

Some advices on how to make course videos

– a teacher’s perspective –

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*Vous devez vous dépêcher si vous voulez voir quelque chose, tout disparaît.*¹

Paul Cézanne

Introduction

I dealt with course videos a first time when making a MOOC about programming and algorithms with Dominique Rossin, and again a few years later for Ecole polytechnique’s INF371 course. This second effort was decided shortly before the outbreak of the pandemic, which then forced me, as well as all teachers at X and elsewhere, to switch to fully remote teaching. This resulted in about sixty lecture videos, lasting between 3 to 25mn.

Some colleagues then asked me questions about how to make such videos. When I started to write this document, I realized it was also useful for me to sum-up and describe the knowledge and experience acquired in the process.

Teaching is an extremely rich task. First and foremost because of the mediated knowledge in itself. But teaching also means taking into account many different constraints and combining various means. How to organize the taught material, narration choices, presentation options, be they verbal or graphical, the use of time and how to raise the attention of the students. All these points still apply when using the video media; but the video, in turn, allows to mobilize new ressources.

What follows is not meant to be a pedagogy handbook; I only hope to help colleagues to take control of this media. I have no intention of making a general apology for remote learning, nor do I want to answer the more political questions that raise from its increasingly ubiquitous usage. I make no hierarchy between lectures made by video and performed before students. Like movies opposed to theater, each way of lecturing has its strong points and weak points, and both share a common ground.

Whether one teaches algebraic geometry or the grammar of ancient latin, any course is a succession of choices: ow to introduce the subject, with which motivations, what metaphors one uses, which graphical representations, finding the most enlightening mathematical definition, in which order one solves a problem, how much time is spent on this or that part... The list could go on for

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¹You have to hurry if you want to see something, all disappears.

ever. Some choices are simple (where to put a punctuation mark) others involve a lot of creativity (finding a new formulation for a theorem). In a course, all these choices are intertwined: modifying one involves a chain of changes and new choices. Switching to videos means making these choice in another space with new dimensions, more constraints in some respects, more freedom in others.

More generally, I want to stress what a fertile pedagogical mean the video media is. Adapting a lecture to video is often an opportunity to revisit the taught material and to rediscover the teacher in oneself. Videos can be a genuine empowerment tool by which the teacher can reclaim fully his or her job.

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1 The Time of the Lecture

In this document I deal with the *lecture* part of a course. A lecture is first a time *spent together* by the professor and the students. In my university, a lecture typically last 1 1/2 hours, which is rather long; north american universities often favor two weekly sessions of 45mn. Switching to e-learning frees oneself from some material constraints (like coming to the classroom at a given time) but it is all the more important to capture the attention of the students and to help them to be in a learning mode when watching you on screen. Therefore, one generally favors shorter videos; 20mn being already on the long end.

A week of lectures thus typically consists of around 5 to 8 videos whose durations are distributed around an average of about 10mn, most of the time between 4 and 20mn. These figures are, of course, approximative.

Splitting up a week's lecture in shorter parts requires you to think it over. You will probably see that in video, the stream of information you send is somewhat more concentrated than in the classroom; accordingly, you have to identify for every moment of the lecture and every slide what message you want to convey. Note also that:

- Sticking to shorter videos will help you during the shooting (to stay clear, not to stammer, etc...)
- Because the message is more concentrated and the lecture prepared in more detail, videos often take a little less time than physical lectures for covering the same material. In other words, the total length of the videos corresponding to a 1 1/2 hours lecture will probably amount to less than 90mn.
- Finally, as explained later on, you will probably fine tune your slides while deciding the details of the words you will say. Doing this thorough preparation work for not too long sequences makes it much easier.

2 The Slides

Which Software

The word “slides” is maybe not the most appropriate, but you understand that I mean the written and drawn material of your videos. Reflecting back on the work done for his Mooc about algorithms², Robert Sedgewick has explained he used surprisingly many different softwares to build his slides: Latex/Beamer, Powerpoint, various libraries to build either charts, pictures and animations... This is all the more noteworthy that, if you look at his course, you will see that the slides are actually quite sober, without visual gadgets, and do not try to appear spectacular.

But, indeed, when switching to video, one often wants slides that incorporate more movement and animation:

- First because one loses the possibility to move in the classroom, be it for emphasizing a transition between two parts of the lecture, to catch the gaze of the students, directing it away from, and then back to, the screen or the blackboard.
- One cannot anymore switch from the screen to the blackboard, for instance to make a drawing while simultaneously giving explanations. One can use technical means to draw on the screen, but without the ability to exit the frame.
- One will thus use other means to hint where the student should look. Having the text appear gradually, or use motion effects can be useful in that regard – even if one should not overuse visual gadgets. The aim is to help the students to be drawn to the main point without spurious visual effort.

