60-223 Intro to Physical Computing Syllabus

Fall semester 2020

Carnegie Mellon University, Pittsburgh, PA

Contents

Schedule

Tuesdays and Thursdays, 9:20–11:10 a.m., in IDeATe's Physical Computing Lab (Hunt A10)

The class is being taught under the "in-person + remote" hybrid modality; all students meet simultaneously during the scheduled class slot. See the course Canvas page for the Zoom meeting link.

Academic units: 10.

Staff

professor: Robert "Zach" Zacharias
email: `rzachari@andrew.cmu.edu`
phone: 412 268 5973
office: Hunt A9C (across the hall from the Phys Comp Lab)
office hours for in-person and remote students:

- 11:20 a.m.–12:30 p.m. Tuesdays and Thursdays
- and liberally by appointment (just email me with your request)

Important links

- *Main course site*: https://courses.ideate.cmu.edu/60-223. This site is updated frequently throughout the semester with assignment information.
- *Student documentation site*: https://courses.ideate.cmu.edu/60-223/f2020/work. Documentation for the three major projects is posted here.
- *Canvas page*: https://canvas.cmu.edu/courses/19731. Some asynchronous learning modules are completed via Canvas; you'll submit homeworks there; and it's where grades are posted.
- *Zoom link for remote students*: see the Canvas page for the Zoom link.
- *This syllabus* is available:
  - in HTML: https://courses.ideate.cmu.edu/60-223/f2020/syllabus
  - as a PDF: https://courses.ideate.cmu.edu/60-223/f2020/syllabus.pdf

1 Course synopsis

The first half of this practical project-based course is spent covering the basic technical skills (including electronics, programming, and hardware) needed to build simple interactive objects with embedded behavior using the Arduino microcontroller. Inputs to read information about the world include sensors such as an ultrasonic ranger, thermometer, light sensor, and human inputs like buttons and knobs. Outputs to affect the world include actuators such as motors, LED lights, speakers, and haptic feedback devices. Individual and group projects challenge students to apply their technical skills in creative ways. The class will be working with a local group of people living with disabilities who serve as design clients for the final project; students conjure and build functioning assistive devices of a practical or whimsical nature for their critique and feedback. Readings and guest speakers address topics pertaining to design for people with different abilities.

1.1 Fall 2020 semester: Hybrid modality

While there are certainly adjustments that we'll all need to make to accommodate the alternative in-person + remote teaching modality, the intention is to keep intact as much of the class's original structure, learning goals, and course design as is possible. With that said, below are some expectations and plans particular to this semester.

1.1.1 Course kit and materials

This is a hands-on project-based course which normally makes heavy use of IDeATe's Physical Computing Lab space. Some students may elect to be on campus and have regular access to that space, while other students are expected to choose to take the course remotely. Every registered student (regardless of their

location) will be receiving a carefully designed, generously portioned kit of parts and materials, which includes tools and materials that students would normally access as common resources of the Phys Comp Lab. The whole contents of the kit are the permanent property of the student as soon as they receive it. We hope these parts and materials will serve you for years beyond the scope of the course!

The current plan is for kits to be mailed out to students who are *off* campus, and made available for pickup to students who are *on* campus, on or about September 4th. This means that nobody will get a kit prior to the third class meeting, and depending on shipping times, some students may not have their kit in hand until later yet. In light of this, we will begin the semester's hands-on technical learning with the use of a web-based simulator, "Tinkercad Circuits" by Autodesk. Once a student has their kit in hand, they can then transition to building with the actual physical electronics.

1.1.2 Class time

Typically the beginning few weeks of this course consist of a sequence of in-class technical lectures, reinforced with hands-on technical exercises and homeworks. As an adjustment to accommodate this semester's hybrid modality, many of these lectures will shift to an *asynchronous mode* of delivery: the lectures, as well as small technical exercises, will be assigned as homework. Some in-class time, then, will be refocused towards addressing students' questions, clearing up common confusion, and discussing finer points. This is sometimes called the *flipped-classroom model* of curricular design.

As this is a 10-unit course, the expectation is that students will expend approximately 10 hours' effort every week over the course of the semester. Approximately 4 hours of this time are normally in-class, though adopting the flipped-classroom model means that some class meetings may be purposefully shortened (e.g. only meeting as a group for 1 hour instead of 2), with that additional hour being spent on asynchronous lecture at a time of the student's choosing, group meeting time for project teams, individual consultation with the professor, or other non-whole-class purposes.

