Version of November 7, 2011

Proposal: Introduce a Master of Science in Computer Science with Specialization in Cyber Security.

Rationale

We propose to design and offer MS areas of specialization, associated with research/training centers that have CS faculty involvement. To initiate this process, we start by proposing an MS specialization in cyber security that will be affiliated with the Center for Reliable Information Systems and Cyber Security (RISCS) and administered by CAS CS. We propose that students who complete the MS specialization receive a diploma that indicates this specialization, e.g. “Master of Science in Computer Science with Specialization in Cyber Security.”

Masters Programs in Peer Institutions

The peers identified in the Department of Computer Science Strategic Plan all offer the Master of Science in Computer Science, and all emphasize special tracks/concentrations. These peers are: Brown University (uses Sc.M. designation), New York University, Rochester University, Johns Hopkins University (uses MSE designation), University of Chicago, Northeastern University, University of Southern California, and the State University of New York at Stony Brook.

Relationship to Other Existing BU Programs

The proposed degree bears similarity with the “MS in CS with concentration in security” currently offered by BU’s Metropolitan College (MET). However, each program targets a different student population. In particular, the MET program is an evening continuing education program and targets mostly working professionals. Our CAS master’s program is a day program that mostly attracts full-time students and is very selective in its admission process. We in fact consider our master’s program as a gateway for exceptional master’s students to join our PhD program.

Other RISCS affiliated programs (ENG and SMG) do not offer degrees in cyber security but offer security related courses that our proposed degree will leverage. Unlike our CS security courses, which focus on issues related to safe software, languages and architectures, courses from RISCS affiliated programs focus on low-level issues such as secure hardware design or on high-level issues of managing security.

Requirements for the Proposed MS Specialization in Cyber Security

This MS specialization has the same course requirements (8 graduate courses, 32 credits) and core breadth course requirements as the MS in Computer Science. In particular, master’s candidates are required to complete at least five courses from the list of designated breadth (core) courses shown in the department graduate bulletin at http://www.cs.bu.edu/gradprogram/grad-bull.pdf. Among the grades received for the five core courses, the number of grades of B+ must not be greater than the number of grades of B or higher. The three remaining non-core (elective) courses are determined in

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1 Although no other MS specializations are currently under consideration, we
consultation with, and approved by, the student’s faculty advisor. No grade lower than B– may be used for graduate credit.

The breadth courses in the Masters curriculum are divided into four areas: Theory, Systems, Software, and Applications. At least one course must be taken in each subject area. Here is the current list of breadth courses:

- **Theory.** Algorithms (530), Complexity Theory (535), Probability in Computing (537)
- **Software.** Object-Oriented Software Principles (511), Programming Languages (520), Compilers (525).

Students in the MS cyber security specialization are further required to take:

i. at least two courses from list A below of core CS security courses;
ii. at least three courses from list B below of CS security-related courses;
iii. up to two courses from list C of elective non-CAS/CS security-related graduate courses, taught in a RISCS affiliated program and approved by the faculty advisor; and
iv. a masters project or thesis in an area related to cyber security as approved by the faculty advisor. A master’s thesis requires two faculty readers.

List A consists of CAS CS 538, 548 and 558.

List B consists of list-A courses plus CAS CS 512\(^2\), 552, and 565.

List C will be updated each semester in consultation with other RISCS affiliated programs and can be found on the departmental graduate web page.\(^3\)

Initial List-C courses include:

- MET CS 693: Digital Forensics and Investigations
- MET CS 703: Network Forensics
- MET CS 713: Advanced Digital Forensics (Malware Forensic Analysis)
- MET CS 895: Developing Secure Systems
- ENG EC500: Cybersecurity\(^4\)
- ENG EC 727: Advanced Coding Theory

\(^2\) CAS CS 512 is a newly proposed graduate course in Formal Methods for High-Assurance Computing System Design and Analysis. CS 512 will also satisfy the software breadth requirement.

\(^3\) [http://www.cs.bu.edu/education/graduate.shtml](http://www.cs.bu.edu/education/graduate.shtml)

\(^4\) This is a topics course that will receive a permanent number next year.
• ENG EC 761: Information Theory and Coding
• SMG IS 828: Managing Information Security

Note that a CS course can be used toward satisfying multiple requirements. For example, CS 552 can be used to satisfy both the Systems breadth requirement and cyber security requirement (ii), or CS 538 can be used to satisfy both the Applications breadth requirement and cyber security requirements (i) and (ii). A sample student program is provided below.

Language Requirement: The department does not have a foreign language requirement.

Staffing for the Cyber Security Specialization:

In SAB/LOA years for security faculty: Sharon Goldberg, Ran Canetti, and/or Leo Reyzin, adjustments will be needed to ensure that at least two courses in list A are offered. In years without such SAB/LOA, all pre-existing courses in lists A and B are already offered at an acceptable frequency with current staff at current enrollment levels. Assaf Kfoury will offer the new course CS 512 in alternate years. If the MS with emphasis in cyber security is immensely popular, then we will need to reassess the frequency of course offerings in list A, and possibly list B.

