



Teaching from Home - Quick Start Guide

By Andrew Ng

Many of us are working to quickly transition from teaching in a live classroom to teaching online from home. The goal of this document is to help you make that transition quickly and successfully with a minimum amount of complexity. We will go over the basics, and only the basics here.

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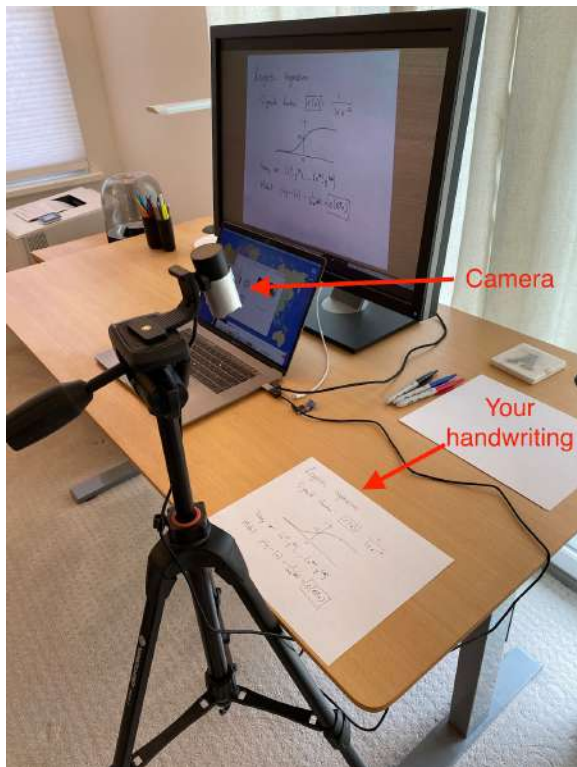
The Mechanics of Teaching Online

How can you migrate a live, in-person class to an online setting quickly, without needing to redesign the class? If you have time to redesign the class into five-minute videos and autograded homework, that's great! But if you don't, here's what you can do.

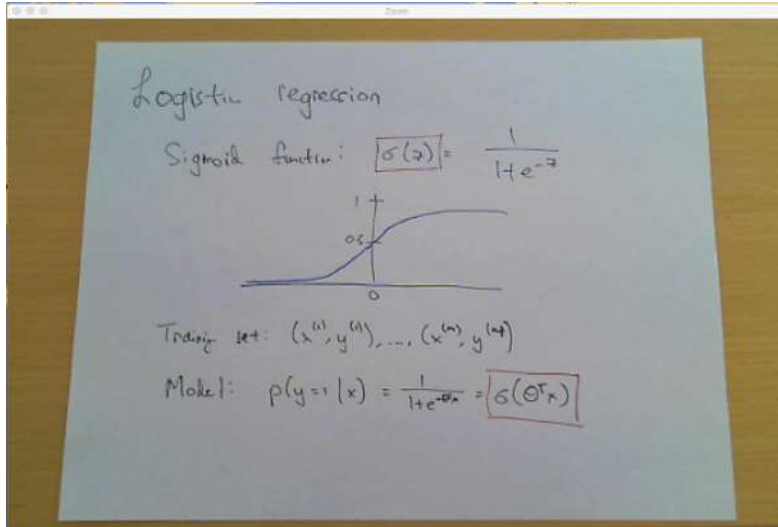
We will go through three quick options with increasing levels of complexity and equipment/setup needed. I recommend using the most sophisticated of these options that you feel comfortable with.

Option 1: Paper-based teaching. Point a camera at a piece of paper, write on it and lecture.

