[Mary] Okay, don't worry about it. Okay. Hi friends in-person, online, in the future. My name is Mary Ton. I'm the digital humanities librarian. Today I'm delighted to be joined by my colleague Dirk Ton from the IDEA Lab in Grainger Engineering.

We usually have Cadence Cordell helping manage the chat, but it's just me today, so my friends online, if you wouldn't mind holding your questions until the very end. I'm going to do my best to monitor the chat, but because of the setup that we had to use today, I won't be able to monitor it in real time.

So I am absolutely delighted to talk a little bit about the research that we've been doing on behalf of the library.

And we have many thanks to give. So there were a lot of people involved in making this presentation possible.

We'd like to thank Megan Sapp-Nelson for helping Dirk travel to the places that we're going to talk about in this presentation. And for the IDEA lab for offering us equipment and support, the Scholars Travel Fund for helping me get to a conference at the David Livingstone Museum in Blantyre, Scotland, which you'll see some of the objects floating around and in the presentation from today.

I'd like to thank Taptika Bhandari, who you see in the picture, receiving joyfully some magic lantern slides from a private collector that I had the pleasure of delivering, who is our contact and fierce supporter at the David Livingstone Birthplace Museum.

Behind her is Kate Simpson from the University of Sheffield, who also helped coordinate some conversations with the Advanced Materials Research Center, it does so much research, I have accidentally put research twice in the slides.

Thanks to Xiao for helping me research some of the - the copyright issues that you'll learn about today, and JP Goguen, as always, for helping us troubleshoot even on - even when equipment just doesn't want to behave for us.

So today's slides are at go.illinois.edu/scanning3D.

It always makes me feel like a celebrity when the participants in-person pull out their cell phones and are starting to take photos.

Anytime you see a yellow text, it means that there's a link and there's a lot of links in there today. There's also - the link is case sensitive. So just keep that in mind when you are typing that in.

I'm gonna periodically scroll over the zoom controls, so that I can see if we have any questions coming in from the chat.

But those of you who are online, just please keep in mind that that chat is visible to in-person participants as well, just because of how we're having to do this screen sharing.

Okay. So, 3D scanning is really cool. 3D scanning is really cool for humanities projects.

There's been lots of conversations about 3D scanning in the cultural heritage sector, especially with this bust of the ancient Egyptian queen, Nefertiti.

This particular bust was made public open access through a Freedom of Information - yes, Freedom of Information Act request from a museum in Germany, and we have some prints in miniature floating around the room today.

But artists more recently have also been using 3D scanning to repatriate objects to their location.

So here you see an example of the return of Rashid, where a group of artists went into the British Museum. They scanned the Rosetta Stone and then used the techniques that we're going to talk about today, and augmented reality to replace the Rosetta Stone back in its - in the courtyard in which it was found.

So our goals for today are to describe how 3D digitization works, identify best practices for creating 3D models, and hopefully, if things are working out for us, demonstrate how to use Polycam.

And again, the short link is go.illinois.edu/scanning3D.

So first, we need to talk about how are models created, and there are two basic families of approach. The first has to operate from the set of techniques that we use to locate objects in three dimensions.

So you've probably heard of radar, especially if you look at the weather app to see how fast the storm is coming into town.

You might have also heard of sonar, or if you've been watching any sort of war movies where they're trying to detect submarines and you hear that "ping...ping".

So these technologies operate very similarly to the technique that we use in scanning called LiDAR. So LiDAR stands for Light Detection and Ranging. How this works is that the sensor first emits light.

The light bounces off objects in the environment. The sensor then takes, or times how long the light wave takes to return, and uses that information about the timing to calculate the distance from the sensor to the object.

And then the sensor also uses the shape of the returning light wave to see the landscape. So here you see a couple of examples of different-different ways that the wave will mold and shape based on what it's

seeing. So you see, on the top, the topmost or the top right, that if there's nothing between the sensor and the ground, it will come back with just little blip for the ground.

If there's an object like a wall, it will have a blip where the light - a small blip where the light bounces off the top of the wall, and a larger blip when the light encounters the ground surface, and then for things like trees it will register, oh that's the top part of the tree, the bottom part of the tree, and that's the ground.

