curriculum and undergraduate degree program of the CS department is designed to prepare students for careers as programmers. Many of the students who start out in the computer science program decide not to complete the degree requirements or fail out of the program. In fact, retention has always been a problem particularly in the CS major, at UMass Boston and nationally. Computer Science can lose half of its students in the first two (albeit challenging) programming courses.⁴ The Department has ascertained that these students represent a class of “techies” who want to work with computers but who do not want (or who are not able) to specialize in programming. The BSIT offers an alternative “applications-path” for these students: they will learn how to use IT to solve real-world problems within the context of a field in which they wish to work.

The BSIT will improve enrollment, particularly retention, in the CS Department for several reasons:

1. It will replace the (difficult) first programming course with a two-course sequence covering the same material.

⁴ Although, we are working to improve this by replacing the first programming course (where we lose the most students) with two courses that cover the same material.

2. This is a hands-on program. There is less abstraction and more practical exercises. Students find abstraction difficult.
3. Collaboration is encouraged in this program. Some students work better when they can ask others questions.
4. Students transferring from the community colleges should do better than those who transfer to the CS program. Currently the CS department is working with several of feeder community colleges to develop syllabi for the introductory core courses. Transfer students will be as well prepared as native students.
5. Increased tutoring services will be provided from Academic Support to IT majors.

Relationship to the Management Science and Information Systems Concentration

The MSIS concentration in CM is embedded in a management degree program requiring students to complete approximately 36 credits of foundation and core courses in general areas of management, and 18 credits in a specialized concentration. BSIT students will not need to take the core business courses required in the MSIS concentration but will focus on IT subjects. The BSIT then allows students who are more interested in the technical issues of IT to focus on technology related subjects but within a business management framework.

4 Need and Competition

Need and Demand

In 2004, the Massachusetts Technology Collaborative (MTC) reported a loss of 12,670 software and communications services jobs in Massachusetts from 2002 to 2003, a 9.3% decrease. Computer and communications hardware jobs decreased by 6,610, or 10.7%, over the same period.⁵

Despite such losses, these jobs remain of great importance to Massachusetts. The MTC reported Massachusetts employment concentrations in both software and communications and computer and communications hardware to be higher than in all other Leading Technology states. The Joint Venture's Index of Silicon Valley reported that out of the top 125 world-wide regions in knowledge competitiveness, the Boston area ranked 17th for IT and computer manufacturing employment per capita in 2005.⁶

⁵ See http://www.mtpc.org/institute/the_index/index_11_23_04final.pdf

⁶ See <http://www.jointventure.org/publicatons/index/2007%20Index/The%202007%20Index%20of%20Silicon%20Valley.pdf>

Most significantly, the Bureau of Labor Statistics and the Massachusetts Department of Workforce Development both acknowledge this downturn and foresee very healthy growth in information technology jobs nationally and in the state over the next decade.

The Bureau of Labor Statistics notes the downturn in information technology industries earlier this decade, but forecasts these to be among the most rapidly expanding from 2004 to 2014. “Information contains some of the fast-growing computer-related industries such as software publishers; Internet publishing and broadcasting; and Internet service providers, Web search portals, and data processing services. Employment in these industries is expected to grow by 67.6 percent, 43.5 percent, and 27.8 percent, respectively.” The BLS forecasts these industries to add 722,000 jobs over the same time period.

The 2006-2007 edition of the *Occupational Outlook Handbook*⁷ from the Bureau of Labor Statistics details this rapid growth with projections for specific occupations:

“Computer software engineers are projected to be one of the fastest-growing occupations from 2004 to 2014. Rapid employment growth in the computer systems design and related services industry, which employs the greatest number of computer software engineers, should result in very good opportunities for those college graduates with at least a bachelor’s degree in computer engineering or computer science and practical experience working with computers. Employers will continue to seek computer professionals with strong programming, systems analysis, interpersonal, and business skills.”

