

An Introduction to 3D Printing for Mac Admins



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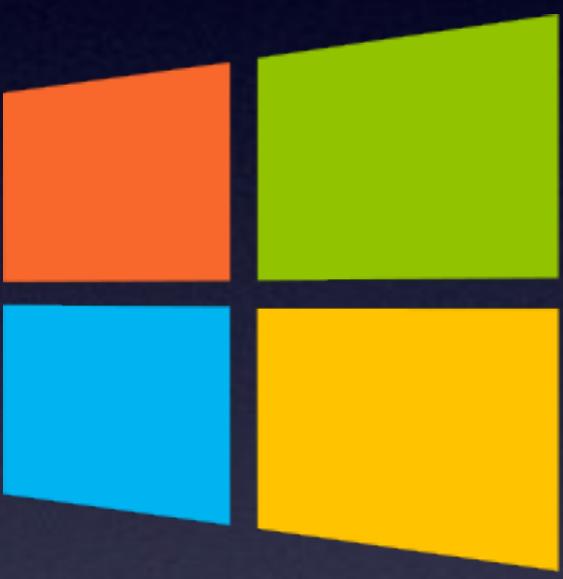
 [rsfurr](#)



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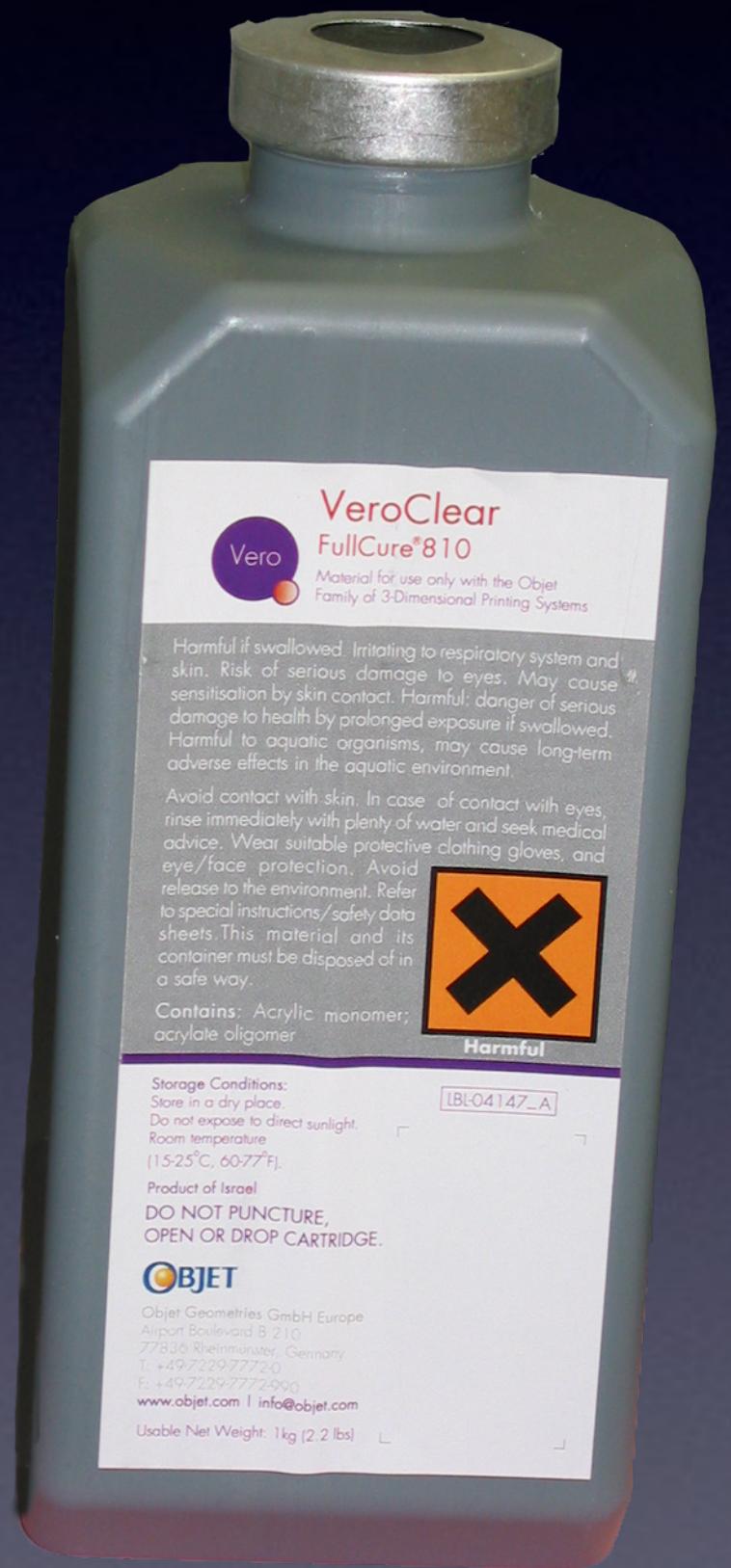
?!

Topics

- The Output
- The Hardware
- The Software
- Models

The Output

Materials





Studio Neat



Made in Austin

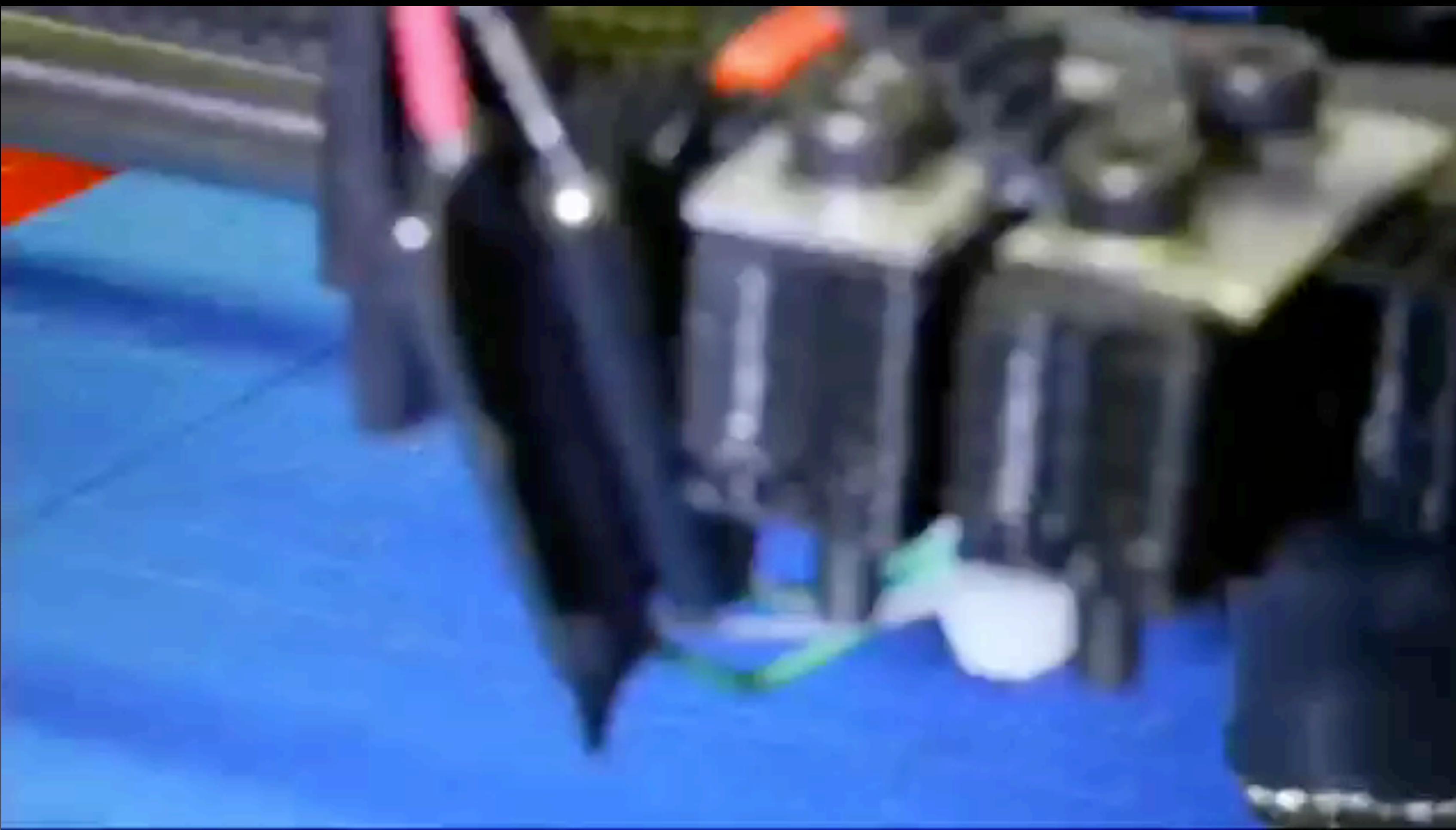
Our first in-house product.

The Apple TV Remote Stand is produced right here in Austin, TX. In Tom's garage, to be precise. We are using an X-Carve CNC machine to mill the walnut. This is our first product we've produced entirely in house.

