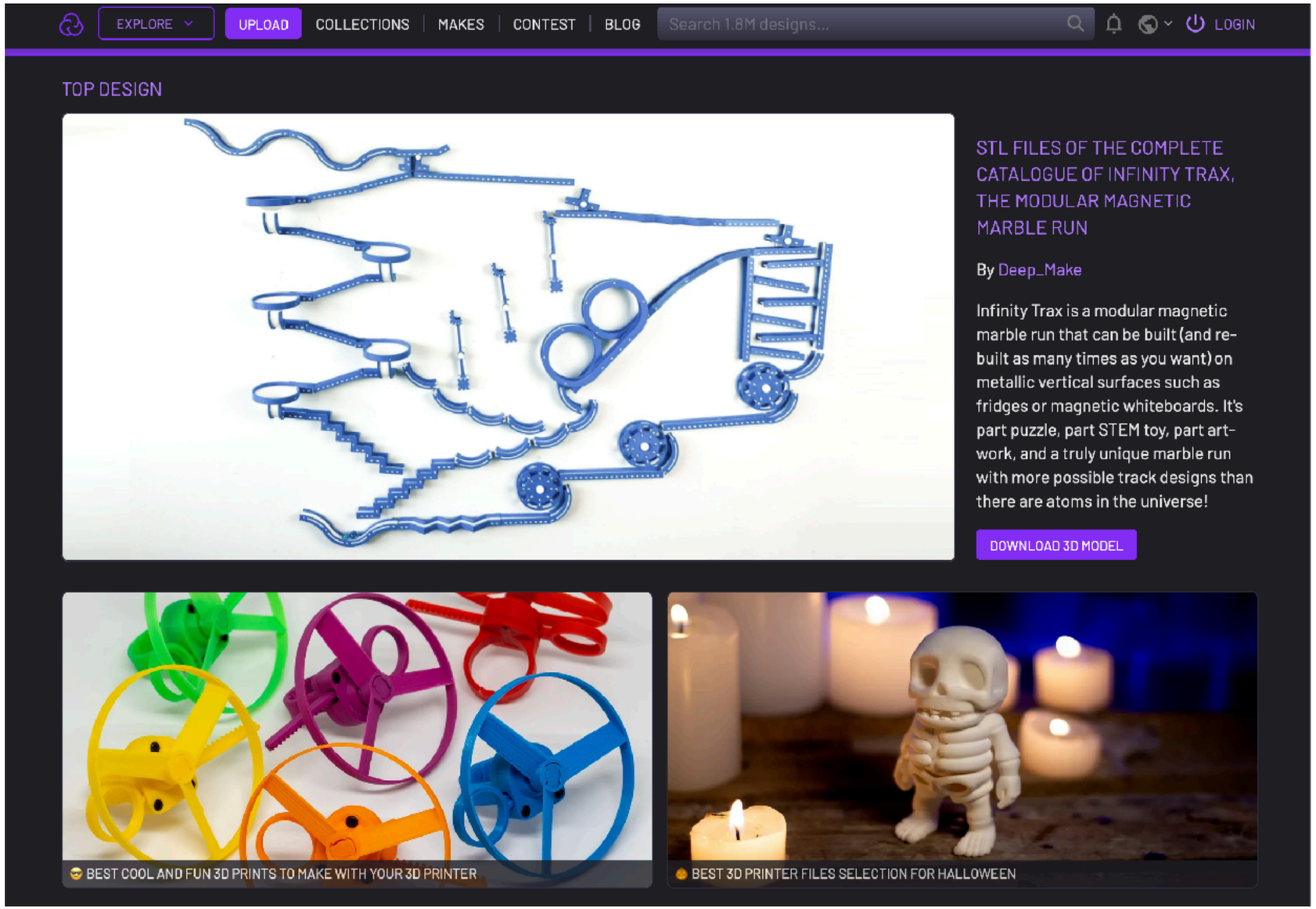
CS122 Class 7: 3D Printing



https://cults3d.com/en homepage

Class 7 agenda

- Zipcrit
- PM4 details
- Studio: OpenSCAD
  - Importing + fixing existing STLs with MeshLab
  - OpenSCAD basics, syntax
  - Slicing & support generation in OrcaSlicer
- Break
- Design for Protest Seminar

To follow along in the studio...