Your setup:

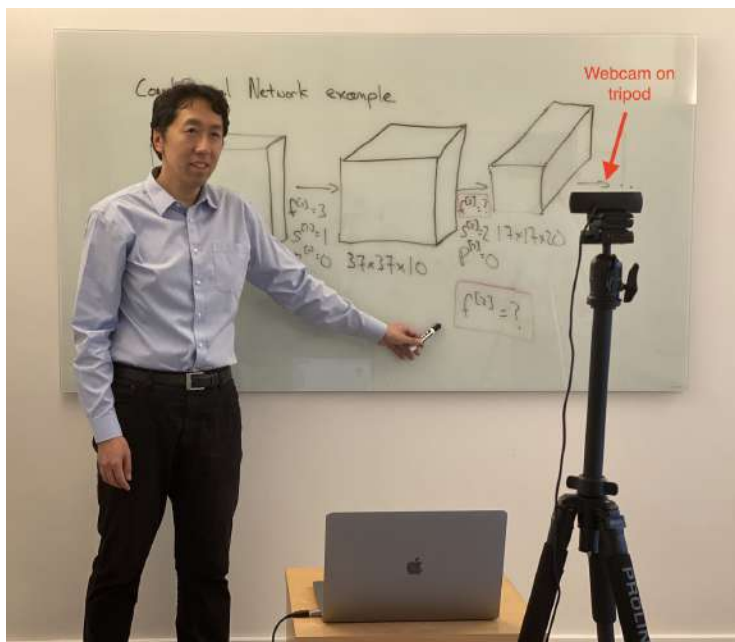


What students see:

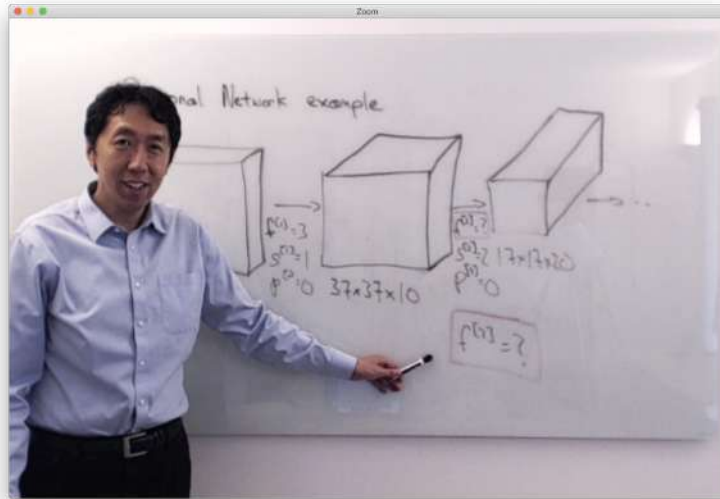


Option 2: Whiteboard or easel teaching. Point a camera at yourself while lecturing in front of a whiteboard or easel+paper pad.

Your setup:



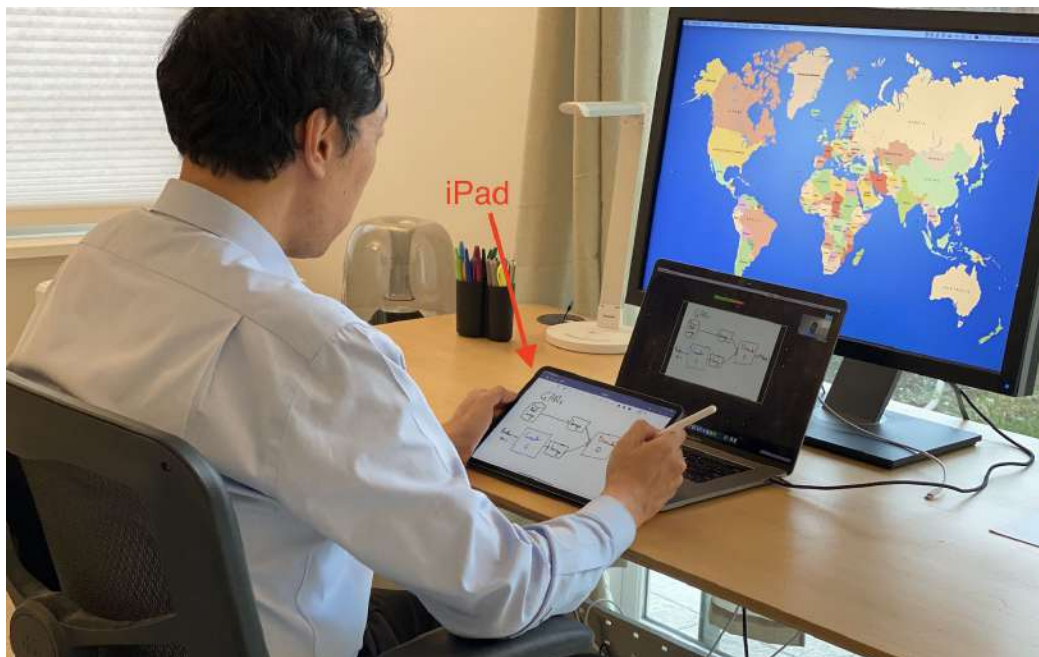
What students see:



