

# Viewpoint

## OMSCS: The Revolution Will Be Digitized

*Lessons learned from the first five years of Georgia Tech's Online Master of Science in Computer Science program.*

**T**HE ONLINE MASTER of Science in Computer Science (OMSCS), a degree program at the College of Computing (CoC), Georgia Institute of Technology, grew out of a conversation I had with **Sebastian Thrun** (co-founder of online learning platform Udacity) in September 2012. We set as our goal to expand access to quality learning opportunities by using massive open online course (MOOC) technology to **mitigate obstructions of time, space, and financial ability**. This called for a fundamental, revolutionary shift from the prevailing paradigm of higher education, in which **a brand is bolstered by exclusion and high tuition fees**.

As a preliminary step, I, as dean of CoC, convened a faculty working group, chaired by Kishore Ramachandran, from the School of Computer Science. Its members were notably concerned with maintaining the quality of CoC's academic content, the logistics, and the student and faculty experience—a focus on quality that would become a key principle of the program. The document the group created became the operational manual for putting the program into practice. The working group, in turn, engaged with the faculty through a series of deliberations and town hall meetings, and in spring 2013 the faculty voted to move forward. The program then



earned the support of Georgia Tech's President and Provost, who advocated for it with the Board of Regents of the University System of Georgia. While the faculty debated and planned, Thrun and I sought funding to cover the costs of preparing, organizing, and introducing the first courses. In January 2013, AT&T provided a \$2 million gift, and added \$2 million more a year later. AT&T's generous support signaled to Georgia Tech the potential of the program, and enabled OMSCS to have **positive net income** from the start. When, in May 2013, **the Board of**

**Regents approved the degree**, we began preparing the first courses, using Udacity's platform and their course design and production experience. Each of the initial five courses cost approximately **\$300,000 to develop**. In January 2014, OMSCS was launched with 380 students.

### Progress and Service

We took the words emblazoned on the seal of Georgia Tech—"Progress and Service"—as our mission. To start with, we committed the program to a unique admissions policy—GRE is not

required, and instead, OMSCS students have to obtain grade B or higher in two courses from a specified list in their first year to be officially admitted (for admission requirements see <http://www.omscs.gatech.edu/program-info/admission-criteria>). While the selectivity of the on-campus Master in Computer Science program (MSCS) is slightly higher than 10%, 70.7% of the more than 26,000 OMSCS applicants were admitted. Added to the novel admissions policy, I insisted on keeping OMSCS tuition affordable—less than \$7,000 for the full degree, payable by course, rather than \$40,000 for a public on-campus program, or \$70,000 or more in a private university.

CoC's MSCS offers a degree on completing a course option (10 courses, 30 credit hours), thesis or project options (each counting for nine credit hours). The course option is the only one available to OMSCS students as it is difficult to scale up the others. However, individual OMSCS students obtained a degree following one of the latter options. According to Goel and Joyner<sup>3</sup> the data strongly suggests there is nothing inferior about the online course experience, students regularly rate their online courses as better than on-campus courses they have taken, and they regularly match or exceed the performance of their on-campus counterparts.

The demographics of OMSCS differ from MSCS: the average age of a starting OMSCS student is 32 as compared with 22 in MSCS, the majority of OMSCS students are domestic (67.1% in Spring semester 2019), while MSCS' is international (55.4%), most work a full-time job and their backgrounds are more diverse (in the academic years 2017–2018 and 2018–2019 70% of the applicants lacked undergraduate CS degree, 17% had a non-CS MS, and 5% had a Ph.D.). OMSCS attracted slightly more underrepresented minorities (14% vs. 10%). Goodman et al.<sup>4</sup> showed most applicants would not pursue an advanced degree at all if it were not online and highly affordable and that OMSCS provides the first rigorous evidence online education can increase educational attainment. The different demographics of our online and residential programs have shown that the former has not cannibalized the latter, for which the number of applications has more than doubled.

OMSCS' growth has been phenomenal—by Spring 2019 term OMSCS offered a total of 30 courses in four specializations to 8,662 students (for a current list of courses and course previews, see <https://www.omscs.gatech.edu/current-courses>). Goodman et al.<sup>4</sup> predicted OMSCS will be responsible for at least 7% increase in the number of master's degrees in computer science attained each year in the U.S. In fact, it now exceeds 10%.

The implications of OMSCS have not gone unnoticed, and the program has been widely recognized both inside and outside of higher education. In 2017, the University Professional and Continuing Education Association gave OMSCS its National Program Excellence Award. In 2017, Georgia Tech appeared on *Fast Company's* list of most innovative companies in the world—the third university recognized on the list, and the first recognized for education rather than research—on the strength of the OMSCS program. And, the OMSCS was cited in more than 1,200 news articles, including more than 50 in the *Chronicle of Higher Education* and *Inside Higher Ed*.

OMSCS' success has inspired similar programs at other universities—more than 40 MOOC-based M.S. degree programs, more affordable than their on-campus counterparts, have been launched recently by more than 30 universities. Georgia Tech too has launched two additional online master's degrees.

### What Has Not Gone the Way We Thought It Would?

From the start we determined to expand the program judiciously, out of

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respect and responsibility to the “pioneers”—the first student cohort. Thus, we admitted only half of the accepted students in the first semester, delaying the entry of the rest to the next semester. All went well.

