Self-Evaluation

Computing Information Systems Major

Department of Mathematics & Computer Science

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I. Overview of the Major

A. Mission Fulfillment:

1. State the purpose (mission) of the major.

The Computer Information Systems (CIS) major offers the computing, quantitative and analytical expertise public and private organizations need to advance the practice of criminal justice and public administration. The program prepares students to be highly skilled computer professionals who assist in the investigation and prosecution of digital crimes and help develop and implement information systems required to improve law enforcement and public agency functions. The program provides the broad background in computing that is needed to thwart the abuse and misuse of computers, data networks, information systems and information infrastructures, in an environment of ever advancing digital technology. The courses prepare students for direct entry into the profession as well as entry into graduate and professional programs that rely on computing and quantitative methods, especially in areas related to criminal justice and public administration. Furthermore, the program prepares students for the life-long retraining that is an integral part of the computing profession.

2. Describe how the courses in the major, taken overall, fulfill the stated purpose (mission) of the major.

The courses of the major are designed to impart professional level computer related skills to meet the current and anticipated needs in the criminal justice and public administration fields. These computer related skills encompass a broad range of activities and disciplines including software development and use, computer security, algorithms, operating systems design and security, networking and network security, database and information system design. The required mathematics courses in the program, which include calculus, discrete mathematics and two semesters of operations research, provide the quantitative and analytical background essential for the study of computer science. Capstone specializations in Criminal Justice and Public administration allow students to apply mathematical and computing skills to solve problems faced by criminal justice and public agencies.

Courses in the major are divided into the following areas: Mathematics Foundation, Computer Foundation, Operations Research Requirement, Electives and Applied Specialization. (Please see CIS Requirements, Appendix D). Foundation computer courses introduce students to the principles, methods, practices, and tools of the computing profession. Besides offering essential background, the required mathematics courses provide practical analytical and problem solving skills that can be applied to criminal justice and public agency problems, e.g., the modeling of public systems using techniques from operations research, statistics, and systems analysis. Capstone courses allow students to apply both quantitative and computing skills to solve criminal justice and public agency problems. Finally, the Electives allow students to develop in-depth knowledge of a specific subfield of computing, e.g., computer networking or computer security, in preparation for graduate and professional study or direct entry into the profession.

The CIS program adheres to curricula guidelines issued by professional computing societies, particularly computer science educational guidelines published by joint task forces of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE). The current CIS program reflects both the recommendations in Computing Curricular 1991 (Tucker et al, 1990) and the 2001 ACM/IEEE Task Force *report ("Computing Curricula," 2001*). These reports outline the essential body of computing knowledge and describe how it should be packaged into courses. In addition, they offer guidance on new knowledge areas as well as social and professional issues that should be treated in the curriculum.

Throughout most of the program, the focus is computer science rather than one of the more specialized, emerging sub disciplines of computing such as information technology. The recent ACM report (Computing Curricula, 2004, p. 18) notes, " While other disciplines can produce graduates better prepared for specific jobs, computer science offers the comprehensive foundation that permits graduates to adapt to new technologies and new ideas." Such a background is essential for computer security and forensic computing specialists who help secure computing infrastructures and combat digital crimes in an environment of continually advancing technology.

3. Describe the relevance of the major to the College's mission.

The CIS major is integral to the aims and ideals of the mission of the college. The major is structured to provide students with computer and quantitative expertise focused on and directed to the needs of the criminal justice and public administration fields. Besides offering the firm grounding in computing and quantitative methods needed for advanced study or direct entry into the computing profession, applications of such methods in public and criminal justice agencies appear throughout the curriculum. Applied Specializations in Criminal Justice and Public Administration, which provide capstone courses in the major, allow students to use the methods of operations research, systems analysis, statistics, and various computing methodologies to solve practical problems in the fields of Criminal Justice and Public Administration. Advanced courses in the curriculum emphasize those areas of applied mathematics and computing most demanded and of most use to Criminal Justice and Public agencies, e.g., databases, computer security, distributed systems, and operations research, which find direct application in the field

B. What does this major contribute to the education of undergraduates in general? Describe the skills, abilities, and subjects a student electing this major is expected to master.

The CIS major allows students to acquire competence in the use and application of computer and quantitative methodologies essential for understanding and contributing to an advanced technological society. The specific skills taught include, but are not limited to, software design and development, hardware operation and logical organization, programming using various methodologies, database design and management, data networks and distributed computing, and modeling of public service systems employing the quantitative disciplines of operations research, statistics, and systems analysis. Consequently, students receive a well-rounded and thorough curriculum of study, which equips them with skills that are extremely useful to the general business community and particularly to criminal justice and public agencies.

C. Describe and assess the preparation provided by this major for each of the following post-graduate activities: (1) jobs or careers, (2) graduate education (e.g., masters and doctoral programs), and (3) professional education (e.g., law school). Assess the data provided by the Office of Institutional Research (OIR) concerning the current status of John Jay graduates who have completed this major. The OIR conducts surveys of students 4 months, 2 years, and 5 years after graduation and will provide information that addresses the above items. See Appendix.

Jobs or careers: The CIS major has provided graduates outstanding opportunities for challenging and rewarding careers, especially in the Information Technology (IT) field. CIS graduates take positions as database designers, network administrators and engineers, web designers, and systems programmers. Many graduates have moved on to important managerial positions in the IT field, for example, the director of computing and telecommunications for the Office of the Bronx, D.A. is a former CIS graduate. During the past five years CIS students have taken information technology positions with the Federal Aviation Administration, Central Intelligence Agency, IBM, NYPD, and the Security Industries Automation Corp. Many find employment in non-IT companies that rely on technology, e.g., hospitals and security firms. For example, one of our graduates managed the implementation of an automated system for processing medical images at Columbia Presbyterian Hospital. Several graduates are chief information technology officers at major New York area law firms.

The CIS major provides the basic background in computing and exposure to enough current computing technology so that graduates can be competitive in the job market. Their success, however, depends on their willingness to develop not only specialized computing skills, but also strong oral and written communication skills. Another factor, of course, is the state of the job market. The unprecedented contraction in the IT field during the past four years has limited hiring in the IT industry since 2001. It has also resulted in a nationwide decline in the number of students pursuing degrees in computing. Computer majors at most CUNY units and several local area private colleges have seen enrollment declines from 30% to 50%.

Fortunately, the IT industry has turned around and again is beginning to offer excellent career opportunities, especially in the computer security area. According to an International Data Group report summarized by Richard (2005), IT industry positions are expected to grow at a rate of about 5% per year with the computer security personnel growing at the fastest rate, 14% per year. The number of positions for Information security professionals world-wide will increase from about 1.2 million in 2003 to about 2.1 million in 2008. In fact, the US Department of Labor (2004) projects the fastest growing of all professions for the years 2002 to 2012 are network systems data communications analysts (57%), computer application software engineers (46%), computer application systems engineers (45%), database administrators (44%), network administrators (37%), computer and information systems managers (36%). All of the positions require at least a Bachelors degree in Computing. The CIS program prepares students for opportunities in each of these IT job categories, especially in the positions related to information security and computer forensics.

Despite the outsourcing trend and contraction in the IT industry in recent years, limited Office of Institutional Research (OIR) data indicate that CIS graduates found employment in the computing profession and continued to seek opportunities in the computing field after graduation. An OIR survey of CIS graduates (Office of Institutional Research, November 2004a) indicated that for the CIS graduating classes from 1999 through 2003, 38 of 67 respondents (56 % of respondents) were working in fields related to their major four months after graduation. The survey also showed that 79% of respondents were seeking a new job related to their major. Since this OIR survey is conducted four months after graduation, students who find a job after the fourth month of graduation are not counted as having a position related to their major. The OIR survey includes only 67 respondents, which is about 30% of the 221 students who graduated during the years 1999 to 2003.

Graduate and professional education

The current CIS major provides sufficient academic grounding to meet the admission standards of graduate programs in computer science, applied mathematics,

forensic computing, management information systems, and various fields that rely on computing. The six computer Foundation Courses are required in most computer majors and provide fundamental background in programming and problem solving, algorithmic analysis, operating systems and the basic principles of computing. The Electives and capstone courses in the Applied Specializations allow students to develop specialized skills in areas they intend to pursue in graduate school. The courses in the Mathematics Foundation ensure that students have adequate mathematics preparation to be successful in the program. In addition, these courses typically are required in most graduate programs of interest to CIS majors. Faculty experience and limited OIR data indicated that most CIS graduates continue their studies in computing in either graduate or professional programs.

Students majoring in CIS can find their major advantageous when applying to graduate and professional schools since their choice demonstrates a willingness to undertake a difficult, rigorous course of study. Furthermore, the particular knowledge and skills acquired have wide applicability and importance in our complex information oriented society. Thus CIS students are attractive to professional schools. OIR data (Office of Institutional Research, November 2004b), although not extensive, indicate that graduates of the CIS course of study at John Jay College are finding positions in the information processing industry, and, provided a satisfactory GPA is maintained, are accepted into graduate and professional schools. (Please see Appendix A, Section 1.)

