# Mechanisms for Supporting Emergency Remote Classes: Towards a Distributed Classroom

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## Abstract

During the rapid emergency transition to remote classes in 2020, our online Master of Science in Computer Science program supported the newly remote traditional classes in several ways. In this chapter, we go over some of those ways, including providing direct feedback, opening up remote instructional resources, reassigning classes to remote instructors, and providing material for the formation of local cohorts. We then investigate how these mechanisms are small steps toward a broader, more fundamental reimagining of classrooms as distributed across time and space.

*Keywords:* Online learning, distance learning, distributed classroom, COVID-19

## Introduction

Georgia Tech is home to the online Master of Science in Computer Science (OMSCS) program, an entirely asynchronous and remote graduate program that grants the same degree as the on-campus program. As of Fall 2020, the program enrolls over 10,000 active students, and it has graduated over 3,000 students in the 6 years since its inception. For more information on the program itself, we recommend reading Goel and Joyner, 2016; Joyner, 2017; Joyner, 2018a; Joyner and Isbell, 2019, and Joyner, Isbell, Starner and Goel, 2019. For the purposes of this chapter, it is sufficient to know: the program employs approximately 300 teaching assistants, the majority of which are remote; most courses in the program are also offered on campus, typically by the same professor; and the online program shares much of the same infrastructure as the on-campus program, including the same learning management system and the same policies and governance. Overall, the online program runs very similarly to the on-campus program, but at scale and without synchronous co-located class sessions. Instead, students and instructors interact via the learning management system and accompanying course forum, in the form of assignment feedback, Q&A, and class discussions. We have interestingly observed that the quantity and range of instructor-student interaction is higher in this medium than in-person (Joyner, Goel & Isbell 2016).

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In the wake of COVID-19 in Spring 2020, our initial concern in the OMSCS program was, as with everyone else, the immediate impact of the pandemic on our operations. As the days turned to weeks, it became clear that the impact on an already-online program was relatively minimal. Not only were our students already attending remotely and asynchronously, but 2/3rds of our teaching assistants are members of the online student body as well. While these students and teaching assistants were still impacted by COVID-19 in their own family and work lives, their work in our program was largely unaffected. In some instances, it was actually accommodated: our first awareness of the pandemic came in mid-January 2020, when a student in Wuhan wrote to express that quarantine was giving him more time to focus on his OMSCS work. Aside from giving a record number of Incomplete grades (a placeholder grade assigned when, for health or family reasons, a student is unable to complete a course on time), our workflows were largely unimpacted—and even those Incompletes were relatively manageable due to the pre-recorded course content and ongoing TA availability.

Thus, our attention quickly shifted to how we might support the on-campus program as it went through a much more dramatic upheaval. In many ways, the on-campus program was tasked with quickly learning to do what we in the online program do every day; however, it was also tasked with creating in two weeks what we usually spend several months developing. In this chapter, we present four of the ways in which the online program supported the in-person program from Spring 2020 through Fall 2020. We then reflect on how these sorts of developments dovetail with broader trends in remote and online education, moving towards a notion of a “distributed classroom” that is less sensitive to the constraints of time and space. We close by noting some of the ways that embracing online learning in a traditional setting has supported our purely online program as well.

## Mechanisms for Supporting Emergency Remote Classes

Early in the transition to emergency remote classes, we focused on providing as much information as possible about how to succeed in teaching online in order to support the campus faculty tasked with carrying out the transition. As time moved forward, we shifted to using online infrastructure and staff to more directly support these new offerings. In this section, we describe four of these approaches.

### Shared Expertise

When university closings began to occur, numerous seasoned remote educators flocked to share advice for teachers newly moving into a remote environment. At Georgia Tech, this took the form of several rapidly spun up working groups for sharing best practices. I, personally,

