

Lab 5: Photogrammetry

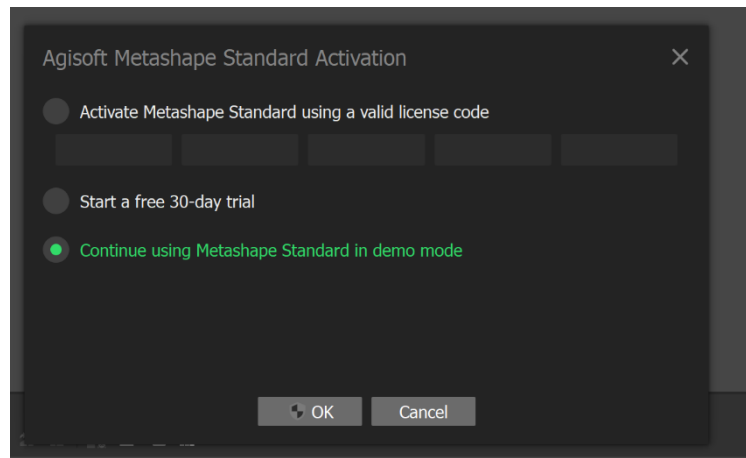
Certain parts of the workflow (e.g. using a cell phone, handmaking targets, etc.) are contrary to the ideal conditions discussed in class. This is purposefully done to make the lab accessible to everyone. Because we are using a free trial of the software, we're only going to be able to finish part of the normal workflow. If you encounter technical difficulties, please reach out to me, and also feel free to adjust quality/detail levels during the prompts.

3D modeling is difficult and success is definitely dependent upon equipment. It is entirely possible your machine won't be able to complete this process! That's ok. Give it a try; **the experience in itself is valuable**, especially when you consider that archaeologists may be doing this in less-than-ideal conditions.

I am grading you based on demonstrated effort – so if your model won't render in step 20, take a screen shot showing me how far you got. It's ok if it didn't work!

I. Software Installation

1. Download Agisoft Metashape Standard edition
<https://www.agisoft.com/downloads/installer/>
2. Install software. Click through the default options.
3. Open Agisoft Metashape Standard
4. You will see an activation screen. You have two options:
 - a. "Demo Mode": you can create 3D models and look at them via the software. There's no expiration. I recommend using this option for class time, and you can always go back and do the trial after you get the hang of it.
 - b. 30 Day Trial mode: you can export your model and save it as a file on your computer.



II. Photography

5. You can take these photos using your phone, a tablet, or a high quality camera. **If you use an Apple device:** check your camera settings; make sure your photos are saved as jpegs. iPhones default to a format that is incompatible with Agisoft software.
6. I am supplying targets in class but want to also show you this homemade option. Use a sharpie or other well-pigmented marker, and draw clean, clear shapes (4 or 5) onto square pieces of white paper. Each shape should be unique.



Note: I only used three targets and regretted it. Use at least four.

7. Select an object.
 - a. Easiest: a fairly smooth surface that rests evenly on the floor and has one or two defining features. Examples: a Yeti mug, a flower vase, a wide bowl, etc.
 - b. Hardest: Keep in mind that you need many overlapping photos, so objects with small interior spaces, soft objects (e.g. pillows, blankets), or cramped handles (e.g. coffee mugs, Hydroflasks), objects that are small + flat (cell phones, eyeshadow palettes) might not be the best first try.



Example of a good object to try.

8. Set up the photoshoot.

- c. Find an area with even, bright light that can stay untouched for a while – you might need to go back and retake photos, and this setup can't be moved! Outside is best. I used my kitchen floor. *Note: those of you living in a darker space should try your best to find good and even lighting. This might require shooting at a different time of day.*
- d. It's ok if there's stuff in the background but try to find an area that's not too cluttered. Shooting with a bookcase in the background can definitely complicate things.
- e. Place targets around the object. You can see here that I used homemade targets – this will definitely increase chances of error, but I want to demonstrate that you don't need a printer. If you have a printer accessible, definitely use the targets!

9. Read over these rules and then start photographing. Your goal is to capture a wide range of distances and angles, covering all surfaces of the object.

- Again: make sure your camera is shooting Jpegs.
- Try your very best to keep at least 1 (2 is better) targets in the frame.
- Definitely get an overhead shot.
- Overlap your photos.
- Make sure the photos are in focus.
- You don't need to go in any particular order but being systematic will help you keep track.
- Do NOT move the photo set up until you are completely done photographing. Move your body, not the object.

In a real-life scenario, we would leave the studio set up while processing the images in case we needed to shoot more. Since we only have 1.25 hours, you won't have the ability to go back and make minor photography tweaks to improve the model.

- More photos are better for producing the point cloud but will also slow down the process. Strategic overlapping and including multiple targets is really going to help in this regard. To give you an idea, the model you see in this lab required 135 images.
- The next page includes screen shots of my image folder. Notice in these examples how I tried to capture a variety of angles and distances.