Several Departmental initiatives undertaken during the past five years are helping CIS students to prepare for graduate and professional opportunities in exciting new areas of computing. A revised CIS mathematics requirement now ensures that all CIS students have adequate mathematics background for entry into graduate programs that require significant mathematical and quantitative skills. (See question IIIB for a discussion.). The Department developed seven new courses and updated existing courses to treat important rapidly developing areas such as computer networking, enterprise level database systems, Java programming, and operating systems security. (See question IE). A NASA Curriculum Improvement Award helped the Department

develop new facilities for and curricula in parallel and distributed computing. (Twelve of the 15 students who worked on the project are pursuing graduate studies in computing.) CIS faculty sponsored five students in the Project Ascend McNair program, which encourages promising undergraduates to pursue graduate studies and eventually a Ph.D. Finally, the Department helped develop the M.S degree program in Forensic Computing. The CIS program thus provides a pathway to a graduate degree in an area of computing of critical interest to law enforcement agencies.

D. Describe the opportunities for supervised internships in relation to the major.

The CIS major has opportunities for supervised internships and a practicum in the courses Internship in Management Information Systems (MAT 404) and Practicum in Public Administration (PAD 404). These courses provide students hands-on experience and contact with government agencies, particularly those interested in individuals possessing computer and quantitative skills. The Public Administration Department administers the PAD 404 practicum while the Mathematics & Computer Science Department administers MAT 404 internship. Students who register for MAT 404 can work at an approved public or private enterprise and receive credit for the course.

The Department has worked to create opportunities for student internships. The Department has long supplied interns to the Office of the Bronx, D.A. This Internship has led to permanent employment for five students. In addition, the Department frequently offers MAT 404 during the summer and on a tutorial basis, when students and faculty identify reasonable internships sites. For example, students have taken summer internships at federal agencies such as the FBI, FAA and CIA. Each of these organizations solicits summer interns, and internships at each site have led to permanent employment for CIS majors. In addition, students are encouraged to pursue internships with the New York Software Industry Association/CUNY internship program. Links to CUNY NYSIA program and other sites for Internships are posted outside the Department office and on the Department's web site.

Over the years the Department has found it necessary to allow students to take the internship course (MAT 404) as a practicum. In order to get credit for an off campus internship, students must spend at least 8 hours per week at the internship site during the semester and16 hours per week during the summer. Many students prefer to take MAT 404 as a practicum and attend regular classes because they cannot afford the time commitment required by an off campus internship.

E. How do the courses in the major, taken overall, address recent developments and areas of new scholarship of significance to undergraduate education? Explain. (Examples of recent developments might include the use of computerized databases in public management, the growing use of community policing, or the development of state constitutional law. Examples of new scholarship might include feminist and multi-cultural perspectives, sociological theories, or critical legal studies.)

It is a challenge to keep the curriculum of a computer major current. Computing today is a very broad field that produces constant technical innovation. Important new methods, practices, and tools that warrant coverage appear frequently. Fields such as computer security and forensic investigation of digital crimes, which are central to the mission of the CIS program, are undergoing rapid development. Although there is general agreement on the basic knowledge areas that need to be covered in an undergraduate program, the level of coverage and the pedagogy for teaching them is the subject of continuous discussion in the computer science educational literature. CIS faculty members regularly review the educational literature, professional computing society educational guidelines, and the research literature to be aware of new pedagogical techniques and new subject areas that should be included in the program.

During the past six years, the Department has undertaken a number of initiatives to keep the major current, ensure courses treat important new areas, and provide the computing environment that offers the latest tools used in the profession. Moreover, seven new faculty members who are active researchers in the areas of artificial intelligence, computer architecture, embedded systems, wireless security, cryptography and network routing protocols are beginning to leave a mark on the program. The following is a summary of recent important program, curricula and facilities initiatives.

(1) *Upgraded and revised curricula and catalogue course descriptions for the six core computer course, three capstone courses, and three elective courses*. Examples of curricular changes include adoption of C++ as the standard language; broader deeper, hands-on coverage of concurrent computing in the operating systems course; coverage of AVL trees in the data structures course; treatment of enterprise-level and web based information systems in the advanced database courses; coverage of client/server systems, web services, and Internet communication protocols in the introductory networking course; and coverage of message passing, client/server computing, and security protocols in the intermediate networking course. In addition, parallel computing in the Message Passing Environment is now covered in Numerical Analysis (MAT 371).

(2) *Developed six new courses to provide broader and deeper coverage of areas of critical importance to the program, e.g., networking and network security, concurrent programming, systems design, and distributed computing*. Courses developed include Artificial Intelligence, Computer Networking, Discrete Mathematics, Graphics and Graphical User Interfaces, Systems Analysis, and an experimental course in advanced application development in Java.

(3) *Implemented a revised mathematics requirement that includes two courses in calculus-based operations research and a course in discrete mathematics*. The new required courses provide background in cryptography, graph theory, probability, and queuing theory, areas of mathematics that support work in computer security and computer networking. The revised requirement reflects current professional computing organizations guidelines, which suggest coverage of discrete mathematics.

(*4) Developed computing facilities and staff expertise needed to support course work and research projects in enterprise level database systems, computer networking, operating systems, and parallel/distributed computing*. Facilities implemented include a Linux Lab for distributed computing and networking, a database cluster with 1.2 Tera Bytes of storage hat runs the Microsoft SQL and Oracle 10G database systems, a

Beowulf cluster for work in high performance and parallel computing, and off campus access to student Linux accounts using the Secure Shell Program. Faculty and staff development includes new expertise in computer networking, enterprise-level database systems, parallel/distributed computing, operating systems and network administration. New computing facilities have allowed students in the database course (MAT 470) and the internship course (MAT 404) to develop a relational database implementation of the FBI's National Incidence Based Report System (NIBRS) data. More information on these developments is available at the NASA Cluster Computing Project web site web.math.jjay.cuny.edu.

In addition, the Department has several on-going projects to ensure that the CIS program addresses recent developments and scholarship of significance to the program. The Department is revising the course Data Communications and the Internet to include additional coverage of web services. Currently a committee, which is composed largely of the new members, is developing a specialization in Computer Security and Forensics. Another new faculty member who teaches the Programming Languages (MAT 374) will introduce the ML programming language so the course provides hands-on coverage of the functional language paradigm. Another recently hired faculty member is developing a computer architecture course that will provide coverage of embedded systems, an important technology for use in security applications. The Summary section (Section VI-B) provides additional details on these activities.

F. How does the major address issues of gender, race, and ethnicity in the major?

Since its inception, the CIS program has had a diverse student body that has reflected the racial and ethnic composition of the College population. Data from the OIR Student Characteristics Survey (Fall 2004) show that in 2004 about 34% of the CIS students were Hispanic and about 43% were African American. The remaining students mainly were recent immigrants of limited economic means.

Despite the increasing presence of women in fields such as law and medicine, the IT profession still includes relatively few women. The CIS program at John Jay is atypical in that about 38% of the students are female. The latest statistics on female computer majors provided by Cox and Alm (2005) of the Federal Reserve Bank of Dallas show that nationwide in 2002 females received about 28% of the Bachelors degrees, about 33% of the Masters degrees and 23% of the doctorates.

The CIS major at John Jay makes a quality education in computing available to students who have had limited opportunities to enjoy financially and intellectually rewarding careers in computing. In fact, the Department encourages minority students to pursue graduate degrees through participation in the Ascend McNair Program.

G. How does the major address ethical or values issues and questions?
Honor property rights including copyrights and patents.

Faculty and staff members remind students in course lectures, at events, and in labs to observe ethical guidelines put forth by professional computing organizations, particularly moral and ethical guidelines published by ACM. In particular, they urge students to adhere to the following moral imperatives "1) honor property rights including copyrights and patents, 2) give proper credit for intellectual property, and 3) respect the privacy of others" (Association for Computing Machinery, 1992, section I). In addition, they remind students of their professional responsibilities "1) strive to achieve the highest quality, effectiveness and dignity in both the process and products of professional work, 2) acquire and maintain professional competence, and 3) know and respect existing laws pertaining to professional work" (Association for Computing Machinery, 1992, section II).

The Department publicizes ethical guidelines and policies regarding the use of computers. A poster that lists the complete ACM ethical and professional guidelines appears in the Department's computer laboratories and is posted near the Department office. In addition, a link to the ACM guidelines is available on the Department's web

site. The Department distributes handouts and posts signs that advise students of College and CUNY policies regarding the proper use of campus computing equipment.

In addition to professional ethical guidelines, increasingly, CIS courses are examining the implications computer and network technologies have for individual privacy, identity security, and access to Internet information resources.

H. Describe College resources necessary to support the work of students in the major. Discuss the Library and other relevant resources such as computer facilities and laboratories. Describe the adequacy of current resources and discuss resource needs over the next 5 years.

Computer Facilities: Currently the Department has adequate computer facilities to support the major. There are three computer laboratories that provide the specialized software needed for both introductory and advanced course work. The three labs are located on the fourth floor of North Hall close to the Department and faculty offices. The recent relocation of two of the Department's labs to the fourth floor of North Hall was a good idea. Having all the Department's computing facilities in one area close to the Department offices affords students excellent opportunities to interact with faculty members and one another. In addition, it is easier for students to learn about and take advantage of the Department's wide range of computer facilities.