²<https://www.coursera.org/learn/algorithms-part1>

- Wysiwig softwares like Powerpoint, or its counterpart Apple Keynote, can be useful in that regard. On the other hand, beamer allows a more precise layout and gives more comfort when typing mathematical formulas. I do not advocate one solution or another, but I think it is worth taking the time to consider various options with an open mind. Note that it is also possible to combine different solutions, as Sedgewick did. One can also favor the one or the other, depending the topic and the style of the course.
- Displaying a figure or drawing: it may be pedagogically wise to have it appear in a nice way, gradually, or just to have it enter the screen in such or such way. Without overusing the visual effects provided by presentation softwares, it is worth to put some effort into this, more than what would be necessary for a classroom lecture. Again, this reflects the difference of how the time flows in the video compared to when professor and students face each other.

Pointing, highlighting

Whatever software you use, there are times where you want to point to one item of the slide; in a classroom you often use a laser pointer or simply a stick or your finger... In a video, you have the choice between various options:

- You can use a specialized software which simulates a pointer on the screen. There are several such applications depending of your operating system. Note that you should check whether this application is compatible with the mean you will use to record your presentation (Powerpoint, Keynote, your pdf viewer) and the screen capture mechanism you will use.
- You can use a graphical tablet like the ones provided by Wacom. They allow you to draw directly on your slides, to underline, to draw lines around items etc. This may actually go way beyond the mere highlighting task and some teachers love these devices. I personally do not use them much, but probably mainly because of my bad handwriting. Take into account that when drawing or writing on the tablet, you will probably not be looking at the camera. So these tablets are probably better suited for slides where your image is not shown.
- Another possibility is to add highlighting steps directly into the slide. That is to visually put forward one item and then the other. I tend to do so, although that demands to spend more time on the making of the slides and can sometimes become bothersome. On the other hand, I do this work once the general design of the slides is completed, at the same time as I precisely decide which words I will actually say. This way, this becomes a quite natural step in the course construction procedure.
- A last solution is to have the highlighting added in post-production, that is after the shooting when editing the video. This requires a good proficiency with the editing software but can be quite practical and give very good results. If you can afford it, it is probably one of the best ways to proceed. Especially if your video is edited by a specialist whom you trust for understanding what to highlight and when.

Of course, it is absolutely possible to combine several of these solutions.

A Certain Beauty

Although it is not essential, it may be worth spending some time on the visual aspect of your slides. Trying to keep them balanced, not too jammed or crowded etc. Remember that when looking at the video, the screen, and thus your slides, will occupy a much larger part of the students' field of view than what would be the case in the classroom.

3 Finding your words and the way to say them

When switch from the classroom to video, you become the first person to watch and hear yourself teach. This can feel awkward at first, but also forces you to change our self-image and by giving you a clearer view of the teacher you are, may help you to train for the better.

The ground on which your course is built is your text, that is the words you say and the way you say them.

The Text

Every teacher has a personal relationship with his or her text. Some love to improvise, other prefer to know their words by heart. In humanities it is common practice to read one's text, in conferences but also for teaching. Very often however, one likes to keep a certain room for improvisation. But this space for improvisation will probably be smaller in videos than in the classroom, for a set of converging reasons:

- When you enter the classroom and start talking, you see the gaze of the students and their expectation. The context helps you to mobilize intellectual resources to produce a discourse *here and now*.
- This mobilization is lost when shooting a video. First because the sense of urgency given by the shared time and space is gone. Furthermore, if you make your recording at home, you will probably not change places: you prepare your course material and once you feel it is ready, you just push the record button.

Thus, you will probably prepare your text in more detail for a video, even if that means accepting the loss of a certain spontaneity.

Furthermore, we have seen that video slides are often built with greater detail than their counterparts for the classroom, typically by adding steps to highlight various elements. Since the choice of these elements and the order in which they are highlighted is intrinsically related to what you are going to say, I have naturally ended up with the following procedure:

- I first prepare my slides with about the degree of detail that I would have done for a traditional course. I generally do this for one to three sequences of one week's teaching.
- Before doing one recording, I go through the slides I will use. I mentally construct my text and add the corresponding animations to the slides.
- One ready, I shoot the video, the text being still fresh in my mind.

If I stammer during the recording, I can stop, adapt the slide and resume recording. In case the slide needs only a minor correction I can just resume recording, knowing the modification can be done later on during editing (see the part about correcting errors).