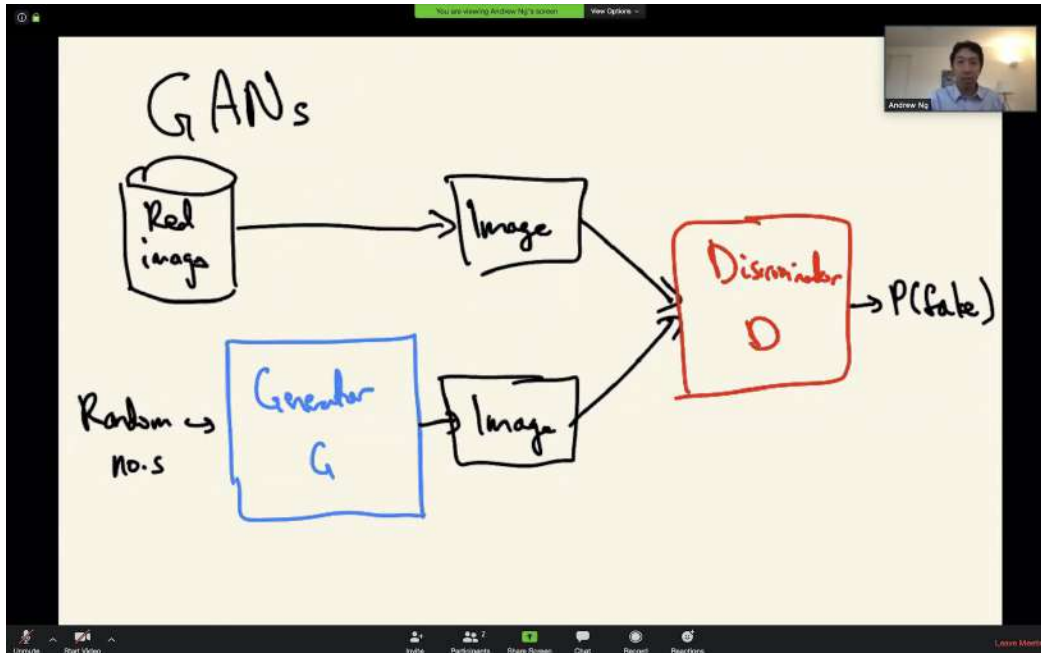
Note: Options 1 and 2 are much easier with an external webcam, which is sold out on most websites right now. If you don't have a usable webcam, consider Option 3 instead.

Option 3: Writing using a tablet/stylus or using slides (without a stylus).

Your setup:



What students see:

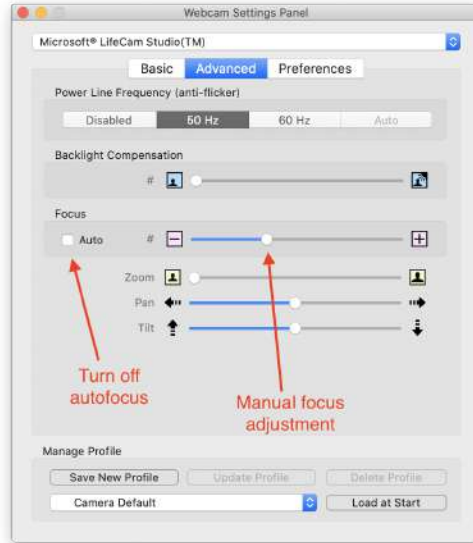


If you don't have a tablet/stylus but you do have prepared slides, you can use this option too.