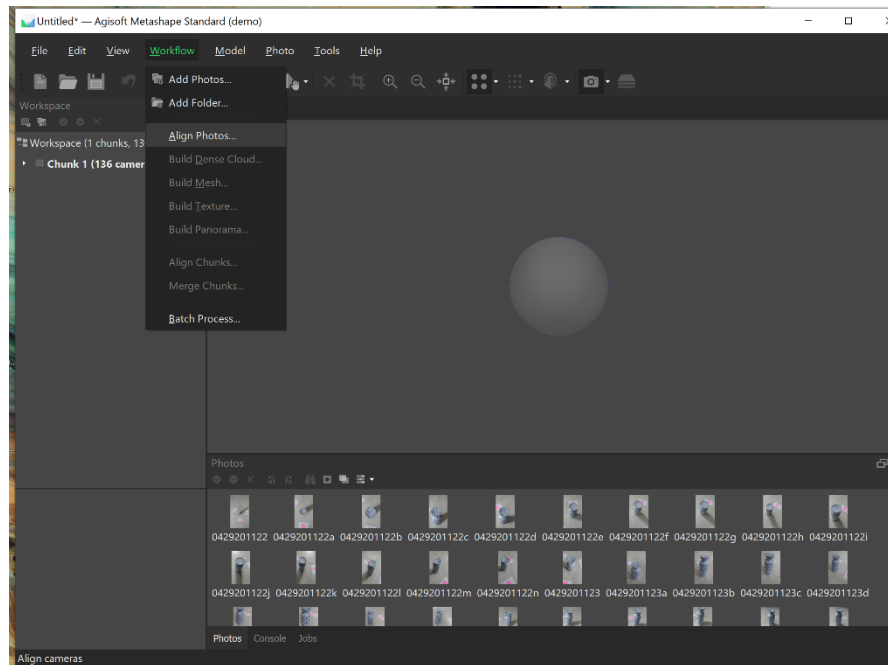
10. In whatever way makes sense for you, download the images to your computer. Save them in a folder called "3DScan".