The Department offers a diverse computing environment that includes the major operating system environments. Two of the Department's three computer labs are Windows labs; one lab is a Linux lab. Students use one of the Windows labs exclusively as an open lab, while the second windows lab is used entirely for instruction. The Linux Lab is used for both instruction and as an open lab for project work in advanced courses such as Operating Systems and Computer Networking. Assistance in using the Windows and Linux environments is available in the labs.

In addition to traditional computer labs, the Department has a number of specialized computing facilities for use in coursework and research. These include enterprise level database systems, web servers, a Beowulf Cluster, routers, firewalls

and a remote access computer that provides access to student Linux accounts from off campus. Students also can use the Academic Computing centers facilities, which provide the C++ compiler and other software used in the CIS program.

Throughout the 90s providing adequate computing facilities was a vexing problem for the Department. Faculty members constantly had to seek external funds to provide both standard laboratories for course work as well as advanced facilities for student/faculty research. When facilities became obsolete, there was no funding to replace them, and college wide support was very limited. Inadequate computing facilities and lack of funding put severe constraints on the CIS program at that time.

Fortunately, the situation has changed dramatically. Thanks to the Student Technology Fee established in 2002, faculty grant activities that have provided significant external funding for higher end facilities, and a new commitment by the College that recognizes the importance of computing, the Department is able to provide facilities to support its programmatic and research needs. The College is committed to providing a reliable College wide network that offers high speed Internet access and supports the services needed in a computer major. The College provides computers for faculty members and upgrades faculty computers on a regular basis. Most importantly, the Student Technology Fee provides the College the funding that is needed to keep computer laboratories in good working order with up-to-date equipment.

The Department relies on many sources to build and maintain the computing environment required to support its programs. The Department works closely with the Instructional Technology Support & Services (ITSS), the Department of Information Technology (DoIT), and other College organizations to ensure that its computing environment has the needed software and support. For example, lab staff and tutors work with ITSS to ensure that required software is installed on lab computers, broken machines are replaced in a timely manner, and the Department takes advantages of software licenses available through the College and CUNY. The Department developed its Linux Lab as a joint venture with the Science Department and with assistance from

the College. The Open Source Software movement makes a range of needed software available at no cost, especially in the Linux environment, e.g., scripting languages, compilers, packet sniffers, security tools, and secure remote login software. The faculty continues to obtain grants that provide state-of-the-art computing facilities to support advanced work and student research projects in computer networking, operating systems and enterprise level database systems. In addition, the Department takes advantage of both the Microsoft Academic Alliance and Oracle Site License to ensure these vendors' major products are available to students.

As the Department's computing environment grows more varied and complex, support is certainly an issue. Experience shows that support is needed at many different levels, e.g., tutors who can advise students how to use software and systems, administrative personnel who maintain student accounts and resolve problems on a daily basis, personnel who have detailed knowledge of the Department's systems and software and can work closely with faculty members to integrate software and systems into the curriculum. Of course, technicians must fix or replace broken equipment and install standard software on a regular basis. While College organizations can provide most basic services, personnel with detailed knowledge of the systems and software used in Department courses and research are essential if the Department is to realize the full benefits of its equipment and software. The Department has reached a point where it now needs a full time person to oversee its computing environment and work closely with faculty members to help develop that environment.

Library Facilities: Historically, most faculty members in the CIS program simply did not look to the John Jay College Library as a resource for either coursework or research. Years of tightly constrained budgets made it difficult for the Library to maintain updated versions of needed monographs and an adequate collection of journals to support the Department's programs in computing. Fortunately, this situation is changing.

The Library has been aggressive in acquiring rights to on-line publications in the past three to four years, since funding became available from the Student Technology Fee. With the Library's addition of the ACM Digital Library, EBSCO Academic Search, InfoSECURITY netBASE, and ScienceDirect, access to journals and on-line publications devoted to computer security, forensics, applications of computing in law enforcement, and computing in general has improved dramatically. Many needed publications, e.g., The Journal of Computer Security, most ACM and SIAM journals, and some IEEE journals are now available. The Department suggests that Library continue this effort by making available access to the complete set of publications in the IEEE Digital Library. Major publications that track general developments in computing, e.g., Computer, published by the IEEE Computer Society, would be of interest to the entire college community and should be available.

Space and budget constraints certainly have impeded the Library's ability to provide recent editions of monographs that are needed to support the Department's programs in computing. Fortunately, through the Library's interlibrary loan program, faculty members have relatively quick access to the substantial collections available at other CUNY college libraries. The LLoyd Sealy Library, however, should strive to expand and update its collections in computer security, computer forensics, discrete mathematics, information assurance, statistical data mining, and other areas of computing that find application in criminal justice and public administration. Major monographs and classic texts in these fields should be available.

The Library has worked closely with the Department to update its collections in computing when funds have become available. For example, at the Library's request the Department provided lists of volumes to purchase in 1994 and 1998, and these were added to the Library's collections. The Department and Library should establish a more systematic approach for adding major works in computing and mathematics to the Library's collections. In addition, it is important that the Library and the Department make faculty members aware of new resources that are available to support research and coursework.

Resource Needs in the next Five Years: The current staff is adequate to mount the current CIS program, which has about 350 declared majors. Growth and development of the existing program, however, is impossible without additional hires. Of course, if the number of majors again exceeds 500 as happened in 1999-2001, certainly, requirements will exceed dramatically current resources.

It should be noted that the Mathematics & Computer Science Department, which has only twenty-four full time faculty members, offers the CIS major, six courses in the M.S. graduate program, and enrolls each semester over 4000 students in over 170 sections of mathematics and computer service courses. As the Department continues to integrate computing experiences into the curricula of its mathematics service courses, it will need access to additional lab facilities. Moreover, the Department intends to undertake a vigorous advertising campaign for the CIS program during the next several years and expects the size of the CIS program to begin to grow again, especially as hiring in the IT industry picks up. The M.S. program in Forensic Computing continues to accept graduate students. Since most faculty members who teach in the CIS undergraduate program also teach in the Forensic Computing M.S. program, expansion of the graduate program affects resources available to the undergraduate program.

The Department needs additional support for many of the quotidian administrative activities that are associated with running a computer major. These include monitoring and scheduling labs, advising students, preparing promotional and informational materials, assisting with grant preparation and administration, overseeing and coordinating activities such as colloquia and other events, and coordinating and developing internships. Right now faculty members, who have limited time and receive no benefit, often assume these responsibilities. All Departmental programs would benefit if College staff and/or support personnel performed these daily administrative tasks.

II. Coordination With Other Requirements, Majors and Programs at the College

A. Describe the rationale for the number of credits required in the major.

Curricula guidelines established by a joint ACM/IEEE task force (Computing Curricula, 2001) indicate that an undergraduate curriculum in computing must provide the following:

(1) Coverage of the core knowledge areas of computing.

(2) Supporting courses, particularly in mathematics, that provide the foundation for the study of computing.

(3) Capstone and specialized courses that complete the curriculum by supporting the institutional mission, areas of concentration offered by the program, and student interest.

The ACM/IEEE professional guidelines define a minimal core of computing knowledge that is critical to any student who obtains an undergraduate degree in computing. The CIS major must cover this core and in addition provide supporting courses, capstone courses, and specialized courses that round out the curriculum. To achieve these aims, the CIS program requires 42 credits of computer and operations research courses, and 9 to12 credits of mathematics foundation courses. (One of the mathematics courses can be used to satisfy the College's skills requirement in mathematics.) The CIS program requires more credits than most majors at the College, but fewer credits than the typical computing major in the United States.

Providing the mix of courses that should be in a computing major has been a struggle given the severe credit restrictions imposed by the College on majors. Scientific and technical majors require more credits than most liberal arts majors. Moreover, computing is an expanding field, and the recommended core knowledge area of computing continues to increase. For example, 2001 ACM/IEEE recommendations

include a number of topics in an area called NetCentric Computing that was not even mentioned in the curricular guidelines published in 1991.

Faculty members who teach CIS courses agree that the major needs to include a course in computer architecture and system organization in the Computer Foundation Courses. (See Appendix D.) The inclusion of such a course in the Foundation adheres to the ACM\IEEE curricular guidelines. Moreover, a background in architecture and systems organization is critical to mission specialized topics such as the design of security and monitoring systems. The Department plans to develop this course and include it in the Computer Foundation. (See section VI B for details)

B. Prerequisites:

1. **What prerequisites are required for completion of the major? (Include only courses that are not themselves part of the major.)**

All required courses for CIS major appear in the list of CIS required courses in the Undergraduate Bulletin. The only prerequisites not listed are the College-wide requirements that students complete ENG 101 prior to taking 200-level courses, and ENG 102 prior to taking 300-level courses.

2. **Are any of these prerequisites "hidden," in the sense that they are not noted in the description of the major in the Undergraduate Bulletin?**

There are no hidden prerequisites in the major.