- Download OpenSCAD - https://openscad.org/
- Download MeshLab - https://www.meshlab.net/
- (Optionally) Download OrcaSlicer - https://github.com/SoftFever/OrcaSlicer

PM4: 3D printing for protest

- “Capstone” project for the first third of the course
- Not just about practicing your making skills or learning technologies, but now design motivated by *users* & *reason*
- We’ll learn more about the protest component in the seminar

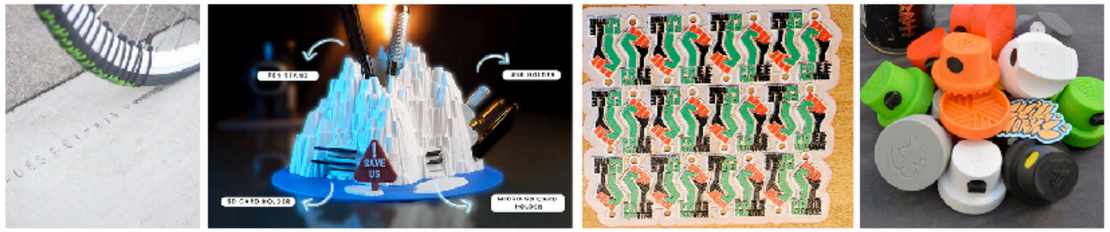
CS122

Search CS122 Canvas

Overview
Schedule
Instructors
Grading
Course Policies
Assignments
Assignment 1 - Hacking Zine
Assignment 2 - Analog Making - Sensory Cardboard