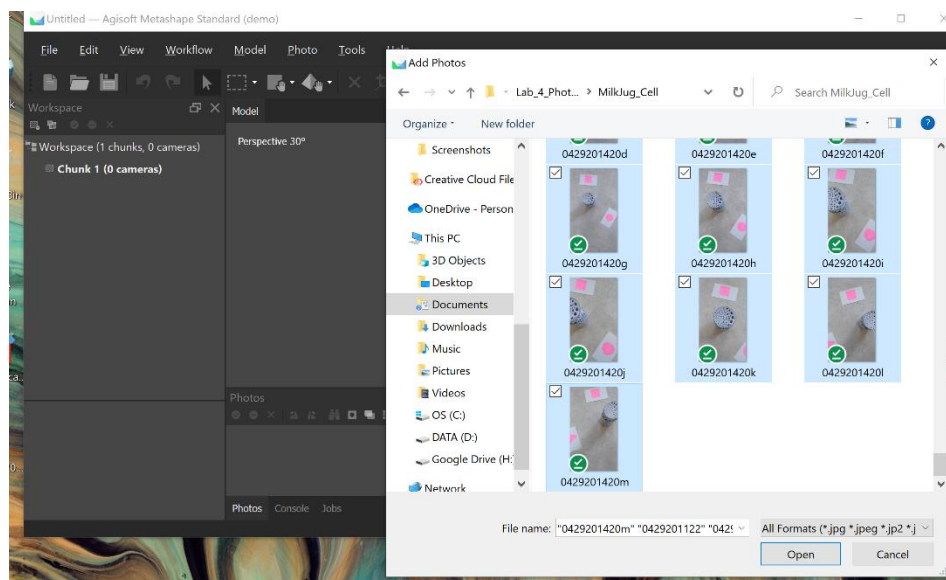
III. Image Processing

11. Open up Agisoft Metashape Standard

12. At the top of the screen, go to Workflow → Add photos

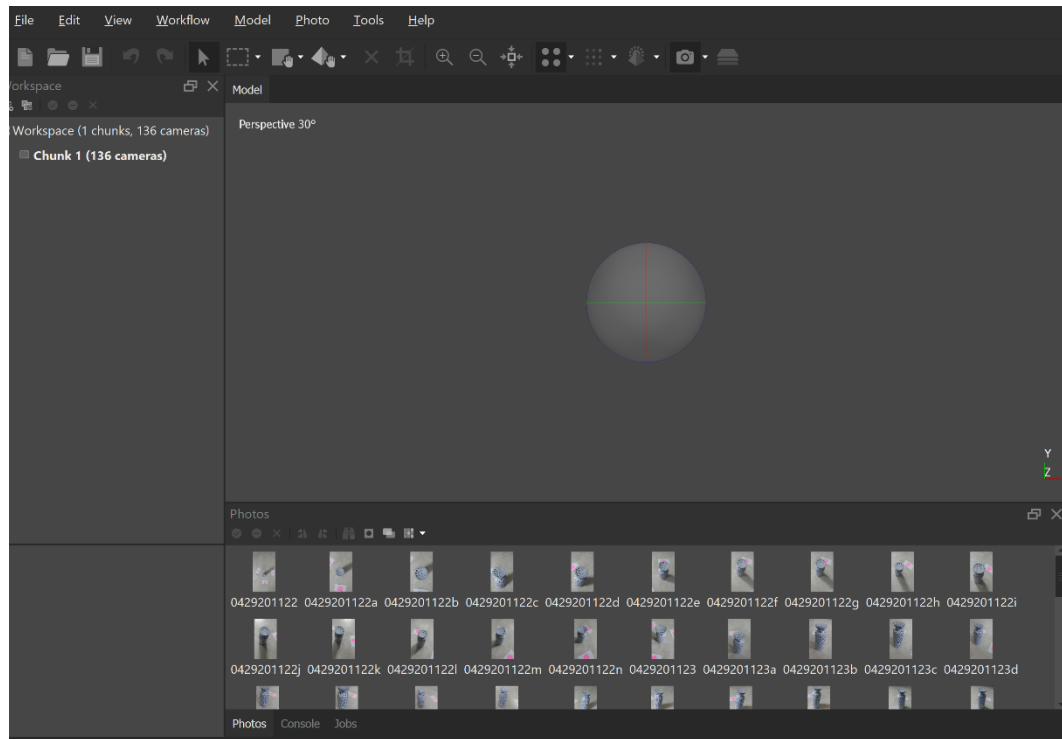


13. Navigate to your 3DScan folder and select all of the photos. Click OK.

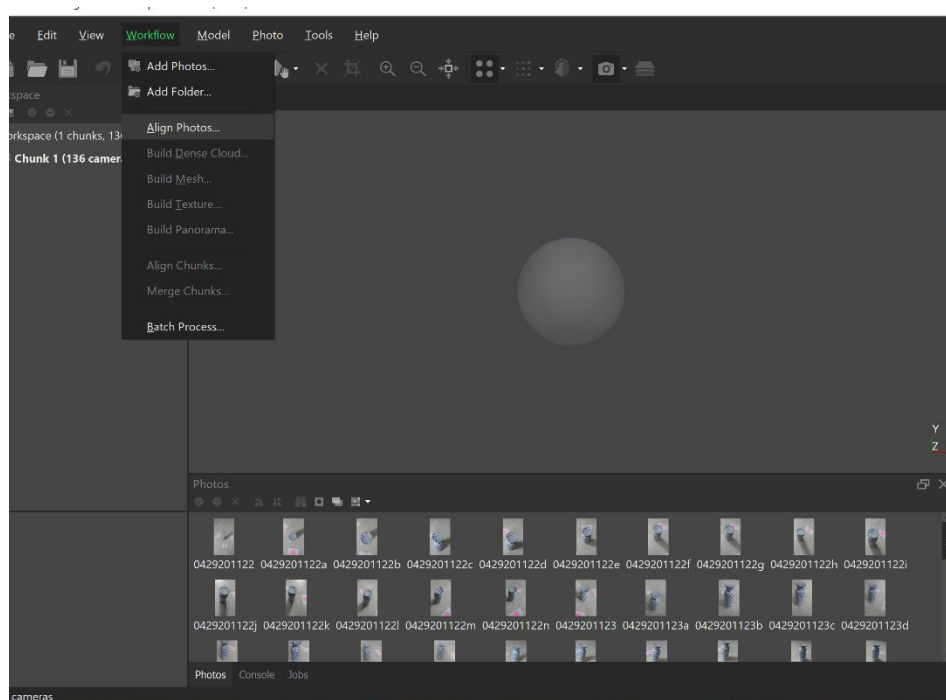


14. You might get a warning message about digital zooming. Just click OK.

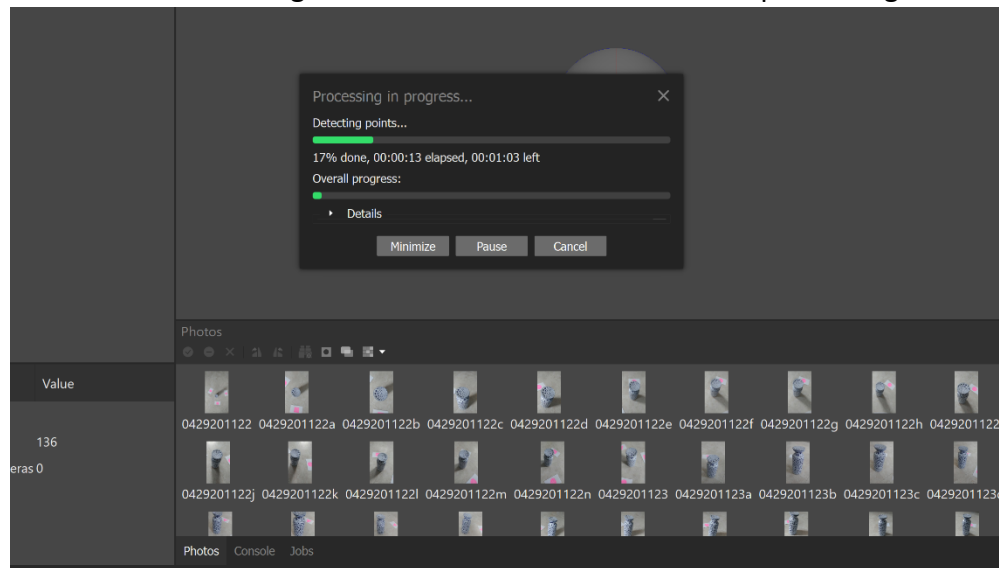
15. All of the photos should show up as small icons on the bottom of your screen:



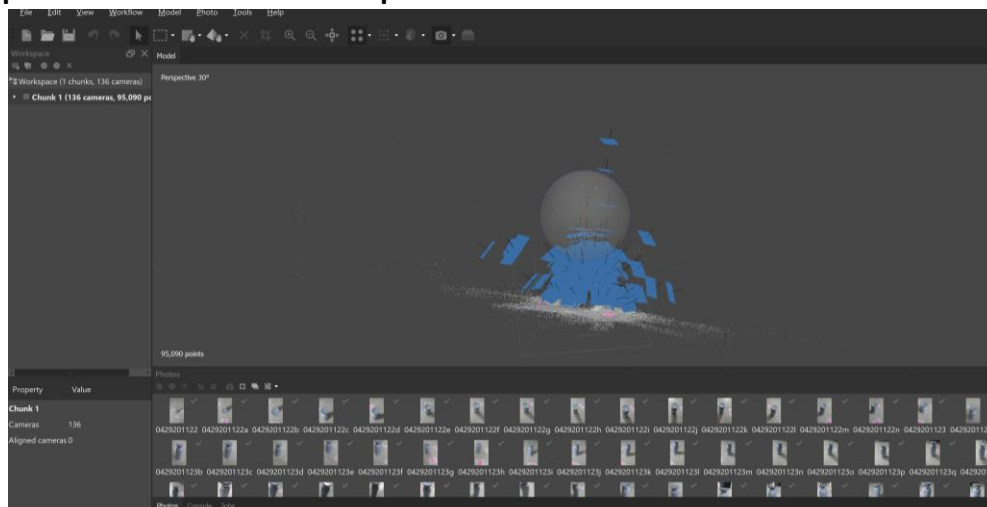
16. Click **Workflow** → **Align Photos**



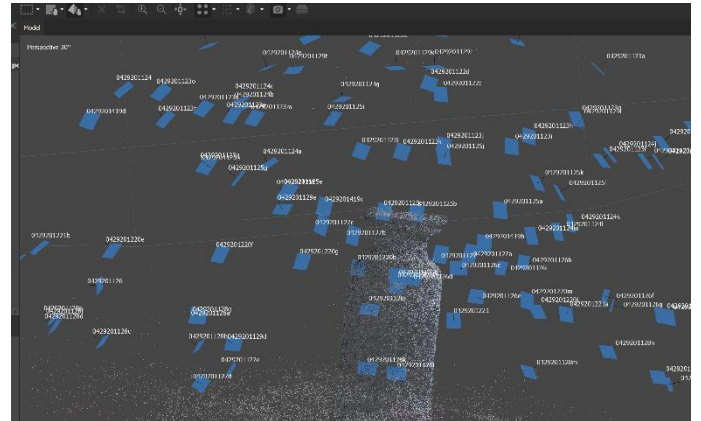
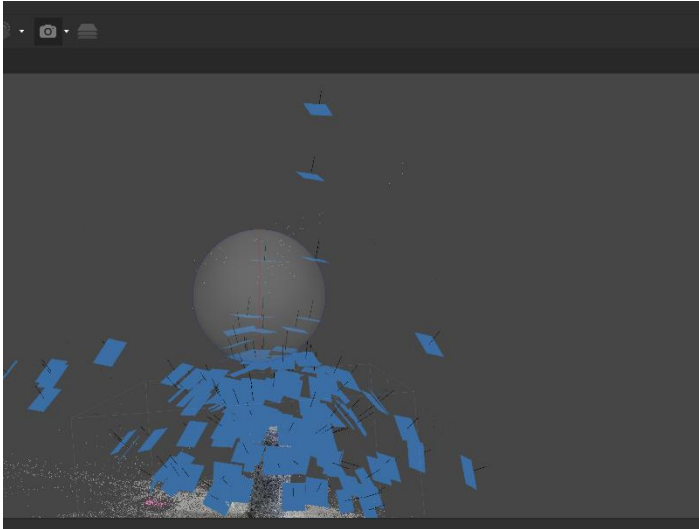
17. You will see some options for defining the quality of your model. If you have a fairly new computer, you should be ok with the default. If your computer is +4 years old and has trouble displaying graphics, change **Accuracy** → **Medium** or **Low**. FYI: you can always redo this step later and choose a different level.
18. Leave all the other settings alone and click OK. You will see a processing status bar:



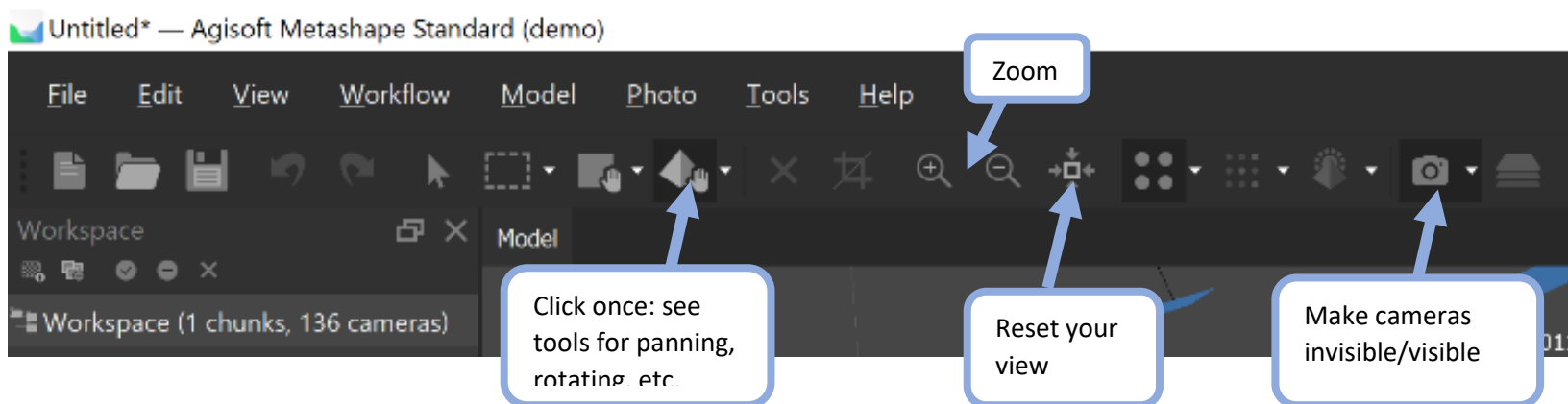
19. You will end up with a point cloud. The blue square are your **cameras** (the location of your lens when the shutter clicked). **If you get an error about misaligned photos, proceed to Section IV for help!**