3. **What is the rationale for these prerequisites?**

Not applicable.

Describe the process of review for prerequisites.

Not applicable.

C. Which courses and prerequisites may be used to satisfy the General Education Requirements of the College? Are students made aware of this information? If so, how?

The CIS major requires three or four mathematics courses; the number depends on the student's high school preparation. Students can satisfy the College Skills requirement in mathematics by taking any one of these courses. Typically, CIS students take MAT 141.

The Department advises qualified students who are interested in the CIS or Forensic Science majors to take Pre-Calculus (MAT 141) or a higher level mathematics course to satisfy the College's Skills Requirement in mathematics. These students are told not to take MAT 105 or 108, which are the courses most John Jay students take to satisfy the Skills Requirement. Information on the selection of mathematics courses appears on the flyer for the major, on the Department's web site, and is provided by the Counseling Department. The Department has worked closely with Freshman Services, the Office of Testing, and Counseling to make sure students do not waste precious time taking mathematics courses that are inappropriate for their major field of study.

D. What policies and procedures are used to permit course substitutions for students who do not complete the requirements of the major?

As a matter of policy the Department does not grant substitutions for courses. CIS courses are offered with sufficient frequency that substitutions are rarely necessary. If a student cannot get a required course in the semester prior to graduation, the Department will arrange for a faculty member to administer the course on a tutorial basis.

E..Redundancies:

1…With respect to the overall content and focus of the major, what other majors at the College, if any, appear to cover similar material?

No major covers material similar to that presented in the CIS major. There are courses throughout the college that discuss the use of the computer as a tool in a specific field. In addition, a number of majors require several introductory computer

courses such as MAT 260 (not a major course) or MAT 271. However, only the CIS major presents the basic principles underlying current computing technologies and methods. The major provides students with both the mathematical and computing background that will allow them to become the designers and implementers of computer information systems rather than just users of information systems. Only the CIS major provides the preparation necessary for graduate and professional study in the computing field or direct entry into the computing profession.

2…How is the major different from those listed above?

Not applicable.

3…To what extent could a student satisfy the requirements of the major with courses that satisfy the requirements of some other major(s)?

As mentioned previously, several introductory courses in the CIS program may be used as electives in other majors. For example, Public Administration majors can select the CIS Elective courses Computers for Administrative Decision Making (MAT 277), Software Applications for Office Management (MAT 278), and Data Communications and the Internet (MAT 279) to satisfy the requirements of the Information Management and Communications concentration in that major. The CIS courses Introduction to Computers and Programming (MAT 271) and Security of Computers and their Data (MAT 270) may be used to satisfy certain requirements in the Criminal Justice Major. No advanced CIS courses (i.e., 300- or 400- level courses) appear in any College major other than the CIS program.

III. Internal Coherence and Structure of the Major

A. List the courses currently in the major, along with course descriptions. (List only officially approved courses; pending changes should be noted in Part VI of this evaluation.)

(Please see Appendix E.)

B. What courses within the major, if any, appear to be outdated, and ought to be reviewed by the governance structure for possible elimination or revision?

At this time no courses within the CIS major are outdated. Faculty members regularly update syllabi in Foundation, Elective and Specialization courses. In addition, the Department has updated catalogue descriptions of most CIS major courses within the past five years. Seven new courses were put in place only within the last three years. In addition, the Department revised the schedule of Electives and Mathematics Foundation within the past two years. The Department has worked closely with the College Curriculum Committee, especially the Subcommittee Committee on New Courses, to review and implement new courses and programmatic improvements in a timely fashion. The Department is grateful to the Curriculum Committee members and the Office of Associate Provost who have helped expedite the curriculum review process and helped the Department keep the CIS major current.

C. Sequencing

1. **What is the rationale for the sequencing of courses within the major**?

The CIS major employs a sequencing of courses that is typical of modern computing curricula. Students begin by taking the Mathematics Foundation and the Computer Foundation Courses. The Computer Foundation consists of six courses, two at the 200-level (MAT 271 and MAT 272) and the remaining at the 300-level. All of the 300-level courses have the two 200-level courses as prerequisites. The yearlong 200-level sequence provides the proficiency in a high level language (C++ effective September 1997) that is necessary for 300-level courses. The 200-level courses introduce computer problem solving, the algorithmic process, imperative and object oriented language programming. The four 300-level courses examine the fundamentals

of data structures (MAT 373), operating systems (MAT 375), programming languages (MAT 374), and algorithms (MAT 377). The 300-level courses may be taken in any order. The College's computerized registration system automatically checks and enforces course prerequisites.

An applied specialization taken primarily in the senior year contains courses and an internship in which computing methodologies are put into practice in the fields of public administration or criminal justice. The applied specialization also provides opportunities to take courses where students learn advanced computing techniques and methodologies**.** The applied specializations serve as a capstone in the CIS program**.**

2. In what way are students required or encouraged to take less difficult courses first? Most difficult last?

The CIS program, like most computer majors, has a fairly stringent prerequisite structure that prevents students from registering for courses for which they are unprepared. In addition, the numbering system (100-, 200-, and 300-levels) indicates the level of difficulty of the CIS courses. Students are urged to consult a CIS major advisor to get advice when planning their programs.

3. List the foundation (gateway) courses for the major?

The courses Introduction to Computing and Programming (MAT 271) and Object Oriented Computing (272), which introduce the fundamentals of programming and problem solving, may be considered gateway courses for the major. This two-course sequence introduces students to the basics of computing and provides essential skills that are required in courses throughout the program. A two-course introductory sequence such as this is typical in most computer majors.

4. **Does the major provide senior-level (capstone) courses? If not, why not? ADD: How do the foundation courses relate to the capstone course(s)?**

The CIS major provides two Applied Specializations: the Criminal Justice Applied Specialization and the Public Administration Applied Specialization. As mentioned previously, the Specializations serve as capstones and allow students to use knowledge and skills gleaned in lower level courses to solve problems that arise in criminal justice and public agencies. The capstones rely on principles, methods and tools covered in Foundation CIS courses.

5. **Does the sequencing need revision? Explain**.

The sequencing of courses is common in most computing majors and consistent with professional educational guidelines. It does not need revision.

D. Tracks or Concentrations

1. Are there tracks or concentrations within the major?

There are two Applied Specializations within the major: the Criminal Justice Applied Specialization and the Public Administration Applied Specialization. The specializations allow students to utilize computing skills in a particular field. Students choose one of the Specializations and take the courses mainly in the senior year.

There are no separate tracks in the current CIS major. Prior to October 2003, the CIS major had, in addition to the aforementioned specializations, two separate tracks: The Standard Track and the Advanced Track. The tracks differed only in the mathematics requirements. Students in both tracks took the same Foundation and capstone computer courses. The Standard Track, however, required that CIS students take only the College mathematics Skills courses, Modern Mathematics (MAT 105) and Social Science Mathematics (MAT 108). In addition, the Standard Track required two semesters of non-calculus based operations research courses (MAT 220 and 221). The Advanced Track, whose mathematics requirement was similar to the current CIS

mathematics requirement, mandated two semesters of calculus and the more rigorous calculus-based operations research courses (MAT 320 and 321).

In 2002, the Department voted unanimously to eliminate the two tracks in the major and put in place a uniform mathematics requirement that reflects current professional guidelines and is widely accepted by the computer science educational community. Throughout the 90s, faculty members observed tremendous disparity in the performance of students in the different tracks. The Advanced Track students were able to keep up with CIS computer courses, graduate in a timely fashion, maintain a respectable GPA, and obtain employment in the field upon graduation. The Standard Track math requirement simply did not provide the necessary mathematics preparation. Furthermore, Standard Track CIS students who did complete the major and wanted to pursue graduate studies often were disappointed to learn they had to take additional undergraduate mathematics courses prior to entering a graduate degree program.

The current mathematics requirement, approved by the College Council in October 2003, is typical of that required by most programs in computing. Like the Advanced Track, it requires two semesters of calculus and one year of calculus based operation research. In addition, it requires one course in discrete mathematics, which is highly recommended by professional computing organizations. Although students who entered the College prior to October 2003 can still take the Standard Track mathematics requirement, CIS faculty advisors urge all new CIS majors to follow the current CIS program requirement.

2. What is the rationale for having tracks or concentrations?

The Public Administration and Criminal Justice Applied Specializations survey the use of computing, quantitative methods, database systems, and quantitative management techniques in criminal justice and public management. The developers of the major chose these areas of concentration because they represented disciplines within the College's mission where computing plays a critical role and has tremendous potential to improve agency functions. Each specialization consists of four courses (12

credits). Two courses offer an introduction to the respective fields whereas the remaining two are a problem-solving course and an internship. The specializations allow students to experience the application of computer science within a specific discipline with greater depth than can be achieved by survey courses.

A third specialization in Computer Security and Forensics is under development. The specialization will meet the increasing demand for computer security personnel and forensic analysts familiar with the methodologies needed for investigations of crimes involving computers and computer networks. The specialization is necessary because the fields of computer security and forensic computing have grown dramatically during the past five years. This Computer Security and Forensics specialization is discussed in more detail in the Summary Section VI-C.