participated in such groups with multiple schools on campus, including one with our College of Engineering, far-removed from my department; but the presence of expertise and familiarity with online teaching from a fellow faculty member immediately translated into live, direct advice for others. Many of the ideas we championed were put into immediate action; most prominently, we shifted the default mindset more toward asynchronous content creation presented in a synchronous environment. We describe this as a “hosted” model, with “hosted” drawing an analogy to talk show hosts who introduce different guests, performances, and video segments. Under this hosted model, a faculty member would pre-record a well-structured presentation of the core course content; this prevented technological problems from having an impact on synchronous students and ensured that the faculty member was comfortable with the product before they actually made it visible. Once produced, the faculty member would present it in a live environment, typically through the video sharing option in BlueJeans, a popular teleconference system; they would introduce the video ahead of time, answer live questions after the video, and interact in the chat box during the video. This model leveraged the benefits of creating polished content in advance, but also preserved the benefits of synchronous interaction among students and instructors. In fact, this model allowed greater direct interaction between students and instructors, as instructors could effectively be “in two places at once”, lecturing through their video and simultaneously answering questions in the chat. Pre-recorded content also tends to be more efficient, opening more synchronous time for student questions or collaborative work. This model has been noted to represent a new development in what has previously been a relatively mutually exclusive dichotomy between synchronous and asynchronous (Dahlstrom-Hakki, Alstad & Banerjee, 2020; Hrastinski, 2008), leveraging the best of each possible medium rather than choosing between then as alternatives.

In addition to private meetings directly with other faculty, we also created public materials usable by faculty at Georgia Tech and at other institutions. For my part as the Executive Director of Online Education in Georgia Tech’s College of Computing, I wrote three pieces that I have heard referenced several times: Five Tips for Moving Courses Online Quickly (Joyner, 2020a), a “quick-start” guide to simple tricks to be a successful remote teacher; Safe, Familiar, Student-Centric—An Emergency Guide to Remote Teaching for Novices (Joyner, 2020b), a more comprehensive guide to transitioning residential courses to a remote environment including their course content, assessments, and administration; and Designing Trustworthy Assessments without Proctoring (Joyner, 2020c), a guide to designing assessments that offer an assurance of academic integrity even in the absence of proctoring.

The guide “Safe, Familiar, Student-Centric” was also presented in a number of workshops, including the AWS Educate webinar series and J-WEL webinar series.

Through these efforts, the knowledge and skills developed through the first six years of our online MSCS program were extended both to our own faculty and to the world at large. What is particularly notable here, though, is that the majority of our advice was not on how to teach the way we do in the OMSCS program; in our program, we operate purely asynchronously with enormous lead-in time on course production. Instead, the advice was constructed collaboratively to transfer the positive experiences in a purely online program into this emergency transition. For example, the “hosted” model is not something we have used extensively in the online program because our students enter expecting a purely asynchronous interaction; the on-campus program by contrast enrolled students expecting live interaction, which created both an expectation to meet and an opportunity to leverage. The hosted model was devised to maximize the benefits of both environments; it went on to inspire a new paradigm of classroom distribution we will share in the second half of this chapter.

**The Remote Teaching Help Desk**

Moving into summer, our attention shifted to setting up a more comprehensive infrastructure for supporting our newly-remote faculty. During a normal semester, we employ almost 100 instructional associates, alumni of the OMSCS program who have continued to work as teaching assistants for various classes. Many of our courses are not offered in summer, however, because the summer semester is shortened and some courses are too demanding for the truncated semester; during these months, those courses’ instructional associates are typically not working.

For Summer 2020, we asked three instructional associates whose classes were not offered if they would act as a sort of “help desk” for College of Computing faculty teaching remote classes in the summer. To each of these three instructional associates, we assigned ~12 faculty members, offering their assistance not just answering questions, but also setting up tools, writing policies, and debugging remote technology. These instructional associates had ample experience with the tools that remote instructors would need to learn, and we felt that having a dedicated person to support these efforts for each instructor would be more efficient than either do-it-yourself guides or a more general help desk. They further helped convert other existing online material to a more open format.

Through this effort, the online program was able to support the in-person program by offering up dedicated experienced online instructional associates to work on these classes. This went beyond simple feedback and advice on the opportunities and challenges of transitioning

online; these individuals were able to actually proactively work on the courses undergoing this transition.

**The Case of CS4641**

Due to a combination of factors related to COVID-19, one of the courses—CS4641, an undergraduate machine learning course—that was taught remotely in the Summer of 2020 lost its instructor halfway through the semester. Individuals qualified to teach machine learning are extremely hard to come by, and indeed, no other faculty members were available who could take over the class for the remainder of summer.

