Syllabus: 60-223 Intro to Physical Computing

Carnegie Mellon University
Spring 2023

Schedule

Mondays and Wednesdays, 10–11:50 a.m. in IDeATe's Physical Computing Lab (Hunt A10)
Academic units: 10.

Staff

Professor: Robert "Zach" Zacharias *(he/him)*

email: `rzachari@andrew.cmu.edu`

phone: 412 268 5973

office: Hunt A9A (across the hall from the Phys Comp Lab, the room with the wavy glass door)

lab hours:

- Tuesdays and Thursdays 11 a.m. to noon
- and liberally by appointment (just email me with your request and I'll be happy to set up a time to talk)

Teaching Assistant: Vishal Urlam

email: `vurlam@andrew.cmu.edu`

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/s2023/work Documentation for the three major projects is posted here.

- **Canvas page**: https://canvas.cmu.edu/courses/34089 Some asynchronous learning modules are completed via Canvas; you'll submit homeworks there; and it's where grades are posted.
- **This syllabus** is available at https://courses.ideate.cmu.edu/60-223/s2023/syllabus.pdf

Course synopsis

This practical project-based course begins by covering the basic technical skills (including electronics, programming, and hardware) needed to build 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. Readings and guest speakers address topics pertaining to design for people with different abilities, as well as environmental effects of the electronics industry. The class will be working with a local group of people living with disabilities who serve as design clients for the final project; students create assistive devices of a practical or whimsical nature for their critique and feedback.

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, as 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.

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** *(15% of final grade)*
  - *Asynchronous learning modules* are prerecorded video lectures that cover the bulk of the course's technical learning, addressing topics like circuit design and programming. These are accessed via the course Canvas site.
  - *Technical homeworks* are opportunities to stretch your ability and understanding of the nuts and bolts of writing software and driving electronics.
  - *Reading/watching homeworks* typically consist of journal articles or videos addressing issues pertinent to the course. There are only a handful of these assigned during the semester.

- *Weekly check-ins* are brief, weekly opportunities for you to ask any questions you've got and/or tell me about your experience in the course.
- **Project 1: A Double Transducer** *(15% of final grade)* 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, but each student builds their own machine, learning some electronics fabrication along the way. These transduction machines are linked to each other so that (ideally) a single input signal can pass through the chain of the entire class's devices and produce a single physical output at the end. Last semester's student documentation for this project is [here](#).
- **Project 2: An Assistive Device for Someone You Know Very Well** *(25% of final grade)* is an opportunity to build yourself something that may be useful to you in your own life. Students work on their own project. Last semester's student documentation for this project is [here](#). 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 by printing out a reminder before bedtime,
  - a device to reward the owner for not using their phone during a timed interval,
  - a reminder for a thrombosis patient not to remain sitting for too long,
  - a bolted-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** *(45% of final grade)* is the major effort of the second half of the semester. Students work in assigned groups of three to produce a novel interactive physical computing device custom tailored to the needs of a particular community member. Last semester's student documentation for this project is [here](#). Prior works include:
  - a portable device to help a color blind user determine the color of any object/surface,
  - a custom keyboard and mouse input to help a user more comfortably play computer games online,
  - a device to automatically lower the volume of a television when loud commercials come on,
  - an alarm clock with a braille interface for a deafblind user,
  - a machine to make yarn balls of user-selected length, and
  - a foot-controlled MIDI instrument for a wheelchair user to play songs.

Course materials

Enrolled students are supplied with a kit of electronics that is theirs to keep, and throughout the semester (as well as beyond), students are encouraged to take advantage of IDeATe's Physical Computing Lab equipment and resources. The Arduino Uno R3 is our primary microcontroller in the course. To program that hardware, we use the Arduino integrated development environment, which is open-source and gratis software, available for download from https://www.arduino.cc. There are no required texts, and there is no course materials/lab fee.

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, verbally, etc.) of one's own work and one's own learning
- Demonstrate the ability to work in a multidisciplinary environment
- Demonstrate an understanding of the cultural context, and social and environmental implications of electronics in the modern world
- 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 of a person living with a disability

Schedule overview

This is a coarse guide, and subject to some adjustment based on the rate at which we're actually progressing. Major deliverables are bolded.

week	Monday	Wednesday	topics and assignments
1	*Jan. 16*	Jan. 18	course introduction; Arduino board and electronics basics
2	Jan. 23	Jan. 25	Arduino programming; electronics theory and practice; more inputs and outputs; Project 1: introduction and ideation
3	Jan. 30	Feb. 1	event loop programming; Project 1: work
4	Feb. 6	Feb. 8	**Project 1: critique**
5	Feb. 13	Feb. 15	Project 2: ideation and refinement
6	Feb. 20	Feb. 22	Project 2: work and prototype
7	Feb. 27	Mar. 1	**Project 2: critique**
—	*Mar. 6*	*Mar. 8*	*Spring break*
8	Mar. 13	Mar. 15	Final project: initial meetings
9	Mar. 20	Mar. 22	Final project: ideation
10	Mar. 27	Mar. 29	Final project: prototype development
11	Apr. 3	Apr. 5	**Final project: prototype critique**
12	Apr. 10	Apr. 12	Final project work time
13	Apr. 17	Apr. 19	Final project work time

| 14 | Apr. 24 | Apr. 26 | Final project work time |
| finals | | | **Final project: final critique***; Final project documentation due† |

* The Registrar will assign us a final exam slot which we *may* use for our final critique. If the class votes, we also may conduct the final critique during our last class, Wednesday, April 26th.
† Final documentation will be due on Friday, May 5th.