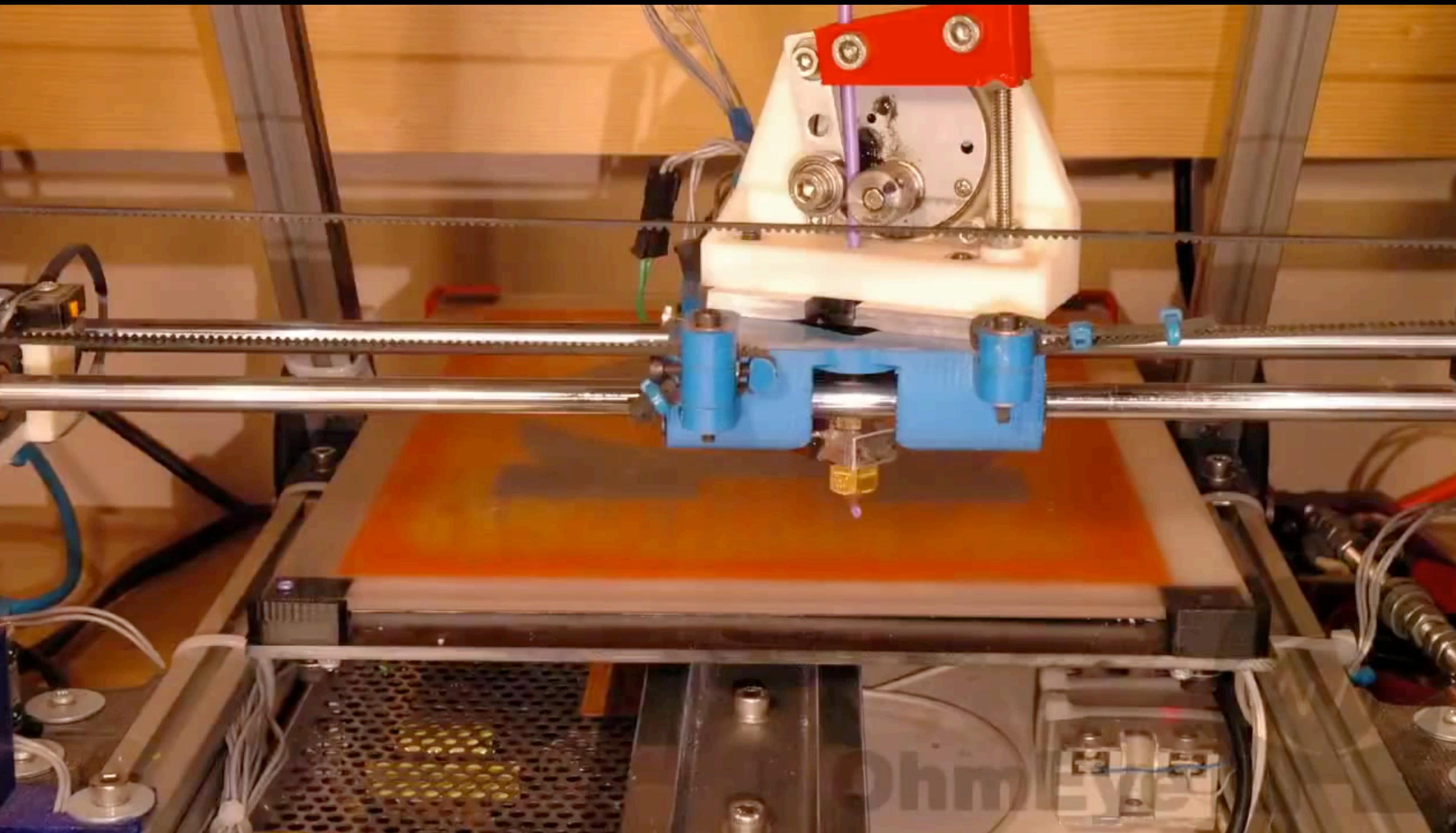


Additive Manufacturing

- Fused Deposition Modelling /
Fused Filament Fabrication
- Layers of resin exposed to light (e.g., UV)



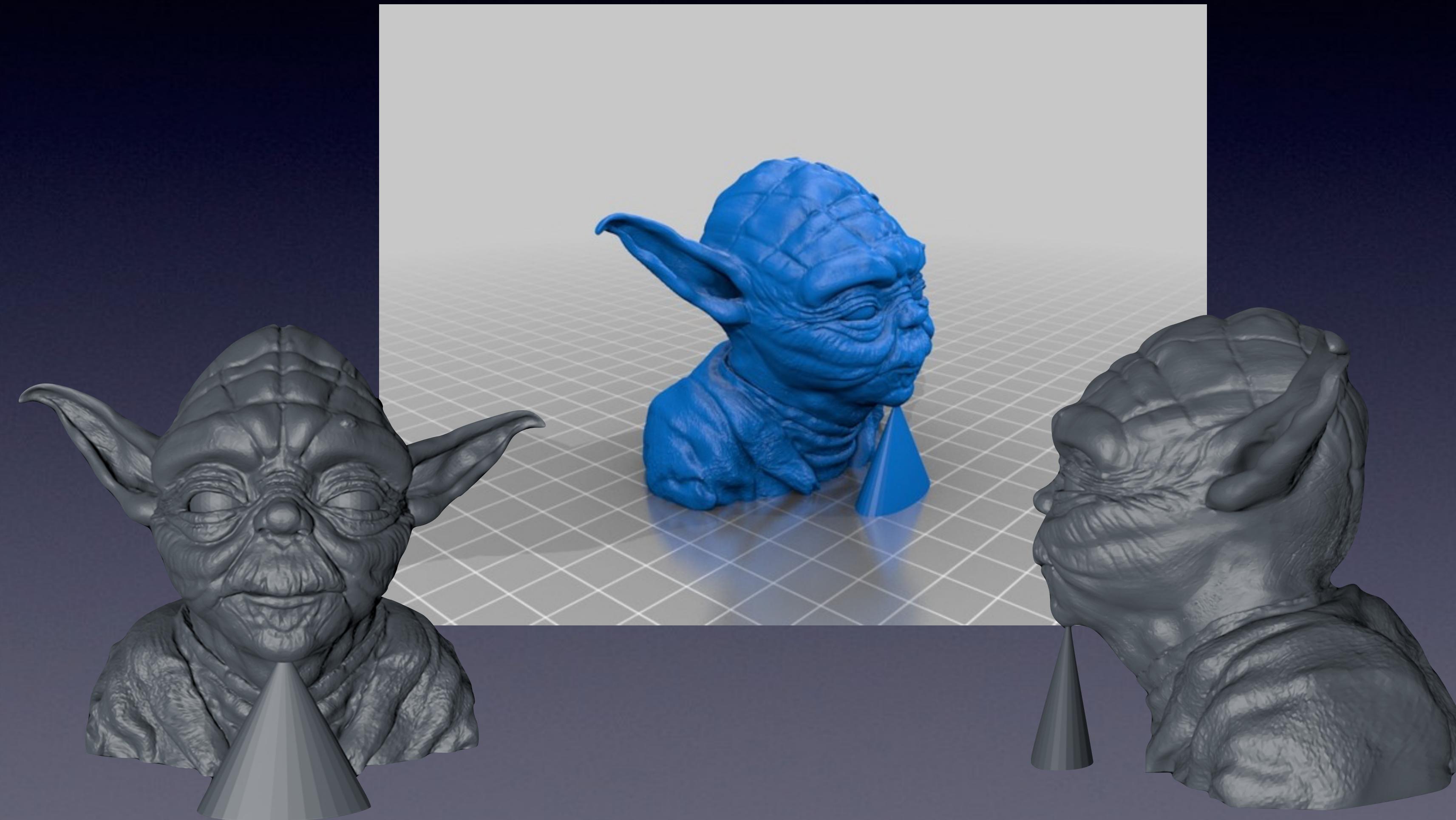
Credit: OhmEye (Creative Commons License)
<https://youtu.be/1213kMys6e8>



