What We Learned from the Abrupt Switch to Online Teaching Due to the COVID-19 Pandemic in a Post-secondary Computer Science Program

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Abstract: Online learning has been extensively researched, and online educators have a wealth of resources to build upon. However, when the COVID-19 pandemic hit, we were forced to abruptly convert course delivery from face-to-face to online. To make matters worse, this occurred in the middle of the semester, and the majority of us were not prepared — the majority of us had never taught online, nor have we received the required training to do so. This abrupt change also made it challenging for students which, in turn, posed additional challenges for educators, especially in relation to navigating student expectations. Unlike students who sign up for an online course, these students were also caught unaware by the switch, and online learning was new to most of them. We reflect upon this experience, paying special attention to the challenges associated with the discipline of Computer Science as well as those faced by teaching assistants. The COVID-19 pandemic will come to an end, but this change to education will stay with us. Hence, we share the lessons we learned.

1 INTRODUCTION

The COVID-19 pandemic drastically changed the way we teach in the Department of Computer Science at the University of Calgary. Mass closures began in Canada mid-March 2020, and our department was abruptly forced to switch to online course delivery as a result. The majority of the instructors within our department had never previously taught in an online format, and likewise did not have any training for online teaching. The switch caught the majority of us off-guard; our plans for lectures, tutorials, and labs were already in place and operational for a face-to-face delivery model. The abruptness of the closures forced many of us to quickly recalibrate our teaching structure without thoroughly vetting our changes for the new delivery mode. Combined with the aforementioned lack of training, many of us experienced hiccups with the transition.

Like any other discipline, Computer Science has its own unique teaching challenges. Writing papers, formulating theses and/or performing experiments and quantitative/qualitative analyses are very small components of undergraduate Computer Science course work, if part of it at all. Most Computer Science courses are heavily structured around building technical problem solving skills. Of course, not all courses in Computer Science are structured in the same way; some focus more on theory than practice and some are quite the opposite. However, the focus on problem solving is a strong part of classroom activity outside of lecture. *Tutorials* are meant to be hands-on sessions in which teaching assistants (TAs) build upon material covered in lectures and provide small-group and one-on-one support to students.

No class structure is perfect — one should always be evaluating and refining one's teaching methodology. That being said, many instructors and TAs in our department have been teaching in the same face-to-face environment for many semesters and have had ample time to determine which techniques work best for them. The practices that instructors and TAs developed have largely been disrupted by the move to online learning during the pandemic. In our department, all teaching practices have been moved online to Zoom (Zoom, 2020), and unfortunately many of the techniques that instructors and TAs have developed have not necessarily translated to the new delivery mode.

Research tells us that our face-to-face teaching experience may not be transferable to online settings without modifications. A proper command of the underlying technologies, an understanding of the new social orders, and the ability to harness the media-rich resources are all required to effectively teach online (Jump and Schedlbauer, 2020; Nelson et al.,

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2005). Not all educators are familiar with online teaching and its associated challenges; even fewer are actually trained to perform it (Bowen, 2010). The institution also needs to provide the proper support and environment for effective online teaching, such as standardization (Creanor and Littlejohn, 2000). Learner-centered education becomes more important in online environments (Creanor and Littlejohn, 2000; Donald et al., 2002; Herrington and Oliver, 2020; Sharma et al., 2020). Salmon identifies the essential characteristics needed by educators to succeed online (Salmon, 2000). These are (1) understanding of the online environment, (2) technical command of the online platform, (3) online communication skills, (4) content expertise, and (5) possession of certain personal attributes that allow the educator to thrive in an online environment. Hence, effective online teaching requires preparation and support that were not available during the sudden shift imposed by the COVID-19 pandemic.