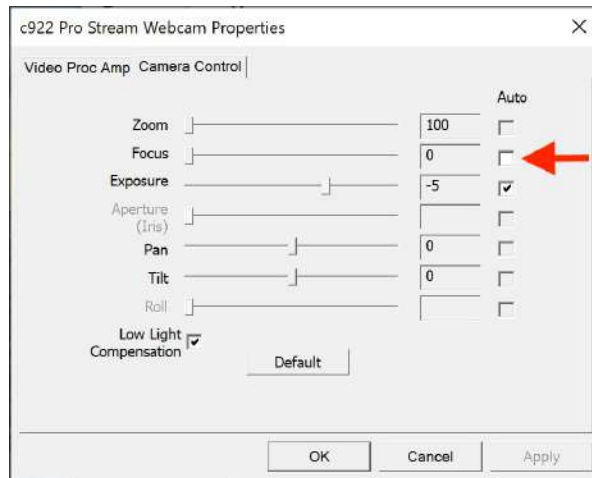
In terms of pedagogical effectiveness, I prefer Option 3 over Option 2 over Option 1. But depending on what equipment you already have and what slides you have already prepared, Option 1 may be easier to implement than Option 2, which may be easier than Option 3.

Some Implementation Tips:

- For Options 1 (paper) or 2 (whiteboard), get an external webcam. This is hard to do with your laptop's built-in camera since positioning it can be challenging. (Appendix II of this document includes a shopping list.) Any reasonable, modern webcam should work fine. As long as you are able to position the camera where you need it, don't sweat the webcam specs too much. Possibly Option 2 (whiteboard) could work with your laptop's built-in camera, but definitely not Option 1 (paper).
- The autofocus on many webcams will have a hard time focusing on the paper and/or whiteboard, leading to a blurry image. Here's what you should do:
 - **On Macs:** I use the program [Webcam Settings](#) (available in the Mac App store) to control my camera's parameters. Make sure to turn off autofocus.



- **On Windows:** See if the manufacturer of your webcam has free software. Alternatively, the Windows app store sells a program called [Webcam System Settings](#) that you can use to disable autofocus and adjust other camera parameters.

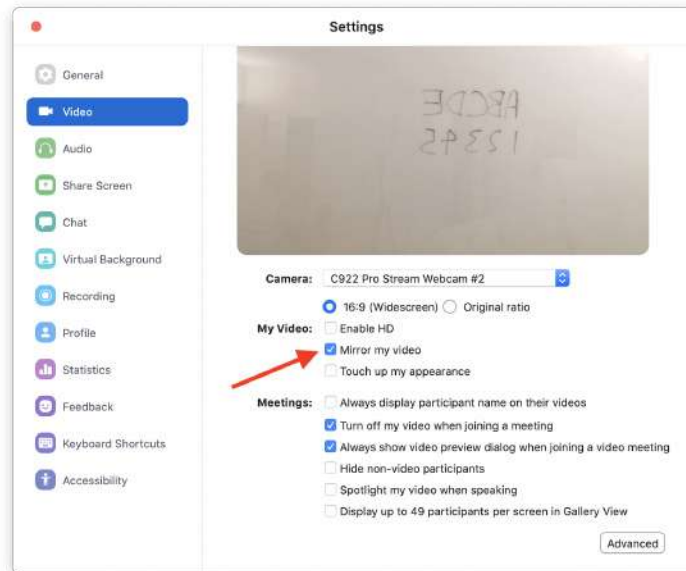


In addition, if you plan to use colored pens/markers, play with the camera's sharpness, saturation, contrast, and brightness settings to make the colors show up clearly. Webcams are not designed to film flat pieces of paper or whiteboards, and *these parameters can have a huge impact on the legibility of your handwriting*. If you use colored pens, these settings will also affect whether the colors show up or if all colors appear black.