Of course, there is absolutely no obligation to proceed this way. But it seems important to stress that, at some point, one has to think *simultaneously* what one will say and the shown visual material.

A last, somewhat trivial point, is your appearance. Before shooting you may want to check what you look like, change some piece of clothing or your hairstyle. . . The reason for mentioning this is that such a little ritual may also help you to be you into the mental situation that is the time of teaching by marking the moment where you switch from the preparation to the performing of the course. Possibly, this can help to recreate some of the creative tension of the classroom. Besides, to give a sense of unity to the course, it may be wise to avoid wearing a suit in one sequence and a grunge t-shirt in the next, be it only because this would cause a distraction from the teaching itself (unless, of course, you want to convey some message by this change of style).

Shooting in a studio

Above, I stress the differences between a classroom and what happens when you record a video by yourself, probably at home. An in-between situation occurs when the video is shot in a studio. In that case, you are freed of some practical aspects of the recording, and the fact of entering the studio and finding yourself facing the operator and then the camera can provide some intellectual simulation. But you still will have to prepare your text carefully and try to avoid stammering in front of the camera; remember that it will be more tedious to change some material and reshoot that it would be at home.

More generally, I think that doing some recordings at home is an excellent training and the gained experience will be invaluable if, later on, you do some studio recordings.

The tone

When we speak with, or in front of, somebody, we immediately chose a certain tone. We can speak in a more or less formal or relaxed way, be more or less humorous, serious, complicit or professorial. With the time, we have developed the ability to make this choice almost without being aware of it. When doing a lecture recording, this choice becomes less instinctive and more explicit. We have to make the effort to figure and imagine the audience we are talking to. Furthermore, we will be the first ones to hear ourselves and to judge our performance. This can make some of us ill at ease or just change the image we have of ourselves.

Everyone has to deal with this in the manner she or he prefers. But realize that, even if it feels awkward at first to watch oneself, this distancing work will generally be useful. Do not be shy to make several recordings and compare them, to judge what effect you obtain by talking this or that way.

If I may add a personal advice, when in doubt, avoid too strong rhetorical effects or jokes. It is difficult to find the right measure in that respect, and a more sober video will last better in time.

Fluency and diction

Once you know what you will say (the text) and how to say it (the tone) you have to do it without hiccups. We are all more or less at ease when speaking; furthermore some will prefer talking to a live audience, while others may feel safer in front of the camera. In addition, one may be more or less a perfectionist. But for most of us, it is worth doing some work to improve one's delivery and diction. The best way being to record oneself, watch the result, spot the imperfections and start over. If you are recorded in a studio, I also advise to do some prior trials at home, be it with a little webcam. This will also help you to calibrate the length of your talk.

- Avoid hesitations like uh, er, um... At worst, this becomes very annoying and, at best, it will blur your message. These sound artefact appear all the more when you are not yet comfortable with your text. Note that it is often possible to cut out these stammers at editing, but this is a non-trivial work for the editor and the cuts will remain more or less visible, damaging the message's fluidity.
- A point useful beyond just videos: make a first, then a second then a third recording of the same talk. You will see that the recordings tend to become shorter and shorter, without you giving the impression of speaking faster. This is due to the vanishing of hesitations and your increasing mastery of the material. Note that this can be useful also when preparing a regular talk (typically a job interview).
- Some corrections can be done very easily by editing. If you miss one sentence, do not touch anything, just stop talking and start the sentence again. Just try to start again at a point which will make the editing easy; you will quickly get used to it.
- Do stress the breakpoints in your talk. For instance change your tone when you switch to a new topic. In the classroom you have several means for that (short silence, move, look thoughtful...). On video your only means are your voice and the slides: make the best use of them. These breakpoints can be stressed further by cutaways at editing.
- Finally, the more lectures you will record, the more at ease you will be. Your recordings will be cleaner, hesitations scarcer, you will become more and more efficient and sure of yourself regarding animation choices.

Teleprompters

One now finds many softwares to turn your computers, tablets or phones into teleprompters. I personally do not use them. For one, it is necessary to type down the full text beforehand. Then one needs to fine-tune the speed of the prompting quite precisely. Finally, having to follow the prompted text takes away the last part of improvisation. Still, this tool can be useful, especially if you want to say a longer text face to the camera – for instance a welcome address or an introduction to the course.