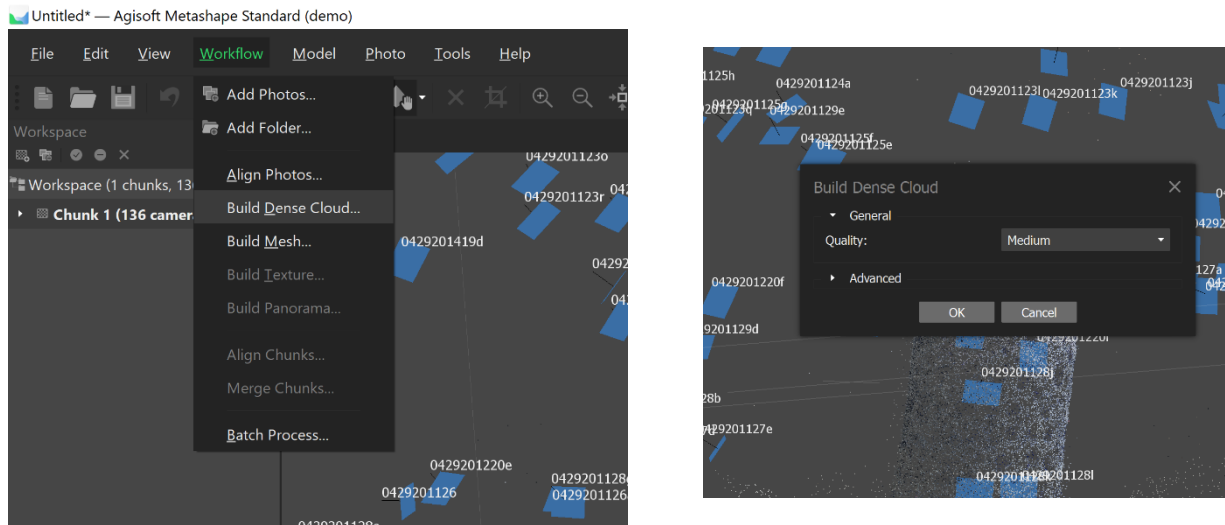
20. Notice that you can zoom in/out and around, seeing how you rotated around the object to create your model. When you zoom in closer, you will see numbers/letters appear: these are just the default image names assigned by your camera (i.e. 49839.jpeg)



21. You will also see your object. FYI: this wasn't a great render, which is why the image looks all speckled. If you want to observe your object up close, here are a few helpful moves:

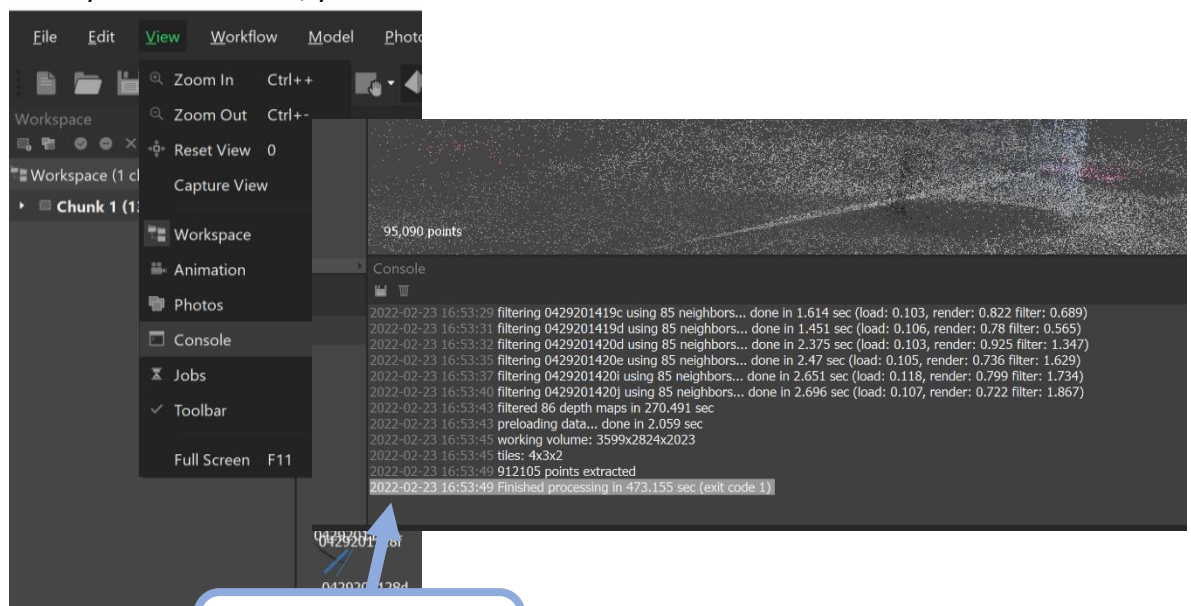


22. Go to Workflow → Build Dense Cloud. You are free to change the quality and experiment if you wish. Again, I don't recommend going higher than medium if you have an older computer.