1.1.3 Office hours

Another adjustment to the schedule will be the addition of more-than-typical office hours slots. Some of these will take the form of traditional one-on-one consultation with a student, while others will include a small group getting help at the same time. Please feel free to write the professor requesting a meeting time if you'd like to discuss any matter, technical or not.

1.1.4 Going remote during the semester

We already know that the portion of the semester after Thanksgiving Break will be remote for all students. If, prior to then, University leadership determine that we will not be able to continue to meet in person, then we'll need to be ready to simply transition the entirety of the class to remote learning from that moment on. (Naturally, this circumstance would not require any adjustment for the students who are already participating remotely.)

For those students who are participating in-person in Pittsburgh, there are different levels of disruption in access to campus or the Physical Computing Lab which are worth keeping in mind:

- The Physical Computing Lab could be closed for a short time (~24 hours) for heavy disinfection if a person who is known to have been a probable/confirmed positive Covid-19 case has been in the space.
- Hunt Library could similarly be closed for ~24 hours for disinfection.
- The room, the building, or part/all of campus could be closed for longer, not necessarily with any advance warning.

In short, continued access to the Phys Comp Lab during the semester can't be guaranteed. For that reason, it's advisable that students not store projects and kit materials in the room if possible. While it's certainly an

inconvenience to carry these items to and from class, the prospect of not being able to access them otherwise is unfortunately real.

1.2 Major deliverables

There are a sequence of homeworks as well as three major projects in the course. See the particular assignments on the main course site for further details on each. Briefly:

- *Homework*
  - *Technical homeworks* are opportunities to stretch your ability and understanding of the nuts and bolts of writing software that drives electronics.
  - *Reading homeworks* typically consist of journal articles addressing issues pertinent to the course. There are only a handful of these assigned during the semester.
  - Combined homeworks are worth 20% of the final grade.
- *Project 1: A Double Transducer* is a technical exercise in changing the form that a physical input signal takes, changing it again, and then outputting another signal. Students are assigned to work in teams of two. These transduction machines are linked to each other so that (ideally) a single signal can pass through the entire class's devices. This semester, some or all of the links between students' transduction machines will be transmitted over the internet, so that the machines can communicate with each other across space. The assignment is worth 10% of the final grade.
- *Project 2: An Assistive Device for Someone You Know Very Well* is an opportunity to build yourself something that may be useful to you in your own life. Students work on their own project. The assignment is worth 20% of the final grade. Prior works include:
  - a variety of creative alarm clocks which, for instance, require a special procedure to silence,
  - a long-term memory aid to keep precious memories intact, which was modeled on academic neuroscience findings,
  - a reminder for a thrombosis patient not to remain sitting for too long,
  - a bolt-on turn signal for a scooter, and
  - a timed lock box to prevent the designer from eating caffeinated chocolate too late at night.
- *Final project: An Assistive Device for a Person Living with Disabilities* is the major effort of the second half of the semester. Students work in assigned groups of three to produce a novel interactive device custom tailored to the needs of a particular community member. The assignment is worth 50% of the final grade. In prior semesters students worked with older local community members, and their projects included:
  - a device to automatically lower the volume of a television when the commercials come on,
  - a cane-mounted mobility aid for a Parkinson's patient,
  - a machine to make yarn balls of user-selected length,
  - a bracelet that buzzes at a specific tempo to help the wearer focus or relax,
  - a foot keyboard for a user whose hands have repetitive stress injuries from typing too much, and
  - a quiz device to gamify dishwashing.

1.3 Prerequisites

There are no formal prerequisites or assumed topical knowledge for this class. However, some basic programming understanding (such as familiarity with variables and their use, the `if...else` structure, `for` and `while` iterators, etc.) will be helpful, since we spend little time in class on the rudiments of programming. In the past, students without any prior programming experience have been able to succeed by learning as they go, and asking for help as needed.

2 General class policies

2.1 Presence

Class time is very precious—we've got only 4 hours a week, about 60 hours over the course of the semester. Because of this, there are some clear expectations for myself and for you:

- I will get to class early and ready to go. During class time, I'll focus exclusively on our course.
- I'll use class time as wisely as I can: if the whole group does not need to be involved in a discussion, I'll try to bring only the needed group together.
- In that same spirit, if I'm able to assign a pre-recorded lecture as homework, rather than taking class time to do that teaching, then I will aim to do that.
- You'll also use class time carefully: you will come on time and ready to learn.
- You'll use class time to focus on the class, and not the fun things happening inside your phone or out on the internet. (See next section for more on that.)