Course grading scheme

Each of the homeworks and projects have their own grade breakdowns; see the relevant assignment pages on the course site for those details.
The course grade is computed from these components:

- 15% homeworks
- 15% Project 1
- 25% Project 2
- 45% Final project

The grading scale is as follows:

final percentage of points earned	undergraduate grade	graduate grade
>=97	A	A+
>=93 and <97	A	A
>=90 and <93	A	A–
>=87 and <90	B	B+
>=83 and <87	B	B
>=80 and <83	B	B–
>=77 and <80	C	C+
>=73 and <77	C	C
>=70 and <73	C	C–
>=67 and <70	D	D+
>=60 and <67	D	D
<60	R	R

Class policies

Presence

Class time is quite precious—we've got only 27 class meetings in total, about 50 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: e.g. 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 lighter on lecture and heavier on hands-on learning; especially since this is the case, when there is a synchronous lecture, please be careful to pay good attention.

Students with a perfect attendance record at the end of the semester will get a charmingly chintzy award made by the instructor.

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 two 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 three unexcused absences; your grade falls to 89.4, which earns 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.

If you expect you won't be able to attend a session for any reason, or if you'll be late, please email me as early as possible to request an excused absence. Excusable reasons for absence include religious, sport, or academic obligations; explanations that won't warrant an excused absence include working on buggy/booth/etc., 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.

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 the instructor, questions.

Phone/computer use

While we're in class, please don't use your phone for non-class purposes. If you need to use your phone to contact others, just step out into the hallway. (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 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 sweet memes and #tags (though I don't especially recommend it).

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.

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.

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[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 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. This sort of critique is very helpful to maintaining a successful classroom and much appreciated.

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`.

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 other axes such as 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 two 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*

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[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

Lab access and policies

Enrolled students have access to the IDeATe Physical Computing Lab whenever Hunt Library is open. Hunt library's hours are posted on [their website](#).

IDeATe spaces' schedules are [available here](#) (you'll have to log in to see them).

The [Phys Comp Lab's inventory](#) is online for your convenience. If you discover that we are running low, or are out of, any part or material in the lab, [please fill this form out](#) so it can be quickly replenished.

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

- Food and nonwater drinks may only be consumed in the *Zone of Shame* by the door; this is an electronic lab space, and it's important to sequester comestibles from our work environment for the protection of both.
- The exception to this rule is that covered water containers are permitted at work tables.
- Please store project material in your cubby; 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!
- 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.
  - 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 electronics bench; these contain toxic metals and need to enter a different waste stream than regular garbage.
- If you're reading this, please click [this](#) link.
- It's kind of a kindergarten situation: when you're done working, please clean up after yourself.

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 complementary 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, the professor can step in to help in ways that group members themselves can't.

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 assignment mark (so you might as well come to class and finish the assignment later).

Homeworks may be turned in late for grading and will be penalized 25% per class day of tardiness. ("Class day" means a Monday or Wednesday we have class. For instance: a homework due on a Monday which would've earned a 10/10 will earn a 7.5/10 if handed in prior to the following Wednesday 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. If you are worried about not being able to complete a project on time, contact the instructor as early on as possible.

- *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 Monday the 6th at 10 a.m., and you submit it Monday after class. You get a 10% penalty for one day of lateness, so a 19/20 grade becomes a 17.1/20.)

It is better to hand in or present *something* rather than nothing. If, for instance, you find right before class that your project is broken, or it's only partially complete, etc., then just show what you've got and you'll get partial credit. If you don't show anything, I'll have no basis for giving you any points!

Grading timeline

You can expect feedback on assignments within one week of handing them in. If you don't get a grade or other response from me within that timeline, please contact me right away to let me know. I might've overlooked your work accidentally, and I don't want you to be waiting unnecessarily long for feedback from me.

In order to help ensure that I get you your grades on time, I'll bring in snacks for the class on any day when I've owed grades for more than a week.

Academic integrity

You are not expected to write every line of your own code in this class. 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.

Homework and collaboration

Homeworks in the course are generally completed individually, though it's acceptable for students to work together on the technical homeworks at the beginning of the semester.

Students' homework code may be analyzed algorithmically to detect collaboration, and also examined and graded by the professor. All code submitted for homework and projects 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!