To resolve this, we turned to the online program. Miguel Morales is an instructional associate in the online program, working on the class CS7642: Reinforcement Learning. Not only has Miguel worked as a teaching assistant for CS7642 for several years, but he also has written a textbook on deep reinforcement learning; his skillset goes far beyond the typical teaching assistant. Miguel lives in Colorado, but because the summer semester is remote for everyone anyway, he was able to take over many of the instructional duties for CS4641 for the remainder of the Summer 2020 term, in collaboration with another institute faculty member that oversaw the course as a whole in a more traditional fashion. Miguel taught remotely via teleconference twice a week and interacted with students on the course forum; along with the other institute faculty member, he also worked with the course's dedicated teaching assistants, themselves remote from the rest of students in the class as well.

Through this effort, the online program was able to support the in-person program by actually supplying an individual capable of delivering the course content to an entire class, uniquely qualified in both domain knowledge and online teaching experience. He was only able to take the role because the remote environment allowed him to present to the class from Colorado. This brought up the question, however: Miguel is uniquely qualified and a gifted lecturer, is it not odd that it is only because of this emergency situation that he was able to have this impact? Would we not want him to be able to teach under normal circumstances as well?

**Georgia Tech-Shenzhen**

Jumping forward to Fall 2020, the constraints and demands changed. In some ways, the transition in Spring 2020 was simpler because the replacement was one-to-one: residential classes were replaced by remote classes. In Fall 2020, the ecosystem was more complex: some classes were residential, some classes were hybrid, and some classes were purely remote. What is more, those hybrid classes (at least at Georgia Tech) were required to be doable by any purely remote students to accommodate international students unable to come to

campus due to visa issues or travel restrictions. They also needed to be designed to make it as easy as possible for students to miss individual classes if forced to undergo a quarantine period after exposure to COVID-19.

One of the major places this dynamic became relevant was with students in China. Many students who would have attended Georgia Tech in Fall 2020 were unable to come to Atlanta because of travel restrictions and halts to visa processing. What was their alternative? Take a year off? Go to a different school instead? These were obviously undesirable alternatives for both students and the institute.

Fortunately, at our service were three undergraduate CS classes that had been developed for online delivery years prior. The longest-running of these, CS1301, was developed by me in 2016 and has been thoroughly researched; we know that learning outcomes from this online CS1301 were equal or better than those of the traditional version of the class (Joyner, 2018b; Joyner & McDaniel 2019). Students in these three undergraduate CS classes typically consume their lecture material asynchronously online, but then attend synchronous recitations and interact on course forums with instructors and teaching assistants.

Thus, to accommodate students in China who were unable to come to Georgia Tech in person, we instead opened up dedicated sections at the Georgia Tech-Shenzhen campus. Here, students would still meet in person, interact with their own dedicated teaching assistants, and attend recitations, but they would do so as part of broader enrollment in online classes that had been developed years prior. Just as if they had been in Atlanta, they were still able to interact directly with instructors and Atlanta-based TAs via the forum, and they were graded with the same expectations as if they had been in Atlanta as well. In every way, the credit they earned was identical, dramatically limiting the impact of COVID-19 on their learning and progress toward their degree.

Through this effort, students unable to come to Atlanta to start their full college education were nonetheless able to start or continue their progress toward their degree, bolstered by our other online offerings; and what is more, they did this without missing out on elements of the in-person experience. They still attended the course from a campus environment, just one that they did not share with the Atlanta cohorts of students. In fact, due to local restrictions in place at the time, the students at Georgia Tech-Shenzhen were the *only* students to have an in-person recitation; enrollment numbers and classroom capacity, as well as heavier requirements for social distancing due to local conditions, meant that students in the Atlanta section attended their recitations online.

## Towards a Distributed Classroom

There are two ways we can view the mechanisms we described in the section above. In one sense, we can view them with a relatively shallow mindset: we had access to experts in online teaching, and so we asked them to help others out. I helped faculty out with their own transitions. Our instructional associates partnered with faculty on their remote teaching work. A remote instructional associate presented to a remote class when needed. We let more remote students use our online material while forming their own local cohorts.

However, we can also think about these interactions more deeply. These mechanisms are not merely useful when handling a rapid transition to remote learning: they provide some inherent benefits that can be generalized to a typically-functioning classroom as well. The expertise developed by a vertically-scaled online program, along with the rapid need to transition in-person instruction, created an environment where innovation and improvement can occur in a durable way that may extend beyond the current crisis. This section describes these benefits, then contextualizes them within the paradigm of a classroom distributed across time and space.