The course is light on lecture and heavy on hands-on learning; especially since this is the case, when there is a lecture, please be careful to pay good attention.

2.1.1 Remote presence (via Zoom)

If you'll be joining us remotely, I ask that you observe a few standards:

- Please leave your camera on during class, so that I can see your face. This really helps me get a better sense of student comprehension and engagement with the material. Your eyes/eyebrows tell quite a tale! If I can't see them, it's more difficult for me to instruct effectively.
  - If you would prefer to leave your camera off owing to a privacy concern, relevant cultural/religous practice, or for any other reason, please write me an email to let me know.
- You're welcome to use the chat if you'd like. I ask that you not engage unnecessarily in private chats with your peers, though it's certainly fine to, for instance, use a private chat to ask a classmate something like "what did he say?" if you missed a few words.
- Please leave your mics muted by default. N.b.: if you hold the space bar down, you'll be temporarily unmuted (until you release the space bar), which can be easier than clicking on the mute/unmute icon every time you wish to speak.
- You can use your physical hand to raise your hand, or the "raise hand" icon. In either case, if I'm failing to notice your signal (which can certainly happen if I'm not looking right at the screen), please feel free to unmute yourself and speak up at a reasonable moment to get my attention.

2.2 Absence

You are expected to attend class, and to arrive on time. Past experience has repeatedly shown that higher attendance correlates with greater success in the class, so it's in your best interest to come to class!

You are given three unexcused absences without penalty; beyond that, any additional unexcused absence will result in a 3 point deduction off of your final grade in the course. E.g.: at the end of the semester your final average is 92.4 (which would earn an A), but you have four unexcused absences; your grade falls to 89.4, which is a B.

Late arrivals to class are disruptive to the group. Please arrive on time (or early). Tardiness of 15 minutes or more is counted as an absence. (This policy applies to in-person as well as remote students.)

If you expect you won't be able attend a session for any reason, or if you'll be late, please email me as early as possible to request an excused absence. Viable reasons for an excused absence include religious or academic obligations; non-viable ones include working on buggy/booth, or your friend visiting from out of town.

If you're feeling ill, please email me advising of the circumstance as early as possible and focus on taking care of yourself. You will never be penalized for missing class for a health-related reason. Seek medical care as needed, and rest up so you can regain your health and return to full participation. If you're able to join remotely during a time of illness, then of course you're welcome to, but if you don't have the energy or focus to do so, that's fine and you won't suffer any academic penalty—just write me to let me know your circumstance.

The outline of each class session is posted after the class on the class log page. If you want to know what you missed, please look there first, and then ask your classmates, or me, questions.

2.3 Phone/computer use

While we're in class, please don't use your phone for non-class purposes. If you are in-person in Pittsburgh and need to use your phone to contact others, just step out into the hallway; if you are remote and need to use your phone, please write me a private chat via Zoom saying that you need to step away to use your phone, and be sure that you're muted, and that your camera is off. (If you're using your phone to look up information/resources/etc. for class, that's fine and there's no need to take special steps to remove yourself from the physical/virtual classroom.) That being said, if I observe you using your phone in a non-academic way, I'll ask you to give it to me so I can put it in the phone basket at the front of the room, and you're welcome to get it at the end of class.

While we're in class, please don't use your computer for random internetting, social mediation, or any other use that isn't pertinent to class. You've got the whole rest of your life to TweetGram awesome memes and #tags (though I don't especially recommend it). Remote students who are accessing the course via computer might feel tempted to use other computer functions during class; my expectation is that you will focus on class solely during our shared synchronous class time.

The use of distracting technology by students in the physical classroom is obviously deleterious to the student who's choosing to use it, but it's also harmful to other students *who are merely sitting near the distracted student*. A 2013 article in "Computers & Education" pretty much spells it out in the title: "Laptop multitasking hinders classroom learning for both users and nearby peers."[1] A 2015 survey of 675 college students in the U.S. found that they spent "an average of 20.9% of class time using a digital device for non-class purposes,"[2] which is pretty alarming. Please do your best to focus on class during class.