What this allows researchers to do is to filter the results based on the shape of those waves, so that they can digitally remove the trees and see the ground that's underneath.

So you've probably heard about LiDAR in conversation with archaeology.

So the example that you see on the left is the courtyard of the temple complex in Ankor Wat, and you see all the visual removed and you're looking at a model of the surface of the ground.

Usually LiDAR is particularly effective when - or, LiDAR can be a very effective technique when you are doing aerial photography, but it can also be used up close too. So the example that you see on the right is from the wall of King Tutankhamun's tomb, and it received a lot of attention because it became the basis for the argument that there's a room behind one of the walls.

That, that claim was later debunked. But I still have hope that it's - that somewhere, there's another chamber hiding.

So limitations, this particular method can be - the equipment to do a LiDAR scan can be very expensive. In fact, the equipment that the library has is $20,000. Makes me nervous every time we pick it up.

Distance can be a factor, so it can help you measure from a great distance, but depending on the tool, you might have to be really, really close. So the tool that we're going to demonstrate, Polycam, has to be relatively close to an object.

And then the surface and environment can affect the results. So things like weather, lighting conditions, is the reflection shot - or, is the surface really shiny, can have an impact on how well the computer can create the 3D model.

So the second family, the second method, or second family of methods that we can use to create 3D models has to do with computer vision and how a computer sees 3D objects. So if you were here last week for the Deepfakes workshop, or have attended any of the generative AI and image-based tools workshops, you kind of know what I'm about to say.

Because a lot of the same techniques, or a lot of the same principles that are running artificial intelligence and tools like Midjourney are also behind a technique called photogrammetry.

So what photogrammetry is doing is, it's using photography to construct that model, and what it's doing is it's actually looking for patterns in pixels.

So pixels are the basic building blocks of digital images, and photogrammetry as a process breaks down images into pixels.

It looks for patterns in those pixels. Specifically, it's looking for red-blue-green color values. So is it black, like the clothing that we're wearing? Is it white like the ceiling?

It also looks for outlines. So the shape of my head, my shoulders.

And then it looks for texture. Is it something relatively solid like my shirt, or is it patterned, like something that has a whole wine or a floral print?

After it has studied those patterns, it will look for patterns to stitch images together in order to create a 3D model. And it requires you to take photos around an object in 360 degrees. Much like you see, so I'm gonna backtrack a little bit.

So what you're seeing here is, a 3-dimensional model that was created from photos that were taken all around the object.

Now, those of you who know computer vision know what I'm about to say, because it is my favorite problem in all of computer vision. When you're looking for patterns, sometimes that process can go wrong, and it's affectionately known in these circles as the Chihuahua or Blueberry muffin problem.

So, the reason why a computer has trouble seeing a - or distinguishing between a chihuahua or a blueberry muffin, and also the reason why computers have trouble building three-dimensional models, is because there might be similar RGB values. There might be similar outlines, so there's, in this case, it's the circle, circular shapes, and similar textures.

So you'll, when we're talking about photogrammetry, you'll see this problem if you're trying to scan something that has a relatively uniform surface or is all one color.

It will also have trouble figuring out what the shape of an object is if it's fairly uniform or standard.

The more unique it is, it - degrees of uniqueness can help it actually construct that model for that reason, because it's looking for patterns in pixels.

Okay, so I've already kind of hinted at what some of the limitations are. Uniform surfaces, uniform shapes can be really difficult for these tools to pick up. Lighting conditions can also create like a streak of reflection.

So we have a model of Mons Meg, the big cannon in the castle in Edinburgh, where we were taking a photograph on a fairly sunny day, and there's like a giant streak in the model.

Here you see on the right hand side, there is a space where it wasn't quite sure how to interpret the surfaces. So you're actually seeing through a small stone model of a head, and because it wasn't quite sure what the patterns and pixels were, you can actually see through the head. Something has gone wrong. So uniform shapes, lighting conditions.

It also requires lots of computing power in order to study these patterns and stitch the model together. It usually requires a powerful machine. But there's some workarounds now that we're really excited to share with you.