“Employment of computer support specialists is expected to increase faster than the average for all occupations through 2014, as organizations continue to adopt increasingly sophisticated technology and integrate it into their systems. Job growth will continue to be driven by the ongoing expansion of the computer system design and related services industry, which is projected to remain one of the fastest-growing industries in the U.S. economy.”

“Employment of systems administrators is expected to increase much faster than the average for all occupations as firms continue to invest heavily in securing computer networks... Most employers prefer to hire persons who have at least a bachelor’s degree and broad knowledge of, and experience with, a variety of computer systems and technologies.”

“Employment of computer systems analysts is expected to grow much faster than the average for all occupations through the year 2014 as organizations continue to adopt and integrate increasingly sophisticated technologies. Job increases will be driven by very rapid growth in computer system design and related services, which is projected to be among the fastest growing industries in the U.S. economy... Many employers seek applicants who have at least a bachelor’s degree in computer science, information science, or management information systems (MIS).”

“Employment of computer and information systems managers is expected to grow faster than the average for all occupations through the year 2014. Technological advancements will boost the employment of computer-related workers; as a result, the demand for managers to direct these workers also will increase... Despite the downturn in the technology sector in the early part of the decade, the outlook for computer and information systems managers remains strong... A bachelor’s degree usually is required for management positions, although employers often prefer a graduate degree, especially an MBA with technology as a core component. This degree differs

⁷ See <http://www.stats.bls.gov/oco/home.htm>.

from a traditional MBA in that there is a heavy emphasis on information technology in addition to the standard business curriculum.”

The Bureau of Labor Statistics forecasts these occupations as being among the top 30 with the highest growth rates between 2004 and 2014. Each is expected to have growth rates exceeding 30% and to be in the top quartile of annual earnings. A Bachelor’s degree is considered to be the primary source of post-secondary education for each of them.⁸

At the state level, according to the Massachusetts Department of Workforce Development, information technology jobs are also forecasted to have some of the highest rates of growth in the state between 2004 and 2014.⁹ The industries consisting of computer system design, software publishing, and Internet and related services are each forecast to be among the most rapidly growing over that time period, with growth rates of 25%, 49%, and 23%, respectively.

Among the forecasts for specific occupations within those industries for Massachusetts are these:

Occupation	Growth Rate	Expected Openings
Application Software Engineers	39.0%	10,980
System Software Engineers	39.2%	9,290
Computer System Analysts	22.3%	6,080
Database Administrators	30.2%	1,770
Network and Computer Systems Administrators	28.6%	3,550

The Massachusetts Department of Workforce Development also states that “education and training will play an ever more critical role in the Massachusetts economy,” and each of these occupations will require considerable education and training.

In summary,

- The Bureau of Labor Statistics and the Massachusetts Department of Workforce Development both forecast strong job growth in the information technology sector over the next decade, nationally and in our state. The BS IT responds to that growth.
- Local industry leaders¹⁰ have repeatedly stressed that educators should be teaching not just computer technology, but how one *applies* that computer technology in business. The BSIT achieves that.
- One of the keys advocated by the Massachusetts Technology Collaborate for a successful innovation economy was that the Commonwealth should “educate the hell” out of its workforce. The BSIT delivers that.

⁸ See <http://www.stats.bls.gov/emp/mlrtab2.pdf>

⁹ See http://lmi2.detma.org/Lmi/pdf/MEP_by_occupation.pdf

¹⁰ Recently, for example, Staples’ Senior Vice-President and CIO at the February BATEC Futures Forum (see http://www.batec.org/futuresforums/itfuturesforum_01_10_2006.asp)

Other IT Programs

In this section we review related programs at colleges and universities in the Boston area and nationally. Locally, there are no programs with the same technical approach to IT education as our program. Nationally, there are a number of very successful similar programs.