2.4 Accommodation

In the spirit of encouraging everyone to be able to be maximally present in class together, it's important that students feel comfortable and supported. If there is anything physically in the environment that can be reasonably adjusted to make your learning experience better, you should feel generally empowered to make that adjustment. If the lights are too bright at your table, please ask your neighbors if it's ok to dim them, and if yes, go ahead and do so; if we're playing music at a work session and it's too loud, please say so; etc.

If you are participating in class remotely and are facing technological hindrances such as not having access to a sufficiently powerful computer, or fast enough internet connection, please let me know at your earliest convenience so that I can do my best to accommodate and help you participate as fully as possible.

If there is any aspect of instruction that is giving you difficulty, such as my not spending long enough on a topic or making reference to a point we haven't covered yet, please speak up, either during synchronous classtime or at another time. This sort of critique is very helpful to maintaining a successful classroom and much appreciated.

[1] Sana, F., T. Weston, and N. J. Cepeda. "Laptop multitasking hinders classroom learning for both users and nearby peers". Computers & Education, volume 62. 2013. pp. 24–31. https://doi.org/10.1016/j.compedu.2012.10.003

[2] McCoy, B. R., "Digital Distractions in the Classroom Phase II: Student Classroom Use of Digital Devices for Non-Class Related Purposes". Faculty Publications, College of Journalism & Mass Communications, vol 90. 2016. pp. 5–32. http://digitalcommons.unl.edu/journalismfacpub/90

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at `access@andrew.cmu.edu`.

2.4.1 Statement on diversity

Heterogeneous teams are better than homogeneous ones at innovating.[3] IDeATe is a heterogeneous environment by design, and our classroom is as well. Having students from a variety of academic backgrounds and college years is one way in which we aim to diversify the space; but also we also embrace diversity along lines of culture, national origin, race, gender, language, socioeconomic status, disability, and religious adherence. We sincerely believe that bringing together many different kinds of people makes for a richer learning environment for everybody.

If at any point you feel that you're experiencing discomfort brought about by discrimination along any of these lines (or others), please immediately notify me so that I can take appropriate steps to rectify the circumstance. I'm always happy to make time to speak with you individually about any concern you've got; I'm just an email away. If you would like to submit feedback or comments to me anonymously for any reason, please use this form I've created for that purpose.

Additionally, there are University-wide resources for reporting incidents of bias or discrimination:

- *The Center for Student Diversity and Inclusion*
  - email: `csdi@andrew.cmu.edu`
  - phone: (412) 268-2150
- *Report-It* service
  - online anonymous reporting platform: http://www.reportit.net
    - username: *tartans*
    - password: *plaid*
  - anonymous reporting via phone: (877) 700-7050

2.5 Room access

Enrolled students have access to the IDeATe Physical Computing Lab during class hours. We also anticipate students will have cardswipe access to the space whenever the library is open but this is a matter of ongoing planning and there is still some uncertainty as of late August. The library's hours are posted on their website, and all of IDeATe's spaces' schedules are available online.

The Phys Comp Lab's inventory is online for your convenience. If you discover a drawer is low or empty, please fill this form out so it can be quickly refilled!

While in the Phys Comp Lab please observe some simple rules:

- Food and nonwater drink must remain in the *zone of shame* by the door
- Covered water containers are permitted at work tables
- Please store project material in your cubby (but see the caveat in section 1.1.4, "Going remote during the semester," above); if you need more space let us know and we'll make arrangements
- Tools that belong to the room (like those on the pegboard in the Heavy Work Zone, or in the red tool cabinet) must always remain in the room. Don't take them elsewhere without asking, and don't hide them in your cubby!

[3] Prat, A. "Should a team be homogeneous?". European Economic Review, volume 46. July 2002. pp. 1187–1207. https://www.sciencedirect.com/science/article/pii/S0014292101001659

- Electronics in the drawers are available for your use; take them as you need. The expectation is that you'll return things when you're done with them, using the return bin; items in this bin will be held under a quarantine before they're re-shelved by staff.
  - Don't worry so much about returning little stuff like resistors and LEDs; do worry about things like motor drivers or rotary encoders or pumps.
- Broken electronic components should be disposed of in the Electronic Waste Bin underneath the soldering bench; these contain toxic metals and need to enter a different waste stream than regular garbage.
- It's kind of a kindergarten situation: when you're done working, please clean up after yourself.

Finally, in order to reduce the likelihood of viral transmission, we will have some more particular guidelines for this semester:

- Please maintain a minimum ~6' distance from others.
- Please wear a mask which covers your nose and mouth at all times.
- When using shared equipment (such as soldering irons), please use sanitizing wipes to disinfect the touchpoints of the equipment before and after using it.
- Follow the various safety protocols promulgated by the University, which are liable to change during the semester.