So, things to consider before you scan. There are some things that aren't technical, but are best practices for thinking about how to create digital models ethically, responsibly, and making sure that - and legally as well.

I'm gonna scroll up and see if I can see anything in the chat. It looks like we're okay.

So the considerations before you scan, it's important to consider the copyright. It's important to evaluate if this is something that is a traditional cultural expression. It's important to consider museum policies as well as any - and assess any risks to the object itself.

So when we're thinking about copyright, we're thinking about the owners' right to distribute the work and their ownership of it.

So copyright does protect works in a fixed medium of expression, which includes sculptures and other works of art. And works have to be sufficiently creative in order to be copyrightable. So most of the things that you're going to find in a museum setting do count as something that's in a fixed medium of expression, so keep that in mind that they do have copyright.

But copyright has some limitations on it, and that might work to your advantage when we're dealing with ancient artifacts.

So, this is a little bit more before I get into that, a little bit more about copyright and the sufficiently creative clause.

So you can't copyright utilitarian things like a bowl or clothing, but you can create - you can claim copyright for the creative elements of that object. So something like the feet on this decorative bowl.

Like I said, copyright has some limitations. So copyright doesn't last forever. It expires and this is much - this is really joyful for us librarians, because it means that we can use things in certain ways.

So the copyright term for anonymous works, including many ancient artifacts, lasts for a period of 95 years from the first publication of the work, or 120 years after its creation, placing most cultural heritage objects in the public domain. So the objects that we were working with is the David Livingston Museum, are over 120 years old and therefore would be considered legally in the public domain.

Now just because everything is legal doesn't necessarily mean everything is ethical. And one of the things that we want to encourage you to think about is if it would be ethical to share and represent these objects.

So. I'm getting ahead of myself though, because I am really excited about the ethics.

So within copyright, there's also the consideration if something is considered a derivative work, or what's in the legal language as a "slavish copy".

So, translating a 2-dimensional work protected by copyright into a 3-dimensional work without the original artists' permission can be considered an infringement on the original artists' copyright and the resulting 3-dimensional work would be considered an unauthorized derivative.

So if you are more creative and you're considering making your own 3D models and printing them, this is something to keep in mind, that if you're basing that work on something that's copyrighted, you will need to get the permission from the original artist.

Now, there is a very famous case, Bridgeman v. Corel, where it determined that slavish copies, copies that are meant to be a - as, like, one to one accurate representation of the original, cannot be considered copyrightable because they do not meet the minimum requirement for creativity and originality.

And central to this case was the portrait of the Laughing Cavalier that's in the Wallace collection in London.

If ever you go, the Wallace Collection has a lot of weapons. Massive collection of European arts and armor. Very cool. So, ten out of ten, recommend.

But, this particular photograph of the Laughing Cavalier is meant to - is not meant to exhibit any kind of creativity. It's meant to represent the laughing cavalier accurately as a painting, and that painting is no longer copyrightable because of its age.

Alright, so, back to... even though it's possible, it doesn't necessarily mean that it's ethical, and there are legal constraints around Native American grave goods, particularly in an American context.

So the Native American Graves Repatriation Act, or NAGRA, protects and returns Native American human remains, funerary objects, sacred objects and objects of cultural patrimony.

Now this applies specifically to tangible items of cultural heritage. It doesn't...it doesn't protect things like oral histories, or songs or dance. And so it doesn't cover intangible forms of traditional knowledge like field notes, sound recordings and videos, or the information that's contained in them.

So there's been lots of conversations about traditional cultural expressions at an international level to give indigenous and local populations more autonomy over these forms of knowledge.

The World Intellectual Property Organization defines them as "traditional cultural expressions", or TCEs, as "integral to the cultural and social identities of indigenous and local communities, and they embody the know-how and skills, and transmit core values and beliefs."

So, Sarah Benson, our amazing copyright librarian, has been deeply involved in these conversations at an international level.

We as a university are advocating fiercely for the rights of Indigenous and local peoples, and making sure that these protections extend beyond national borders and national legislations.

So can museums, if... if museums can't copyright their work, can they at least, or can they restrict making copies of their work in any way?