A unique challenge that many of us faced during the pandemic was the abruptness of the transition to online learning. The sudden shift meant that educators already had lecture and assessment plans in place assuming a face-to-face delivery. Scrambling in the middle of the semester to re-adjust lesson plans and modify assessment methods can only add to the challenges of online teaching. There has been no previous event comparative to the scale of COVID-19 that has necessitated such a large shift to online learning, as such research is required to document and understand ts unique challenges. These challenges do not only apply to students but also to instructors and TAs alike. To our knowledge, online teaching challenges for TAs were not previously studied except in massive open online courses (MOOC) context (see (Ntourmas et al., 2018) and the references within). Unlike in MOOCs, our TAs had already planned their instruction for a face-to-face delivery when the pandemic hit and the vast majority of them have never received any training for online instruction.

Face-to-face and online assessment methods can be substantially different. One specific challenge in many Computer Science courses is that, when not proctored, students have the ability to test code snippets and answer questions without demonstrating any learning. For example in programming courses, it is popular to ask students to find the output of a code segment or correct its syntax errors (see Figure 1 for example questions). It takes a few seconds for a student to copy or type the snippet into a skeleton program, compile and execute the code, then correctly answer the questions without giving any thought, let alone demonstrating understanding. Educators need to innovate when designing online assessment tools and we generally do not have the luxury of time and resources in a sudden change due to a pandemic.

Q1. What is the output of the following program segment?

```
unsigned int size = 20;
int *ptr;
int i;

ptr = calloc(size,2);
for (i=0; i < 10; i++) {
    *(ptr+i) = i;
    *ptr += 2;
}

for (i=0; i < 10; i++)
    printf("%d", *(ptr+i));

free(ptr);
```

Q2. Correct the syntax errors in the following program segment:

```
int x = 10
while (x > 0) {
 printf("%d," x);
if ((x%10) = 1) break;
continue;
x-;
}
```

*Q3. Which of the following code segments outputs **2 11**?*

a.

```
static int a[] ={10,2,3};
int *ptr = a;

printf("%d ", *(ptr+1));
printf("%d ", *ptr+1);
```

b.

```
static int a[] ={10,2,3};
int *ptr = a;

printf("%d ", (*ptr+1));
printf("%d ", *ptr+1);
```

Figure 1: Sample questions from popular question types used in computer science exams (C language is used).

While student challenges are as important, this paper only discusses the challenges faced by our teaching staff. The second author of this paper is a lead teaching assistant (TA) who is responsible for mentoring the remaining TAs in the department. The remaining authors and instructors. One instructor has over two decades of teaching under his belt and the other is fairly junior. Hence, we provide a fairly diverse representation of the teaching power in our department. Furthermore, TAs form an intrinsic and crucial component of our teaching capacity, thus reflecting on our TAs' experience is important.

In Canada, the academic year includes two main semesters. The Fall semester runs from September to December and the Winter semester spans the period of January to April. There are two additional short semesters: Spring (May and June) and Summer (July and August). Our reflection covers experience

from two semesters: the Winter 2020 semester, during which the pandemic hit in the middle of the semester, and Spring 2020, which starts immediately after the Winter semester leaving little time for preparation.

As of this writing, the world is still battling COVID-19 with a vaccine light starting to appear at the end of the tunnel. The status quo of teaching and learning remains unchanged and the lessons learned from this experience of the abrupt change continue to be valuable. In addition, the pandemic has given many educational institutes the opportunity to start pondering with switching some or all of their programs to an online model. Our shared experience, conclusions, and recommendations can be valuable in these situations.

The remainder of this paper is organized as follows. In Section 2, we give a description of our department contextualizing our reflection. Our unique TA mentorship program is discussed in Section 3. The reflection on our experience is provided in Section 4 and recommendations are discussed in Section 5. Section 6 concludes the paper.