- Consider buying a USB extension cable. A typical webcam USB cable might be six-feet long, but depending on your room geometry, sometimes a few extra feet of cable can make your life easier (especially with Option 2) when you're trying to

position the camera. If you use a new Mac with USB-C ports, also make sure you have a male USB-C to female USB-A adapter for the webcam.

- With any of these options, you can also easily switch to projecting a web browser, a desktop app, etc. to show a demo. For example, when coding, I sometimes switch over to a Jupyter notebook in my browser and share (show the students) my browser window in Zoom.
- Optionally go to Zoom's video settings and uncheck "Mirror my video." The students will see the same thing (an unmirrored video) either way, but this way, the text won't appear to be backwards to you.



- Let your family members know in advance when you'll be broadcasting live so you don't end up like this [BBC interview](#).

[Appendix I](#) dives deeper into the specific setup details of all three presentation options.

The Mechanics of Managing a Live Online Class

Just as we are figuring out how to teach online, our students are also figuring out how to learn online!



If you are using Zoom to schedule meetings in advance, here are some recommended configuration settings when scheduling meetings:

- Set video to “on” for both host and participant
- Schedule lectures at the assigned time slot for the class
- Select the following configuration options in Zoom:
 - Disable join before host
 - Mute participants upon entry (otherwise there will be a lot of background noise)
 - You can also record the meeting automatically (so you can post the video for students in far-away timezones). If your institution has the option of saving the recording in the cloud, I recommend taking advantage of that. (Alternatively, you can also start recording manually in Zoom.)
- When the time comes, log in to Zoom, and you’re off!

If you are recording the video, please let students know that you are doing so at the start of the lecture, and also make sure to comply with student privacy laws (such as FERPA). Recording and posting lectures online will be important for students that may not be able to attend live.

I strongly recommend practicing at least once -- say, deliver five minutes of your lecture to a TA -- before the class to make sure you’re familiar with all of the buttons, how to use chat, ensure that your ink is visible, and so on. Also make sure that Zoom has all of the needed permissions enabled. If you are planning to ask a TA to host the Zoom session, do a practice session with them. However, Zoom is easy enough to use, so I usually just do this myself.

In addition, here are some ways to make the class more interactive.

Use Chat

One advantage of online, live teaching vs. teaching in a classroom is that any student can ask a question in text Chat at any time without “interrupting” the lecturer. I usually keep the Chat window in Zoom open while I’m speaking, so that I can see if someone is asking a question.

To encourage students to ask questions:

- At the start of the class, ask everyone to answer an icebreaker question in Chat such as, “Hey, everyone jump into Chat and tell us something cool you did over the weekend!” I particularly like questions that let the students “brag” about something they did. Doing this also gets everyone familiar with the Chat function.
- When someone does ask a question in Chat, call them by name and thank them for their question. This will encourage others to do so.



- If you want students to answer each others' questions in Chat, you should also encourage this explicitly and thank them when they do. Let's say that a student asks, "What is an RNN?" because you wrote "RNN" without explaining. Another student may reply in Chat, "Recurrent Neural Network." So the question is answered without you even having to break the flow of the lecture.
- Sometimes, if a student asks a question in Chat but I don't understand what they mean, I'll also invite them to jump onto audio and explain their question verbally.

During the class, you can also ask questions and get **everyone** to answer! In a physical classroom, usually only one student at a time gets to answer. But now you can ask everyone to participate. This works best if you ask low-stakes questions where there are no wrong answers. Since students' responses are public, this way there is less risk of embarrassment. For example, I've made requests such as, "Everyone please name one ethical challenge of AI" (where hardly anyone ever gives a wrong answer) or, "Would you use algorithm A or B, and why?" (where both are reasonable choices). The allows you to generate discussion about people's reasoning.