They can do that through several vehicles. They can not allow photos in the gallery. So if ever you've been to a museum and aren't allowed to take photos, that's one way that museums can control how these images are shared and objects are shared. They might try to license high quality scans for a fee. And they might also limit the use of their digital collections through terms of service.

So by using our digital collections, you agree not to use the images in the digital collections for commercial purposes or remix them, things like that can be in the Terms of Service.

Now, the good news is that museums in the European Union are under increasing pressure to make files open access due to the 2019 EU copyright directive, and that's part of the reason why we now have the high quality scan of the bust of Nefertiti out and available to people for people to download, print and share.

So finally, risk factors. It's important to consider the object as well as the goal.

So some risk factors can be exposure to certain kinds of light that can damage an object, moving an object and turning it around as part of the photography project can, can risk it.

It can also...some people use substances to minimize reflections, so like baby powder on an object, especially for engineering applications.

Great if you have, like, a fully metal machine part that you're trying to digitize. Not great if it's something that's sensitive to baby powder, and an ancient artifact that you're trying to preserve.

The other consideration is using a substance to minimize movement. So, when we were chatting with some engineers at the AMRC, they use like the blue sticky tack to make sure that objects are secure to a plate, so it doesn't move while you're trying to photograph it.

Again, works great if you're machining parts, not so great for cultural objects.

So this is an example of a low risk activity in the National Museum of Scotland, where we were taking both LiDAR and photogrammetry, or creating models with LiDAR and photogrammetry.

We were not risking the object, we were abiding by museum policies. And we also were mindful of the other museum guests, to make sure that they could experience the object too.

So, overall, do's, evaluate the copyright status of the work. Honor indigenous ownership of traditional cultural expressions. Follow Museum photography policies and keep the object safe.

Don't's. We do not recommend scanning objects under copyright without the creators' permission. Sharing traditional cultural expressions without permission of indigenous communities, violating museum policies, or damaging the object as you're digitizing it.

So, you've heard my voice for quite a bit now. I'm going to pass it to my colleague, Dirk Ton.

I think we might need to just switch seats because camera and the rolly-chairs. One moment, please. [laughter as they switch places] The rolly-chairs are the one thing that does work. Yay! [undistinguishable]

[Dirk] So there's a lot that we can actually use nowadays for the purpose of trying to create these digital scans, and some of it we actually have here on campus.

So one of the objects we - sorry, not one of the objects, one of the tools we have... One of the tools we have here on campus is the aforementioned Artec Leo.

It is a combination LIDAR and full color scanner. And so what it's doing is it's taking that LIDAR scan of the surface, and simultaneously overlaying a true color photograph of the object from that exact same angle.

And so what it's doing is inside the unit, it is meshing together the photograph onto a wireframe that it is building inside the unit.

This is particularly useful because that means it is handheld. It weighs about 15 pounds. But it's handheld and can actually be taken out into the field.

I tried to find a photo of it, but there's actually a group in Iran who is using an Artec Leo to scan ancient sites to preserve them while they can.

Unfortunately the Artec Leo maxes out at about 2 meters. So what they did was, they took this very portable, very expensive piece of equipment, and put it onto a 30 foot bamboo pole, and were running it up and down the surface of the inscription of the temple to try and capture it.

It worked. I wouldn't want to be that person because, if it tipped over, your dollars.

But what that does is it gives us very high quality scans, not just of the surface, but of coloration.

So things like Tutankhamun's tomb, where something that you have very high visual impact, you can actually then say, well, the coloration is great. We'll use that for these purposes.

But we want to see the actual surface, and that's where this question of "is there a door" came in, because suddenly, if we ignored the coloration of the wall, we suddenly saw that there are these perfectly straight lines in the fabric of the wall, and that got people thinking like, "Why would you have perfectly straight lines on a wall if it wasn't covering up a door?" And so that kicked off that whole controversy.

The Artec Leo also does have some detractors, one that it is a proprietary software. The file that the scanner makes can only be read by the Artec Studio program. Cannot be exported in any other fashion.

Not great. But it is trying to stitch a lot of information together simultaneously. Okay, we'll give them that.