Credit: OhmEye (Creative Commons License)
https://youtu.be/NzQF7SRU_1E

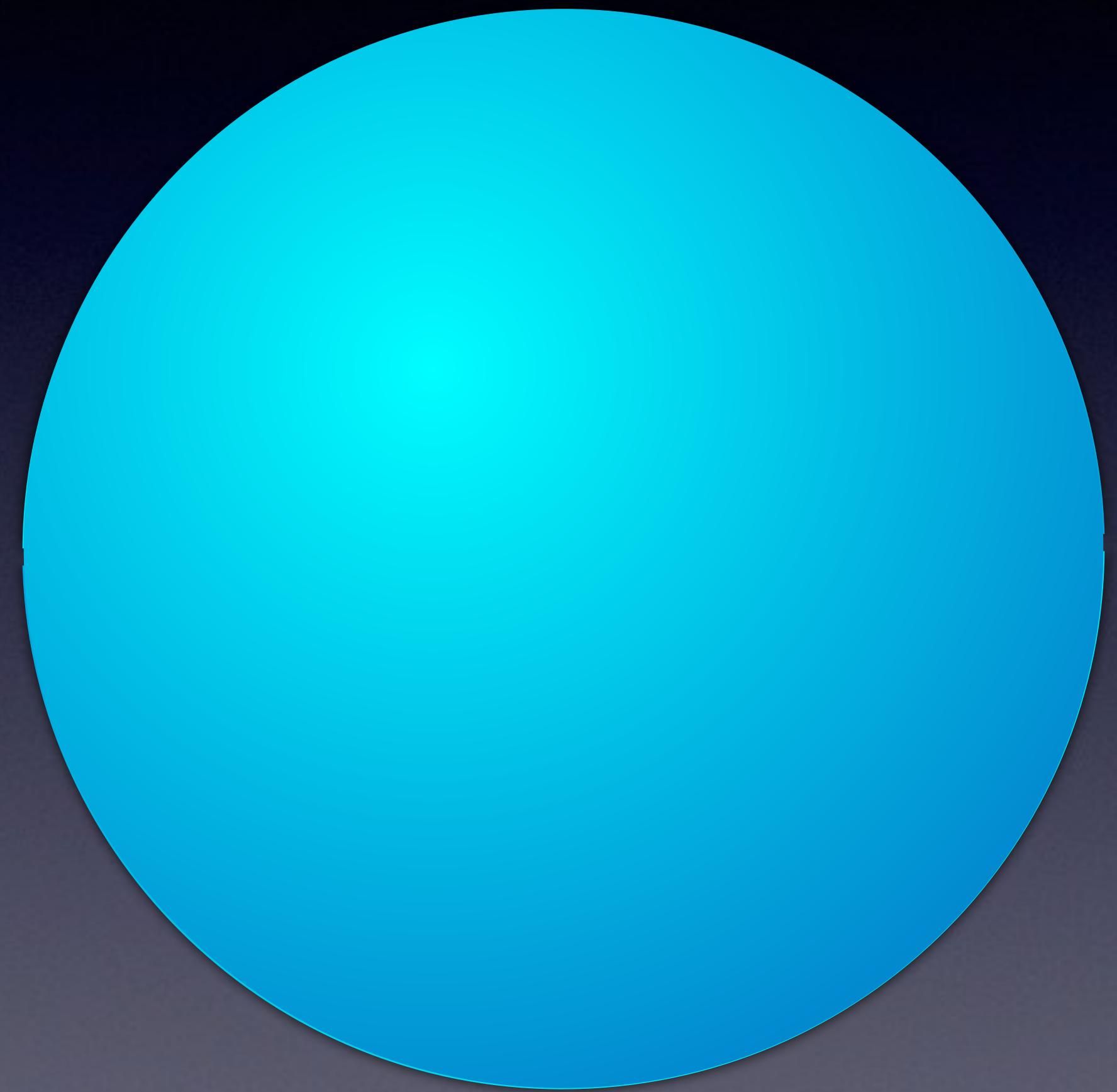


FDM/FFF



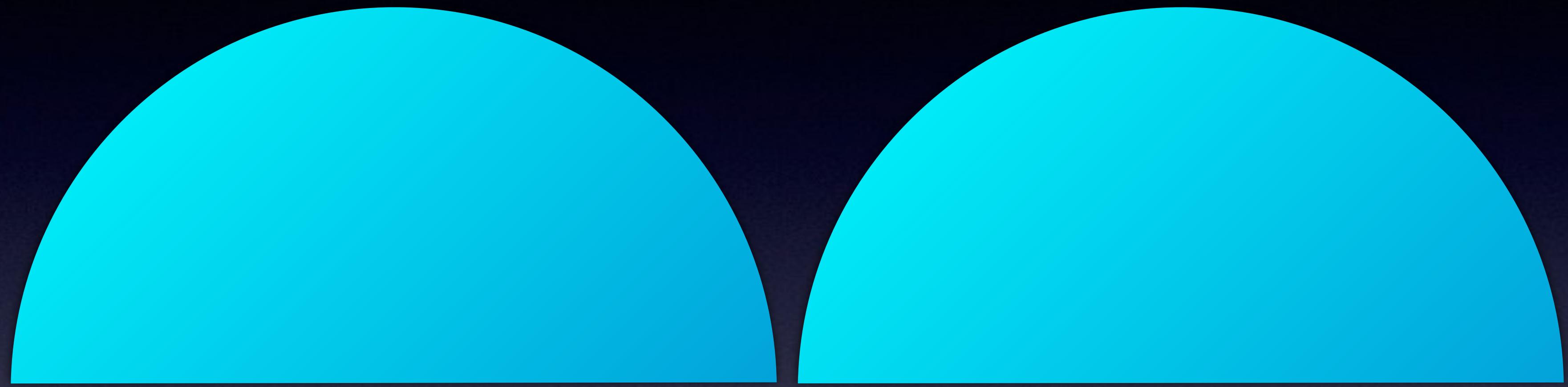


FDM/FFF





FDM/FFF





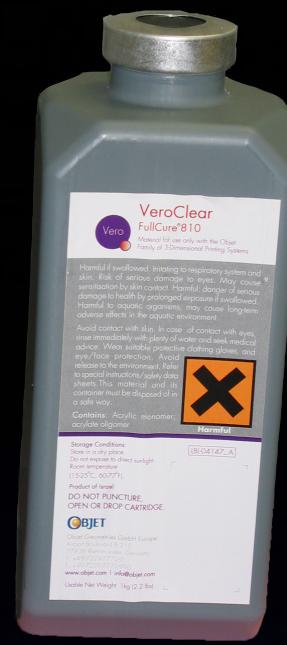
Operations & Safety





FDM/FFF

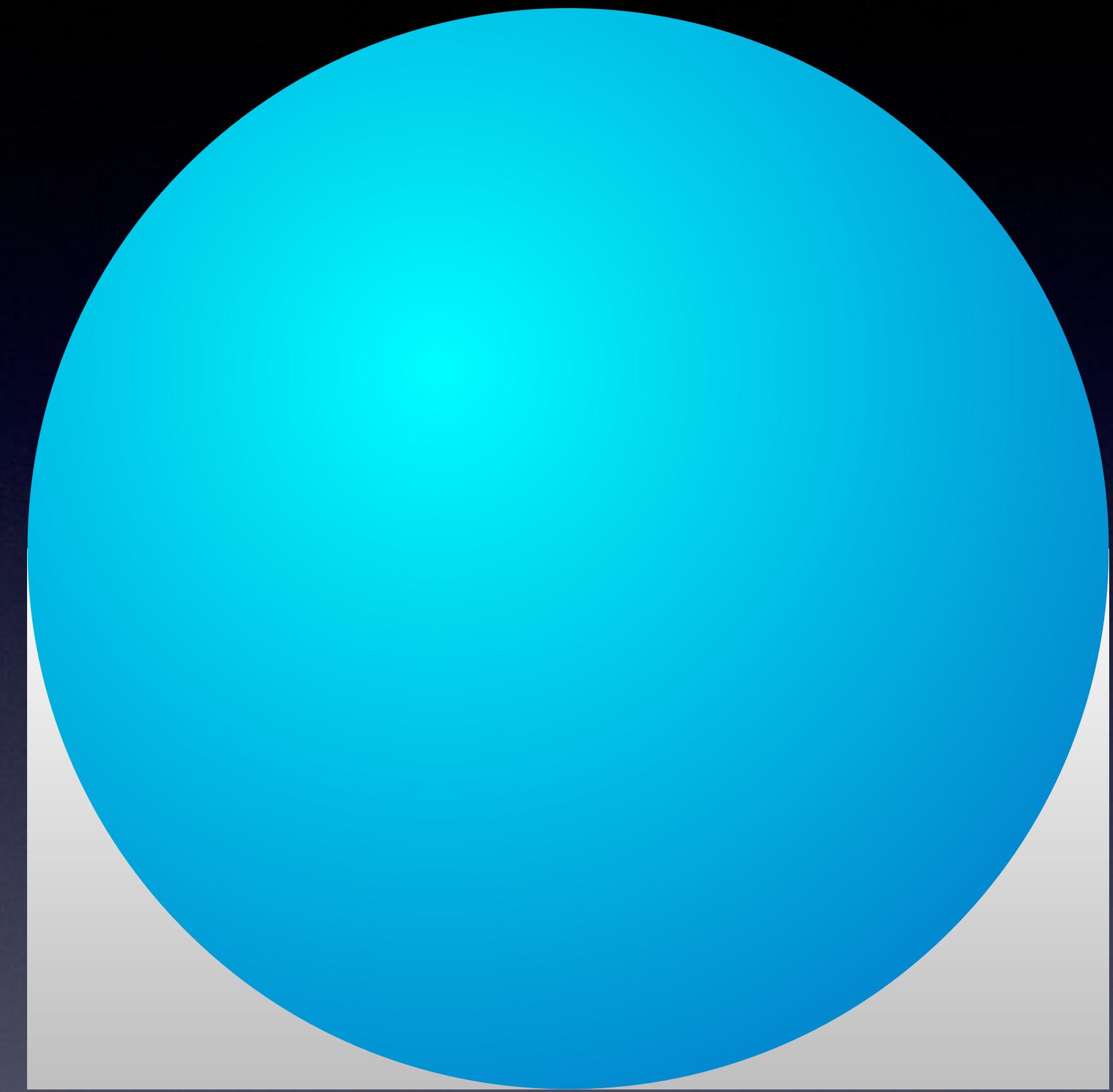
- Less expensive printers & materials
 - ▶ Often print hollow
- Variety of materials & colours
 - ▶ PLA, ABS, Nylon, Wood
- Printing angle a consideration
- Some designs can't be printed
- 100 µm (0.1 mm) minimum thickness
(250 µm typical)



Resin (PolyJet)

