A proposal for a professional Master of Computer Science program

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This document lays out a proposal for a professional Master of Computer Science (MCS) program in the Department of Computer Science at William & Mary.[1] This proposal is made in response the Commonwealth's call for vastly increased production of degrees in computer science.

As part of the state's commitment to Amazon and its recently announced Northern Virginia "HQ 2", the Commonwealth seeks to *double* the number of degrees in computer science and computer engineering produced in Virginia.[2] The recent legislative session produced the Tech Talent Investment Program (HB 2490), which sets the goal of producing an additional 25,000 BS and MS degrees in computer science and computer engineering between now and 2039.[3] This proposal assumes a concomitant expansion of our undergraduate program.

In addition to responding to a priority of the Commonwealth, the proposed MCS program will also increase the options available to our students. Our existing MS program is more oriented towards research than is appropriate for a professional master's program. The professional MCS will attract a different type of student than our MS and broaden the appeal of our graduate program.

The main selling points of the program would be:

- a relatively small program with limited cohort sizes (at most 30–40);[4]
- a high-quality W&M education;
- a curriculum tailored towards professional needs with a solid academic foundation;
- qualification for Curricular Practical Training (CPT); and
- qualification for Optional Practical Training (OPT).[5]

One particular group of students we would target would be students with some computer experience but who have little or no formal training in computer science. We already see quite a few such applicants in the pool for our existing MS program. For example, this year's MS applicant pool includes applicants with degrees in economics, physics, information technology, engineering, cognitive science, software engineering, and Spanish. The field of data science may become another source of applicants. We have had success attracting our own undergraduate CS minors to our fifth-year MS program (particularly students who discover CS late in their undergraduate careers) and the MCS would provide another appealing option. William & Mary's reputation for teaching would make the MCS program attractive to those seeking to make a transition into computer science.

The program

The MCS program would consist of 30 credits (10 three-credit courses). MCS students would not be eligible for any stipend or tuition support.

The prerequisites for the program are CSCI 141, 241, 243, 301, 303, or equivalent professional experience. These course roughly comprise an undergraduate CS minor at W&M. The equivalence of professional experience for these prerequisite courses will be determined by the graduate admissions committee. These prerequisites have been chosen so that students with little formal background in computer science can pick up the necessary prerequisites during the summer (these courses are

[1] We have borrowed the naming convention used at the University of Virginia, which distinguishes between a professional MCS, a research MS, and a PhD in computer science.

[2] See the Governor's website, https://www.governor.virginia.gov/amazon/, "About the Proposal" tab, question 2.

[3] See the proposed changes to the Code of Virginia, §§23.1-1239—23.1-1243.

[4] In contrast, Virginia Tech plans to graduate 750 Masters students per year at their Northern Virginia campus.

[5] The CPT program allows non-citizens to work while enrolled as students. The OPT program allows non-citizens to work after graduation. In computer science, OPT can last up to 36 months.

currently offered as summer courses or soon will be). Students that need to take summer courses should expect to pay summer tuition for these courses.

To ensure that students have a solid foundation to successfully complete the MCS program, the MCS program would require students to take four 500 level courses, These classes include a number of courses cross-listed as undergraduate courses (with additional requirements as 5xx courses). Examples of such courses are:

- CSCI 515: Systems Programming,
- CSCI 524: Computer Architecture,
- CSCI 526: Simulation,
- CSCI 527: Computer Graphics,
- CSCI 534: Network and Systems Design,
- CSCI 542: Compiler Construction,
- CSCI 554: Computer and Network Security,
- CSCI 564: Applied Cybersecurity.

Students who demonstrate a strong prior background in computer science (by attaining a 3.7 average GPA on three 5xx courses), can elect to substitute one 5xx course for an independent masters project (610).

The degree would also require six additional courses at the 600 level. Four of these courses will be specially geared towards the MCS degree and have a practical orientation. These four courses will be exclusive to the MCS degree and cannot be taken by doctoral students. These four new courses are:[6]

- CSCI 603 (Applied Algorithms): a course similar to the extant graduate algorithms course, but with an emphasis on implementation and applications rather than theoretical analysis.
- CSCI 604 (Applied Software Engineering): modern software development methods and experience working in groups.
- CSCI 606 (Practical Machine Learning): application of machine learning techniques to real-world problems.
- CSCI 609 (Programming Modern Architectures): programming modern and emerging hardware architectures (e.g., multi-core CPUs, GPGPUs).

Two additional 600 level courses would be chosen from the existing set of 6xx offerings as electives. This will offer our MCS students the opportunity to study the latest developments in focused areas of computer science.

We imagine most students would take three or four semesters to complete the MCS. Tables 1–3 lay out representative paths through the program. Table 1 shows how a well-prepared and ambitious student could finish the program in two semesters.

semester	courses		
	5xx	60x	6xx
1	3	2	
2	1	2	2

Table 1: A two-semester track through the MCS program.

Table 2 shows how students might complete the program in three semesters. We expect this to be the most common situation.

[6]The titles of the new courses are tentative and we may add other options later.

semester	courses		
	5xx	60x	6xx
1	2	1	
2	1	2	
3	1	1	2

Table 2: A three-semester track through the MCS program.

Finally, Table 3 shows a four-semester track through the program. This course of study would be pursued by students who need to make up gaps in their background in their first semester. The 3xx classes would be taken pass/fail in addition to those required for the MCS program.

semester	courses			
	3xx	5xx	60x	6xx
1	2	1		
2		2	1	
3		1	2	
4			1	2

Table 3: A four-semester track through the MCS program.

The professional MCS degree is designed as a terminal degree. Students who desire to enter the doctoral program will need to take two additional 780 courses, and four additional 6xx courses. Consequently, students electing to continue in the PhD program will need to complete one additional year of graduate courses (and attain a 3.7 GPA on at least five of their 6xx and 780 courses, excluding 60x and 610).

Resource requirements

This is an on-going conversation with the administration. Virginia's new Tech Talent Investment Fund is the logical place to seek funding for the faculty needed for the MCS program. The proposed MCS program would require at least, five additional TE faculty. These resource requirements are intertwined with those needed for the anticipated expansion of the undergraduate program in response to the Commonwealth's call for increased production of computer science and computer engineering degrees.

Assessment

The MCS program will begin with small cohorts of students. In the long-term, we foresee a program with entering cohorts in the range 30–40. The success of the program will be measured in terms of

1. the number of students in the program,
2. the number of students successfully completing the program,
3. positive employment results for the MCS graduates.

In case the professional MCS program does not meet these goals, the teaching power will be recommitted to the greatly expanded undergraduate program that the Commonwealth envisions.