And with these combination scanners, they are not cheap. There are alternatives out there that do similar things. And we'll discuss a couple of them. But with anything that is trying to really push the bounds of technology and scanning, you get what you pay for. And if you want really good, you're gonna have to pay really well for it.

One alternative is pure photogrammetry. So if you have a camera, you can actually use photogrammetry. Full stop.

The camera and the source of the photo is the biggest expense. This is an example of a program called Meshroom. It is free to download, open source, free to use. And it is one of the more robust photogrammetry programs.

It will take any photo, as long as you have enough photos, and it will try and stitch an object together from it. Doesn't matter if it's from your cell phone, from a really nice macro lens DSLR. I don't know why you would do it with 3,000 Polaroids, but you could. [Mary laughs]

[Mary] Digitized Polaroids.

[Dirk] Digitized Polaroids, still has to be a file. I'm hoping for one day that you can just show the photo to the webcams like, no, see, it's the same thing.

But Meshroom's party trick is, it will take photos and it will make an object.

There is some limitation, as Mary pointed out about computer vision in that you have to give it enough photos that it understands how to stitch this thing together.

So, the fewer photos you're using, the more you're really kind of relying on the AI or whatever processor you're using to say like, "oh yeah, sure, with, with an eye of faith, that could be the same object."

Well, let's not guess. Let's give it more photos and make sure. But since it just takes that raw data to create a point cloud to create an object-if it's a digital photo. It'll take it.

Then we have, kind of the bridging tools. So LIDAR is great. Very high sca-high scan. Kind of expensive. Photogrammetry, very great for coloration detail because you're just feeding data into a processor.

And what kind of struck me is photogrammetry and LIDAR have kind of been with us for a bit. And LIDAR was actually invented during the Apollo missions. To keep track of, I think...Was that? Apollo 14?

Where they first, NASA first officially announced that they were using LIDAR to track the module during TLI.

And so with, since we've had this technology for a bit, it has had time to mature, and we're now seeing a very real interest in, "Well, this is great. How can we use it in a much more open source, accessible fashion?" And one of the answers to that is a program called Polycam.

Polycam is free to sign up for. You can put it on a phone. Yep. And it's leveraging the fact that most modern cell phones have multiple lens cameras. And if you have multiple lenses, then you can triangulate -well, not triangulate, but you can create a focal point of a known distance, and if you know the focal distance, and you've got a photo, then you can actually start stitching those photos together with the metadata needed to give a program the data to stitch those photos together faster and in a much more detailed manner.

So with Polycam, it's also got the added benefit that most modern cell phones also have their own mini-LIDAR range finder. So if you have...

[Mary] It looks like a little dot on the face of most cameras, and it's used for finding the focal length if you are taking it portrait.

[Dirk] Yup. So if it's using LIDAR to find out how far away you are for your selfie, then why can't we use that LIDAR to scan an object? It's literally doing the same thing.

So Polycam, we found, is an interesting bridge between photogrammetry and LIDAR scanning, and it's within a much smaller, much cheaper device that you can carry on you, and that means that instead of having to make sure the Artec Leo is charged and that this condition's good for scanning, you can be walking in a museum, after checking their policies, and say, "Hey, this is a really amazing piece. I've got my cell phone on me."

And you can actually scan right then and there. The advantage of this is that it's creating the object, it's now giving you full access to the object in a device with cameras and a display.

This means that Polycam's other party trick is it is actually designing itself to help with augmented reality.

So you can take a scan of any object or any statue or anything, after checking its copyright status, and you can then use that same device and project that 3D image or that 3D object into a new space that you can then view in full dimension within that display.

So much like, if you get the chance, check the Repatriating Rashid, where they're taking that scan, then taking a display device back to the courtyard and they are projecting it, and you can move around the projected image using augmented reality to then see how it interacts with the space.

So Polycam is great for objects. It also has a really great other feature inn that you don't have to be concerned with just objects.

Using the LIDAR, you can also create scans of spaces. So if you are very concerned about an object, that's great. You also have the added benefit of what is the context of this object.