Recently, the useful and somewhat-frightening bot [ChatGPT](#) was publicly released in beta form by OpenAI, a nonprofit research organization. This chat service is able to respond to a user's prompt to produce Arduino code of reasonable quality, though it's certainly not bug-free. Use of ChatGPT for homeworks and Project 1 is prohibited; however, it is permissible to use it to assist you in writing code for Project 2 and the Final Project. If you use it as a source, it should be cited as you would any other.

Standard homework comment block

Below is an example of the format of the standard comment block that should appear at the top of all submitted project code, above your actual code. Don't just copy and paste this block without changing the relevant fields! Your submission should contain *your own* name, your own collaboration, etc.

```
/*
 * 60-223 Intro to Physical Computing, Project 2
```

```
 *
 * The Waker-Upper: a Machine to Encourage me to
 * Get out of Bed!
 *
 * Collaboration and sources:
 * 1) The function "Wheel" is copied from this Adafruit
 * tutorial:
https://learn.adafruit.com/multi-tasking-the-arduino-part-3/utility-functions
 * 2) I used ChatGPT to help debug the timing task
 * on lines 40-44.
 *
 * Description: This device reads a button, potentiometer,
 * and rotary encoder as inputs, and drives LEDs as
 * outputs. While the button is held down, the lights
 * blink at a rate set by the potentiometer's position.
 * Once per second, the rotary encoder's movemement is
 * sent back to an attached computer via the serial
 * interface.
 *
 * Pin mapping:
 *
 * Arduino pin | role   | description
 * ------------|--------|-------------
 * A2            input    potentiometer for speed selection
 * 2             input    rotary encoder pin A
 * 3             input    rotary encoder pin B
 * 4             input    pushbutton to activate lights
 * 9             output   red LED
 * 10            output   green LED
 * 12            output   yellow LED
 *
 */

(actual project code would start here)
```

The Diary of Sorrows

There is a discussion board on our course Canvas site called the "Diary of Sorrows." This is meant to be a place for you to share the frustrating, difficult, annoying, exasperating experiences that you'll inevitably go through as a new practitioner of physical computing. Rather than wallowing alone in your frustration at the obnoxious tiny bit of metal that took you an hour to discover which was breaking your project, use the Diary of Sorrows to share it with the rest of the class!

Recording class

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

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, Physical Computing, and Immersive Technologies in Arts & Culture. 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.

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/.

Relevant IDeATe skill-building micro courses

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. Here are some 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!)

IDeATe resources

IDeATe Open Fabrication Hours

IDeATe offers Open Fabrication Hours Monday–Friday, 5–6 p.m. for the duration of the regular academic year. During this time, you can get individual help from IDeATe student staff in using the laser cutters, 3D printers, and other IDeATe facilities. This resource is available to all university affiliates. See https://resources.ideate.cmu.edu/open/ for further details—and please note that Open Hours are subject to change based on pandemic safety restrictions and other factors.

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. 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.

As a student in this class, during the semester you will be able to charge the purchase of certain consumable materials available at IDeATe Lending to the course budget. Details of this will be discussed in class.

Laser cutter and 3D printer access

IDeATe maintains three Rabbit 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. Please read the latest laser access policy information here: https://resources.ideate.cmu.edu/equipment/laser-cutter/laser-cutter-policies/. Note that there are certain safety trainings required[4] before you'll be able to use the lasers; see that policy page for details. Schedule permitting, we will run a laser safety and use tutorial during class time which can serve as part—but not all—of the credentialing necessary to access the IDeATe laser cutters.

IDeATe runs 3D printing machines also in the alcove off of room A5. To submit a print job to our Stratasys Mojo printer queue, go to https://skylab.ideate.cmu.edu and upload your STL file. For further information about 3D printing with IDeATe, including the other printers available, please see https://resources.ideate.cmu.edu/equipment/3d-printers/.

IDeATe advising

If you have questions or need advice about IDeATe minors or courses, please get in touch with Kelly Delaney, the Associate Dean for IDeATe. Her office is in Hunt A5A (right outside the double doors to A5, the digital fabrication space), and her email is `kellydel@andrew.cmu.edu`.

Taking care of yourself

I look forward to hearing from you in your weekly check-ins so I can get a sense of 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. I'm always happy to make time to speak privately with students about any concerns.**

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. There's a big beautiful park literally across the street from

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[4] If you think you may want to get certified to use the lasercutters (and I recommend it), it's a good idea to sign up early for a fire safety training through BioRAFT, since they're offered on a limited basis: https://cmu.bioraft.com/node/284572

Hunt Library. Go take a walk some time! 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 https://www.cmu.edu/counseling. The Student Academic Success Center is also a great new resource—visit them at https://www.cmu.edu/student-success. Consider reaching out to a friend, faculty member (I really am always happy to talk), or family member you trust for help getting connected to the support that can help.

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 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 through the act of helping others. I'm looking forward to learning with you this semester.