### Asynchronous Access to Content

So-called lecture capture has been around for decades; under this mechanism, cameras and microphones record an in-person lecture and make it available to other audiences. These recordings are often afterthoughts, however: a stationary camera and subpar microphones generate a raw recording that marks off that the lecture was recorded but with little attention to practical usefulness and reusability. There are exceptions, of course, such as the state-of-the-art distance learning classrooms at Georgia Tech Professional Education's Global Learning Center and elsewhere on campus, but these are dedicated to the needs of Georgia Tech's distance learning programs rather than heavily leveraged in normal operations.

The push for hybrid classes in Fall 2020, however, means more attention has been paid to the quality of these recordings. The primary function of these recordings is supporting a remote, likely asynchronous audience, whether due to temporary factors like a quarantine or illness or more persistent obstacles like travel restrictions. The recordings are generally available to the in-person students as well, though, which provides a key benefit: classroom content is no longer a scarce resource. Without a recording, students are expected to be in the right mindset for learning every time a class meets for weeks on end, and to understand the material right away: if they do not, the lecture has passed, and they are left without a persistent resource from which to study. With a quality recording, students are able to rewatch content if

they were unable to understand it the first time, whether due to their own difficulties with the content or due to external factors.

This asset may expand even more when following the “hosted” model I described previously. Under this model, a teacher may film the core course content in advance; during a synchronous class time, they then play the core content, answering student questions live and pausing for students to work on problems themselves. This preserves the ability to generate a comfortable, vetted video about the core content while also getting to interact with students live during the presentation. The core content then becomes asynchronous available, further supporting students’ ongoing learning. For teachers who teach the same class multiple times per day, this also provides a significant time savings: rather than re-delivering all content throughout the day, they may record it once and use it multiple times. For remote students residing in other time zones, this may also open the ability to offer more “sections” as adding another time does not obligate the teacher to reteach the content, but rather just to be on hand for questions.

**Remote Instructors**

As seen in the example of Miguel Morales presenting to an otherwise-residential section of CS4641 in the summer and the instructional associates serving as a remote help desk for faculty based in Atlanta (but teaching remotely), an additional benefit of these arrangements is the ability to distribute teaching staff. Under a traditional model, teaching a college class requires a person to commit to being in a certain place at a certain time multiple times a week for several weeks in a row. This precludes many professionals and practitioners from also working as teachers. Our experience in the OMSCS program—especially the ease with which we attract teaching assistants (Joyner 2017)—has shown us that experienced professionals like Miguel would generally like to give back to the community by teaching, but the inflexible requirements prevent them from doing so.

Under a remote teaching model, however, more such individuals may be brought into the instructional fold. Synchronous presentation may still be needed but, removing the need to physically travel to a campus, especially during a regular working hour, tremendously increases the ability of qualified professionals to support the teaching process. We have seen this during the pandemic as well: one of the developments has been a greater ease with which guest lecturers may be invited because such an invitation does not require the guest to visit in person, but rather just to sign on at the right time. If entire classes can run on remote teaching models, then the pool of potential instructors expands tremendously.

This is not necessarily restricted only to entirely remote classes. A couple years ago, I delivered a guest lecture to a class at Carnegie-Mellon University, but I did so remotely; the instructor in the classroom put my presentation feed on the screen and pointed his camera at the class; I was able to see the class to which I was presenting, and answer questions live. In this way, a remote teaching model could be leveraged even to support in-person classes, retaining the types of in-person discussions and groupwork that typically thrive in synchronous co-located classes.

**Remote Cohorts**

In the example above, though, what makes the instructor 'remote' and the class 'co-located'? Is the class not itself remote from the instructor? In the example above, it seems obvious: I am alone in my office, and the class to which I am presenting is meeting at the same place every week. Clearly, they are the 'home' of the class, not me.

But in another one of our examples above, the dynamics are a bit different. Our cohorts in Shenzhen meet synchronously with one another in the same classroom; that synchronous meeting, however, is augmenting their enrollment in an existing online class, where communication is facilitated asynchronously. The Shenzhen location is not the "home" of the class in that the class predated the section, and yet students in the Shenzhen section interact in a way that others do not, with their own dedicated in-person recitation mirroring the in-person recitation typically offered at the Atlanta campus (prior to the pandemic).