If it's in its natural context and that is something that you believe needs to be documented and scanned along with the object, all you have to do is change mode and start scanning the environment that that object is in. And it uses the same techniques and the same tools to go from object to space.

And so you can scan essentially all in one for anything - not anything you might need, but, you know, it gives you more robust options.

Other great aspects of it, highly mobile. If you can access your phone and move it around and you can move around, you can scan a space or an object.

There is a free version. There is a pro version that does cost a subscription. But as we quickly found out, all you have to do is give some sort of review, and...

[Mary] You get like 50 credits.

[Dirk] Yeah. You just get more access. And so - for free. And it is worth commenting. It's not just you don't have to say, oh, this is great. We should always use it. You can critique.

They are looking at the comment section to say like, well, in this environment the LIDAR has problems with this kind of object or this kind of setting. And they'll actually address that and roll - hopefully, take that to heart and roll out updated versions.

And you don't have to, you don't have to keep it stuck just on your phone. You can access Polycam via a desktop or laptop. And it will give you the ability to more detail - edit your object in more detail.

You can also upload video files. So it will then take that video, break it down into individual frames, and use that as the image source for creating a model or an environment. So again, all it wants is data. It doesn't really care how it gets it.

So what? You've been spending this time scanning environments, scanning models. Realistically, what can we use it for?

For educational purposes, you can absolutely annotate. Your object, make it available and use it as a teaching object.

Give people the ability to manipulate it digitally, to zoom in. Add data points like, with the example of this magic lantern, you know, name the parts.

If it's something like a pot or a cultural object, you know, give the details as to why it's an important piece. Well, this this decoration here, we know is being made by somebody's thumbprint, you know, 15,000 years ago.

So we know that, you know, this is a decorative stock. This is why we're calling this particular flint a scraper rather than an arrowhead because of this distinct shape.

You can attach your own metadata. You can attach new information to the object as you need.

It also gives us the advantage in, now that VR is becoming a much more accessible medium, we can actually take this data of these, not just the objects but the environments, and we can port them into AR and VR programs.

So that if you need an asset for a video game you're working on, and you just need - I need a house. I don't wanna go through the hours it's gonna take to 3D model a house. I'm going to scan my house. So you just walk around your house, turn it into a virtual model.

And then you can port that directly into Unity and Unreal Engine, the engines being used for most high-end video gaming. And you have just saved yourself a lot of time trying to 3D model this thing and, your house is now in an Assassin's Creed video.

[Mary] Yeah, and fun fact. So, Dirk just mentioned Assassin's Creed, but one of the things that was really cool about partnerships with gaming industries, and I'm leaning into the mics so that friends online can hear us.

Don't worry, we actually are married. So, that's why we shared the last name. Surprise!

But, Assassin's Creed scanned the cathedral of Notre Dame so that when the fire hit, the best and most highest quality scan that they had was for the Assassins Creed and they're using the information that they gathered from the gaming industry to help reconstruct it after the fire.

Okay. I'll scoot out and back to professional mode.

[Dirk] So one other advantage of creating these digital models and making them of available and shareable is, with the rise of 3D printing, we can actually take something from the physical to the digital and back to the physical.

And in case you have more questions about this magic lantern, here is a QR code and link.

[Mary] That was placeholder slides.

[Dirk] A blacksmith hammer-

[Mary] -going from the digital model, or the physical object, digital model, back to the physical.

[Dirk] So this is proof of workflow that you can take something from physical again, to digital. Do anything you need to with it digitally and then take it back to the physical.

[Mary] We're gonna have to speed through 3D printing so that we have time for questions and for demoing Polycam.

[Dirk] So, so FDM printing, one of the most common 3D printing styles, at the moment. Essentially you're heating up plastic, laying it down, as you would a birthday cake icing. And it's using the same G code process of XY and Z access. As you would a milling machine or a CNC router. These are actually very cheap for introduction and very user friendly.

[Mary] This is video. Oh no.

[Mary] So the 3D model that's floating around of the African headrest, that is that object and the video that you see are the same thing. This was created on IDEA Lab printers. Thank you, Dan, for modeling it for our in-person friends.