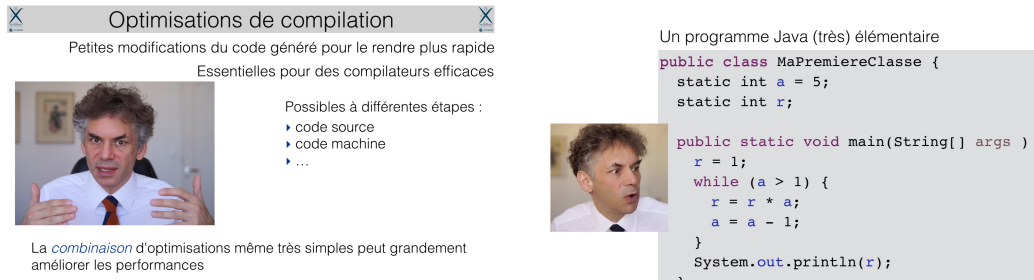


Figure 1: Two way to use the gaze: on the left, facing the camera for a discursive part; the text only highlights some points. On the right, the teacher seems to look at the code he is describing; actually, he is looking at the screen which is facing him left of the axis of the camera.

4 Should one see you ?

Not necessarily

Another question is to what extent you want to use your own moving image in the video. You should feel free in that respect, and every teacher can chose to – literally – *expose* oneself more or less. Very often, one likes to start with a shot of the teacher for the introduction and to end with another one for the conclusion. More generally, for a course lasting several weeks, it may be useful for the students to be able to get a picture of their professor. But you definitively can settle with showing little of you. A good example is Andrew Ng’s excellent course *Machine Learning* <https://www.coursera.org/learn/machine-learning> on Coursera: Andrew is generally only visible in the beginning and conclusion shots, with typical webcam image quality.

A well-conceived slide can certainly work solely with the voice of the teacher. And having her or his face in a tiny square in a corner is not necessarily helpful.

However, as mentioned above, using a brief face shot between some slides may help to emphasize important transitions and stress the transition to another point in the lecture.

Using the gaze

You may also insert your image in a slide in a more constructive way. For instance, if you look at the camera while talking, you signify to the students that they can focus on your words. If you then turn to the side, they understand they may turn their attention to the displayed material you look at, or you seem to look at. You can thus use your gaze to point to various parts of the slide.

Doing this requires a little work which quickly becomes quite easy and natural. You can, when constructing your slide, keep an empty spot for your face. This spot will be more on the left or on the right, depending upon where it is easier for you to turn your head to (see 1).

Actually, the side you turn your head to is generally the side where you have put the screen to view you slides. In some cases I have cheated by mirroring my image to seem to look the right way; this is quite easy to do at editing.

Finally, changing, or not, the size or the position of your image between two animation steps or two slides can help to hint at continuity, or stress a minor breaking point.

More generally, it is your image and you are free to use. Just remember that:



Figure 2: Text overlay

- Without overblowing the importance of this question, guiding the gaze and attention of the students can really make your videos more light-footed and easily digestible, by reducing the work to visually select the relevant information. And remember that our brains are trained to follow the gaze of our interlocutor.
- You can also sometimes play with your image, make it smaller, larger, distort it, if this can help you make a point.

One shot, two recording files

I come back later on various technical points (angle of view, lighting...). But let me already point out that it is much easier to record at the same time the “projection” of the slides on one hand, and your image and voice on the other. In theory one could make two separate takes and assemble them when editing. But this would require an unpleasant number of adjustments.

This means I generally try to record all the material for a video in one run; each time I record two files simultaneously:

- one for the slides,
- one for my face.

The first file is produced by the computer: I go through the slides while talking, and the computer records what is displayed together with my voice. The second file is essentially produced by the camera. It is recorded on the camera’s memory card, or by the computer if the camera is a webcam.

To assemble these two files into a single coherent movie, which can switch from one shot to the other, or sometimes mix the two, is what is called the editing work. Having a soundtrack with my voice on both original files makes it much easier to synchronize them when editing.

Overlaying Text

A minor point: it is very easy to add some text overlay on an image. For instance to stress some points while you are talking face to the camera without slides (see 2). This can be done either by

adding the text with the editing software, or to use slides with a green background. Just be careful to use a font color which stands out from the image background.

5 The Equipment

If the recording is done in a studio, about everything will be provided. But if you do the recording by yourself, some equipment is needed.

The Computer

It will be used, first, for recording the video stream of your slides and your voice. One possibility is to simply have the screen in front of you, go through the slides and record the video output (screen capture) together with your voice. Softwares like Keynote or Powerpoint give a little more comfort for recording a talk (for instance by letting you also see the next slide).