Assignment 3 - Digital Making - Press Fit Kit
Assignment 4 - 3D Printing for Protest

Assignments / Assignment 4 - 3D Printing for Protest

Personal Making Assignment 4: 3D Printing for Protest



Various 3D models found on Cults3D. Left to right, revolution, glacier organizer, Free Palestine keychains, grafitti caps.

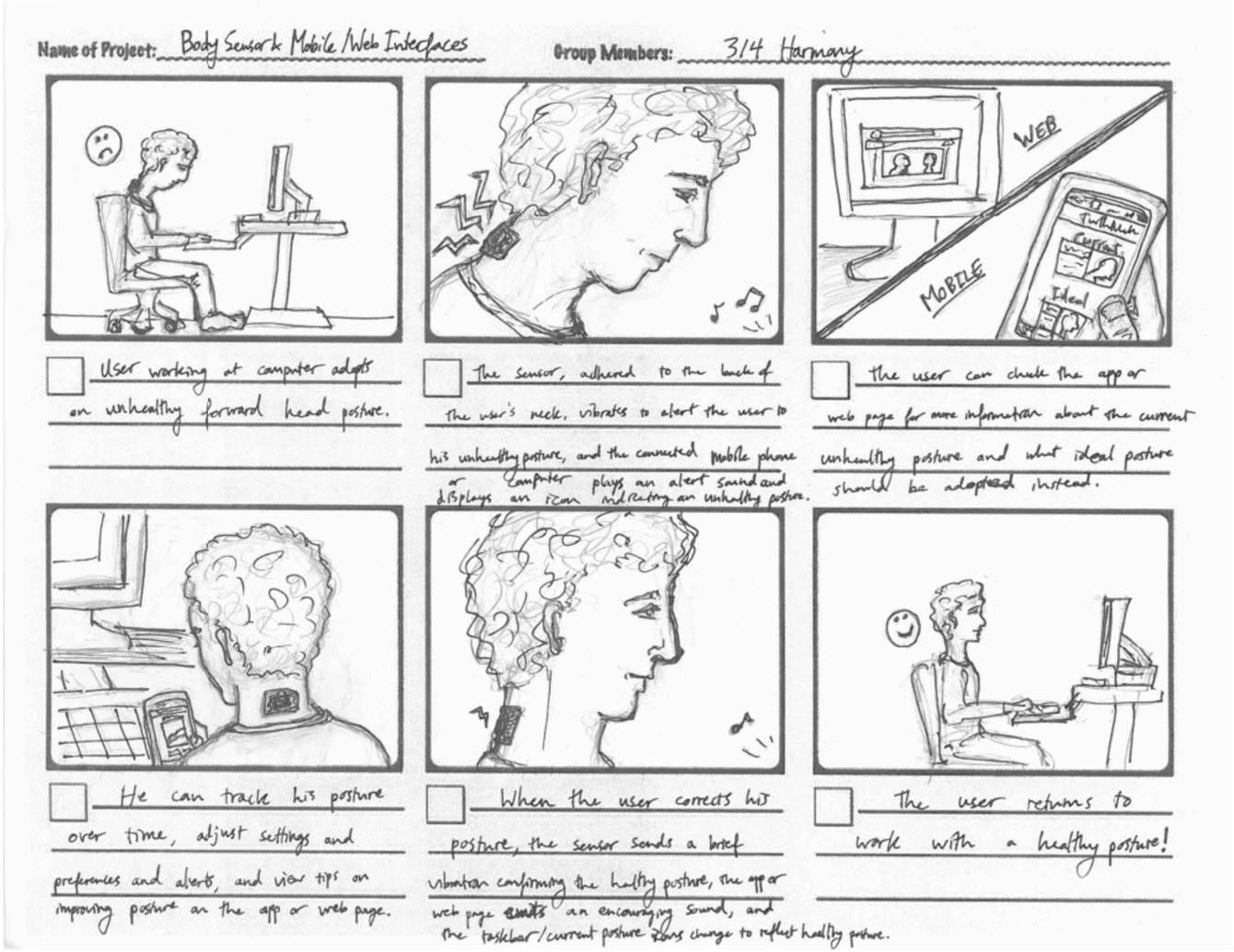
This assignment may be done alone or in pairs. If in pairs, please contact the instructor with the names of both students in the pair. I suggest making pairs based on similiar protest interests, and you can use the class Slack to look for partners!