23. A processing bar should appear. Wait for it to finish up. Avoid using your computer while this is running. If you've chosen to make a high-level point cloud/took several hundred photos, the process can take a few hours. Keep this in mind if class is almost over! Mine took about 10 minutes.

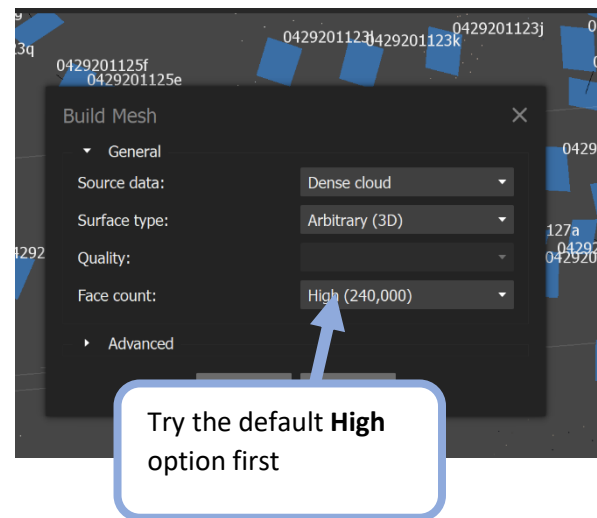
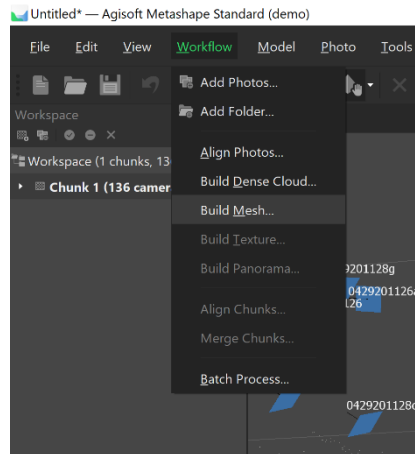
24. The Console tab at the bottom will indicate the process is successfully completed. If you can't see your console tab, you can turn it on: **View → Console**



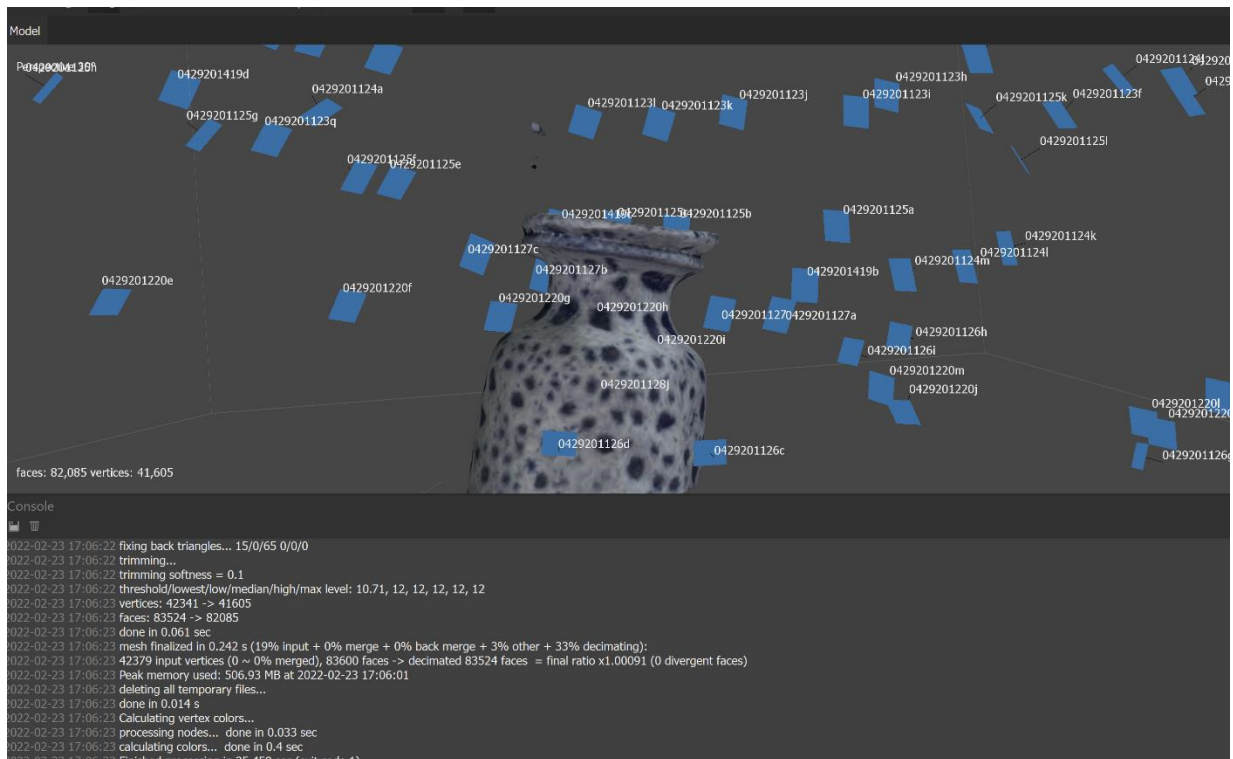
Shows the process
has completed

*** please tell me when you've reached this point in class ***

25. Go to **Workflow** → **Build Mesh**. The **Quality: Face Count** setting will automatically default to high. Try this option and if it doesn't work, we can move you to a lower setting. Click OK.