Greater Boston

The following table summarizes our findings for colleges and universities in greater Boston. This list excludes Computer Science and Information Systems degree programs:

<i>No IT degree and no plans for an IT degree</i>	BU Harvard MIT Tufts Wellesley
<i>IT Minor</i>	Bentley Framingham State
<i>BS IT</i>	Framingham State Northeastern Simmons
<i>MS IT with a focus on IT Management</i>	Bentley Boston College Brandeis University of Massachusetts Boston

What follows are brief descriptions of the undergraduate IT programs:

Bentley

Bentley has a very successful IT Minor (with no plans to add a Major). Approximately, 100 of 900 seniors are taking the Minor, with 300 of the 900 have taken the first course of the minor (Data and Information Management).

Framingham State

Framingham State has a successful IT Minor (larger than CS) and introduced a new Business and Information Technology major in Fall 2006. The degree was jointly developed between the Business and Computer Science departments, and is run out of the business department. In terms of existing programs at UMB, this program is closest to MSIS than the proposed IT degree. Students take 13 business and finance courses and 6 technical courses. In its first year, there are already more IT majors than CS majors.

Northeastern University

An IT degree is offered through the School of Continuing and Professional Studies. The 18-month program is aimed at mid-career students already holding an Associate degree in management. The program “emphasizes the combination of outstanding technical skills, communication and leadership skills, and specialization in essential IT domains needed to grow your career.”¹¹

Simmons College

This is the only IT program we have found that is considered unsuccessful by its founders. The Computer Science department began offering an IT in 2003. Since then, there have been only 2 majors (there are only 17 CS majors at the moment.). Bruce Tis, Department Chair, believes that the problem has to do with both poor marketing and that it is difficult to attract women to technology programs.

National BS Information Technology Programs

The following table summarizes our findings for selected programs nationwide. These programs have been quite successful at attracting students to Information Technology.

University	IT Students	CS Students	Placement Statistics	URL
RIT	1200	700		http://it.rit.edu/
Purdue	(capped at) 500	? (way down)	90 – 98% (estimated)	http://www.tech.purdue.edu/Cpt
NJIT	370	382	no data – tracks enrollment	http://it.njit.edu/
IUPUI	450	50	no data	http://www.engr.iupui.edu/cpt/
U of Cincinnati	12 Freshmen majors	no data	no data	http://it.cas.uc.edu/IT/
US Naval Academy	112	83	Most go to subs, air and marine.	http://www.cs.usna.edu/

Rochester Institute of Technology (RIT)

As the numbers show (no – not a typo), RIT is a major player in technology education. They have one of the oldest and most established IT programs. Their BS in IT has the "track" structure and their program (partly) inspired our own track structure.

Purdue

¹¹ See <http://www.spcs.neu.edu/cohort/it.html>

Purdue University offers a BS in IT through the Computer and Information Technology (CIT) Department in the College of Technology.

The CIT department head, Professor Lonnie Bentley, says that they are currently capping enrollment at 500 undergraduates; there are about 100 additional students who want into the program but CIT cannot accommodate them. They once allowed the program to grow to 725, thinking the University would provide more resources but this did not happen. So now they have raised the standards for admission, requiring higher SAT scores and a 3.5/4.0 GPA in 18 credit hours of specific coursework before transferring into the program. CIT also has a graduate program, capped at 60 students; they turn away 40 per year.

Bentley has no figures for CS, but says they are way down, as they are for us and for the nation as a whole.¹²

He reports a 90 – 98% placement rate for his students, but this must be a guesstimate, since the department has not collected firm data.

Bentley thinks that "applied computing" is the theme of today. Purdue's CS department was the first CS department in the country. He says, "As such, they are very proud, but a little inflexible in responding to industry. They believe that they "define" CS, and the old timers continue to force that department to march forward with same traditional theory based focus and shy away from incorporating any "applied" computing into their program. From my standpoint, that is great because we represent applied computing on this campus and wouldn't want the competition."