2 THE DEPARTMENT

The University of Calgary in Alberta, Canada is a research intensive institute with a population slightly over 35,000 students, more than 76% of which are undergraduate students. The Department of Computer Science offers degrees in Computer Science and Data Science. The vast majority of students are in the Computer Science stream. The department is a house for 50 full-time faculty members. In the Winter 2020 semester, our department had 1,202 students, almost 88% of which were undergraduates and offered 47 courses with 54 sections at the undergraduate level and 14 graduate courses with 21 sections. The average class size in Winter 2020 was 64 students for undergraduate courses and 7 students for graduate courses. In Spring 2020, the department offered 14 undergraduate courses in 21 lectures and no graduate course, with an average class size of 84 for undergraduate courses. Note that the department offers a substantially lower number of courses in the Spring and Summer semesters due to their condensed length.

With very few exceptions, every undergraduate course in the department has *tutorials*, where the class is divided into smaller sections of at most 25 students. A typical course includes in a week: 150 minutes of lectures where the whole class meets with the principal instructor for the course and 100 minutes of tutorial time where the smaller groups meet with their designated TAs. TAs work in tandem with the principal instructor. Typically, tutorials are meant to provide hands-on experience to students, which otherwise cannot be offered by the instructor given the relatively large class sizes. TAs are graduate students in the department and are assigned to courses at the beginning of the semester. Every admitted graduate student is offered a teaching-assistantship within the department for a period of 2 years (for M.Sc. students) and 4 years (for Ph.D. students). That is, the TA program has two direct objectives: (1) providing graduate students with a form of financial support in return for the work they provide to the department and (2) making use of this human/brain power of graduate students to support our faculty with their teaching.

3 TAiR PROGRAM

Realizing the importance of tutorials as an integral part of the learning experience for students, and given the fact that the majority of our TAs do not have much prior teaching experience (as a matter of fact, most first year graduate students do not have *any* teaching experience), in 2013 the department established a unique program to mentor and support TAs (Stephenson et al., 2014). The program is called *TA in Residence* (TAiR for short). The TAiR program has evolved over time with successive improvements, but it mainly consists of hiring an experienced and often stellar TA to be a mentor for the remaining TAs, paying special attention to rookies and under-performers. Currently, the program consists of:

1) Conducting regular *class observation visits* in which the TAiR visits and observes tutorials. An observation is then immediately followed by a one-on-one meeting between the TA and TAiR. The TAiR provides feedback to improve a TA's teaching practices. Follow up visits are common.

2) Hosting regular *experience share program* (ESP) sessions, where the TAs have informal coffee gatherings, moderated by the TAiR, to share and discuss their experiences. It is an opportunity for less experienced TAs to seek support and advice from more seasoned TAs. For the longer term, the ESP intends to create a community of practice among TAs; and

3) Requiring the participation in teaching *development workshops* that can be tailored to our TA needs or can be offered outside the department as well as long as their focus is on teaching and learning.

TAs sign contracts at the beginning of each semester outlining their time-commitment and the duties required from them. A specific number of hours in these contracts are explicitly dedicated for TAs' professional development.

The second author of this paper was serving as a TAiR during the Winter and Spring 2020 semesters. The first author was the Associate Head for Teaching and Learning who was supervising the TAiR program.

4 REFLECTION

This section is a qualitative, reflective discussion based on our experiences, instructors and TAs. These are our own experiences as well as impressions we obtained from discussions with our colleagues. First, we provide observations from lectures. Observations from tutorials are given in Subsection 4.2.

4.1 Instructors' Experience

Assessment: The abrupt change to online teaching created a challenge for instructors to stick to their assessment plans. For instance, some instructors had final exams planned, but not all instructors were able to stick to their predetermined plans. In some courses, unproctored exams allow students to use resources (development environments including compilers and online tools) that are otherwise unavailable in a traditional exam environment; these tools can allow students to ace the exams without demonstrating any mastery of the learning outcomes. This deemed some multiple-choice or short-answer questions useless since students can type the code, test it, and answer certain questions without demonstrating any understanding of the material. We have already given some examples in Figure 1. Designing thoughtful and alternative ways of online assessment is difficult in the first place. The short period of time that was given to instructors to switch made this challenge even more aggravated. Many instructors resorted to revisiting their grade distribution to allocate more marks to out-of-class components, such as take-home assignments.