- Build Material
- Support Material

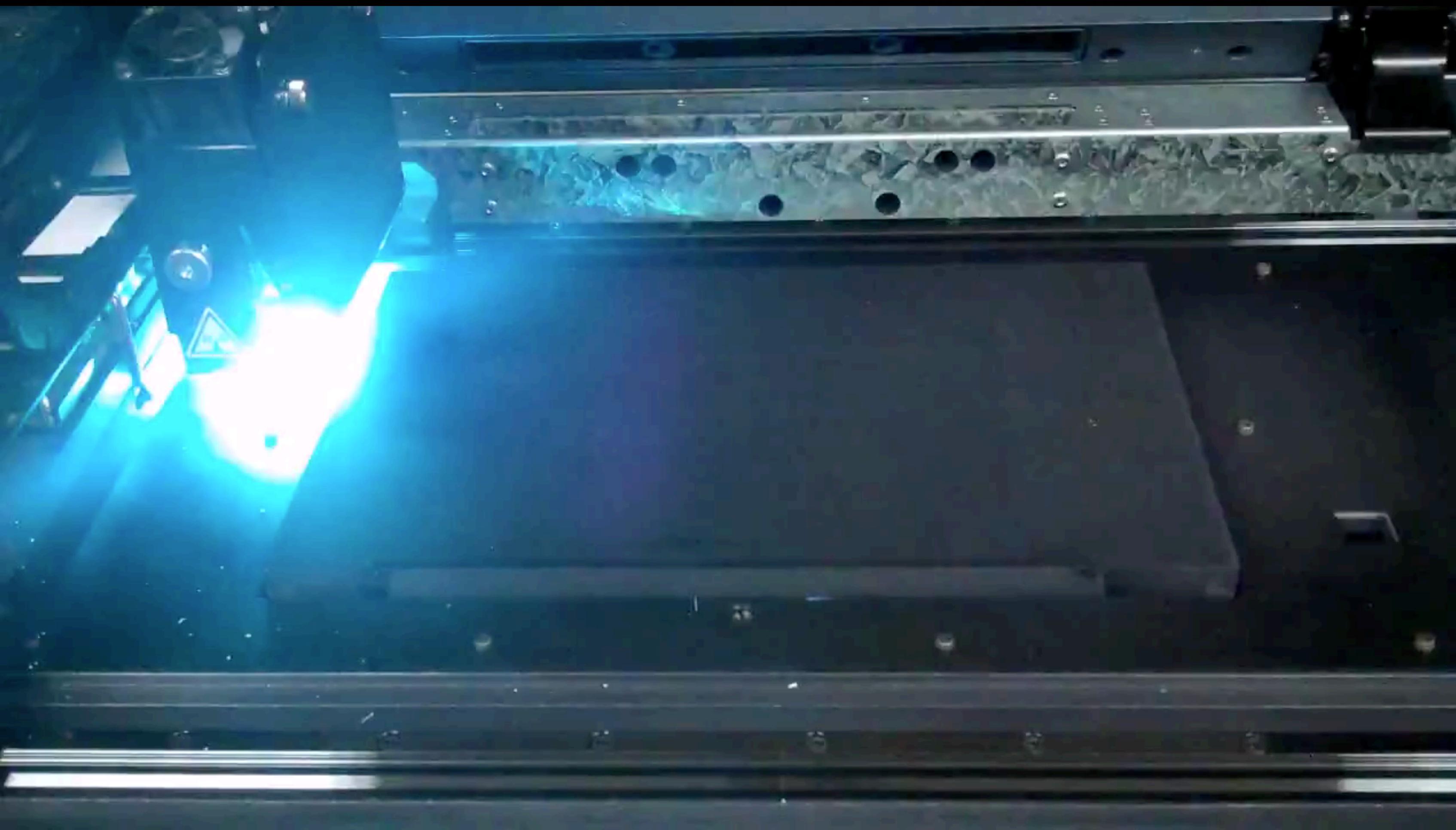
Build Material



Support Material



Credit: James Thornburgh (Creative Commons License)
<https://youtu.be/AKca08-ggX0>



Credit: James Thornburgh (Creative Commons License)
https://youtu.be/-rJnVPey_5Q



Operations & Safety





Resin (PolyJet)

- More expensive – proprietary
- Material variety increases with cost of printer
- No angle restrictions
 - ▶ *Solid objects*
- 28 µm typical (0.028 mm)
- Hazardous waste
- Model cleaning required



(Back to) The Future

- Resin Stereolithography
 - ▶ *Form 2 et al*
 - ▶ *Speed an issue*
 - ▶ *Immature technology*

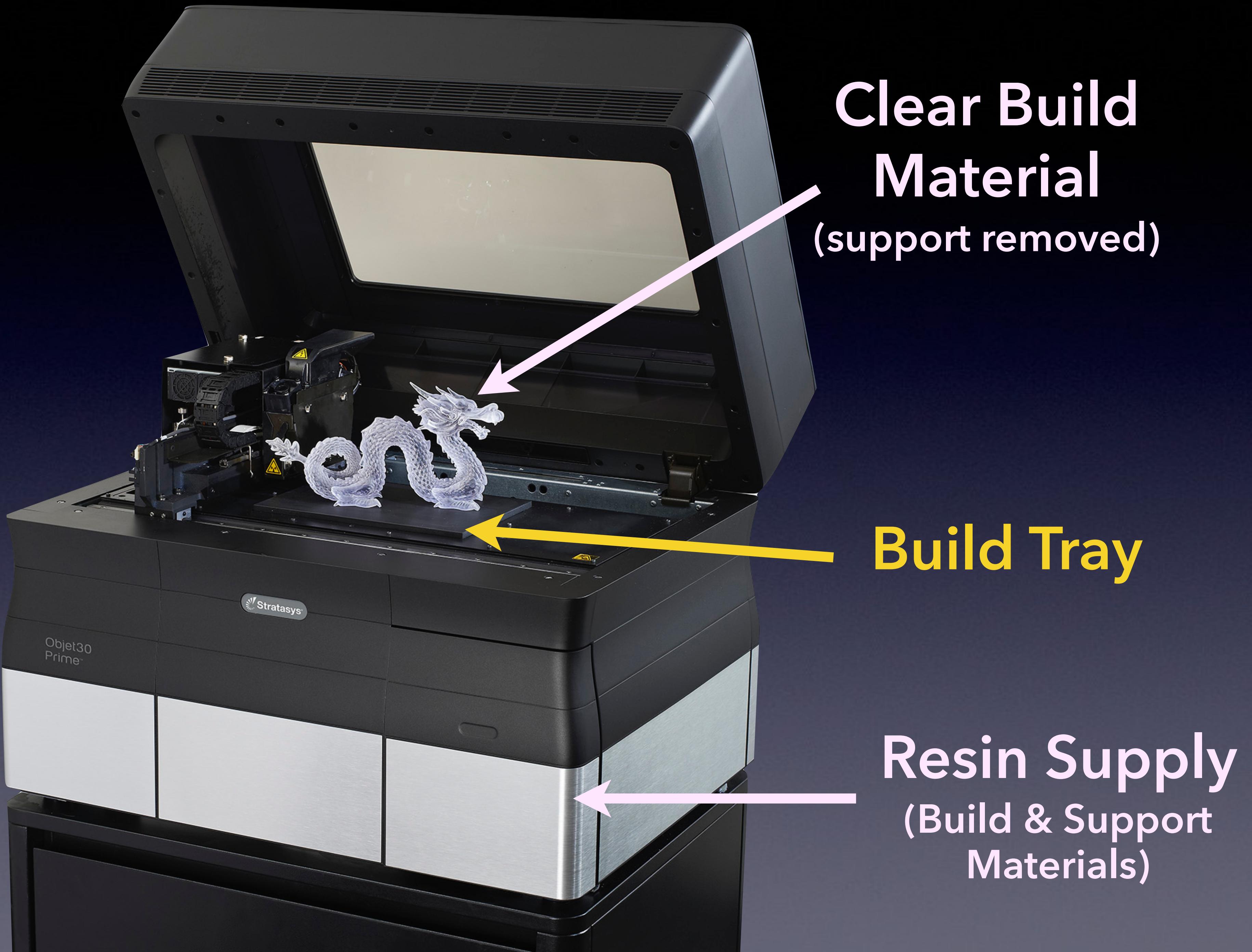
The Hardware



Build Tray

**Filament
(Build Material)**

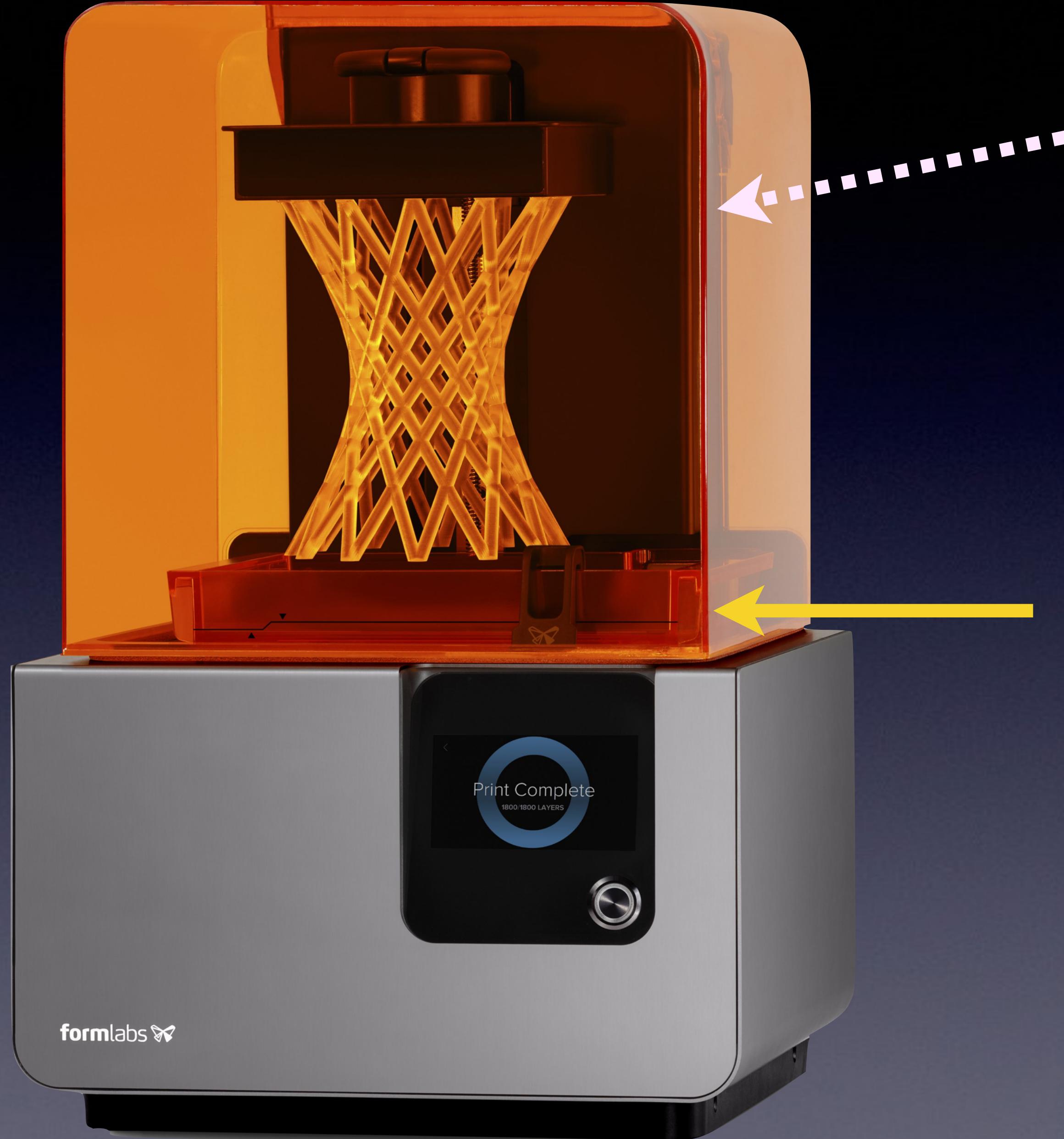




**Clear Build
Material
(support removed)**

Build Tray

**Resin Supply
(Build & Support
Materials)**



Resin Cartridges
(Build Material)