This assignment is due in 2 weeks to account for time needed on the 3D printer. Please start early. For real: the makerspace has ~six 3D printers, and your print will take several hours to finish, so you'll likely need to use late days if you wait until the last day since all the printers will be in use. The Mudd makerspace website also has live feed of what 3D printers are currently in use.

This assignment is the “capstone” of the first third of the course and worth 150 points (instead of the usual 100). As such, it is highly encouraged to submit your storyboard for feedback by EOD Mon 2/23.

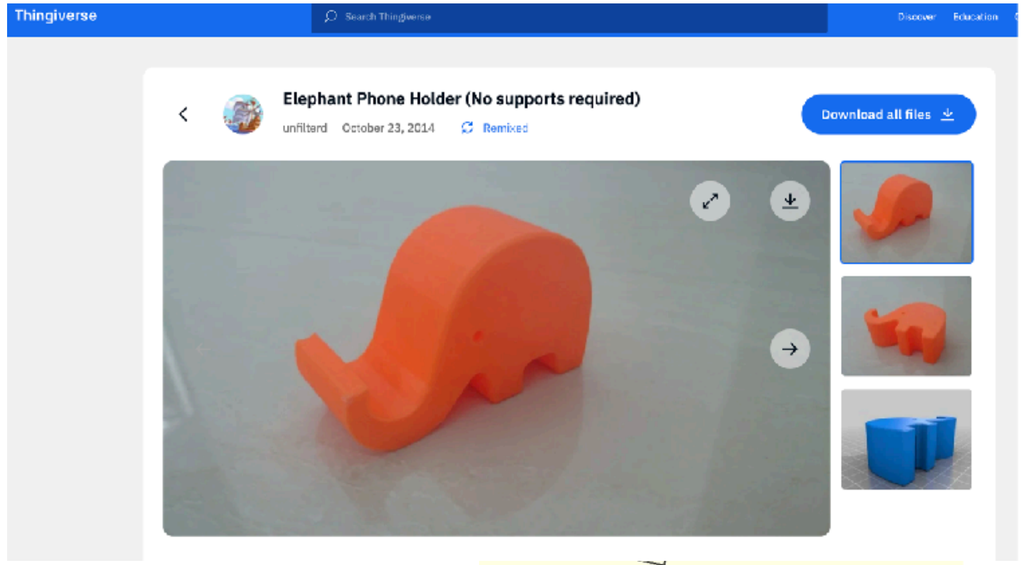
Step 1: Storyboarding

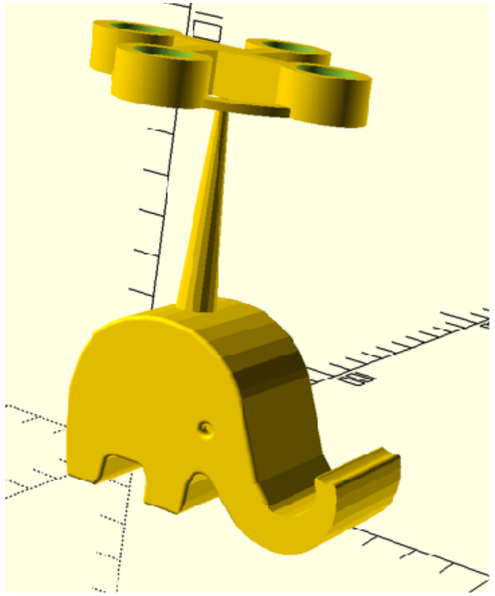
- A storyboard visually communicates *context* and *use* of your design. What scenarios will people use your object?
- Making a storyboard forces you to make design decisions
- Have a *user-centric* perspective before you jump into designing/ 3D modeling your object



Steps 2-3: Modeling & printing

- This is what the studio tutorial will be about
- Incorporating existing .STL (a common format for 3D printing) files is allowed/encouraged, as long as you modify them in some way
  - You might have to fix them in MeshLab
- Your protest object doesn't have to be 100% 3D printed, it's fine to incorporate other materials/found objects. However, some (non-trivial) part of it has to be 3D printed
- You are not required to use OpenSCAD if you have other preferred 3D modeling tools, but OpenSCAD 3D models with code so I figured it'd be the easiest to teach :)
- Unsure? Submit your storyboard next week for feedback!





Write up extras: *justify* your design

- How does your design address protest?
- Why does your object suit the 3D printed medium, rather than other ones (like analog or laser cut?)
- What are the limitations of 3D printing for protest?
- Questions?