Of course, be careful to have enough disk space and to make safety copies of your shots elsewhere.

If you do some editing yourself, it is better to have a reasonably powerful computer with a well-suited video card.

The Microphone

Among the specific technical devices you will use, the microphone may be the most useful one. Your voice remains the base of your course and a good microphone will, again, help the students to catch your message without spurious efforts.

It thus may be worth using a microphone adapted to this task, even if the mic built-in your computer can already be quite correct. What one wants is:

1. to have a good sound (clear voice, little noise, no sound artefacts...),
2. to avoid capturing too much ambient noise (all the more since we are here dealing with home recordings, in the studio you can leave the choice of the microphone to the professionals).

You can either chose:

- either a so-called “Lavalier microphone” which is clipped to the clothes,
- or a more classic microphone with a stand to be placed on, or attached to, the desk.

A Lavalier microphone is generally made to capture only nearby sounds. For a desktop microphone, one can favor a directional model, which will cut many ambient noises.

It does not seem necessary to invest large sums in the microphone. I have no personal experience with Lavalier microphones; I now use a directional mic with a little stand to place on the desk which fully satisfies me (Bird UM1, available at woodbrass.fr a.o.) for about 60 euros. Many models seem comparable. The Blue Yeti is renowned but more expensive.

One point is the conversion of the sound to digital. Your computer or its soundcard may do it if you have a microphone with analogue output (jack or XLR), but it is not always the case. Verify early on that everything works and that you are satisfied with the result. If you buy a mic, it is probably more convenient to chose a model with aa USB output (like those mentioned above). In general your computer should have no problem recognizing the USB device as a sound source.

Camera Model

As already hinted, there is no fundamental need for a high image quality in order to make good course videos (I here mean the image of your face, not the quality of your slides which is more important). Andrew NG's ML course obviously uses a webcam. But the more you use your image in the course, the more you may want a nice image. This point is complex, as we enter the world of photography.

I describe the shooting itself later on. Simply considering the camera, you have several possible choices:

- A webcam, either the one built into your computer or added-on (USB). It is easy to use and it can take long shots without problem. The quality of the image depends of the model and can be reasonable. However, you will have little control over the angle of view (it will probably be quite wide), the position of the camera or the depth of field (in general everything will be in focus, from the tip of your nose to your bookshelf in the background).
- Camcorder. I have no personal experience with recent camcorders. The prices range from a few dozen to a few hundred euros. You will need a stand for it, they will give you better control of the framing and the point of view and probably a sharper image. One good point is that they are made for longer video shots and you should have no overheating issues (see below).
- Digital camera. Those can be expensive and you will not want to spend 1000 euros just to look better in your videos. But if you already have such a camera at hand, it may give you an optimal image quality. Like for the camcorder, you will need a stand. Two points are specific to these equipments:
 - The larger the optical sensor of the camera, the more you can reduce the depth of field (DoF). The DoF also depends of the lens aperture and its focal distance. Without going into too much detail, let us say that a *full frame* will give a narrower DoF than an APS camera, which in turn will have a narrower DoF than a camcorder. The webcam having the most DoF of all.
 - Some of these cameras are not primarily conceived for video takes, and can overheat during long shots. This can be the case, for instance, of my Sony A7 in the summer. This can be taken care of by using an HDMI to USB video capture device, which shifts most of the video encoding work from the camera to the computer. Among such devices, one finds the El Gato Cam Link 4K. Basically, these devices have an HDMI input and USB output. The HDMI is connected to the output of your camera; by connecting the USB end to the computer, the camera can be used like a webcam, but keeping the high image quality. One then just has to capture the video stream on the computer with some software.

A last possibility, which I have not tried, is to use a phone. Some phones have a quite high image quality, and this could be an interesting backup solution in some cases. However I imagine it is not very convenient to set up the phone, find the right angle etc... You will also have an important depth of field.

Photographic Stand

The kind of stand you will need depends of the rest of your installation. There exists some small stands which cost little money, to be installed on your desk. This may work but the camera will be quite close to you. A higher stand will give you more freedom and without necessarily being expensive.

Other accessories

In addition to the microphone and a video capture device, some other accessories may be useful. In order to be able to shoot at night, or if the lighting is not very good, you can have a look at some artificial lighting. One now can find some quite efficient affordable studio lights, mainly LED panels. Note however that it is difficult to reach the quality of natural light – but I am no expert at all in artificial lighting.

A useful device is a second screen, especially in order to be able to see your own image while shooting. This allows you to check the framing, to be sure your camera is recording etc. . . The main screen will probably be used for your slides. You can often connect the video control screen directly to the camera (HDMI cable). The details of the installation will vary, for instance depending upon whether your video is recorded on camera or on computer.