"Build Area"
(Resin Tray)

Setup & Operating Considerations



Setup & Operating Considerations



Setup & Operating Considerations



Setup & Operating Considerations



Setup & Operating Considerations



Printer Selection

- Parts or Art?
- Materials
 - ▶ *Particular materials needed*
 - ▶ *How often do you need to swap*
- Build Volume



The Software



.sc1



.zpr, .zbr



.ma



.blend



.c4d



.mud



.mlp

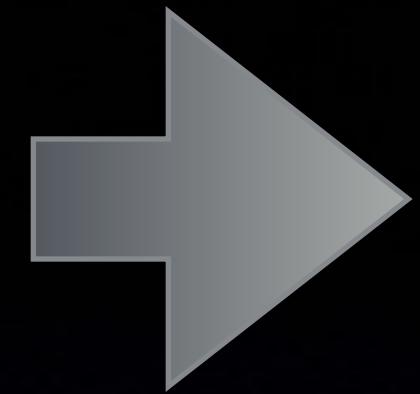


.vwx



.3ds

.STL
.OBJ



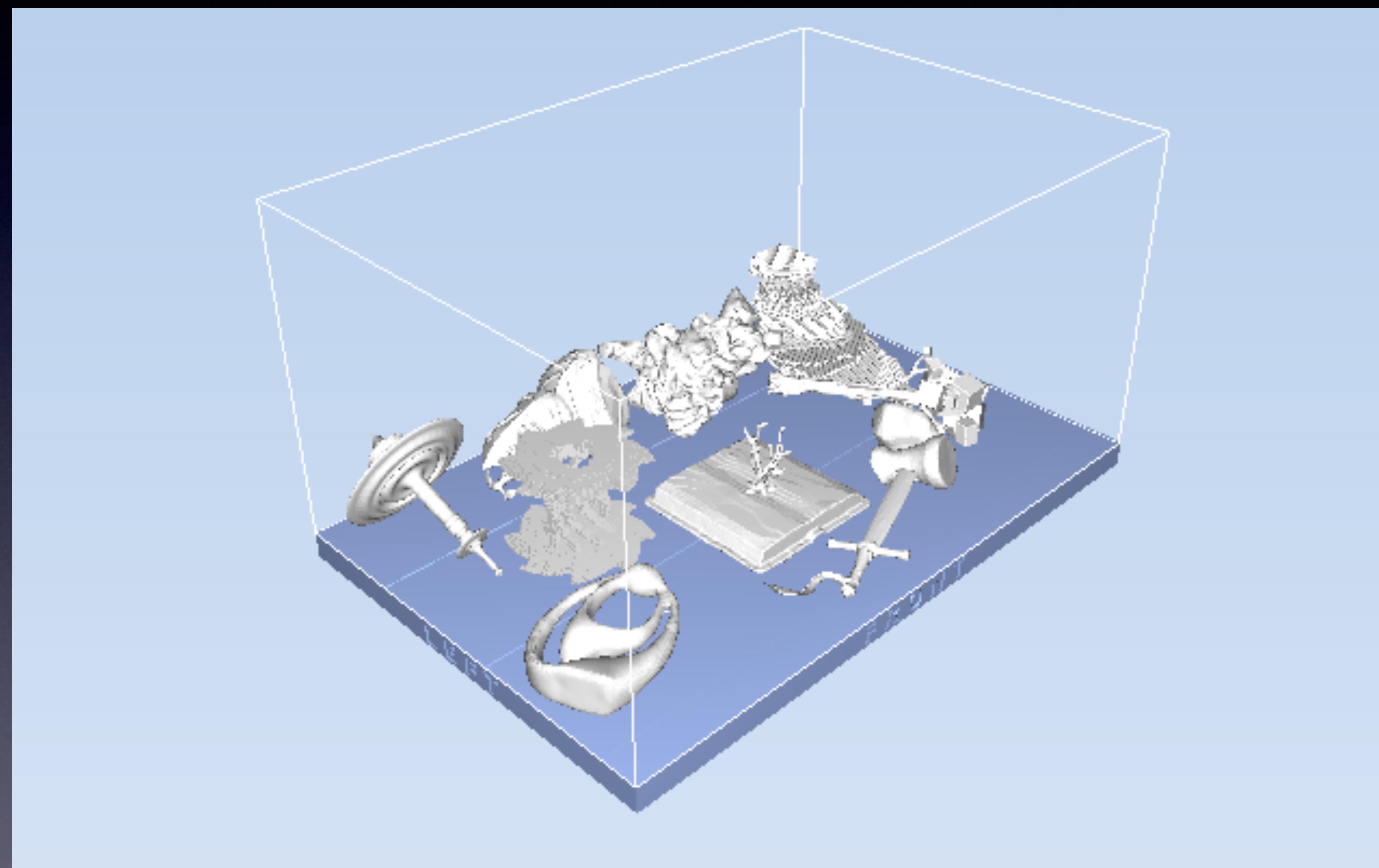
File Conversion Tools

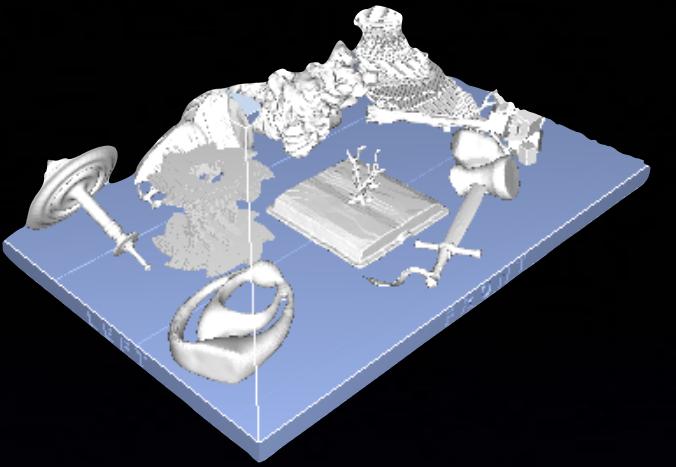
- The App that created it
 - ▶ *Might need to use an intermediary format*
- MeshLab
 - ▶ *meshlab.sourceforge.net*
- A commercial app with STL export
 - ▶ *e.g., Cinema4D (maxon.net)*