2.6 Projects and collaboration

As mentioned above, this and all IDeATe courses purposefully attract students from a wide disciplinary range, including art, design, engineering, architecture, computer science, business, science, and more.

Two of the three projects in the course are completed in groups rather than individually. The expectation is that group members will honestly strive to work together on their projects and will rise or fall as a unit, understanding that identifying complimentary strengths and weaknesses early on will help the team succeed. All members of a group receive the same grade for a project except in unusual circumstances.

The final project includes a peer critique during the process, which is an opportunity to give feedback to the course staff about your group dynamics. That said: if your group is having trouble working together, please reach out to the instructor as soon as you think there may be some real issues. As an authoritative outsider, I can step in to help in ways that group members themselves can't.

2.6.1 Grading and due dates

Assignments are generally due at the beginning of class, and arriving late to class because you are finishing the assignment results in a late project mark (so you might as well come to class and finish the project later).

Practical **homeworks** (i.e. the type that involve a tech demo) are graded in class when they are due. Homeworks may be turned in late for grading and will be penalized 25% per class day of tardiness. ("Class day" means a Tuesday or Thursday we have class. For instance: a homework due on a Tuesday which would've earned a 10/10 will earn a 7.5/10 if handed in prior to the following Thursday class meeting.)

Projects generally have two grade components: the *project itself*, and *documentation* of the project/process.

- *Projects* are graded based on their state at the time they are due, i.e. the day of the in-class critique. They may not be handed in late, except in extreme circumstances.
- *Documentation* is generally due one week after the project. Late documentation is penalized 10% for each 24-hour period of lateness past the documentation due date/time. (Example: project documentation is due on Tuesday the 6th at 9:30 a.m., and you submit it Tuesday after class. You get a 10% penalty for one day of lateness, so a 19/20 grade becomes a 17.1/20.)

2.7 Academic integrity

This is not a class where you are expected to write every line of your own code. We gratefully stand on the shoulders of giants and also regular-sized heroes who share interesting projects on Instructables, or Github, or their blogs. You are expected to incorporate ideas, hardware/electronics designs, and even verbatim software fragments from other sources. This isn't considered plagiarism in this class if: 1) you properly cite sources, and 2) you don't simply make a wholesale reproduction of somebody else's project but instead use their work as a jumping-off point. If you do plagiarize, however, you can expect a serious response, detailed below.

If you're not sure if you're borrowing too much from somebody else, or you don't know how to credit the work you're borrowing from, please discuss it with the professor.

2.7.1 Homework and collaboration

Different homework assignments carry different collaboration standards. For instance, some homeworks will permit full collaboration with your peers, so long as each student types out every single character of the code they submit. (I.e. two students may submit the same code for the same assignment, though neither of those submissions may be copy/pasted from the other.) In other cases, discussion between students of the *ideas* of the homework is permitted, but direct code collaboration is not permitted. It is your responsibility to read and follow the collaboration guidelines specific to the homework you're completing.

Students' homework code is analyzed algorithmically to detect collaboration, and also examined and graded by the professor. All code submitted for homework assignments should have an opening comment block as specified below, where any collaboration with other students, or sources from the internet, printed media, or any other place, must be disclosed.

A failure to explicitly note any collaboration or code source in this comment block is considered plagiarism and carries a harsh penalty: the student will receive a –100% on that assignment (e.g. for a 10-point assignment the student receives a grade of negative 10 points). Additionally, the student's advisor will be informed of the infraction, and the University disciplinary structure may be invoked as well, at the instructor's option. **Please** don't copy code from any place or person without properly citing it. As always, if you have questions, ask!