This Computer Science specific challenge of having tools available to students that allow them to answer exam questions without demonstrating learning lead some of us to resort to project-based learning during the Spring semester avoiding exams altogether. However, the project-based approach also introduced its own challenges. Project-based learning requires more commitments and extra resources that allow the instructor to attend to student requests throughout the semester as well as evaluating these projects at the end of the semester. Many of us struggled to find the time to cope with these requests, especially given often unreasonable student expectations.

Expectations: The switch to online delivery created unreasonable expectations from many students in regard to instructor and TA availability and in terms of content. Students expected us to be available 24/7. Some students were inclined to ask for *immediate* Zoom meetings outside office hours expecting us to always honor such requests. This was aggravated on homework assignment and project due dates. Some of the due date times were set at midnight and we had students asking for immediate Zoom meetings a few hours or minutes before the deadline! The expectations for responding to email were not better. Many students expected instantaneous replies to their email messages. One student wrote complaining to the instructor that it took the TA almost an hour to reply to the student's email. We have never experienced such expectations in the face-to-face delivery model. It is apparent that something in the online environment is encouraging students to have such unreasonable expectations.

In terms of content, some students expected that the course material would be watered down due to the pandemic. This created friction while enforcing our position that there are course objectives and learning outcomes that must be achieved regardless of when and how the course is offered. This resulted in some instructors being called "inconsiderate", to say the least. This is an interesting shift in expectations from the perspective of some students. They expected more from the instructor but thought less was expected from them. Nevertheless, we emphasize that this experience was not universal among all students or in all courses.

Interaction and Behavior: Some of us did not see the face of a single student, or hear their voice during (online) lectures for the entire semester. In one course, where the students were required to work in groups during lectures, through the "breakout rooms" feature in Zoom, all students carried out the group discussion in the chat box. In another case where the instructor gave priority to questions asked outside the chat box, attending to the latter at specific times during the lecture, many students chose to ask questions in the chat box, sacrificing the option of having their questions answered immediately rather than in a delayed fashion. Very few, if any, of those who went for questions outside the chat box chose to turn on their cameras. This seemed to be more prevalent in introductory and large-enrollment courses. Upper level courses tend to have smaller class sizes and these students have likely worked together previously in other courses. For such courses, it was not as challenging to engage students. Zoom allows users to change their user names, and some students chose cryptic names. Hence, even when using the chat box to ask questions, some students were unidentifiable.

This sense of anonymity also resulted in an increased behavior of rudeness toward the instructor. The fact that students were unknown to, unseen, or unheard by the instructor gave a sense of immunity to unacceptable behavior and sometimes the use of abusive language (Postmes et al., 2001). In face-to-face interaction, students tend to observe certain norms of social interaction that were no always followed with online interaction. We cannot dismiss as well the stresses that the pandemic placed on students as a contributor to such behavior as well.

Indirect Feedback: A critical aspect of teaching that instructors take for granted in a face-to-face setting is the indirect feedback received during lectures. Such feedback includes students' facial expressions and body language. Many of us did not realize how heavily we have been depending on this kind of feedback to assess the degree of student engagement and understanding. In an online settings, most of the indirect feedback has become limited or unavailable. In order to approximate feedback in an online setting, students must have video cameras and must be willing to turn them on. However, not all students had the equipment, and for those who did, only a very small portion was willing to turn them on. As mentioned earlier, some of us did not see a student face or hear their voice for a whole semester. One of us started the term by encouraging students to turn on their cameras and explained why having the camera on can help them better engage and learn. As a result, more students turned their cameras on. However, the Zoom monitor cannot show more than 25 students simultaneously. Therefore, relying on indirect feedback in these online teaching environments was not an ideal way for the instructor to receive the required feedback.