Software & Services



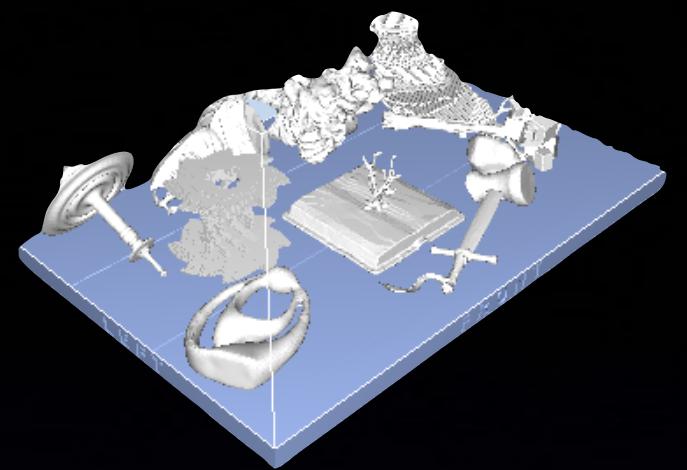
Making a Tray





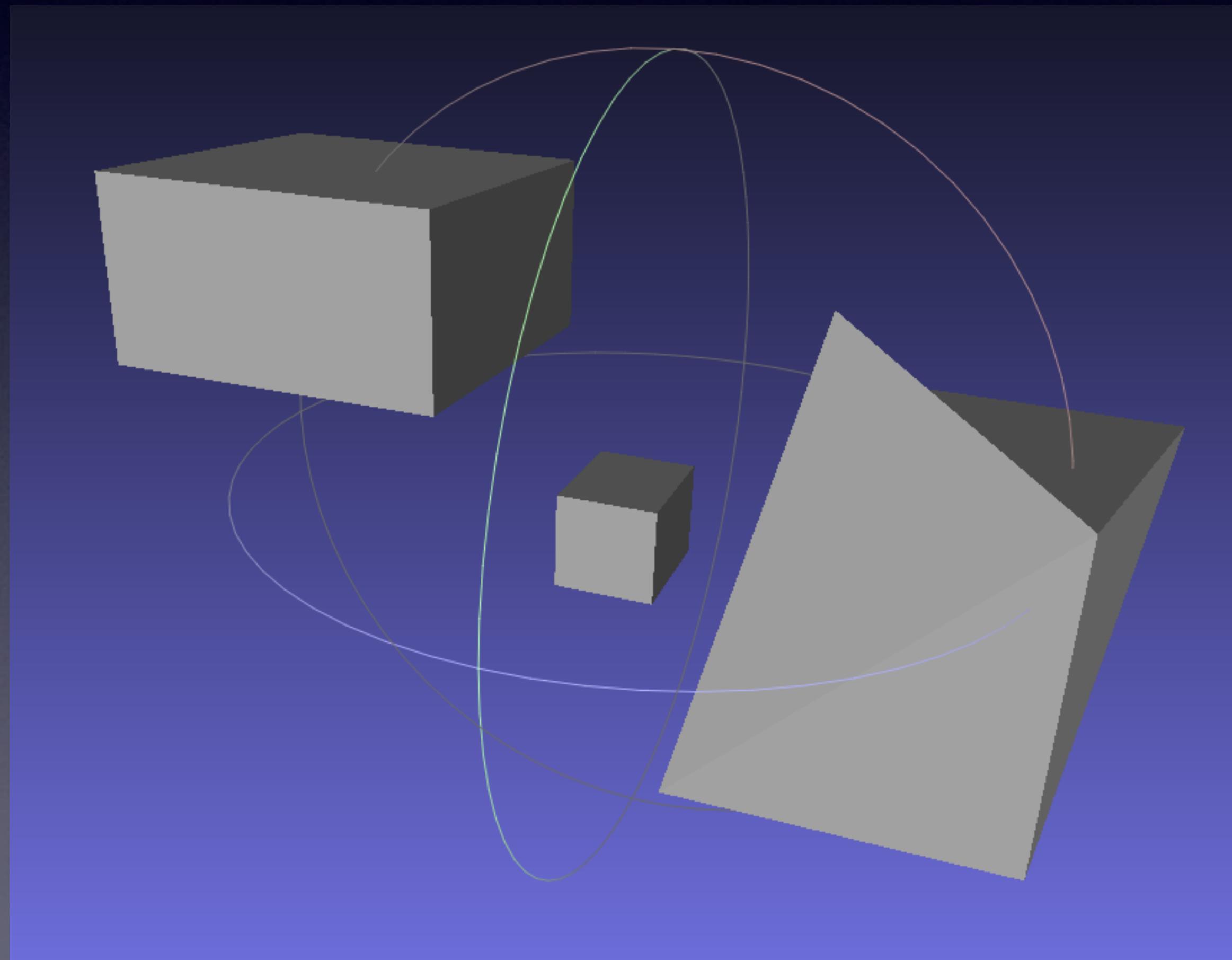
Making a Tray

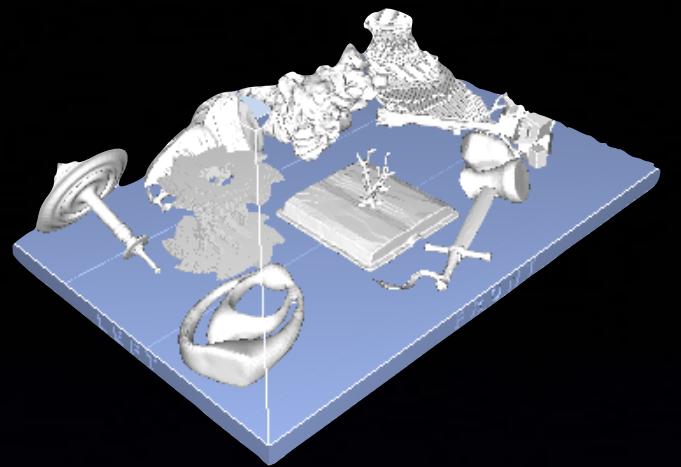
1. Collect your STL model(s)
2. Open the software (VM is OK)
3. Import each model, specifying scale units
(mm or inch)
4. Adjust placement (auto or manual)
5. Verify tray
6. Estimate materials & Save Tray



Making a Tray – Issues

2+ models in 1 STL file

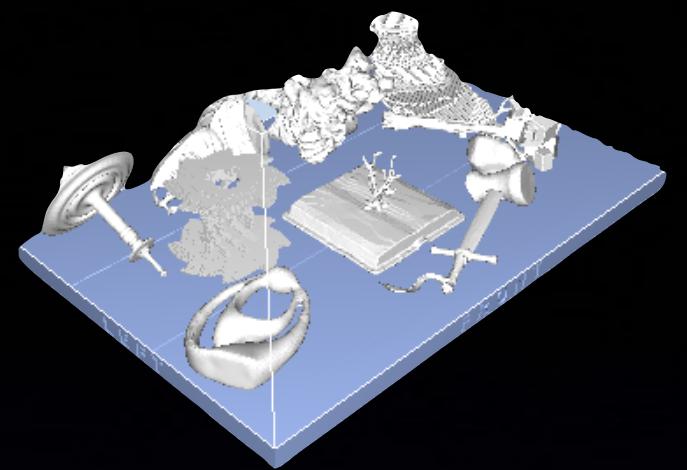




Making a Tray – Issues

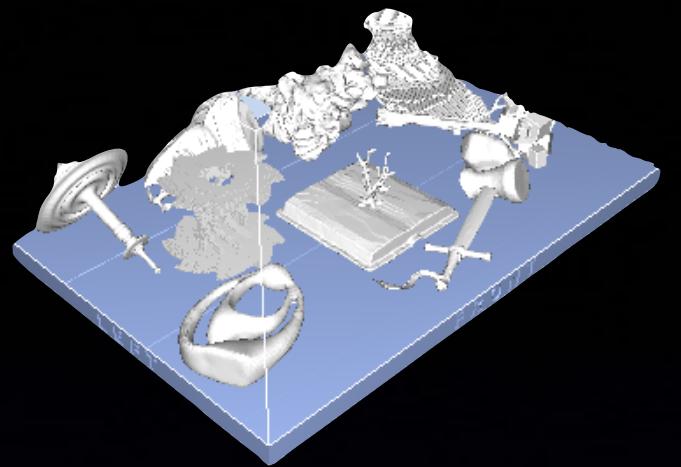
2+ models in 1 STL file

- User exports models separately
- Split with an app:
NetFabb Basic (Free)
 - ▶ www.netfabb.com/downloadcenter.php?basic=1



Making a Tray – Issues

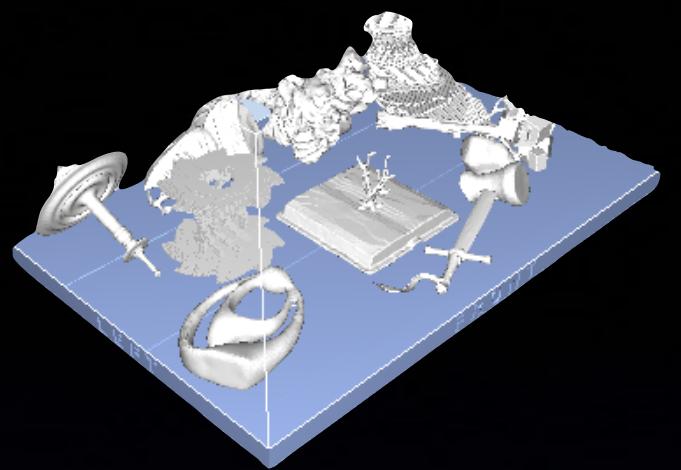
Unclosed contours, vertices, other defects



Making a Tray – Issues

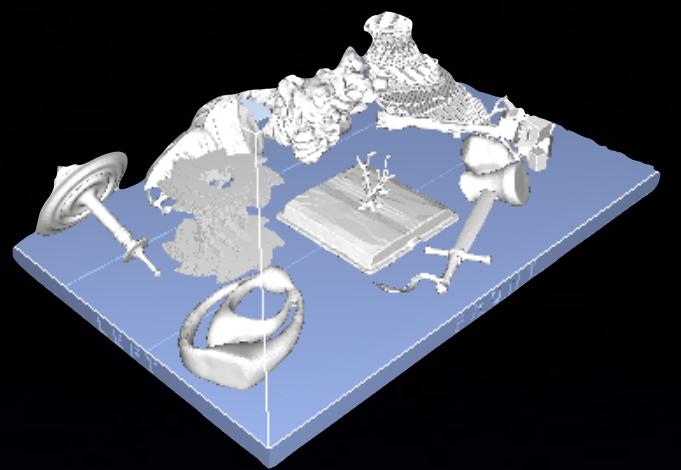
Unclosed contours, vertices, other defects

- NetFabb Basic
- MeshLab
- NetFabb online (“cloud”) service
 - <https://netfabb.azurewebsites.net/>
 - Requires (free) Microsoft account
- NetFabb Private (“personal”)
 - US\$300
- NetFabb Professional (\$\$\$\$)



Making a Tray – Issues

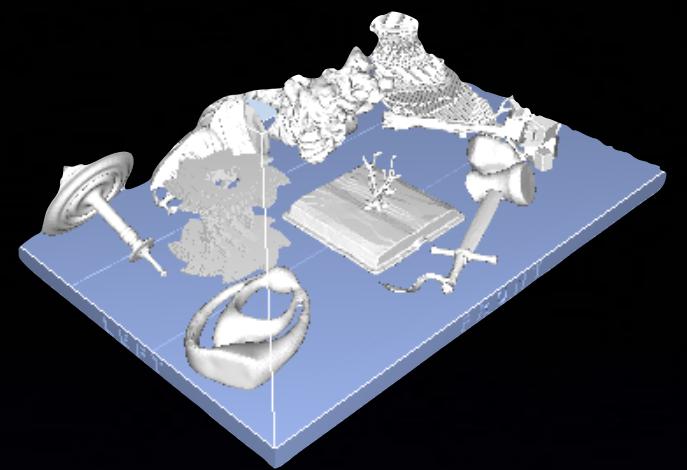
Model too large



Making a Tray – Issues

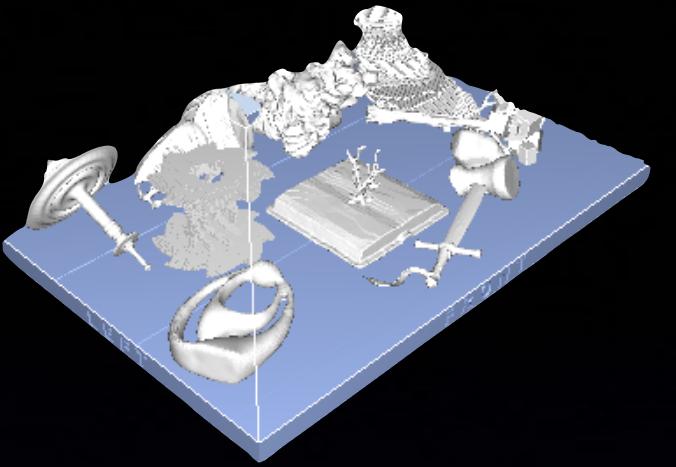
Model too large

- Scale the model
 - ▶ *printer software*
 - ▶ *any design software*
- Split the Model
 - ▶ *NetFabb Basic*
- Resin: re-orient the model