3. **In what way do the tracks or concentrations differ from one another? Is there excessive redundancy among the tracks or concentrations**?

The differences in the Applied Specializations are described in the following section.

Each specialization contains a unique set of courses and there is no redundancy..

4. **Are the courses within each track or concentration suitable thereto**?

The Public Administration Applied Specialization was formulated in conjunction with the Department of Public Management. Since the introductory courses in this specialization are also required courses in the Public Administration major at the college, they are certainly germane. The capstone provided by the senior level problem solving course and internship is an essential part of the philosophy behind the major, that is, to combine theory with application in a practical context.

The Public Administration courses allow students to use skills and knowledge obtained in 200- and 300- level CIS courses to solve problems arising in public agencies. For example, students take an advanced management course where they

use principles and techniques of operations research to develop models of public agency functions. Students analyze the models and consider the management and organizational implications. In addition, students take a practicum course where they have the chance to apply computing skills to solve problems arising in city, state and federal agencies. Projects typically involve a literature study, research, and interaction with a field supervisor from the agency. In a planning course, students have the opportunity to apply their computing background and analytical abilities to problems in planning and decision making in the public sector. Students also take courses where they can develop background in financial resource administration and an understanding of the general theory of public administration.

In the Criminal Justice Specialization students have the opportunity to appreciate the critical role information systems, computing and mathematics play in the practice of law enforcement. This Specialization allows students to make use of computer, quantitative and analytical skills to solve problems that arise in criminal justice agencies. In addition, the specialization exposes students to advanced computing and quantitative methods that are improving the practice of law enforcement. The specialization includes the courses Quantitative Methods in Criminal Justice, Internship in Management Information Systems, Database Systems in Criminal Justice, Security of Computers and their Data. Students employ knowledge gleaned in core computer courses to address the many challenges that face law enforcement, e.g., digital crime, securing information infrastructures, and managing data resources.

The CIS specialization focuses on those areas of computing that are having the greatest impact on the practice of law enforcement. For example, database systems are a critical computing technology in the criminal justice field, and all students in this specialization take the course Database Systems in Criminal Justice. In this course students have used statistical techniques to analyze crime data in the FBI's National Incident Based Reporting System (NIBRS). In addition, they learn how data mining techniques can facilitate criminal investigations.

The course Quantitative Methods in Criminal Justice allows faculty members to introduce computational and mathematical methods that are needed to solve problems of concern to criminal justice and law enforcement agencies. In recent years, the course has introduced students to practices, methods and tools for securing host computers and computer networks, methods and software for detecting and tracking intrusions, and techniques for collecting and analyzing forensic data. Students also learned how operating system vulnerabilities lead to the wide range of exploits that pose constant security threats.

The Internship Course provides additional contact with problems arising in the criminal justice community. Students have worked with faculty members to develop a full relational database implementation of NIBRS. In the internship course students have had the opportunity to apply their computing skills in various law enforcement and public agencies including the CIA, FBI, and the District Attorney Offices in the Bronx, Manhattan and Brooklyn. Student internships have led to full time careers for John Jay students at the Federal Aviation Administration, the District Attorneys offices, and the Federal Reserve Bank**.**

Both the Criminal Justice and Public Administration specializations are taken after the students have completed six core courses in computing, usually in the senior year. Experience shows that students at this point are in a good position to put their knowledge of computing to use in a practical setting. Over the years, the specializations have served as effective capstones that lead to career opportunities in the criminal justice field.

Given the increasing deployment by law enforcement of methods and tools produced by the computer science and mathematics communities; the Department has decided to develop a third specialization that is tentatively entitled Computer Security and Forensics. The Criminal Justice specialization would continue to focus on database methods in law enforcement, especially the increasing use of data mining techniques in criminal investigations and distributed information systems. The new

specialization would focus on computer security and forensic techniques used in combating digital crimes. The new specialization will permit enhanced coverage of identity theft, misuse and abuse of information systems by insiders, the use of computer networks for criminal or terrorist acts, measures to protect private and national information infrastructures, and incident response techniques. The addition of five new faculty members and new expertise in computer security and networking put the Department in a good position to develop this new specialization. A committee of CIS faculty members is currently developing the specialization; additional details appear in the Summary Section VI-C.

E. Considering all of the possible course combinations, which can be used to complete the major, can students, take inappropriate course combinations and still meet major requirements?

The CIS major is a highly structured program and students cannot take inappropriate courses and complete the major. (Please see Appendix D).

F. How does the curriculum for this major compare with similar majors offered at other colleges?

The structure of the major is similar to a computer science major. (Please see response to IIA). The CIS major contains six core courses in computing that cover the core knowledge areas suggested in recent ACM/IEEE curricular guidelines (Computing Curricula, 2001). In addition, the major also provides the requisite mathematics courses. The major is unique in that throughout the program it focuses on areas and applications of computing that impact the practice of criminal justice and public administration. Moreover, the capstone courses provide specialized treatment of applications of computing and mathematics that occur in criminal justice and public agencies.

G. Complete the table on enrollment in courses for the last four academic years. In light of these data, are courses offered frequently enough and in enough sections for students to meet major requirements? Consult the Office of Institutional Research for enrollment data.

The four-year enrollment data (Appendix B) show that courses are offered with sufficient frequency for students to complete the program. The enrollment figures also show that when necessary the Department increased the number of sections of major courses. Current enrollment figures show that enrollment in 300-level Foundation Courses has been stable for the past two years.

IV. Faculty and Students

A. Are there any areas of expertise appropriate to the major that are not sufficiently represented among the faculty?

Yes, the Department must hire additional faculty members with expertise in computer security and forensic computing. These new hires are needed not only to ensure adequate coverage of these rapidly developing and expanding areas in the undergraduate program, but also in the M.S. program in Forensic Computing. Moreover, the Department needs additional staff. It should be noted that CIS faculty members must teach mathematics and computing service courses in addition to CIS and M.S Forensic computing courses. Each semester, the Mathematics & Computer Science Department, which has only 24 full time faculty members of whom 3 are on substitute lines, enrolls over 4000 students in more than 170 course sections.

B. Describe the problems, if any, created by the role of adjunct faculty in the major. What, if anything, is done to orient and supervise adjuncts and to integrate them into the program?

In any given semester, adjuncts staff one or possibly two sections of CIS courses. Full time faculty members offer the bulk of the instruction in the program. Adjunct staffing is not an issue.

C. Are there regular meetings of faculty teaching in the major for the purpose of discussing and improving the major?

There are several ways in which CIS faculty members communicate. There are regular meetings and the Coordinator of the Major acts as a facilitator. The section on governance provides additional details. In addition, one faculty member maintains an e-mail list of all Departmental members who teach CIS courses or have an interest in the major. Through an e-mail distributed to all on the list, anyone can voice a concern or raise an issue regarding the CIS program.

D. Advisement:

1. **What is done to advise students who have elected this major about the course requirements of the major? (i.e. student clubs, external speakers, tutorial services, early warning system.)**

The Department has worked closely with Freshman Services, the Counseling Department and the Admissions Department to get information about the CIS major to interested students. The Department participates in both the freshman and sophomore orientations offered by the College where CIS faculty members provide an overview of the major and requirements. The Department makes materials on CIS course requirements available to the Admissions Department for use in Transfer Orientation Seminars. The Counseling and Admissions Departments distribute CIS informational materials to the general college community. Moreover, the Department maintains a web site with extensive information on the CIS major and encourages students to visit the site. Finally, the Department has five CIS advisors who are available each day of the week to help students on issues concerning the major**.**

The Computer Science Association is the student computer club at John Jay College. The Club has been a tremendous resource for CIS majors at John Jay College and has worked closely with the Department to help improve the CIS program. In addition, the club sponsors events that provide numerous opportunities for learning outside the classroom. Each year the club organizes seminars on computer technology, trips to Information technology firms, and events that allow CIS students to be aware of what is going on in the CIS program. The Coordinator and several other CIS faculty members serve as advisors to the Club. Thus CIS faculty members have a close relationship with the club leadership, and the Department is aware of students' concerns and ideas for improving the major. Indeed, the John Jay College Computer Science Association won the prestigious ACM Best Service Award in 2000. Each year ACM gives this award, which carries a $500 prize, to one college computer club in the nation.

2. **Are there printed guidelines or informational flyers about the major? If so, how are these made available to students**?

Yes, there are three different flyers and a web site. One flyer provides detailed information on the CIS program and includes a complete list of required CIS courses. (Please see Appendix F.) CIS literature is made available to students through College advisement functions, the Counseling Department, and the Mathematics & Computer Science Department. (Please see response to previous question). The flyers along with comprehensive information on the CIS program are available on the Department's web site. Students can access the CIS home page from the College home page.

3. **What is done to advise students about careers or jobs for which this major serves as a preparation?**

The College, Department and Computer Science Association sponsor a number of events to inform students of career opportunities in the major. The College offers a career day in which representatives of law enforcement, public and private agencies visit the College and make students aware of professional opportunities. The Department seminar series attracts speakers from IT firms and government agencies that have a need for IT professionals. The Department maintains a list of internships on its web site; these frequently lead to full time employment. In addition, notices of open positions are posted outside the Mathematics & Computer Science Department. Finally, the student computer club sponsors trips to major IT firms and public agencies in the New York area that hires computer majors. Recent club trips include visits to IBM, Computer Associates, the NYPD Computer Crimes Squad, and several computer security companies.