Sample Student Program:

A sample program might consist of the following eight courses:

• CS 530 (Algorithms): satisfies the Theory breadth requirement.
• CS 511 (Software Engineering): satisfies the Software breadth requirement.
• CS 552 (Operating Systems): satisfies both the Systems breadth requirement, and cyber security requirement (ii) as a list-B course.
• CS 538 (Cryptography) and CS 558 (Network Security): satisfy both the Applications breadth requirement, as well as cyber security requirements (i) and (ii) as they are designated on both lists A and B.

The above five courses meet the CS core breadth requirement of five breadth courses, with at least one course in each subject area (Theory, Software, Systems, and Applications). Cyber security requirements (i) of at least two courses from list A, as well as (ii) of at least three list-B courses, are also satisfied.

The three remaining courses can include two list-C (elective) courses, and one directed study course to complete the master’s project:

• MET CS 693: Digital Forensics and Investigations
• SMG IS 828: Managing Information Security
• GRS CS 9xx: Directed Study in Cryptography or Security
November 7, 2011

Dear Professor Sclaroff:

Thank you for sharing the proposals for renaming the MA designation to an MS in Computer Science and to introduce a specialization in Cyber Security.

As a graduate from a European University (Dresden University of Technology, Germany) I can attest that there is indeed a perception issue with the MA designation among international students and that a change to a Master of Science will emphasize the technical nature of the degree. I believe the change will help attracting more international students and support it without reservations.

The introduction of a Specialization in Cyber Security is very timely and addresses a critical need for educating cyber security professionals. Since 2005 the Center for Reliable Information Systems and Cyber Security (RISCS) has worked to facilitate faculty collaboration in cyber security research and education and I am pleased to see that the new Cyber Security Specialization integrates courses from CAS, MET, ENG and SMG—the four colleges from which RISCS faculty is drawn.

I am in strong support of the program and believe that it will enrich the curriculum, give more opportunities to BU students and further strengthen the collaboration of faculty through the Center for Reliable Information Systems and Cyber Security (RISCS).

Sincerely,

Tanya Zlateva, Ph.D.
Associate Dean for Academic Programs Metropolitan College
Director, Center for Reliable Information Systems and Cyber Security (RISCS)
Professor Stan Sclaroff  
Chair, Department of Computer Science  
Boston University  
Boston, MA 02215

Dear Stan,

We have discussed your proposed new degree as Master of Science in Computer Science with Specialization in Cyber Security within our Department, as well as the proposed change in the designation of the current Master degree in Computer Science. Our department concurs that the change from Master of Arts to Master of Science is desirable, and typical of designations used in the top programs in Computer Science, many of which are located within Colleges of Engineering.

Our Department is also supportive of the new degree with specialization in Cyber Security. We hope to develop a parallel program within the College of Engineering in the future, and would welcome the opportunity to use some of your courses as part of that program. We currently offer one graduate level course in Cybersecurity, EC500, that provides an introduction to the topic, and which will receive a permanent number next year. This course is taught by RICS affiliated faculty. It is our hope that this course can be integrated into the proposed MS program, and that we can avoid overlap in the content when designing other courses.

Sincerely,

David A. Castañón  
Professor and Chair
Dear Stan,

Thank you very much for sharing with us the proposals for changing the Master of Arts in Computer Science (CS) designation by College of Arts and Sciences (CAS) CS Department to Master of Science (MS) in CS, and for introducing a MS in CS with Specialization in Cyber Security, and for giving us the opportunity to share our opinions about the proposed programs.

We have discussed the proposed curricula at our faculty meeting in relations to the degrees that are offered at our department. As you know, the CS department at Metropolitan College (MET) has been offering a MS in CS degree since 1979, and we have more than 1500 graduates from that program. We are currently in the process of developing an MS CS in the online format. In 2004 we also introduced a MS in CS degree with concentration in Information Security. At that time our programs were certified by Committee on National Security Systems (CNSS), which was one of the requirements for BU to be designated as a national Center of Excellence in Information Assurance Education by the National Security Agency. That led to the creation of the BU Center for Reliable Information Systems and Cyber Security (RISCS), which was founded in 2006 by the faculty from both BU CS Departments at MET and at College of Arts and Sciences.

Even though the specialization areas of the proposed programs are similar to the areas of our existing MS programs, they will serve a completely different student population. Our MS programs are geared towards professionals who are interested in part-time education offered at the most convenient times and location and through innovative delivery methods. As stated in your proposal, the MS programs that you will be offering will be geared towards full-time students with a strong research interest, and will be used as a gateway towards your PhD program.

Based on all of the above, we believe that the proposed MS programs by the CAS CS department will very well complement the current offerings by the MET CS department and we strongly support their approval.

Moreover, we believe that the proposed programs will contribute to even closer collaboration of our two departments, both through the proposed student cross-registration as well as through common research projects through the RISCS center.

Sincerely,

[Signature]

Lou Chitkushev, PhD
Associate Professor and Chairman