Making a Tray – Issues

Speed of Printing



Making a Tray – Issues

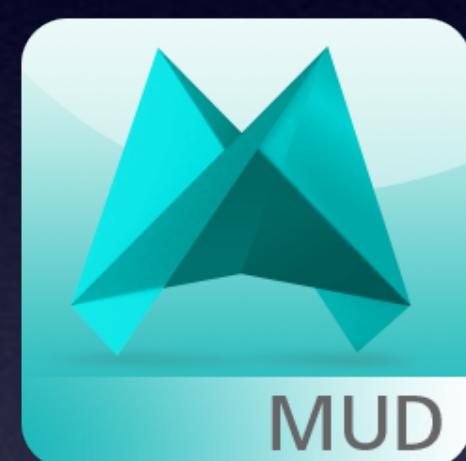
Speed of Printing

- Resin: Z-axis is slowest
 - ▶ *9h when z=100 mm*
 - ▶ *5h when z=50 mm*
 - ▶ *3h when z=25 mm*
- Fill the tray
 - ▶ *6h for 4 copies on 1 tray when z=25 mm*

Models



Free



Open Source



Open Source

Making Models



Sculptris (Pixologic)

► *pixologic.com/sculptris/*



Blender

► *www.blender.org*

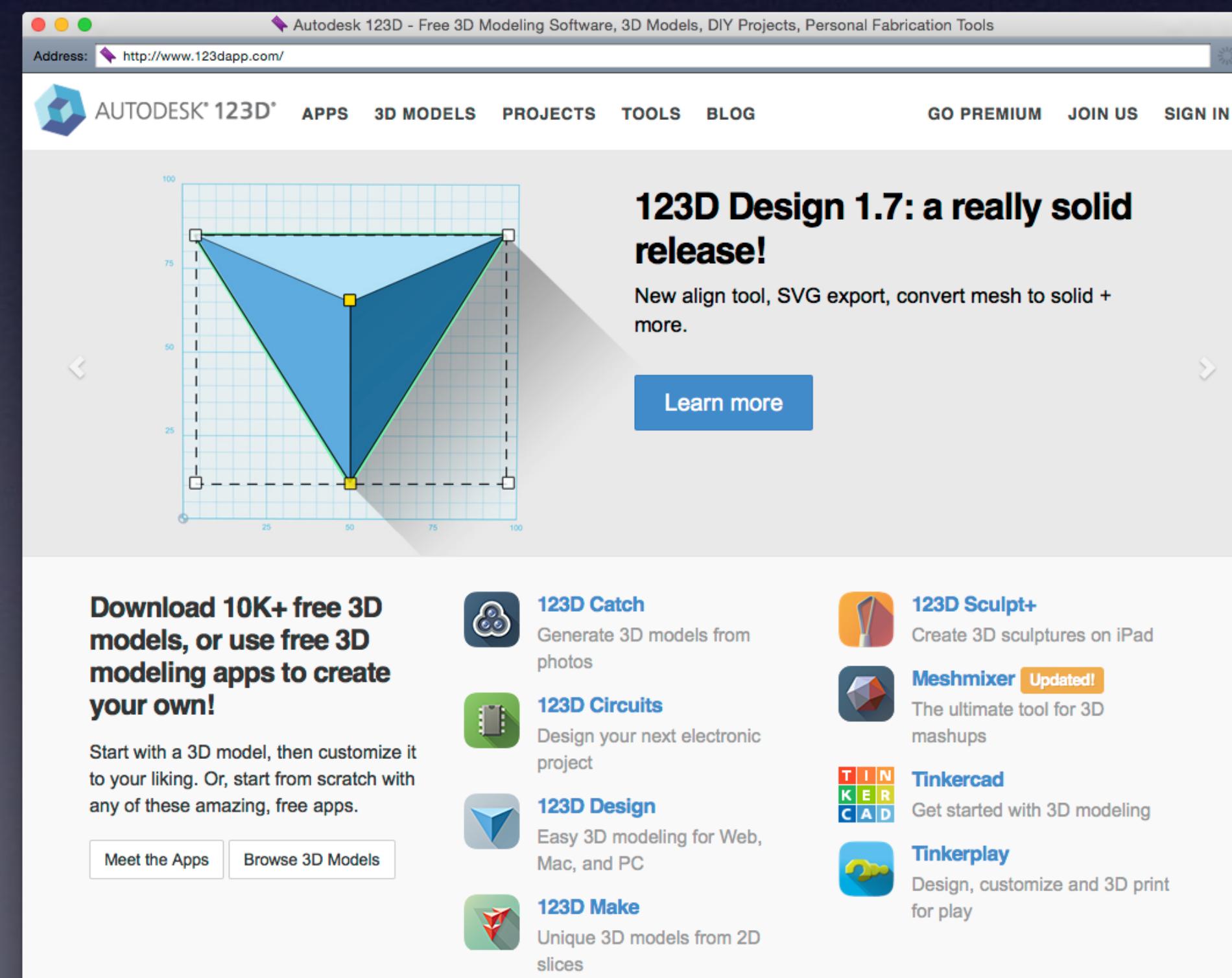


MeshLab

► *meshlab.sourceforge.net*

Making Models

- Autodesk 123D
 - ▶ www.123dapp.com

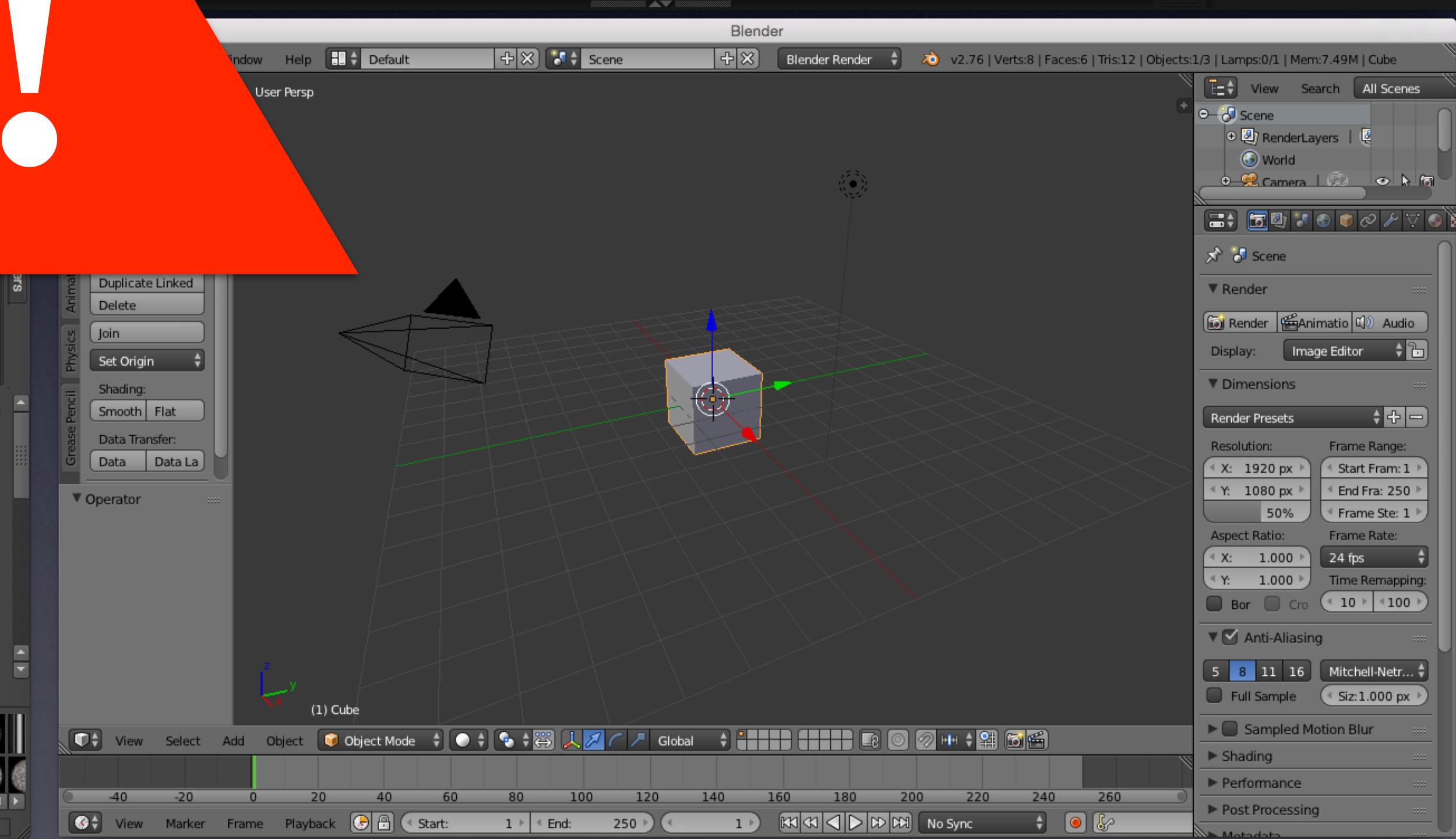