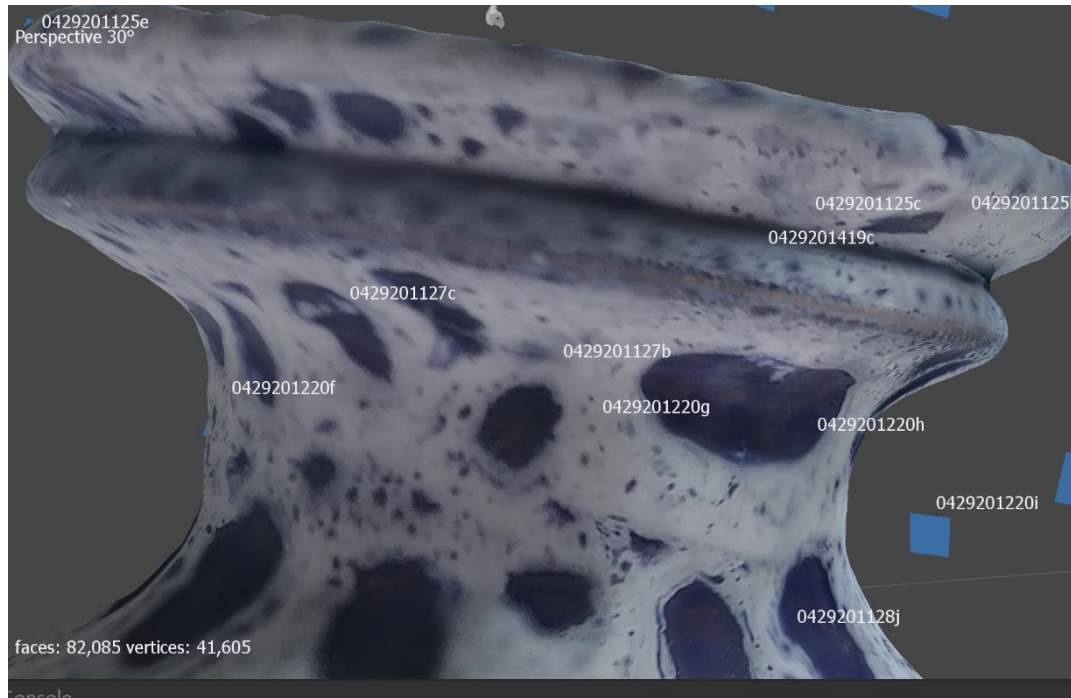


26. You will see the process updates in your console. When it's finished, you will see a 3D model appear on your screen.



27. Now, go to **Workflow** → **Build Texture**. Leave the defaults and like before, keep an eye on the console to know when it's finished.

28. Really zoom into your model – notice how this step created in-depth textures:



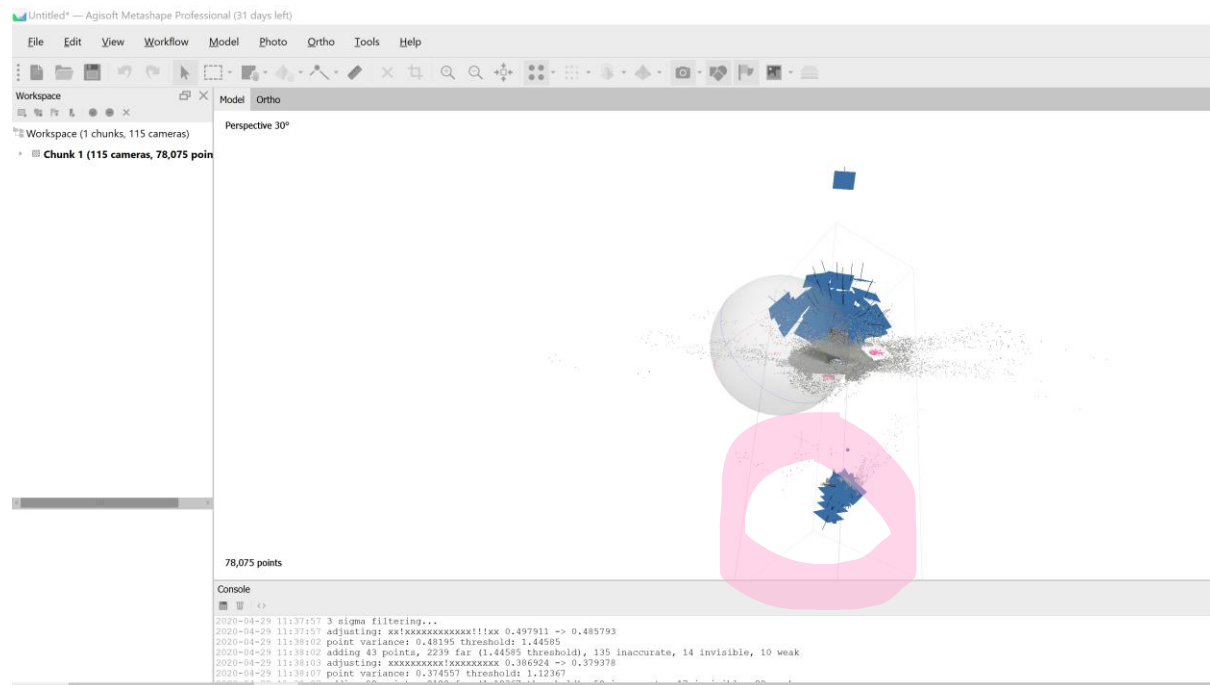
29. Make the cameras invisible and choose a good angle for viewing your model. Take a screen shot (or multiple!). Upload the screen shot to Canvas (see today's module) so I can see your amazing work!