Internet connexion

Once edited, a course video takes typically about 500Mb. Before editing, the corresponding files often amount to more than 1 Gb. If you record at home, you will, at some point, need to upload the one or the other. Either to the video server, or to send them to the editor.

This can be a constraint. It is problematic if you are restricted to a 4G mobile connexion. Furthermore, on a ADSL connexion, upload is much slower than download, so transfer can take some time. The best is being able to rely on a good fiber connexion; the upload then just takes a few minutes.

6 When shooting

Seated or standing

If you do the shooting by yourself, you will probably chose to be seated. In a studio, you may be asked to be filmed standing. This is basically fine, but remember that if you move and walk, the resulting impression will be very different from what happens when you move in front of a classroom. It is also possible that you will be given the possibility to be filmed in front of a green background screen, which will make it possible to overlay your image over the slides. In this case, I recommend not to move too much. Having the image of the teacher “dansing” in front of the slide can be disturbing.

Placing your camera

If you film yourself seated, probably at a desk, you will naturally place your camera in front of you. You should pay attention to two points:

- The vertical position: have the camera placed such that your face is somewhat the upper border of the frame, with the camera being horizontal; in other words avoid high-angle or low angle views.
- The control screens: you can position in front of you a screen to show you the slides during the shooting, and, if possible, another one with the image currently taken by the camera. Try to put the first one as close as possible to the axis of the camera, without obfuscating the camera image itself. This way your gaze will not move too much between the camera (that is the students) and the slides. Also, check where your gaze on the image lies when you look at the slides. You can then organize your slides accordingly (see the section “using the gaze”)

Angle of view

The camera will give a more or less tight framing around your face, depending of the distance your camera is positioned and the angle of view of the lens. Check what framing you prefer and what you can do with your equipment. Note that having a very wide angle is not necessarily useful.

It seems that, if you are filmed seating, you will use a lens with a diagonal angle of view comprised between 40 to 60 degrees. For a “full frame” camera this means the focal length of the lens is comprised between 35 and 60mm. With an APS camera, the same angles correspond to lenses of 23 to 40mm. You can try higher focal lengths (telephoto lens) but you will need a lot of room.

What lens and depth of field ?

This section will most likely be useful mainly for camera geeks. But if you happen to be using a camera with interchangeable lenses, you can wonder which lens to use. You can also set the aperture in order to have more or less depth of field (that is how blurred the background is). Without going into full detail, this depth of field (DoF) depends of three factors:

- the aperture of the lens: the more open the lens (low aperture value), the narrower the DoF,
- the angle of view: a lens with a small angle of view (telephoto) will have less DoF than a wide angle,
- the size of a sensor: a large sensor (full frame) will result in a narrower DoF than a small sensor (by decreasing size: APS, camcorder, webcam ou phone).

Having a narrow depth of field allows to blur the background, for instance to avoid having the viewers being distracted by the details of you bookshelf. A very short DoF however will make it more difficult to have your face in perfect focus. In theory, the focus should be on your eyes.

A minor point: if you want to try lenses with large apertures without spending much, you can, on many cameras, adapt old manual lenses which can be found today for little money. The soviet Helios-44 lens for instance gives good results for a few dozens of euros. Do not hesitate to ask me for details.

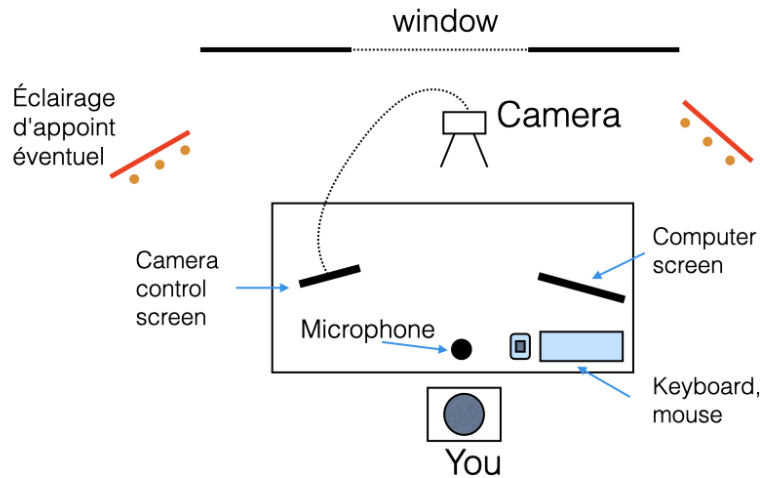


Figure 3: A possible setting for your equipment.