Purdue Indianapolis (IUIPI)

This is a campus similar to ours; IUIPI is an urban campus in the Purdue system. They've a Department of Computer and Information Technology within the School of Engineering and Technology. They offer a BS in IT in one of several tracks: the "standard" track, a business track, a networking track, and a web development track. The "tracks" actually look like minors in one of the given categories.

New Jersey Institute of Technology (NJIT)

NJIT has a thriving program in the middle of Newark, NJ. IT is a cross-college discipline, and so reports directly to the Provost. As in computer science, numbers are down this year (they have 64 freshmen and 66 sophomores, as opposed to 130 seniors and 102 juniors), but are roughly in line with computer science. Robert Friedman, the Chair of IT, says they have no placement data but that it roughly tracks enrollment.

University of Cincinnati

¹² Fortunately, the nation's and our CS numbers appeared to have bottomed out last year, and are finally climbing back, but are nowhere like where they were in 2000.

Their program has just been approved by the Ohio board of Regents. They've accepted 12 freshmen into the program this year and have about 300 students taking IT courses. Most are in legacy programs. Due to a huge consolidation of programs and colleges at the University of Cincinnati a few years ago, they've inherited 6 IT programs from two other colleges. They've about two years consolidating these programs into the new bachelor's degree in IT.

They are beginning a marketing program for the IT program. They find that high school counselors and others really don't understand IT. Many prospective students are referred to the engineering college when they really are interested in our hands-on approach to IT.

United States Naval Academy

Kay Schulze, the CS Dept Chair, says the IT numbers would be higher but for two reasons: (1) they've had to cap enrollments until they can hire the faculty to teach them, and (2) several midshipmen who thought IT would be an easy major were forced out because of low grades.

While most graduates are traditionally placed in submarines, surface ships or in the Marines, more recently graduates are finding their way into various national security posts.

5 Students

Enrollment

The projected enrollment of the BSIT is for thirty (30) full-time students in the first year, and additional 30 in each following year, to reach a total enrollment of 120 in the fourth year. Additional growth will depend on additional faculty to teach the necessary additional sections.

The University's Director of Enrollment Management has indicated full confidence in her office's ability to fill the program's first-year target with UMass Boston students alone and will work with us to attract students from the community colleges and high schools as the program grows.

Articulation with the Community Colleges

The University of Massachusetts Boston has already begun to formulate articulation agreements with area community colleges that have Information Technology programs and degrees; this has been done through BATEC. In particular, we have been meeting

with Middlesex Community College, Bristol Community College, and Bunker Hill Community College.

6 Program Diversity

Given the hands-on, collaborative nature of the program, it is anticipated that it should attract a more diverse population. Moreover, it is expected that women will find this program more attractive than traditional programs in computer science. That prediction is based on the results of Maria Klawe's (formerly Dean of Engineering and Applied Science at Princeton University and now President at Harvey Mudd College) survey addressing the question of why many women leave programs in computer science and engineering.¹³ Women want to work in a profession where they are helpful to other people, and where they would work closely with other people. In the IT program proposed here, students will work together to solve problems beginning in the first course of the core, throughout the core and the tracks, and in the capstone class. Moreover, in the Boston Public Schools, 86% of the students are "under-represented minorities", and most of the white students are in the lower grades. Felicia Vargas (TechBoston) asserts that her school reflects these numbers.

7 Administration and Operation

Administration, Governance and Operation

Both the College of Science and Mathematics (CSM) and the College of Management (CM) will share the responsibility of managing the BSIT.

The BSIT will appear, word for word, in both the College of Science and Mathematics section, and in the College of Management section of the University's Undergraduate Catalog. In addition,

- There will be a program director, alternating between the two colleges, overseeing the program. The term for the Program Director will be two years.
- The two colleges will staff the core courses roughly on an equal basis.
- There will be a curriculum committee with equal representation. This committee, the two departments, and the two colleges must approve any changes to the core. This committee and the department and college offering a track must approve any new track.