We incorporate a class room response system (CRS) into the lectures, requiring students to work in groups to solve graded exercises. The participation in the breakout rooms was at a high rate. One of us observed that with the exception of less than handful of students, the whole class opted to participate in breakout rooms. It is worth mentioning that the breakout rooms were generated randomly and were not consistent throughout the term. It is possible for those who did not participate in breakout rooms to still communicate with their piers through other means outside the Zoom environment. Some students prefer to maintain a consistent group to work with throughout the term. As we mentioned earlier, many of those who joined the breakout rooms carried out discussion through texting only. The use of CRS has been shown to engage students (Kawash and Collier, 2019) and improve their content retention (Collier and Kawash, 2018) in a face-to-face setting. In spite of the absence of concrete data, we believe that these benefits were maintained in an online environment.

4.2 Teaching Assistants' Experience

Now, we discuss our experience from the sudden change to online teaching as it relates to tutorials and TAs. Recall that tutorials are conducted by TAs to complement lectures and consist of smaller groups of students. Zoom was also the platform for teaching tutorials. The following is the product of about 15 tutorial observations from the Winter 2020 semester (the semester in which we transitioned to online learning), about 11 tutorials from the Spring 2020 semester, and interviews with multiple TAs throughout the pandemic.

Platform Familiarity: Since the transition to online learning occurred midway through the Winter 2020 semester, TAs in the department were abruptly dropped into an online learning environment without any training. This became apparent during TA observations; TAs were generally unfamiliar with Zoom. This includes, but is not limited to Zoom features such as: screen-sharing, breakout rooms, and waiting rooms. Often TAs acknowledged that they were aware of such features, but missed the implications of these features. For example, TAs were aware of screen-sharing, but were not aware of the screen annotation or remote control functions that come along with it — these features can be particularly helpful in one-on-one sessions with students, especially when helping students debug their code. Breakout and waiting rooms were not used by any TA during observations.

Behavior: There is a diversity of tutorial types in our courses, but they all contain some common components. Many include a "lecture" component, an exercise component, and/or a hands on component. The lecture component is perhaps the least affected component through the transition. In this regard, Zoom is an adequate platform for this type of interaction, however when it comes to exercise and hands on components, there is a noticeable gap. Hands on components require more interaction from students, yet students were reluctant to enable voice chat — instead preferring to use the text chat within Zoom. During observations, not a single student enabled video chat, with the only excepting being an instance of screen sharing in which the student shared their screen with the class (an option which we would rather avoid.)

Text chat is the mode of communication that students overwhelmingly preferred. During the post observation meeting, many TAs felt text chat was an inefficient use of time, stating that it was much easier

and faster for TAs to interact with students using voice chat. One TA had gone so far as to disable the text chat feature of Zoom in an effort to encourage more audible participation in their tutorial. Since many TAs were recording their tutorials for later distribution, disabling the zoom chat had the secondary benefit of archiving the tutorial's discussion, since the text chat is ephemeral and not recallable in any way. However, one must take care in disabling the chat. Some students may not have proper audio equipment, or some may reside in noisy environments in which it is not feasible for a student to participate via audio. While it was uncommon, some students did choose to turn on their microphone. However, if a student did speak during a tutorial, it was because the TA had already built an explicit repertoire with that student.

Similar to lectures, there was also the expectation of quick turn-around times for help outside of class, mostly via email. These expectations were relatively consistent among tutorials. In contrast to lecture, TAs did not report much friction or rudeness between themselves and students. This is likely because the group of students TAs teach is significantly smaller than that of an instructor, and it is easier to build closer relationships with students, even in an online setting.

Attendance: Attendance numbers were roughly on par with in person tutorials, however it is unclear whether or not students were physically present at their machines during tutorial. The lack of any visual feedback for TAs made it hard to gauge whether or not students were not only present but also whether or not they were understanding the material. Informally, one TA asked their tutorial students to type in chat if they were present, of the 15 students in the Zoom session, less than 50% responded.