The Light

As already stated, the image quality is not essential for a good course; but you may want to do as well as possible. The lighting question is complex, as shown by the importance of the director of photography in movies. Here are a few remarks:

- Try to have enough light, even if modern cameras are more and more efficient in low light.
- Avoid too violent or directed light (direct exposure to the sun or a single or close lamp). The more diffused the light is, the better (that is the light has to come from all sides).
- Especially if you have to shoot many videos, avoid being too dependent upon the circumstances. For instance needing nice weather or having to finish your recording before the sun has disappeared behind the building on the other side of the street.
- On the other hand, note that it will be probably difficult to achieve the same quality with artificial than with natural light.

Without being too much of a perfectionist, it is worth to make some trials first. Working close to, or even better face to, a window facing north, is perfect. If your window faces south, a translucent curtain should be enough to dim and diffuse the light when you would be exposed directly to the sun.

You may want to add some artificial lighting, like a LED pannel, for the dim days or in order to be able to work at night.

A last delicate point is the white balance. It is difficult to control, and shootings with artificial light can quickly result in a color rendering reminding 1970ties TV colors.

A possible setting

This is just one example among many possibilities, but you can view one setting in figure 3.

7 The Editing

The editing is the stage where all the work described up to now merges and takes shape.

The editing designates the set of operations performed to transform the raw recorded material into the final video. Typically, one will start with two video files, one with your face and one with the slides. As mentioned above, having a soundtrack on both will be helpful for synchronizing them. However it is sufficient to have a “good” soundtrack on only one of them (that is the one obtained with your good microphone). The other sound recording is used for the synchronization but then erased from the eventually built file.

Most of this section will not be necessary if the editing is done by a specialist. But, even then, having an certain knowledge of the process may be useful:

- to have a better idea of what will happen and what you can expect from the editing,
- to be able to edit by yourself if there is some unexpected problem (network failure, you are late with your recordings, the studio is overwhelmed...)
- finally, having edited some videos gives a much more complete vision of the whole video construction process.

I will not give a technically precise description how the editing is done for two reasons: first because it varies depending of the software used, and second because this is best learned through video tutorials. Furthermore, learning to use editing softwares is quite independant from teaching questions.

The Software

Several more or less sophisticated editing softwares are available, depending of the operating system.

On Mac OS :

- iMovie, shipped with every Mac,
- Final Cut Pro, the professional editing software from Apple.

I know less the softwares on Windows and linux, but many are available, some free, others not.

Image resolution and frequence

Video files come in various digital formats. In general the are no big compatibility issues, but this may happen. Do make a test before you first recording.

Furthermore, videos have some physical dimensions that cannot be changed later on without some loss in quality: the size of the image (resolution) and the number of frames per second (fps). For the resolution, one generally uses the formats called 720p (1.280×720 pixels), 1080p (1.920×1.080 pixels) or 4K (horizontal resolution of about 4.000 pixels). Understand that the

resolution is not a sufficient condition for a good image quality. In general 1080p will be enough for course videos – at least they should not be perceived as obsolete before quite some years. Even a good 720p image will be satisfying. But be careful to make the editing easier by having a good compatibility between you video and slides recordings:

- Have files of the same resolution.
- Do set the camera and the computer so that the fps rates of both files are the same, or at least are compatible. Having one 30fps and one 60fps file should be fine. But avoid exotic, generally historic, rates like 23.976 fps; this would make the editing very tedious.

These frequencies are set:

- For the video/photographic take, generally, through the menus of the camera.
- For the slide capture, in the parameters of the software (or the exportation settings for keynote/ppt).

In general the default settings will be fine. It may be easier to make a test: export a video file, open it with VLC and then check “informations about the media”.

How it works

In general, you will start by importing your recorded files. You will then create a new video (or “project”) which will have its own timeline. You will place the imported files on the timeline, adjust their respective positions (using the soundtracks). You can then cut out part, switch from the image of one file to the other, or insert your face in slides by cropping and resizing it, etc. . .

It is also possible to add additional material like fixed images, or add some highlighting effects. . . I will say some more words about using the editing to correct errors later on.

Once you are satisfied with the result of your editing, you can export the result as a new file. Export at full resolution if you are in 1080p or 720p. Your video can now be made available online.

Does the editing take a lot of time?