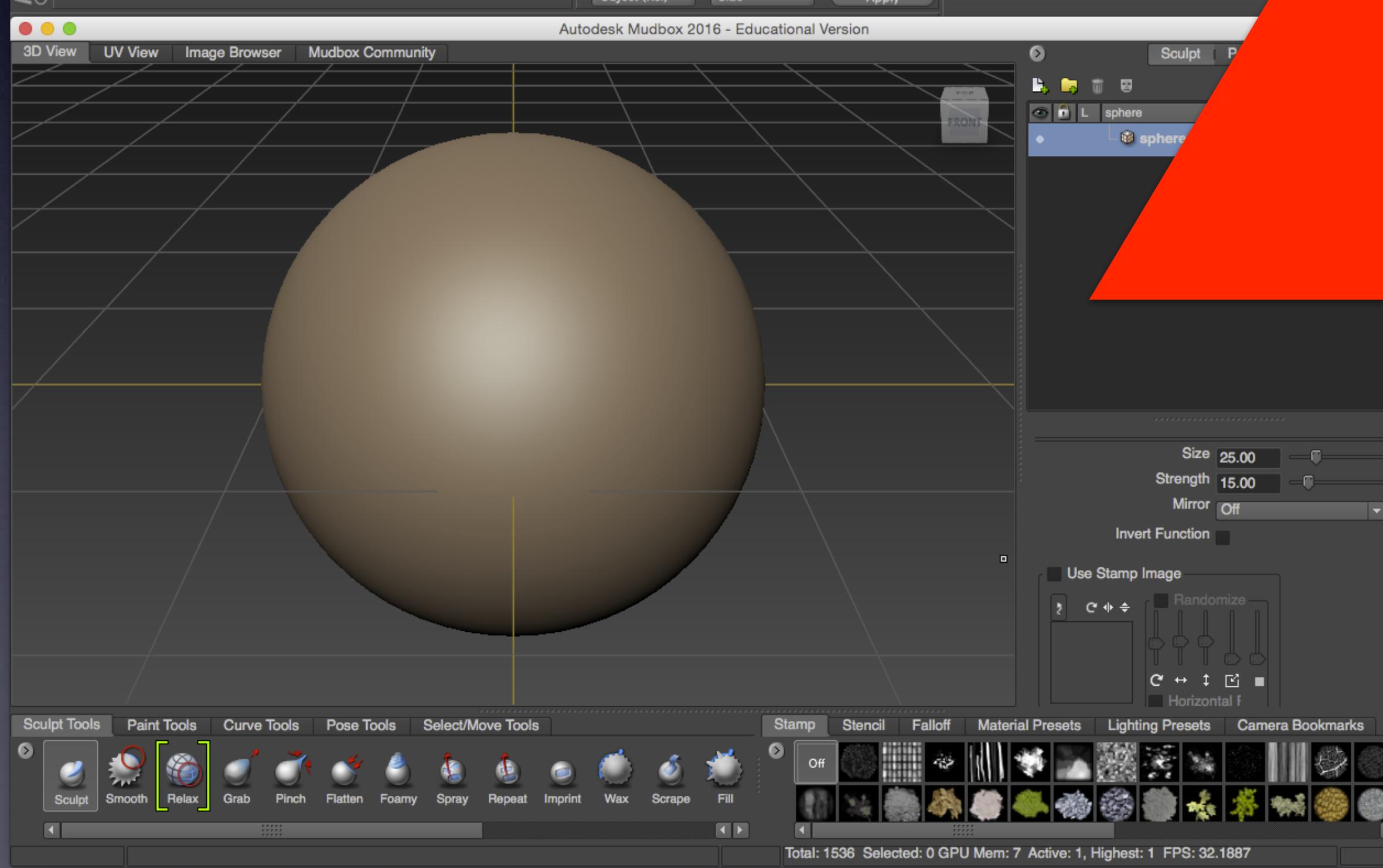
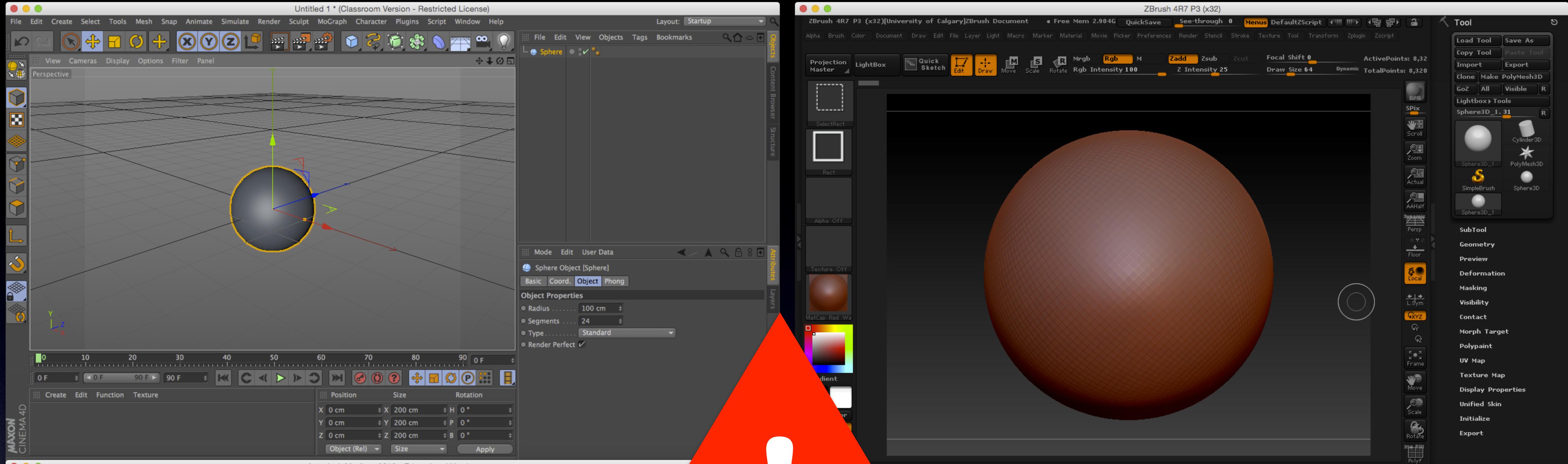


Making Models



SketchUp Make
(Trimble Navigation)

- ▶ www.sketchup.com
- ▶ *Ruby API*
- ▶ *SDK*

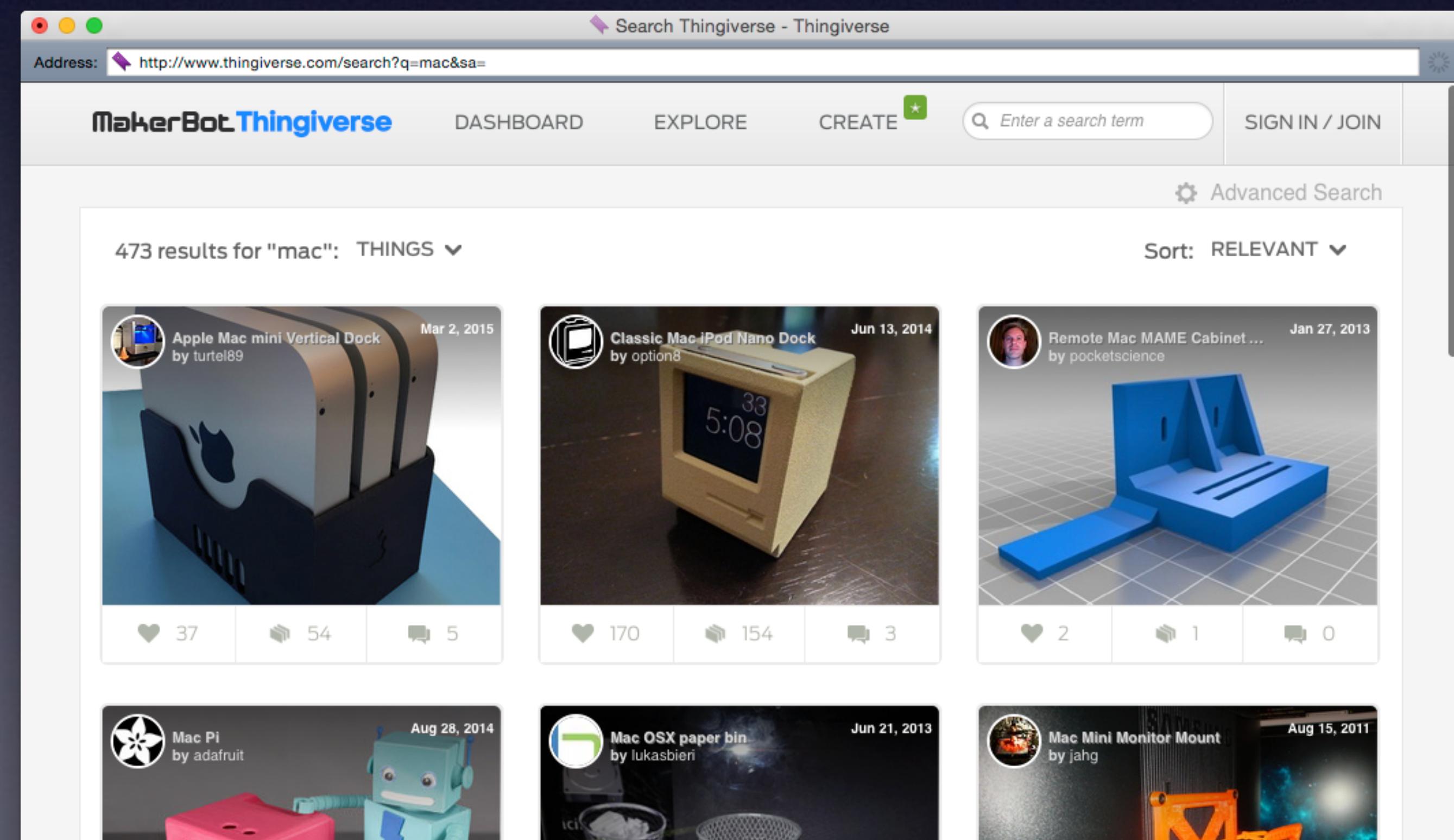


3D Scanning

- Different Kinds, Different Sizes
- Notorious for needing model cleanup

Community

- Thingiverse (Makerbot)
 - www.thingiverse.com



Community

- 3D Warehouse (SketchUp)
 - ▶ *3dwarehouse.sketchup.com*
- TurboSquid
 - ▶ *www.turbosquid.com/Search/3D-Models/free*
 - ▶ *Paid royalty-free models as well*

ucalgary.ca/iaml/help/pro/3d4ma

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