2.7.1.1 Standard comment block

Below is an example of the format of the standard comment block that should appear at the top of all submitted homework; individual assignments may specify variations particular to that assignment.

```
/*
 * Homework 3
 * Andrew Carnegie (acarnegi)
 * 1 hour 25 minutes
 *
 * Collaboration: Ada Lovelace helped me understand
 * variables and we worked on the code together.
 * The function "Wheel" is copied from this Adafruit
 * tutorial: https://learn.adafruit.com/multi-tasking-the-arduino-part-3/utility-functions
 *
 * Challenge: I tried to write a switch...case but
 * it did not go as planned. It took me an extra hour!
 * I was held up with bracket trouble the whole time,
 * it seems.
 *
 * Next time: I'll start by writing comments or pseudo-code
 * before trying to write the actual code. I think this
```

```
 * will reduce my getting tangled around the code
 * structure.
 *
 * Description: The code below blinks three LEDs according
 * to a pattern. Pushing a button selects the next pattern
 * from a pre-defined list.
 *
 * Pin mapping:
 *
 * pin   | mode   | description
 * ------|--------|------------
 * 4       input     momentary pushbutton for mode selection
 * 9       output    red LED
 * 10      output    green LED
 * 12      output    yellow LED
 *
 */
```

2.8 Recording class

Please do not record class without obtaining prior written permission from me. If you have special dispensation via the Office of Disability Resources to record as an accommodation, then naturally that is permissible.

Some of the class meetings may be recorded directly via Zoom for the benefit of students who aren't able to join live. The professor will always mention that recording is going to begin before starting recording, and reiterate that recording has begun once it has. Links to the class recordings may be posted on the class Canvas site (never on a public-facing site), and for the privacy of all of your classmates, you should not share those links with any person outside of the class.

2.9 Grading scheme

Each of the homeworks and projects have their own grade breakdowns; see the relevant assignment pages for those details.

The course grade is computed from these components:

- 20% homeworks
- 10% Project 1
- 20% Project 2
- 50% Final project

The grading scale for undergraduates is as follows:

final percentage of points earned	grade assigned
>=90	A
<90 and >=80	B
<80 and >=70	C
<70 and >=60	D
<60	R

2.10 Research to improve this course

For this class, I am conducting research on teaching and learning. This research will involve some student work. You will not be asked to do anything above and beyond the normal learning activities and assignments that are part of this course. You are free not to participate in this research, and your participation will have no influence on your grade for this course or your academic career at CMU. If you do not wish to participate, please send an email to Chad Hershock, `hershock@andrew.cmu.edu`. Participants will not receive any compensation. The data collected as part of this research will include student grades. All analyses of data from participants' coursework will be conducted after the course is over and final grades are submitted. The Eberly Center may provide support on this research project regarding data analysis and interpretation.

The Eberly Center for Teaching Excellence & Educational Innovation is located on the CMU-Pittsburgh Campus and its mission is to support the professional development of all CMU instructors regarding teaching and learning. To minimize the risk of breach of confidentiality, the Eberly Center will never have access to data from this course containing your personal identifiers. All data will be analyzed in de-identified form and presented in the aggregate, without any personal identifiers. If you have questions pertaining to your rights as a research participant, or to report concerns to this study, please contact Chad Hershock, `hershock@andrew.cmu.edu`.

3 IDeATe

IDeATe, the **I**ntegrative **De**sign, **A**rts, and **Te**chnology network at Carnegie Mellon, offers undergraduate minors and courses in Game Design, Animation & Special Effects, Media Design, Sonic Arts, Design for Learning, Innovation & Entrepreneurship, Intelligent Environments, Soft Technologies, and Physical Computing. These areas merge technology and creativity and provide learning opportunities for interdisciplinary collaboration. IDeATe minors and courses are open to all majors. We welcome students from every discipline to the unique learning environment that exists at Carnegie Mellon.

3.1 Relevant IDeATe skill-building courses

IDeATe is not its own department. Rather, Carnegie Mellon's departments contribute faculty and courses to the IDeATe curriculum. Therefore, IDeATe does not have its own course number prefix. You can find the IDeATe course offerings for the upcoming semester by going to the Courses section of https://ideate.cmu.edu/.

IDeATe offers a selection of "micro" courses; these are skill-building workshop-style classes which meet only a few times and confer 1 academic credit. Micro courses relevant to Physical Computing:

- 99-353 IDeATe CAD and Laser Cutting (super useful for fabrication!)
- 99-359 IDeATe 3D Modeling and 3D Printing (also very useful for fabrication and design)
- 99-352 IDeATe Soft Fabrication Skills (opening a whole new world of textile possibilities)
- 99-357 IDeATe Pragmatic Photography (a great and broadly portable skill to have in your bag)
- 99-360 IDeATe E-Textiles (integrating electronics and fabrics. Very neat!)