I know you're busy and might not have time to redesign a lot of material. But coming up with a few discussion questions where you can get everyone to participate, and sprinkling them into your lecture, will be a high ROI use of your time. You can then also read the students' responses and give live feedback and commentary on them. If you want to just dip your toe in to start, feel free to start small and try just one or two questions in your first lecture that you ask people to answer in Chat. For the long term, asking one question every 10 to 15 minutes would be great, and it will make your online class feel much more interactive.

Encourage Use of the "Raise Hand" Feature

In the "participant view," there is a Raise Hand button that students can use, which causes a "Hand" logo to appear. (Depending on the version of Zoom you're using, UI appearance may differ.) Many students will not be familiar with this feature, so teach them at the start of the quarter. This is a good way to let students request to jump onto audio to ask a question.

The screenshot shows a Zoom meeting interface. At the top, there are four video thumbnails of participants. Below them is a presentation slide titled "Small data". The slide contains two bar charts. The first chart, titled "ML works well when the data distribution is this:", shows five bars of equal height (1000) for categories "Cat", "Dog", "Elephant", "Moose", and "Panda". The second chart, titled "Not so well when it is this:", shows four bars of decreasing height (12000, 10000, 5000, 3000) for categories "Elephant", "Moose", "Moose", and "Panda". On the right side of the Zoom window, there is a "Participants (17)" list. A red arrow points to the participant "Ankur Rawat" in the list.

Ask Everyone to Turn on Their Webcams

As an instructor, you will get a better feel of the audience's reaction if their webcams are turned on, and you will be better able to respond to the students. Students will also be more alert if everyone can see each other. Sometimes this isn't possible for a few students (e.g., if they're in a low-bandwidth environment) but we should consistently encourage this. I usually bug everyone to turn on their webcams.

Consider also asking a TA to be responsible for logging in and sending private messages in Zoom's chat (Zoom supports private or broadcast messages) to bug people to turn on their webcams if they haven't already done so.

Recommended Standardizations (for Discussion)

If you do some things in a relatively standard way across your department or university, it will make life easier for students. For example, if they have to search in email for the Zoom link to one class, on Piazza for a second, and on Canvas for a third, it will add complexity to their lives. Let's standardize where we can to make things simpler for our students during this messy time.

I would urge your department or academic unit to consider the following standard "default" practices for any instructors that are comfortable with adopting them. These should likely be discussed as a group to see if the team is comfortable with them.

- **Make live, in-class attendance mandatory**, unless they have good reason not to attend.
 - Students are already much more isolated than usual, so live participation in classes helps tie the community back together. Also, live participation will improve everyone's experience -- the student's, their peers, and yours.
 - Good reasons not to attend live include being in a very different time zone, a conflicting class, being in a low bandwidth environment, or any other reason that attending live would cause undue hardship.
- **Ask everyone to turn on their webcam**. This will make everyone more engaged. If everyone in your department does this, it will reduce the feeling of any one instructor being the "mean one" who intrudes on everyone's privacy.
- Standardize on tools for homework submissions and for discussion forums. For example, I like using **Gradescope for homework submission** and **Piazza for discussions**.
- Use one place to schedule Zoom sessions. For example, if your university uses Canvas, that could be a good way to schedule Zoom sessions and post videos (while staying compliant with student privacy laws).

Appendix I: Details on Implementations of Options 1-3

This appendix goes through Options 1-3 in greater detail. If you have already selected one option, please skip directly to that section.

Option 1: Paper-based teaching

Pros:

- Relatively easy setup with minimal equipment needed: Just a computer, webcam and a tripod.
- The blank piece of paper is your new whiteboard. So whatever you used to write in a classroom on a whiteboard you can probably transfer to this setting without needing to change the lecture content much.
- You can write some things (or print out) on your pieces of paper in advance, with empty blanks to fill in during the live lecture.

Cons:

- A webcam, which is out of stock in many places, is a must-have. This would work only if you can obtain a webcam.
- Depending on how you set up the camera and what equipment you have, it might be an awkward setup. For example, in the picture above, I'd have to reach around the tripod to write.
- You have to switch between the external webcam (paper) view and the laptop built-in camera view depending on whether you want the students to see the writing or see you.