By contrast, the typical online model we use in OMSCS has students around the world use pre-recorded content to participate in a class, communicating asynchronously with instructors and classmates via learning management systems and forum tools. The online model thus expands access, but at a cost: the in-person synchronous classroom experience is lost, replaced by asynchronous remote communication. If remote cohorts can reintroduce the synchronous classroom experience, however, then we may achieve the best of both arenas: students retain the asynchronous access to the original teacher as they would in a typical online class, but also may interact with a teaching assistant and a cohort of their own local classmates for team projects, group discussions, and other direct, synchronous interactions. Thus, students no longer need to commit to moving to Atlanta in order to include live interaction with classmates as part of their curricular experience, minimizing what portions of the experience they must relinquish in order to participate within their constraints.

**The Distributed Classroom**

If we tie these different initiatives together, we start to see something groundbreaking emerge, what we have come to describe as a distributed classroom. The distributed classroom, by our definition, is a classroom experience distributed across time and space. The teacher need not be in the same place as the students, and the students need not be in the same place as each other. The teacher might teach synchronously to students physically in the same room, synchronously to students in remote locations, or asynchronously in general. The typical barrier of needing to be in the same place at the same time fades.

This might seem just like typical asynchronous online learning, where students watch lectures from their homes instead of coming to the classroom and interact via forums or chat rather than face-to-face. The key to the distributed classroom is that it is distributed across these spectra rather than constrained within one. What that means is that a teacher may be teaching synchronously to a co-located class of students, but that class may be livestreamed to another cohort of students in a different location, as well as live-streamed to a synchronous remote audience. Each of these groups may have its own teaching assistants to support their own interactions and discussions, built on the foundation of the live lecture; these teaching assistants then may help facilitate live interaction between the remote cohorts and the teacher, curating questions to pass along while answering more low-level questions directly. All cohorts similarly would continue to interact with the instructor and full teaching team via asynchronous mechanisms outside of class, or even through dedicated synchronous remote interactions such as a dedicated remote office hours session.

Then, once the lecture is prepared for streaming, it may easily be recorded as well, allowing more fully asynchronous cohorts of learners to participate both with the course content and with the instructional team. For example, a section in Shenzhen might watch course content on a 12-hour delay due to the time difference, or a section of remote adult learners who sign onto BlueJeans together in the evening may watch the morning's content together. In both these contexts, dedicated instructional support would be available to facilitate and structure these interactions, as well as answering those questions that can be answered by an individual with knowledge at the level of a typical teaching assistant. All of these interactions are clearly optional: it remains entirely possible for a student to interact with classmates and instructors through asynchronous mechanisms only as in our existing distance learning classrooms. However, these optional synchronous interactions enhance the experience, reintroducing the social learning that students needed otherwise to give up in order to access the program in the first place without moving to Atlanta or committing to classes during work hours. All these

students may then interact with one another and with instructors on shared course forums like Piazza, submit their assignments to the same learning management system, and receive grades and human feedback from the same team of human teaching assistants. This is the distributed classroom: an attempt at distributing not just learning across time and space, but the actual classroom experience—including synchronous interaction—even while removing the requirement to attend at a certain time and in a certain place.

## Conclusion

While this chapter has focused on the ways that the existence of our large online programs supported the rapid transition to remote teaching in 2020, the online program has benefited as well. We have seen how increased comfort with teaching online has led more faculty to want to develop their own online courses. In many cases, these may even be developed using material they created to teach their initial online class; for example, in Fall 2020 we began teaching CS6457 online using material that the instructor developed to teach the class remotely in Summer 2020. For other classes, even if the material is not usable as-is, it provides a far more valuable prototype and structure to use to support a fully online development.

But the largest sea change we see as a result of these trends is a general blurring of the lines between online and residential education. While the two have often been thought of as discrete categories, bridged only occasionally by dedicated distance learning classrooms, the lines have blurred tremendously. This trend was already under way, with learning management systems and course forums distributing assignment submission, grading, and course Q&A across time and space, but stronger delineations existed regarding the classroom experience itself. But as we see more efforts toward remote instructors, remote students, and remote cohorts, it is becoming clearer that a classroom experience can be distributed across time and space as well.

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