4. **What is done to advise students about graduate and professional school admissions**?

The Department encourages students to pursue postgraduate study in computing. The Department receives informational materials from graduate and professional programs throughout the country and these are posted outside the Department. CIS faculty members and advisors provide information on graduate studies and specific programs to all interested CIS majors. CIS faculty members urge students to consult with a major advisor when choosing electives in order to prepare themselves for graduate opportunities in specific fields of computing. The Department sponsors students in the Project Ascend McNair program, a program that encourages undergraduates to pursue graduate studies and eventually a Ph.D. Finally, five faculty members also are on the graduate faculty of the CUNY Graduate Center and can advise on graduate opportunities in Computer Science and Mathematics at CUNY.

E. Student Input:

1. How can students communicate with the governance structure of the major?

Students can communicate their concerns about their courses or the CIS program by contacting the chairs of the Mathematics & Computer Science Department or Public Administration Department, the deputy chair of the Mathematics & Computer Science Department, the CIS Coordinator, officers of the Computer Science Association, or faculty members who teach courses in the CIS major.

2. Describe student grievance policies and procedures.

The Department handles student grievances informally on an individual basis. If the grievance is not resolved, e.g., a grade dispute, it is referred to the Departmental Appeals Committee. For serious grievances the Department follows the guidelines in the faculty handbook and forwards the grievance to the appropriate College committee, the Office of Associate Provost, and/or the Office of Student Services.

3. Does the governance structure seek student evaluations of the major? If so, how is this done? (This does not include teaching evaluations of the John Jay faculty administered by the College.)

The governance structure elicits student evaluations of the CIS program in several ways. First, faculty computer club advisors seek student feedback from the Computer Science Association, especially at club meetings. Second, in classes CIS faculty members encourage students to voice their concerns regarding any issues related to the major. Finally, the Coordinator routinely asks computer club officers, especially the club president, for input regarding programmatic and curricular aspects of the major.

F. Faculty Scholarship

1. Describe the nature and extent of faculty scholarship in this area. For each full-time faculty member teaching in the program, attach a one-page summary of faculty scholarship (publications-articles, books, and/or letters to the editor, grant activity, presentations at national conferences, membership in professional societies and offices held if any, etc.) conducted over the last five years.

Faculty members of the Mathematics & Computer Science Department are active researchers in areas of computing and mathematics that are vital to the mission of the major. These areas include architecture and systems organization, artificial intelligence, computer networking and network security, computer science education, cryptography, discrete mathematics, database systems, distributed systems, network forensics, operations research, probability and statistics, and software systems. Faculty members have published books, published in refereed journals, presented papers at refereed conference proceedings, edited books, and reviewed articles and books for professional journals. They have been successful in obtaining external funding from agencies such as NASA and the National Science Foundation to support both research and educational activities. A one page summary of the scholarship of each faculty member who teaches CIS courses appears in Appendix C

.

2. Describe faculty credentials and reputation. Also provide percent Ph.D. level instructors (part-time and full-time).

The Department has 24 full time faculty members, which includes three members on substitute lines. Of the 24 members, 19 have doctoral degrees (6 in computer science, 10 in mathematics, 3 in mathematics education). The remaining faculty members have M.S. degrees in either mathematics or computer science. Of the 10 Ph.D.s in mathematics, 3 are active researchers in computer science. Four others have degrees in applied areas of mathematics such as computational mathematics, operations research or statistics. Furthermore, these four are active researchers in areas of mathematics that are related to computing and computer science.

In addition, to the full time faculty members, there are over 50 adjuncts. Currently only one adjunct teaches a CIS computer course. She has an M.S. degree in Computer Science and is pursuing a Ph.D. at the CUNY Graduate Center with a specialization in database systems. Thus 1 out 30 sections of CIS courses was staffed by an adjunct in fall 2004

The reputation of the faculty is evidenced by the positions they hold, their publications, ability to attract external funding, and professional activities. Four faculty members who teach CIS courses also are members of the graduate faculty at the CUNY Graduate center. Nine faculty members serve on the graduate faculty in Forensic Computing here at the College. Departmental faculty members publish in top journals; review journal articles for professional organizations such as ACM, IEEE and SIAM; and present referred papers regularly at national conferences. During the past five years faculty members have attracted funding from NASA and the National Science Foundation for projects in high performance computing and network forensics. Several of the newly hired faculty members are active researchers who work with nationally recognized groups in computer networking and computer architecture at the University of Massachusetts and the Georgia Institute of Technology. Other faculty members are chairs of ACM and IEEE technical committees.

V. Governance of the Major

A. Describe the organizational structure and governance of the major.

The Mathematics & Computer Science Department is responsible for the supervision and the administration of the CIS program. The Public Administration Department mounts the courses in the Public Administration Specialization and administers that specialization. One faculty member of the Mathematics & Computer Science Department serves as Coordinator of the CIS program. The coordinator works closely with the Chair and the Department Curriculum Committee to oversee the daily administration and long-range development of the CIS major. The Department Chair and the Curriculum Committee have the ultimate responsibility for the administration and development of the CIS program.

Over the years the CIS Coordinator has evolved into an important position for the CIS program. The Coordinator works closely with the Chair, the Deputy Chair, CIS faculty members, and CIS students. He or she helps oversee the daily operation of the major, brings issues before the Department Curriculum Committee, and most importantly, helps bring the concerns of CIS faculty members and students to the attention of the Chair and the rest of the department. The Chair appoints the Coordinator.

B. What mechanism does the major use to monitor and review the curricular matters covered in sections I-IV of this evaluative instrument?

The Department Curriculum Committee meets regularly to discuss the CIS major and suggest improvements or needed developments. The Coordinator of the CIS program and Deputy Chair normally serve on the Departmental Curriculum Committee and often bring CIS issues before the committee. In addition, the Coordinator and CIS faculty members meet frequently to track issues of interest to both faculty members and students. The Coordinator, Deputy Chair, Chair and interested faculty members discuss and formulate possible curricular or programmatic changes. These are then brought before the Department Curriculum Committee in the case of curricular issues,

or addressed by the Chair if they are purely administrative issues. When major programmatic changes are suggested, the Curriculum Committee and/or the Chair may suggest that they be brought before the entire Department. For example, the Curriculum Committee and Chair felt the decision to eliminate the Standard and Advanced Tracks and upgrade the CIS mathematics requirements was of such gravity that it should be brought before the entire Department.

C. **What mechanism, if any, does the major use to monitor and review courses within the major? In particular, how and to what extent does the governance of the major monitor satisfaction of the minimum writing requirements of the College, fulfillment of the College Policy of stressing analytical and critical thinking, and fidelity of syllabi and teaching to the course descriptions in the Bulletin?**

This report described the mechanism for monitoring and review of courses in the response to the preceding question. Basically, faculty members who teach CIS courses assess the need for changes in the curriculum and bring the issue to the attention of the Chair, Curriculum Committee or Coordinator. For example, the extensive revisions to CIS courses that occurred in 2000 and 2001 followed this procedure. The CIS Coordinator and CIS faculty members discussed the needed revisions. Working with the Departmental Curriculum Committee, they developed a package of revisions that were approved by the Departmental Curriculum Committee. The Department then submitted the package of revised courses to the College Curriculum Committee and the College Council for final approval. The case of the course revisions involved modifications to the catalogue descriptions, which must be approved by the College Curriculum Committee. Most revisions to syllabi or programmatic changes in the major need not be brought before the College Curriculum committee.

CIS courses help develop a student's ability to write well, analyze problems and think critically. Most CIS courses require students to take exams that involve short answer questions. In preparing computer projects, students usually must provide a report that describes the problem, explains the method used, and discusses the results. With regard to analytical and critical thinking, throughout the program, students face

problems where they must propose a hypothesis and then analyze data to either establish the hypothesis or prove it false.

The CIS program is a highly structured program and adherence to syllabi is essential. Principles, methods and skills learned in lower level courses are needed in upper level course work. If a faculty member does not cover the required material in a particular CIS course, the Chair cannot assign that course to the faculty member in the future.

D. How often do the monitoring and review of the curriculum occur? Describe recent revisions of the curriculum, if any, made in response to such monitoring and review.

Monitoring and review occur at least once per semester and as often as is necessary. Each year since 1999 the Department has addressed a major programmatic or curricular need in the CIS program. These have included hiring of new faculty members with expertise in systems areas of computing; a Departmental final in MAT 271; revision of CIS courses and catalogue descriptions; development of seven new courses, including courses in Java, artificial intelligence and computer networking; revision of the CIS mathematics foundation; establishment of formal articulation agreements with community colleges; building new laboratory facilities for both course work and research; and changing the name of the Department to the Mathematics & Computer Science Department. Given the rapid pace of change in the computing discipline, it is essential that a computer major have a workable management structure that allows it to keep pace. In view of the developments in the CIS program during the last six years, we believe the management of the CIS program is effective.