FYI: Since we are using the standard license, we can't export or save. The 30-day trial will allow you to do so.

IV. Misaligned Photos

What's happening:

You might get an error about misaligned photos. This means that photos can't be placed in the point cloud, either because there's no target in the shot or because the photo isn't overlapping with another well-aligned photo. In the example below, you can see that there are images floating below the bottle's point cloud – Agisoft could not place them in relation to the rest of the photographs.



There are a variety of ways to fix this. The professional (read: difficult) way is to manually realign them in Agisoft. We're not going to learn this because it's 1) hard to teach using the trial software 2) with cell phone quality images 3) using homemade marker sheets. In most cases, manual realignment is reserved for very complex models that took 10+ hours to render.

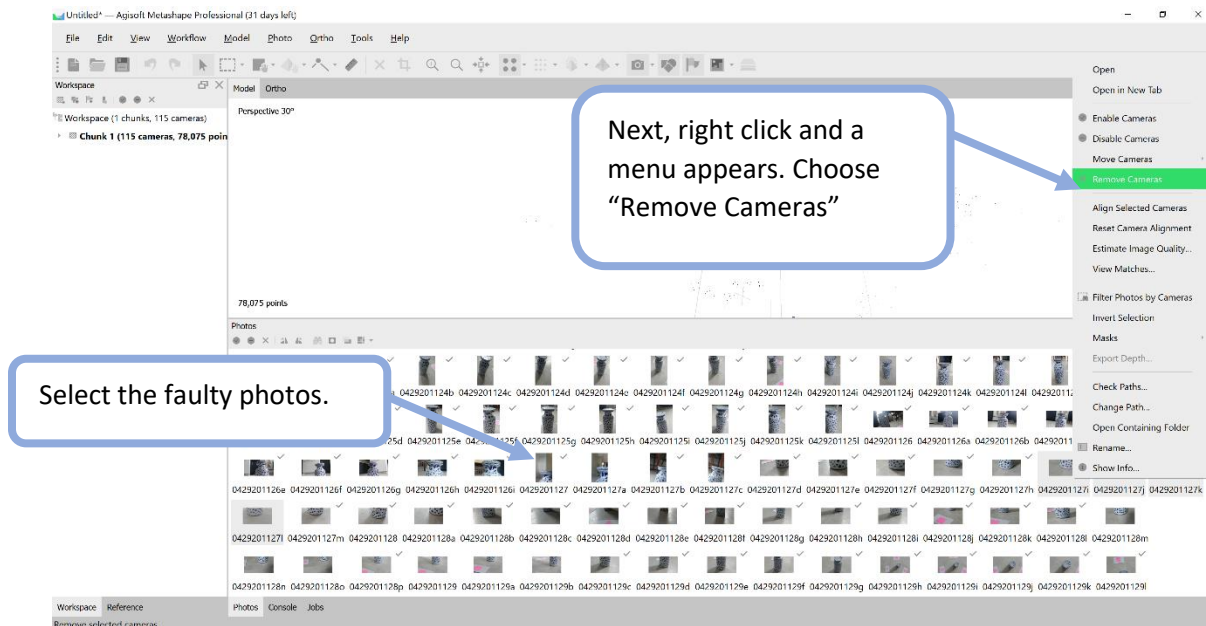
If you're interested in learning more about manual realignment, I recommend this Youtube tutorial: <https://www.youtube.com/watch?v=Uny9nTr22go>

Easier + Efficient Way:

30. Zoom into your object (see step 11 for help) and make an assessment.
 - a. Is the object actually well rendered and the misaligned images are just some surface texture?
 - b. Are there large gaping holes in your model?

31. If you choose option A (good model; just some texture missing), you can simply delete the misaligned cameras.

- c. Click on the Photos tab at the bottom of the screen. It's going to show thumbnails of every picture. If there's a green check mark, that photo was able to be aligned.
- d. Select the faulty photos. Right click → Remove cameras → the images are then deleted and don't appear. FYI: this doesn't delete the images from your computer. It just removes them from the model.



32. If you choose option B (large gaping holes):

- e. Look at the misaligned photos and understand where you need to refocus. Note the names of those files.
- f. Delete the misaligned photos (see step 13, above).
- g. Delete those images from your hard drive.
- h. Reshoot those photos, taking care to improve your technique.
- i. Add the new images into your existing image folder.
- j. Repeat Part III and render your model.

Here are some targets if you ever want to try this again!



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