One idea would be to make tutorial attendance mandatory, however, zoom makes it very easy to log in, then walk away from a tutorial. From the observed tutorials, making tutorial attendance mandatory was an ineffective way of engaging students; attendance was higher, but participation was generally low across all tutorials. However, another possible solution is to introduce small and simple graded exercises into tutorial structure to incentivize staying on track — the tutorials with the highest attendance and the highest participation were ones that had helpful exercises incorporated into their class structure.

One-on-One Aspect: Overall, the weakest component of tutorials was the one-on-one aspect. TAs found it difficult to interact with students in the way that they were normally accustomed to in person. With face-to-face delivery, a TA often looks over a student's code and provides the student with feedback or hints as to why it is not behaving as expected. In person, this simply involves sitting next to a student, having them explain their thought process, and providing expert feedback on whether there is an issue with their thought process, or how they have expressed their thoughts in code.

Through Zoom, this translated to students posting their code in the chat (either privately or to the entire tutorial). Obviously, posting code for the entire class to see is a unacceptable; this may reveal sensitive information to other students, either in the form of solutions to assignment problems, or sensitive information such as the student's institution ID. Aside from these concerns, it is very difficult to read code through Zoom's chat, since it does not properly format and highlight code for maximal readability. Some students shared their code with the TA via e-mail, which can help with readability, but this too has problems — it creates another non-standard process in the work flow of helping students. We say non-standard because it is unclear on how the student should/will communicate: will they send the TA a source file? A simple text file? A zip archive? For larger classes, looking through this amount of code can burden the TA with a large amount of outside hours work.

Screen sharing was perhaps the most simple and elegant option provided by Zoom that can solve these problems, but students were somewhat reluctant to share the screen of their personal computers (although, during observation there were a few instances where students globally shared their screen to the entire tutorial). However, the lack of proper tools to annotate a student's code makes this less useful than one would hope. When helping a student in person, one often physically points to errors in code either by hand or by using the student's mouse; some also commonly write small comments in students' code indicating where logical flaws are. Zoom does have the ability to allow a TA to annotate a student's shared screen but TAs were generally unaware of this feature. Moreover, the tools Zoom provides are difficult to use via keyboards and mice. Some TAs have noted that tablet computers would have been helpful in this regard, but providing every TA with a tablet is not a viable option. There is a feature within Zoom to remotely control students' screens, but TAs reported that they were worried that students would feel this as an invasion of privacy.

More judicious use of screen sharing could facilitate better one-on-one interactions, but there also needs to be an environment in which students feel comfortable sharing their screens. Recall that Zoom has a feature called "breakout rooms" that allows one to group participants into private rooms. This could

be used to conduct one-on-one sessions, providing the required privacy. However, TAs had noted that this feature felt more suited to assigning groups to work on problems. Another feature that Zoom supports is a "waiting room" where students are kicked out into a lobby and the TA may control who they interact with on a one-on-one basis. TAs chose not to use it since it felt abrupt, disrupted the flow of tutorials, and there is no mechanism in Zoom to queue students.