A mini (half-semester) course you may be interested in:

- 62-478 digiTOOL (covers CAD for lasercutting and 3D printing, in more depth than the micro courses)

3.2 Learning goals for this course

Some of our learning goals are:

- Demonstrate an appreciation for and ability to participate in critique of one's own work and the work of others

- Demonstrate an understanding of the role of reflection in learning and designing (begin to become a reflective practitioner)
- Demonstrate an ability to articulate the story (visually, orally, verbally, aurally...) of one's own work and one's own learning
- Demonstrate the ability to work in a multidisciplinary environment
- Demonstrate an understanding of the history, cultural context, and social implications of electronics
- Demonstrate technical and creative skills in writing software in the Arduino IDE, creating circuits that safely work as intended, and making an effective, interesting, useful device to help improve the life on an older person.

3.3 IDeATe resources

3.3.1 IDeATe Lending

Once you are enrolled in an IDeATe course, you will have access to IDeATe Lending, and you will maintain your access through the rest of your time at Carnegie Mellon.

This is a resource which is only open to a limited extent during the University's pandemic response; if you have need for a particular item or material please discuss it with the professor to see if it will be possible to access IDeATe Lending to retrive that part. Please visit https://resources.ideate.cmu.edu/lending/ for more detailed information on available resources, to review the IDeATe Lending Borrower Policy, and to find hours of operation.

3.3.2 Classroom and Lending access

If you are enrolled Intro to Physical Computing at least a week before the start of the course, you will have keycard access to the Physical Computing Lab starting on the first day of class. (If you add the course during the Add Period, you may need to wait a few business days to receive access while the lists are updated.) If you add a course after the last day of the Add Period, email `help@ideate.cmu.edu` with your name, Andrew ID, and course number so we can add you to our systems.

3.3.3 Laser cutter access

IDeATe maintains three laser cutters in the digital fabrication alcove off of room A5, and these tools are very precise, very fast, and very useful for all sorts of fabrication. Unfortunately, the room the machines are housed in is not well suited to consistent social distancing.

As an alternative for this semester, if you wish to learn how to use laser cutters, consider registering for a course (number forthcoming), which is a one-credit, pass/fail offered by Mechanical Engineering in their Tech Spark space in ANSYS Hall. Once you've taken that class you will be entitled to one hour of reserved laser time, and unlimited walk-up access to their machines (based on availability).

3.3.4 IDeATe advising

If you have questions or need advice about IDeATe minors or courses, please get in touch with Kelly Delaney, the Assistant Director of IDeATe. Her office is in Hunt A9 (immediately accross the hall from the Phys Comp Lab) and her email is `kellydel@andrew.cmu.edu`.

4 Taking care of yourself in a difficult time

This is obviously a challenging time for all of us. I don't expect you to be constantly operating at 100% of your normal-circumstances capacity during this semester, and I believe that you shouldn't expect that of yourself, either. I want to be as supportive as I possibly can, and am happy to be reasonably flexible in terms of due dates, assignment expectations, etc.

I will be scheduling opportunities for us to have one-on-one chats during the semester so I can check in on your progress and wellbeing, but **I also ask that you reach out to contact me if there's anything that you think that I should know about your circumstances which can help inform my teaching and expectations.**

Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. Be sure to take breaks if you've got large blocks of screen time. Get some fresh air. (For those of you on campus: there's a big beautiful park literally across the street from Hunt Library. For those of you joining remotely: I hope you're able to get whatever outdoors time your circumstances afford you.) Maintaining healthy habits will help you achieve your goals and cope with stress.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 or visit http://www.cmu.edu/counseling. Consider reaching out to a friend, faculty member (I'm always happy to talk), or family member you trust for help getting connected to the support that can help.

5 Coda

Thank you for reading this lengthy syllabus. I've tried to be thorough in my discussion of the class so that you have a good sense of what to expect and have clarity around what I expect, as well. All of the structure provided by the rules and grades and submission requirements above is there partly because we're operating in an academic environment that requires that I evaluate you as fairly as I can with a grade at the end of the semester, and partly because a bit of structure helps provide us an environment in which we can thrive. Ultimately, though, my goal is to help you have a successful semester, and I ask you, again, to please reach out and write me an email or send me a private chat if you've got any concerns I can help with.

I hope you're taking this class because you're interested in learning something new and useful. I'm teaching it because I sincerely believe that the ability and confidence to use these technological tools can be transformative—and that it's good to work towards a world in which as many people as possible are empowered to solve meaningful problems in creative ways, build interesting things, and help enrich our shared experience. I'm looking forward to learning with you this semester.