In the first year, the Teaching Assistants (TAs) were on-campus students, but as the number of students rose we were faced with the dearth of TAs. In the second year, we advertised for TAs among OMSCS students and were surprised, even astounded, by their overwhelming positive response. Research by Joyner<sup>5</sup> found online TAs were far more likely to be intrinsically or altruistically motivated. The students, typically computing professionals with full-time jobs and family, serve as TAs even after graduating—for modest pay, and sometimes even on a pure volunteer basis: in Spring semester 2019, 65 out of the 282 TAs were OMSCS alumni, in addition to 109 current OMSCS students.

Another issue was student services (for example, the Office of Student Life, registration, admissions, bursar, career services, and so forth), many of which were not designed for our scale. By careful integration and cooperation we assure OMSCS students receive the same services and policies as on-campus students. For example, an older student body (that is, with families, aging parents, young children) requires more support for unforeseen health or other personal emergencies, and a geographically dispersed student body is likelier to be affected by natural disasters of which the university administration is not otherwise aware. To reduce the burden on the school's central Office of Student Life, which is responsible for validating and responding to requests for special accommodation, an application is used to track such cases and (with input from instructors) to determine the response.

Aware that student retention is critical for the success of OMSCS, we carefully monitor its metrics. 60.5% of those who started in the years 2014–2017 have graduated or were still enrolled in the Spring 2019 term. Approximately 15%–20% may drop out during any semester, yet all but 5%–6% return in the next semester. Students might need or wish to withdraw or leave the program for various reasons—some did not intend to obtain a degree in the first place, but rather update/upgrade

their skills, and others perhaps had not anticipated the *rigorosity* of the program. At five years, it is too early yet to deduce retention, but we ascribe the relatively high retention thus far in part to the **peer social connectedness**.

Among the frequently cited criticisms of online education is the lack of **opportunity to experience the benefits of teacher-student and student-student interactions**. Our concerns were allayed as we soon discovered OMSCS engendered a palpable spirit of community and of service. OMSCS students have created and led more than 70 online forums—entirely student-run social communities based on shared geography, interests, or background—where students can network, ask for help, and form the kinds of relationships they might form on campus. Students across states and countries (all 50 U.S. states, **120 countries**) coordinate projects across time zones, share solutions, and support each other—and offer advice to prospective applicants. The OMSCS program’s sense of community effortlessly spans the globe.

### Lessons Learned

We learned OMSCS serves a large unmet demand, underserved by the institutions of higher education. Faculty and administration in some institutions of higher education have been skeptical of online programs being able to provide as high quality education as residential ones, concerned that offering those programs will devalue their residential programs, and mindful of possible slippage in popular rankings that privilege student-faculty ratios.<sup>1</sup> We learned an inclusive admission policy does not detract from students’ attainment, nor from the college reputation.

Bacow et al.<sup>1</sup> acknowledged “very few institutions are using either the savings from online education or the incremental revenue to reduce the price of education to students.” At the time OMSCS was established, many institutions charged tuition equal to or greater than the tuition charged to residential programs. We learned that high-quality low-cost online degrees are realizable and viable—OMSCS has been **financially self-maintaining** since its third year (in the first two years it was in the black thanks to AT&T), and thus far has produced **cumulative net income to Georgia Tech of \$13 million**.

## We believe the MOOC-based technology that powers the OMSCS degree can expand the availability of computer science in K–12 schools.

We learned that for a radical change in higher education to happen it must be led and supported by the faculty. Carmean and Friedman<sup>2</sup> described how, at other institutions “...money, control, job security, tradition, and quality” precipitated into discussions “... within a faculty divided against itself, [that] too often disintegrate into questions of governance and control.” We avoided “the online education **tin-derbox**” by respecting and addressing our faculty’s concerns.

### Expanding Tomorrow’s Opportunity


The realignment of today’s workforce with tomorrow’s economy requires more than plugging shortages of master’s degrees. The shortfall in technology education permeates every level of study. There are 1.6 million students in K–12 education in the state of Georgia alone, but **only 95 qualified CS teachers**. We believe the MOOC-based technology that powers the OMSCS degree can expand the availability of computer science in K–12 schools. The Constellations Center for Equity in CoC is developing a hybrid model of online and in-person instruction that will allow far more students access to quality CS education.

CoC already offers its MSCS students the use of the OMSCS videos. It offers undergraduates the choice of an online version of an introductory computing course (Introduction to Computing with Python). In the Spring 2019 semester, 55% of the undergraduates made that choice and reported liking it as much or more than their in-person courses. Two more introductory courses were offered undergraduates in the Fall 2019 semester. These courses will

be available to University System of Georgia students and to Georgia high school students. The addition of online courses may help the students reduce their time on-campus, attain graduation sooner, and reduce the cost of college education by taking introductory courses before reaching Georgia Tech and then combine online learning with internships, co-ops, and while working.

Georgia Tech and CoC are dedicated to finding ways to use technology to expand the impact of CS education. As a public university, our responsibility is both to the students we serve and to the nation, and OMSCS pioneers the change in the educational landscape with both responsibilities in mind. Our future depends upon it.

### Postscript

In the Spring 2020 term, 9,597 students enrolled in OMSCS, almost 1,500 graduated in this academic year. In December 2019 the conference “Reimagine Education” presented OMSCS with the Gold Award for the best distributed/online program for nurturing 21<sup>st</sup>-century skills. In May 2020 the University of Cambridge announced it will move all lectures online for the full 2020–2021 academic year. 

### References

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