And so the blue one was created using the same method of printing, but a different printer. And it has had those supports removed so that it could. So you could see the full object. That one still has it supports because it needed extra material in order to build out the headrest part.

[Dirk] So the other most common form of 3D printing is SLA, or goo printing. I know.

So instead of laying down the material in a coordinated fashion, SLA printing is actually using UV and essentially your cell phone screen to shine UV into a vat of UV-reactive plastic, which then hardens. It pops it off the surface.

Resettles about half a millimeter away from the screen again. Next photo. And so it's like a reverse MRI, where instead of creating slices of an image, you're actually creating slices of an object from an image.

Like very, very fine detail. So the anvil, some of the Nefertiti busts are actually SLA printed and so they can do smaller objects.

Much more detail. And even that's becoming a very accessible printing method. The resin printers are becoming much cheaper, much higher detail.

[Mary] Yeah, if you're a tabletop gamer, SLA is the best way to print DND minis and minis for your games.

[Mary] Yeah. There was this. This is my bad, not his.

[Dirk] So, like any technology, 3D printing is becoming very popular. It's definitely entered the public consciousness.

It's not perfect yet. You do have to get to know your printer. You do have to get to know the method and the program that you're using. Because unlike the movies, you can't just push a button and walk away.

[Mary] Yes. So the issue that you see here, Dirk was talking about the suction that it - it cures a layer of resin, pulls it off the plate, and then puts it back down again.

What happened was the suction was so strong, that it pulled the model off of the supports that you see still above in the bill plate. So it just kept curing and curing resin while it was in the bath. So that was unfortunate.

So, I'm gonna talk about resources. One more speedy thing. [aggressive scooting] Okay. Hi friends.

So, I'm gonna quickly go through resources. We'll set up polycam while I do that. And, we'll take some questions before then, but library resources.

So of course there is the IDEA lab. There's lots of support and equipment for you to use. They're closed for the summer, but if you're thinking about using this for your teaching or are curious to explore, you can reach out to them.

So for scanning they have the Arctec Leo, they have Meshroom. For 3D printing, they have several filament printers as well as resin printers.

I see some Grainger folks in the audience here. So yeah, we gotta represent.

And then, for virtual reality, lots of headsets both that are tethered and untethered. And more!

Coming soon. So one of the things that we're most excited about is a partnership with Illinois Computes to have an instance of Meshroom on our supercomputers free to use.

So, stay tuned for more updates about that, but essentially, Illinois Computes is giving us the computing power to stitch together those photos so that it decreases the time it takes to create those models.

So please check out Illinois Computes. They also have a lot of other resources for digital humanities. One of my favorite things that they offer is Jupyter Notebooks. So if you do any sort of code, you can use their super computers to do that.

There's also the SCIM lab in Grainger Engineering. They also have a range of augmented and virtual reality equipment. They also can do cool things like motion capture video and use AI to generate versions of that using TensorFlow.

At the moment they are by consultation only, so be sure to check out the link in the PowerPoint.

And finally, there's also Preservation Services, who have been doing digitization for far longer than we have. So they also do conservation and preservation as part of their services.

And they have done 3D modeling in the past, including some musical instruments from the Sousa Archives, and we strongly encourage you to check out their hard work and excellent work on our digital collections.

So last but not least, if you have questions, we usually have answers, but we also know where to ask if we don't.

So please feel free to reach out to me, Mary Ton, if you are doing 3D modeling for cultural heritage. I have also supported teachers who are teaching with replicas.

So what kinds of printing methods are best suited for the teaching applications that you have, as well as the assignment design, what kinds of questions can you ask and what kinds of insights can you get students to come to through that conversation?

There's also Sarah Benson with copyright questions, and the IDEA Labs' general email, for all your scanning, photogrammetry, 3D printing and VR needs.

So, I will say, one last plea. Please take the post workshop survey. We are hoping to offer a version of this workshop in the fall, and any feedback that you can give us would be fabulous.

For our friends in-person, I'm afraid we do need the objects back at the end of the workshop, but I'm going to stop the recording and open the floor to questions, and we'll demonstrate polycam in just a moment.

Thank you!