¹³ For example, in a talk at the ACM Special Interest Group on Computer Science Education (SIGCSE) 2005 Symposium (see http://www.princeton.edu/~seasweb/dean/Klawe/SIGCSE_2005.pdf) and in a discussion with Bill Gates and Richard Rashid at the Microsoft Faculty Research Summit 2005 in Redmond, WA (see <http://research.microsoft.com/workshops/FS2005/webcasts/12495/default.htm>).

- Advising of students will be balanced among the faculty. Advising for IT will count as advising in one's own department.
- Faculty (full-time or part-time faculty) will be members of either the MSIS department or the CS department. Faculty offices are located in their home departments. One's home department takes all personnel actions (tenure, promotion, annual reviews, etc).
- The course evaluation form used will be that of the instructor's department. Additional surveys may be administered for accreditation purposes, but these needn't identify an instructor.
- FTEs for a course will go to the college whose instructor teaches the course (regardless of who "owns" the course).
- In order not to threaten the accreditation (ABET for CS and AACSB for MSIS) of existing programs, more than half of the courses must be taught by full-time faculty.

8 Resources

The program introduces 12 new courses in the core, capstone and two tracks. It will require two new tenure-track faculty and two lecturers. Although CS and MSIS faculty can teach some of the courses, it is important that the BSIT be staffed with faculty primarily assigned to its delivery. The program will also require a half-time laboratory supervisor, and four teaching assistants (TAs).

There are several courses that need a laboratory. System administration requires that we have networks that are connected to umb.edu, and networks that are not (for experimentation and security). There are times students will want to work at desks, either with their own laptops in front of them, at desks with laboratory computers set up in specific configurations (desktop computers with removable drives are best here), or at benches where they are working (with tools) on computer hardware. This could all be housed in either one large lab (with two spaces) or two smaller labs, each capable of holding 30 students.

The library has a good collection. The only addition that will help an Information Technology program is a library subscription to the Safari book program. A subscription to Safari would cost our library \$15,000 per year.

Space will be needed for new offices (for new faculty) and for the laboratory.

See Attachment B for the new program budget form.

Attachment A-1: A Typical BS in Information Technology Program

System Administration Track for a student in CSM

Freshman Fall Semester

IT 110 IT Problem Solving (new)	3
IT 111 Managerial Statistics	3
IT 114 Intro to Java Part 1	3
ENGL 101 Freshman Comp I	3
First-Year Seminar	3

Freshman Spring Semester

IT 240 Web Fluency (new)	3
IT 246 Networking	3
IT 115 Intro to Java Part 2	3
ENGL 102 Freshman Comp II	3
Gen Ed (Natural Science or Math)	3

Sophomore Fall Semester

IT 230 Databases	3
IT 244 Intro to Linux	3
Gen Ed (Natural Science or Math)	3
Gen Ed (World Culture/Language)	3
Intermediate Seminar	3

Sophomore Spring Semester

IT 210 Data Structures	3
Gen Ed (Natural Science or Math)	3
Gen Ed (Arts)	3
Math 140 Calculus I	4
Gen Ed (Humanities)	3

Junior Fall Semester

IT 285 Social Issues & Ethics	3
IT 341 Intro System Admin (new)	3
IT 442 Windows Sys Admin (new)	3
Gen Ed (Natural Science or Math)	3
Gen Ed (Social and Behavioral)	3

Junior Spring Semester

CS 443 Network Secur Admin (new)	3
CS 441 Network Servi Admin (new)	3
Gen Ed (Social and Behavioral)	3
CS 240 C Programming	3
Elective	3

Senior Fall Semester

IT 425 Project Management	3
CS 310 Adv Data Structures & Alg.	3
Elective	3
Elective	3
Elective	3

Senior Spring Semester

IT 485 IT Capstone	3
CS444 Operating Systems	3
Elective	3
Elective	3
Elective	3

Major	48 credit hours
Gen Ed	42 credit hours
Electives	30 credit hours
Total	120 credit hours