Implementation tips:

- After setting up the camera, mark your table with a pencil or sticker to indicate where to place the pieces of letter-size paper, so you can reliably put down new pieces of paper in the center of the camera view.
- Don't hesitate to use duct tape or any other physical materials needed to position the camera. The students can't see the wads of duct tape holding up your setup!
- If your writing isn't showing up clearly, try adjusting the webcam settings. If possible, also do your practice session at a similar time of the day (or under similar lighting conditions) as your live lecture.

Option 2: Whiteboard on camera

If you have a whiteboard or easel, you can set up a camera to point at yourself while you teach. The picture above showed the use of a whiteboard, but an easel works fine too.

Pros:

- It replicates a classroom setup that you might already be very comfortable with.

Cons:

- Jumping back and forth between the whiteboard and the laptop to monitor Chat could get awkward.
- You're further from your laptop or camera microphone, so the audio might be class clear. I'd strongly recommend testing the audio in advance before using this option.
- A webcam is a strong nice-to-have. If you don't already own one, it could be hard to find one right now.

Implementation tips:

- Even though I said not to worry too much about webcam quality, realistically, your webcam will be a much lower-quality camera than professional studio cameras. Therefore, playing around with the camera settings (auto-focus, brightness, contrast, sharpness, etc.) is going to be really important, and it will have a huge impact on your writing's legibility!
- Make sure you have fresh markers. If you're filming at home, it's up to you to make sure you're stocked up. Slightly faded markers, especially on a webcam, can be hard to see. Stick to bold-colored markers (such as Expo markers with the four basic colors: black, blue, red, and green).

Option 3: Stylus or slides

Pros:

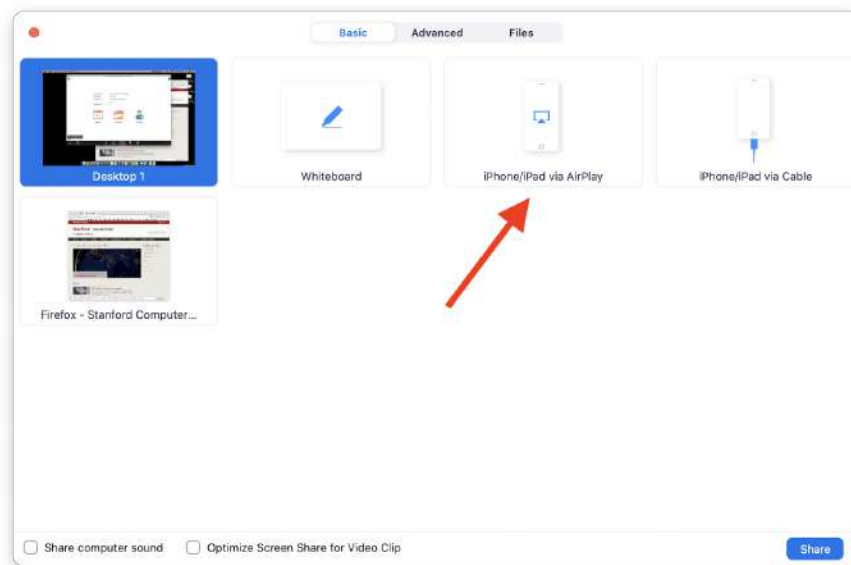
- Gives you a lot of control over the presentation material.
- Allows you to write on a blank (digital) whiteboard, or on prepared slides with blanks.
- Your writing is projected directly to the students -- no image-quality problems such as focus, sharpness, or other issues.

Cons:

- Needs the most specialized equipment and setup, such as a tablet/stylus if you plan to write. Or if you don't need to write, showing prepared PowerPoint/Keynote/etc. slides would also work, but it requires slide preparation in advance.