VI. Summary and Recommendations

A. Provide an overall assessment of this major. Include achievements and pitfalls over the past 5 years.

The 1995 external evaluation of the CIS major (Drew, 1994, p. 1) made the follow comment about the CIS program: "…the degree program in Computer Information Systems is reasonable and proper for the Mathematics Department at John Jay College of Criminal Justice. It combines a reasonable amount of theory and applications in computer usage and operation… It prepares the student for an interesting career in a field fitting and in-line with the mission of the College." The evaluators also noted that the program should be advertised widely because of its unique nature and the benefits it offers to the New York City area and national communities.

At that time the CIS major was a fledgling program that barely had the faculty members, facilities and resources necessary to sustain the program. Nevertheless, the program provided students the opportunity to prepare for an interesting and rewarding career in the IT profession, especially in law enforcement and public agencies. Faculty members worked hard during those years to support the program. They developed the computing foundation courses, obtained external funding for laboratories, and even obtained grants to provide Internet service to the Department when the College could not provide this service. For most of the 90s, however, inadequate resources inhibited developement of the CIS program. Fortunately, that situation has changed.

Thanks to the work of the past seven years both in the Department and on the part of the College, the CIS Program now is in a good position to be a leading national program that prepares computing professionals to meet the challenges posed by the rampant misuse and abuse of information systems and supporting computing infrastructures. Today, the program offers excellent computing facilities, coverage of areas of computing of critical importance to law enforcement and public agencies, and a strong faculty with a wide range of expertise. With the newly established Forensic Computing M.S. Degree program, the Department offers CIS students a pathway to an M.S. degree in computing that treats the mathematical, computing and legal issues that

surround the prosecution of digital crimes. The CIS program provides a solid undergraduate education that prepares students for direct entry into the profession and/or graduate study. Recently John Jay graduates have gone on to become systems programmers at IBM, computer support specialists for the director of the CIA, and IT directors for the Office of the Bronx D.A and local law firms.

Several developments since 1999 have enabled the Department to move the CIS major forward. The most important is the hiring of seven new faculty members; four of whom were hired only in the last two years. These faculty members bring a wide range of needed expertise to the major, and they already have left a significant mark on the program. In addition, the new members relieve the rest of the faculty of the extreme burden of carrying on an understaffed major and have allowed existing faculty members to be more productive. Other important developments are the Student Technology Fee and the commitment on the part of the College to maintain state-of-the-art computing facilities and a reliable College-wide network that provides adequate bandwidth to the Internet. The Department can now offer CIS faculty and students the basic computing resources needed in the program. Moreover, faculty members can now focus their fund raising activities on obtaining advanced computing facilities for research and advanced/ specialized coursework. The Department can now look forward to developing the CIS major, especially the Applied Specialization in Criminal Justice and the proposed Applied Specialization in Computer Security and Forensics.

The Curriculum Committee, CIS Coordinator, CIS faculty members and other interested members of the Department met last fall to review the CIS program and formulate a development plan for the next five years. The following two sections contain the short-term and long-term recommendations that grew out of that meeting. Newly hired faculty members played a considerable role in developing many of these recommendations.

B. **What short-term (one year) changes in curriculum/resources, if any, are recommended**?

By September ’05 the Department hopes to hire three faculty members with expertise in computer security, discrete mathematics and cryptography, forensic computing, or information assurance. Such expertise is needed to help develop both the undergraduate and graduate programs in computing. The College placed an advertisement in the January ’05 issue of the Communications of the ACM and is currently interviewing candidates.

The CIS program will propose adding a course in computer architecture and systems organization to the Computer Foundation Courses. In a recent review of the six foundation courses, CIS faculty determined that students who enter the operating systems course do not have the requisite background in architecture and systems organization. For example, the introductory courses do not provide adequate coverage of digital logic and machine representation of data. A background in these topics is essential for the study of various solutions developed by the computer security industry for law enforcement and security organizations. Moreover, a 200-level architecture and systems organization course would prepare students to understand the interplay between hardware and software that is required to building operating systems security mechanisms, e.g., techniques that rely on processor privilege levels and the interrupt system. A newly hired faculty member, who has considerable expertise in computer architecture, is developing the course and the Department should have proposal before the College Curriculum Committee early in the fall of ‘05.

The Department will develop a junior level course in software engineering that emphasizes secure system design. The course will provide coverage of techniques for large-scale project management, software development lifecycle, and explore the security pitfalls in current software system designs and implementations. Another newly hired faculty member, who has managed software development teams for over ten years, is preparing the course, which will probably be included in the new Applied Specialization in Computer Security and Forensics.

Working with Information Technology Support Services, the Department will upgrade its two Windows Laboratories so all machines also run the Linux Operating system. The Linux Operating system provides a rich environment in Open Source Software that offers lab environments to support topics throughout the curriculum. Moreover, experience in the Linux environment will prepare students early for work in junior level courses such as Operating Systems, Programming Languages and Computer Networking where the Linux environment is required. Finally, there is keen interest in Linux on the part of students because it is used heavily in the network and security industries and provides highly marketable skills.

The Department needs to choose an effective development environment for its introductory programming and problem solving courses (MAT 271 and 272). Students find the current environment, which provides the Borland C++ Builder compiler, very intimidating, especially in the first course where students learn to develop simple imperative language console applications. Besides offering support for object oriented programming, the new development environment should make it easy for students to write imperative language programs that employ simple I/O statements. The Department is considering introducing students to C and C++ compliers and debuggers in Linux or using some other Windows integrated development environment.

C. **What long-term (multi-year) changes in curriculum/resources), if any, are recommended**?

With the addition of faculty members during the past several years, the Department now is in a good position to develop further the capstone specializations, which support the mission of the College and the goals of the major. A working group of CIS faculty members is developing a new Applied Specialization called Computer Security and Forensics. The Department believes a separate track in this area is essential given the explosive growth in security and forensics during the past five years. At the same time, the committee will examine the Criminal Justice Specialization and attempt to incorporate new computing methods, information systems, and technologies that are used (or needed) to improve criminal justice agency functions. Topics under

consideration include enhanced coverage of data mining techniques for criminal investigations and coverage of distributed systems used by law enforcement and security agencies. The Department desires to have this specialization developed and in place within two years.

As part of further development of the Specializations, the Department is considering establishing a one-year course sequence in the senior year, possibly by linking the Quantitative Methods (MAT 400) and Internship (MAT 404) courses. The sequence would give students the opportunity to develop in-depth expertise in an area of computing such as systems programming, data mining or networking. Students would use this expertise to address a problem in computer security, forensic computing or to develop a system that addresses a need in law enforcement. The sequence would be an excellent capstone since it would require students to make use of computing and problem-solving skills gleaned throughout the program. In addition, students would become fully acquainted with an outstanding technical issue or problem of interest to the law enforcement community.

The Department must work closely with the Office of Admissions and other organizations within College and CUNY to advertise the major locally and nationally. The CIS major offers a unique opportunity for students to pursue careers where they can play a vital role in security, law enforcement and public agencies. Students considering careers in computer security and forensic computing immediately should look to John Jay College. Moreover, the College now provides a pathway from a B.S. degree to an M.S. degree in forensic computing – a very attractive feature of the CIS program. The Department has conducted mailings to local high schools, worked closely with the Office of Admissions and Freshman Services to recruit from the local College population, and established an articulation agreement with Borough of Manhattan Community College, which went into effect this year. More widespread recruitment needs to be done on a regular basis and College support is vital. President Travis' recent report (Travis, 2005) stresses the need to revitalize College recruitment efforts both at the undergraduate and graduate levels.

Both the Department and College must develop close ties to law enforcement groups who need computing expertise to investigate digital crimes. Area law enforcement agencies should view the CIS and M.S. Forensic Computing programs as a resource that offers both highly skilled professional computing personnel, and research level expertise and technology. Area law enforcement agencies could benefit not only from the Department's courses, but work underway in the Department in computer and network security, embedded systems, high performance computing, large-scale database systems, and wireless networks. Department faculty members have active contacts with agencies such as the Office of the Bronx D.A., the NYPD computer Crime Squad, and the Secret Service. During the past year faculty members in the Math & CS and the Science Departments, through grant-funded programs, have jointly sponsored seminars by investigators in law enforcement agencies. These have led to contacts, but more needs to be done. The Department and College must establish working relationships with groups who investigate digital crime and formalize these relationships if possible. .

Administrative support for the CIS program must be improved**.** Over the years faculty members have assumed too many of the routine administrative responsibilities associated with running a computer major. These include overseeing the daily operation of labs, establishing and maintaining internships and relationships with agencies, preparing flyers and literature for the major, scheduling lab sections, maintaining a web site for the program, developing and monitoring articulation agreements with other colleges, inventory management, and even collecting data on students and the program. Faculty members are not given credit for these activities. Moreover, these tasks detract from a faculty members primary responsibilities, course and curriculum development, proposal writing and research. In fact, no one, not even the coordinator, gets any released time for working on the CIS program. There needs to be an administrative person in the Department who is responsible for the many routine tasks that arise. In addition, this person would coordinate with other College offices that provide needed services for the major. The CIS major is now too big and too complex to be administered by faculty members on a volunteer basis.