Step 4: Documentation & write up

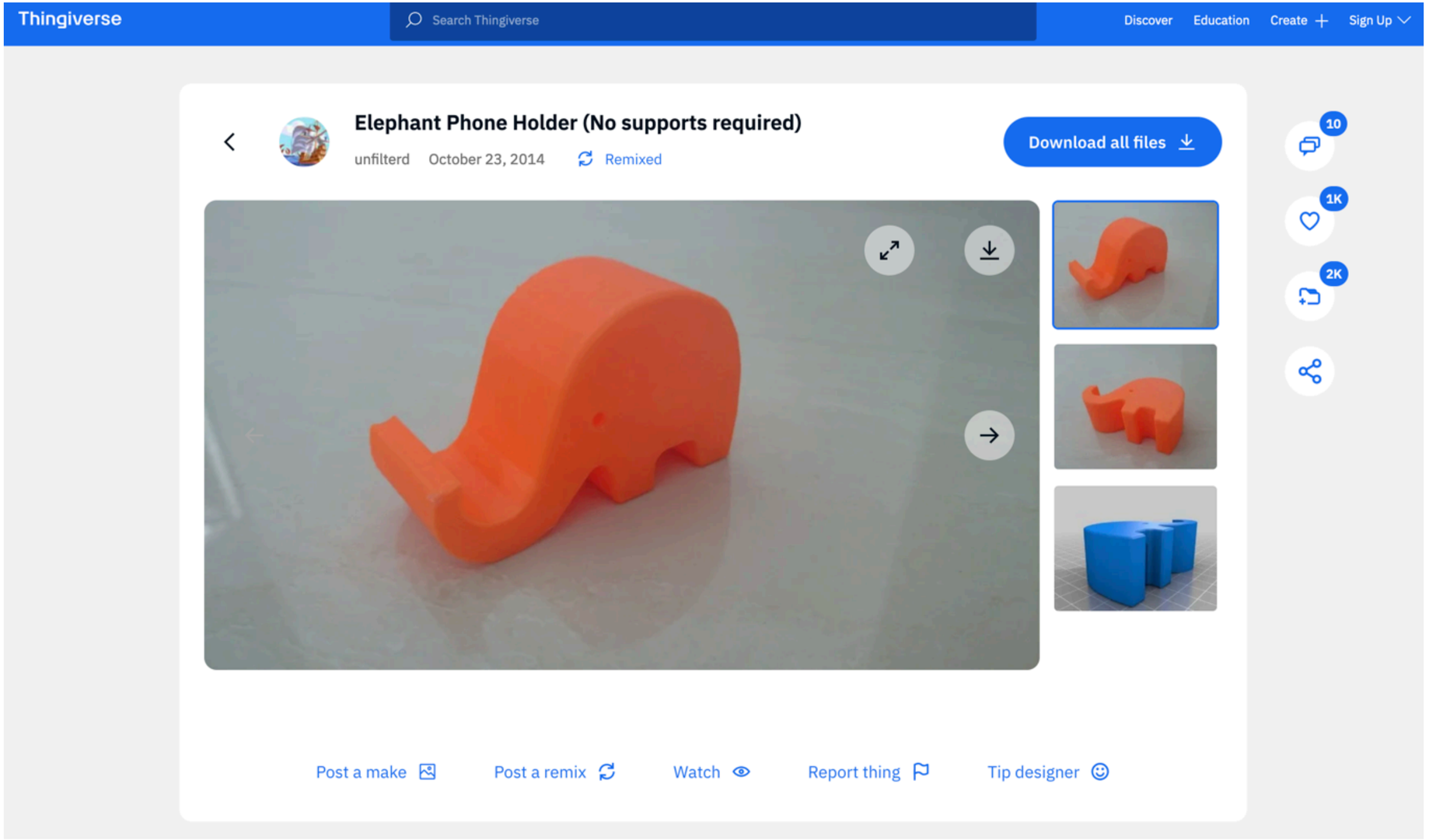
Your PDF write up for this assignment should include, in addition to the design documentation, 3 written paragraphs addressing (1) some background of your protest, (2) justifying why your object is 3D printed and not some other medium, and (3) reflecting on the limitations of design for protest. Specifically, create a PDF that contains in order:

1. A paragraph on background context of your protest. What/who are you protesting? Why do you care about the issue?
2. Your **storyboard** showing the context and motivation behind the protest object.
3. A paragraph justifying why your object suits the 3D printed medium. Why is it better suited for 3D printing rather than analog means or laser cutting?
4. Your design documentation of the process. Include at least:
   - One screenshot of your STL file (such as rendered on OpenSCAD)
   - One screenshot of your piece visualized in the slicer software
   - Two photos from two different angles of your final 3D printed object
5. A paragraph addressing the *limitations* of your 3D printed object for protest. For instance, in Printing Utopias, the author says, "On the one hand, the 3D printer helps make utopian desires tangible and negotiable. On the other hand, the 3D printer tends to promote a techno-positivist approach that oversimplifies social change, losing sight of alternatives and ambiguities." This echoes the Making versus Making Do reading—how does your object lie on this spectrum of making a utopian desire tangible versus being techno-positivist? If you weren't forced to 3D print something for this class assignment, would you still think your object helps in your protest, or would the protest be better addressed through other, non-technology centric factors?
6. Acknowledgements: List any online resources you used, modified, or got inspiration from. Link any STL files you downloaded and remixed. List any people (such as makerspace stewards) you got help from. **If you worked in pairs**, please also write what specific parts of the assignment did each person contribute to in this section.
7. Finally, the usual feedback/reflection paragraph: How long did you spend on this assignment? How did this assignment match up to your initial expectations? What was the most challenging part? What did you learn about interacting with 3D printers? Were there any parts you had to redo, or lessons you learned for the future? And, as always, how is the workload of the class matching to your expectations? (This assignment is our "midterm" equivalent!)