This is a legitimate concern and the answer is “it depends”. Once you master the basic features and commands of the software, some videos can be edited quite quickly. In general, you will at least need some more time than the duration of the final video. In some cases you do not need much more time, but only if everything goes well and if you do not use complex effects. Some points:

- The cleaner your recording, the smoother the editing will be.
- On the other hand, cleaning the recording, for instance to cut out mistakes, can take time.
- The fact that your slides are well-designed can also make the editing much easier and faster. It will be much more work if you have to perform some adjustments in order to fit in your face.
- It takes some time to add other moving images (like a live-coding screen capture or a graphical animation made by a program).
- Of course, adding highlighting at editing also takes some time.

8 Going online

Your videos will be accessible online from the page of your course. Polytechnique provides its own ubicast server, with a the possibility to control and restrict the access from the moodle pages.

Note that, in case of a problem, you can upload videos on youtube or dailymotion using the option “not referenced” (or “private” on dailymotion). In this case, one will not need a password to see it, but know the URL, which limits the risks of uncontrolled diffusion. It can be a backup if there is some problem with the ubicast server.

Note that any server (ubicast, youtube or dailymotion) will compress your video before it is made visible. This will take a little time.

9 Correcting Mistakes

Written Mistakes

I often do errors in my slides – among others because I tend to modify them even just before the shooting. When one notices a written error after the recording, and even after editing, it is generally not very difficult to correct the video:

- one makes a corrected version of the slide,
- and then inserts this corrected version “over” the erroneous slide with the editing software.

It happened to me several times to notice an error during the recording. After a while I caught the habit not to stop the recording, knowing it would be easy to correct later on.

Spoken Mistakes

It is more tedious if you have made an oral mistake (for instance if you said “x” instead of “y”). If you want to correct it without going through the whole recording and editing sequence again, you need to record an audio “patch” which will be pasted over the original soundtrack, again using the editing software.

When you record this patch, you need to reproduce the same conditions than the original recording, and, most difficult, to talk with the same tone. This is not very easy; fortunately this is mainly a cosmetic detail.

10 A little further: Movie making

It is admitted that the technical tools are part of a cinematographic artist’s palette. A movie maker can chose creatively to have the sound-track of one shot to go on although the image has already switched to the next shot, she or he can choose the musical soundtrack, the framing, the depth of field, more or less contrasted lighting... In other words, in movie making, all the technical tools can be used by the artist and contribute to the filmwork.

Even if we only deal with modest lecture videos, we may also make a creative use of the many technical ways of the motion picture tool. All the more that the digitalization has made many effects much easier and cheaper. You can, for instance:

- add animations, possibly produced by your own programs, to illustrate how some algorithm works.
- Use crossfades between shots.
- Shoot some sequences outdoors. For instance, I remember Dominique Rossin recorded himself in a machine room, in order to introduce some questions related to the communication between computers.
- Have another colleague make a short intervention, possibly as a dialogue with you, on her or his speciality.

The only limit is your imagination. Of course, the aim remains teaching; but used well and with measure, such innovations and excursions can make your course more lively, more attractive, and, in the end, more efficient.

11 The Quizzes

Many teaching platforms enable you to submit quizzes to the students. Very often, these quizzes consist of MCQs which have to be answered during or after watching the videos. Finding out good questions for these quizzes is often somewhat tedious. All the more since it is quite easy to make mistakes when doing so.

They can however be useful for several reasons.

- It is the first moment where the students are explicitly asked to be *active*.
- Answering, even a simple question, is a confirmation for the student that she/he has indeed understood and has acquired new knowledge.
- The simple fact of asking this or that question already highlights one point of the material. As such, the quiz is part of the course.
- If the first questions generally closely stick to the lecture, one can then ask other questions to open up the field, hint at other applications. However, I generally view the quizzes more as a learning than an evaluation tool.

Note that you can use the quizzes to motivate the students to watch the lectures in time. One possibility is:

- Some points of the final grade are earned through the quizzes,
- a part of these points are earned just by answering the questions in time, another part by giving the correct answers.

12 Brief Conclusion

These few pages start with very general considerations about teaching to end with many very practical details. But I believe this reflects the very nature of teaching and specifically the combination of teaching and video. I would not know bibliographical references on the topic, although I am sure there are some; I will be grateful to the readers who would point to previous work on the topic. I would be happy to listen to possible remarks, and to answer possible questions - be it because they would help to discover the blind spots of this text.

Even if it does not specifically deal with teaching, the book *Visual Thinking for Design* (Colin Ware, Ed. Morgan Kaufmann 2008) helped me to realize how important the spacial organization of presentations could be.

I wish all the best to the colleagues who embark on this adventure.