The Department needs a dedicated computer person to support its growing computing environment, which now plays a critical role in the undergraduate and graduate programs as well as in faculty research. Departmental computing facilities include three Windows labs for undergraduate work, an advanced lab for Forensic Computing, a Beowulf Cluster, specialized facilities for database work, SSH servers for remote access, and an experimental network for research and coursework in networking. The Department needs a highly trained computer person who will work closely with faculty members and the ITSS staff, who does much of the routine software and equipment installation. The support person, however, would provide a higher level of support than the College provides. This person would be dedicated to the Department and would develop specialized expertise in the systems and software needed for both the Department's academic and research programs. The person would create and maintain student and faculty accounts, install specialized software and configure systems, and solve technical problems that arise almost daily in a computing environment that supports undergraduate and graduate programs in computer science. Most importantly, the support person would supervise students and other staff members who help maintain the Department's computing environment on a daily basis. It should be recognized that almost any computer department that offers programs similar to the Mathematics and Computer Science Department has such support personnel.

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Appendix A

Survey of Graduates from Office of Institutional Research (OIR)

1. Statistics about educational and career choices of recent graduates who completed this major.

Information for this section is taken from the OIR Graduating Student Surveys for the years 1999 through 2003, and the OIR Two Year Alumni Survey of Graduates for the years 1998 through 2002. In the Graduating Student Survey, OIR surveys students four months after graduation; in the Two Year Alumni Survey, OIR surveys students two years after graduation. A total of only 67 CIS graduates responded to the yearly Graduate Student Survey during the years 1999 to 2003 (about 30% of CIS graduates during that period). Only 18 responded to the Two Year Alumni Survey during the years 1998 to 2002 (about 10% of graduates during that period). Although the surveys offer an indication of the educational and employment prospects for CIS graduates, they might be misleading given the low response rates.

The data in the OIR surveys and faculty experience indicate that about half of the CIS graduates are interested in pursuing postgraduate educational opportunities. The Two Year Alumni Survey of Graduates indicated that 8 respondents (about 44%) had applied for some type of postgraduate degree or certificate program. Of these, 7 graduates (about 88%) were accepted. Five of the 8 (about 63%) had applied to an M.S. degree program while 3 (about 38%) had applied to a certificate program. The Graduate Student Survey, however, indicated that only 9 of 67 respondents (about 13%) had applied to a postgraduate program four months after graduation. Faculty experience indicates that after graduating from the CIS program, most students are financially exhausted and most work for several years before entering a postgraduate program. Indeed, many of the graduate school recommendations faculty write are for second and third year CIS alumni. The OIR surveys indicate that CIS graduates who responded sought advanced degrees in computer science, management, and education.

Employment is an important consideration for CIS majors, and the OIR surveys indicate that 82% of respondents worked while pursuing the CIS degree. The Graduating Student Surveys for 1999 to 2003 indicated that four months after graduation 38 of 67 respondents (about 57%) were working in a field related to the CIS major; 18 (about 27%) were not. Eleven graduates did not respond to the question. Fifty-three students (79%) were seeking a new position related to their major four months after graduation. The Two Year Alumni Survey of Graduates showed that 12 of the 18 respondents (about 67%) were earning more than $50,000 per year two years after graduation. The Graduating Student Survey shows that CIS students hold positions as administrators, analysts, computer programmers, instructors, managers, network assistants, paralegals, secretaries, security officials, supervisors, teachers and web masters. It is difficult to draw conclusions from the data in either survey due to the low response rate and the rather general nature of the questions. However, it appears the major does help students in the employment market.

2. Information about the performance of graduates on standardized exams, e.g., GRE, LSAT.

The College does not collect this information about its graduates.

3. Acceptance and Completion rates for graduates who seek post-baccalaureate degrees.

OIR data from the Two-Year Alumni Survey indicate that of the 18 survey respondents from the years 1998 to 2002, 8 students applied to a post-baccalaureate program and 7 were accepted.

4. Data about the proportion of graduates who completed this major who are working in their chosen field.

See question 1.

5. Data about the number and percentage of students who graduate with this major.

This section provides data on CIS graduates during the past ten years. The table below presents data culled from the Five Year Comparison of Enrollment and Graduation in Undergraduate Majors, which is prepared by the Office of Institutional Research, and the report, Degrees Awarded by John Jay College: 2001-2002 & 2002-2003, which is prepared by the Registrar. The table shows the number of CIS graduates for each of the years 1995 through 2004, the percentage of graduates who were CIS majors, and the total number of John Jay College graduates for the year

Graduation year	CIS Graduates	Percent of Graduates	Total Graduates
1995	15	1.6	949
1996	17	1.4	1186
1997	27	2.5	1067
1998	25	2.1	1199
1999	28	2.2	1299
2000	50	3.4	1480
2001	26	1.9	1337
2002	50	3.7	1340
2003	67	4.6	1460
2004	44	2.9	1525

The data show that the absolute number of CIS graduates has increased over the last ten years with the exception of the years 2001 and 2004. The year 2003 saw the largest number of graduates with 67. The number of graduates fell to 44 in 2004.

The spike in graduates in 2002 and 2003 and the fall off in 2004 was expected. One of the most accurate indicators of number of students actively pursuing the CIS program is the enrollment level in the Operating Systems course sections, which are offered during the fall semesters. The Registrar's record of declared CIS majors is helpful, but can be misleading since any student can declare a major and never take a course in that major. The Operating Systems course (MAT 375), which is required and taken by most CIS students in the junior or senior year, shows the number of students who have made a definite commitment to the major and have successfully completed the introductory sequence (MAT 271-272) or its equivalent. The course enrollment data

in the Appendix B show 79 enrolled in MAT 375 in fall 2001 and 72 in 2002. This accounts for the relatively large number of graduates in 2003. Since 2002, the enrollment level in MAT 375 has stabilized at 42, which is about the registration limit for two sections of this course. The Department expects the number of graduates to drop to and remain about 40 per year for the next two years.

6. Data on student retention

Student retention in the CIS major is difficult to measure on an input-output basis.. A significant number of students transfer into the major so it is not reasonable to look simply at the number of freshman who declare themselves CIS majors and complete the program. Many students must work and cannot finish the major in four years. In addition, a student can declare a major without taking a course in that program. Even if declared a CIS major, students often choose to try the entry-level programming course before proceeding in the program.

In the report, Analysis of Degrees Awarded in 2001-2002 and 2002-2003, the Registrar provides some insight into student retention in various majors. The report compares the percentage of students enrolled in each major in fall 1998 to the percentage of students who graduate in 2002 and the percentage enrolled in fall 2002. The report shows that 7.44% of the undergraduates were enrolled in the CIS program in fall 1998. The percentage of students who received a CIS degree in 2002-2003 was 4.96% of the graduates. The percentage of students enrolled in CIS program in Fall 2000 was 6.02% of the undergraduate population.

The Registrar's analysis indicates some loss of students in the CIS program, but it is difficult to say just how many. A similar analysis indicated loss of students in the Forensic Science, Criminal Justice BA and the Legal Studies programs while the Public Administration, Government and Forensic Psychology programs seemed to gain majors during the period. Again, this is a rough indicator of the situation. More study and a better metric are needed to understand and quantify retention in majors at John Jay College.

Appendix B

ENROLLMENT IN MAJOR COURSES FOR LAST FOUR YEARS

Course	Spring 01	Fall 01	Spring 02	Fall 02	Spring 03	Fall 03	Spring 04	Fall 04
141	169	166	214	175	272	189	311	237
204			12		12		12	13
205	25		19		10		15	
220		75		50		36		36
221	33		65	1	39		31	
241	73	86	69	107	71	90	68	107
242	42	46	70	52	70	65	84	49
243	12		12					11
270		60	20	48	14	41	23	30
271	103	112	77	71	76	62	70	51
272	64	41	67	40	55	32	22	37
273				17	9	10	7	8
276				12				
277		17		19		12		22
278								
279	41	58	39	39	27	41	40	30
290[1]	11	33	14					
295	14		16		11		6	
296	12							
323		13		11		19		15
324	13		15		10		13	
373	26	81	17	65	21	38	19	17
374	50		58		47		53	
375		79	1	72		44		43
377	44	18	75	16	66	14	39	
379			40		28		16	
400	10	27	21	29	21	24	12	20
404	11	10	20	29	29	7	20	14
470	23	1	45	24	37	9	22	
490		20		30				

[1]MAT 290 was the experimental version of the course MAT 273.

Appendix C

Summary of Recent Scholarship of Selected Faculty

1999 – 2005

(For each full-time faculty member teaching in the program, attach a one-page summary of faculty scholarship [publications –article, books, or letters, grant activity, presentations at national conferences, membership in professional societies, offices held, courses developed] over the last five years.)

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Appendix D – List of Required CIS Major Courses
Appendix E – Course List with Descriptions
Appendix F - CIS Flyer