Implementation tips:

- My favorite setup is to use an iPad + Stylus, which I mirror to a computer (Mac or PC) and share with students via Zoom, so the students can see what I'm writing.
 - If you plan to prepare slides in advance, you can use Keynote or PowerPoint for iPad, leave blanks in the slides, and write on top of them.
 - If you are not preparing slides in advance, use an app like [Notability](#) (or GoodNotes, Penultimate, or Paper, or just blank PowerPoint/Keynote slides) and write on top of that. I like Notability's mirror function, since it allows you to project the writing area but hide the menus/toolbar. However, many possible apps should work fine.
- Here are the steps:
 - Make sure your iPad and computer are on the same wifi network.
 - If using a Mac:
 - Start Zoom, and select *Share Screen*. Of the windows that Zoom offers for sharing, choose *iPhone/iPad via AirPlay* (or *iPhone/iPad via Cable*, if connecting via USB cable).



- Swipe down from the upper-right of your tablet to open up the iPad control center. Tap "Screen Mirroring" and select your computer. If you don't see your computer, double-check to see if your iPad and computer are on the same Wifi network.
- If using a PC (this workflow also works on a Mac, but requires installing AirServer):
 - Install and start AirServer on your computer.
 - Swipe down from the upper-right of your tablet to open up the iPad control center. Tap "Screen Mirroring" and select your computer. If



you don't see your computer, double-check to see if your iPad and computer are on the same Wifi network.

- In Zoom, click Share Screen, and share the window that mirrors your iPad.
- There are many other configurations you can use to project slides and/or write, so don't hesitate to experiment and pick something else.

Appendix II: Shopping list

For Options 1 (paper) and 2 (whiteboard):

- **External Webcam.** Any modern webcam should be fine. I have used a lot of Logitech webcams, and I also like the Microsoft Lifecam. Unfortunately webcams seem to be sold out right now on many websites.

- **USB extension cable**, such as [this](#) one. This is particularly useful for Option 2 (whiteboard) and perhaps Option 1 (paper) as well. This cable makes it easier to position your webcam.
- **Tripod**. The specs are not important. You do not need a \$500 tripod. I own [this](#) basic tripod, and I'm happy with it. The choice of tripod will make pretty much zero difference.
- **Expo markers** for Option 2 (whiteboard) only. Get a couple of sets [here](#).
- For Mac users, also:
 - Get the software [Webcam Settings](#) to control your external webcam's settings. (The built-in FaceTime camera does not have adjustable settings.)
 - If using a newer Mac, remember to get a USB-C to USB-A adapter, such as [this](#) or [this](#), for the external Webcam.
- For Windows PC users, also:
 - Get either free software from your Webcam manufacturer, or try [Webcam System Settings](#).
- (Optional) **External Microphone**. Most laptops' built-in microphones are quite good, so don't worry about it if you don't have an external microphone. But a higher quality microphone could make your voice sound better. I usually don't bother with one myself, but it does make you sound clearer. I've found anything in the [Blue Yeti](#) line to be pretty good.

For Option 3 (stylus or slides):

- My preferred setup (if writing by hand):
 - **iPad + Stylus**. I use an iPad Pro 11 inch with an **Apple Pencil**. (I've also used the 12.9 inch and find it slightly awkwardly large. But if that's what you have, it works completely fine too.)
 - If using a PC, use [Airserver](#) to mirror your iPad to your computer, so that it can be shared on Zoom. Airserver also runs on Macs (and I've found it helpful on occasion), but Zoom is able to mirror an iPad directly on a Mac, without Airserver.
 - If you are writing freehand on blank pages, [Notability](#) is a good choice. But many other writing apps also work fine.
 - If I am using prepared slides, I use PowerPoint or Keynote for iOS.
- Other setups that also work well:
 - Use a Windows surface laptop with a stylus, and write on top of PowerPoint slides.
 - Use a Wacom tablet attached to a computer, and write on top of PowerPoint slides.
- (Optional) **External Microphone**. Most laptops' built-in microphones are quite good, so don't worry about it if you don't have an external microphone. But a higher quality microphone could make your voice sound better. I usually don't bother with



one myself, but it does make you sound clearer. I've found anything in the [Blue Yeti](#) line to be pretty good.

Acknowledgements

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