5 RECOMMENDATIONS

5.1 Advice Regarding Lectures

Based on the observations discussed in Subsection 4.1, we recommend the following: 1) Set expectations for instructor and TA availability. Just because it is an online course, it does not mean that the teaching staff are available 24/7 to answer questions. The unreasonable expectations that they are always available will not only generate dissatisfaction from students, but will also burn out the teaching staff. Dealing with student complaints will simply emotionally drain the teaching staff. Students should be encouraged to make use of designated office hours. Email response policy must be also clearly stated and communicated to students at the start of the semester. We find also that reminders are sometimes necessary.
2) Set expectations for course content. Courses have certain objectives and outcomes that must be achieved, and students need to demonstrate that they meet the required bar regardless of how the course is delivered. This must be explained to students at the beginning of the semester with reminders throughout the semester to reinforce the appropriate expectations.
3) Give priority to voice/video interaction over text message interaction during lectures. Questions asked with voice/video are often timely to the subject at hand. Rarely a student will make the effort to ask such a question when it is irrelevant to topic at hand. However, this is not the case for chat box questions. We found that there can be a delay between when the relevant topic was discussed and the when the question was asked. Students also do not hesitate to through any question into the chat box (something relevant to an assignment, grading, personal, etc $\cdots$, but is irrelevant to the topic being discussed.) These questions often interrupt the flow of the lecture. Interrupting the flow of lectures is not desirable and can lead to student complaints. Hence, specify certain intervals in the lecture, depending on its flow, to attend to these questions.
4) Incorporate a CRS component into your lecture. The use of CRS allows the instructor to break the monotone of an online lecture. It is also a great mechanism to provide two-way feedback. Feedback to the students to test their understanding of the subject matter and feedback to the instructor. The importance of the latter is magnified in online delivery due to the lack of feedback we receive from body language in face-to-face format. Better yet if some or all of the CRS questions are designed as group activities.
5) Utilize breakout rooms or other similar functions to perform in-class group activities. This can be combined with CRS activities or using polling features.
6) Refrain from using traditional exams for assessment, especially in courses that rely heavily on programming. Design of programming questions, as we discussed in the Introduction section, is tricky in an unproctored environment. Writing code from scratch can be more effective than finding the output or correcting errors. However, be mindful to design questions that require application and synthesis skills and whose answers cannot be readily pulled from readily available online resources. If you have the resources, converting the online course to project-based learning would be more effective.

5.2 Advice Regarding Tutorials

Based on the observations of Subsection 4.2, we recommend the following for TAs:
1) Be clear with how you plan to conduct your tutorials, and be clear about your expectations in terms of participation and use of the platform. That is, if you'd like students to use screen sharing, be clear about it and set that expectation, but again, prepare to be flexible. Set these expectations as early as possible.
2) Be explicit and direct with your schedule and tutorial structure. If you choose to use waiting rooms for one-on-one sessions, make sure you allocate time for that and inform students about the breakdown — the intention is to make the tutorial feel continuous when you force everybody out into a waiting room.
3) Try to use screen sharing and annotation tools in one-on-one sessions, but be flexible since not all students will be comfortable sharing their screen.
4) Try to incorporate exercises into your tutorial structure, and make them worth some small amount of the student's final grade. If you have no freedom to change the grading structure of the course, incentivize this in other ways: make exercises directly relevant to assignments and be explicit about that to the students. Do not solve their problems for them, but give them problems that require the same skills of problem solving needed in assignments

Considerations for instructors:
1) Ensure that the material that you would like covered is explicit and delivered promptly to the TAs — TAs need more preparation time in order to work within the constraints of online learning.
2) Try to incorporate some amount of graded exercises in your plans for tutorial. Or, at the very least, provide TAs a small fraction of the final course grade to to use it for "participation" marks and some freedom to assign these marks to students.

6 SUMMARY

In this paper, we shared what we, as educators, learned from the abrupt change of teaching modality — from in-person to remote teaching — in a computer science program. We provided a brief description of our department and our TAiR program intended to mentor and support teaching assistants. We reflected on our (instructors' and teaching assistants') experience and provided recommendation to improve online teaching. While the pandemic will not last forever, and we surely hope it will be over sooner than later, it may as well have lasting effects on teaching and learning and the society as a whole. Moreover, it is not unreasonable to expect another pandemic at some point in the distant future; the lessons we learned now may help us then. The pandemic also gave us an opportunity to think of teaching and learning in a context that some of us we would not have considered in normal times. It is conceivable that some traditional institutions may realize the financial benefits of remote teaching, and they may adopt it in full or in part post-pandemic. Some of the lessons we learned benefit others during the pandemic, but also they can be beneficial in the post-COVID-19 times.

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