Studio: 3D printing workflow demo

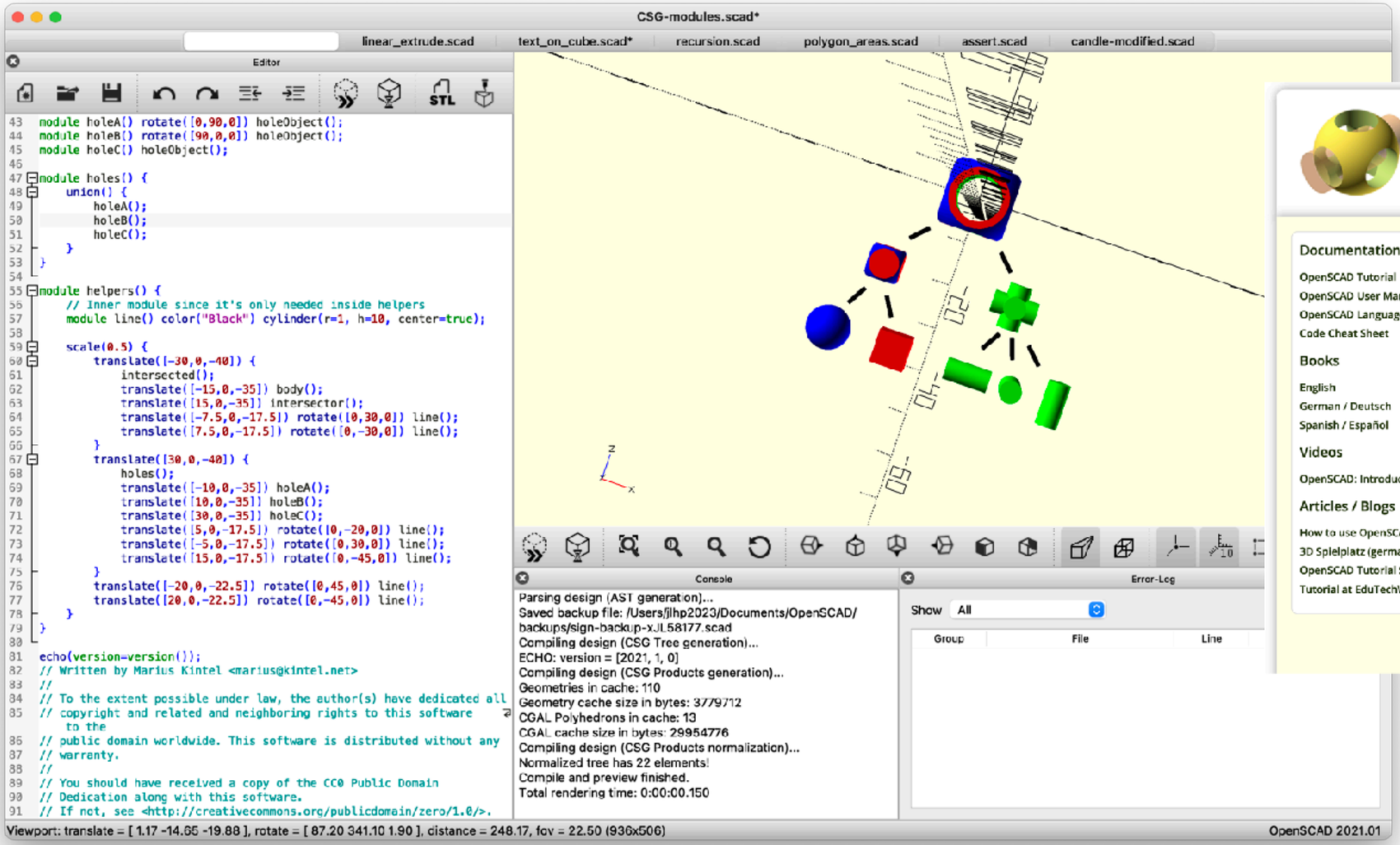
3D printing demo broad strokes

- 1. Download existing STL from Thingiverse to remix
- 2. Edit parametric example code in OpenSCAD (parametric = has parameters)
- 3. Fix “broken” STL in MeshLab
- 4. Generate support material in OrcaSlicer



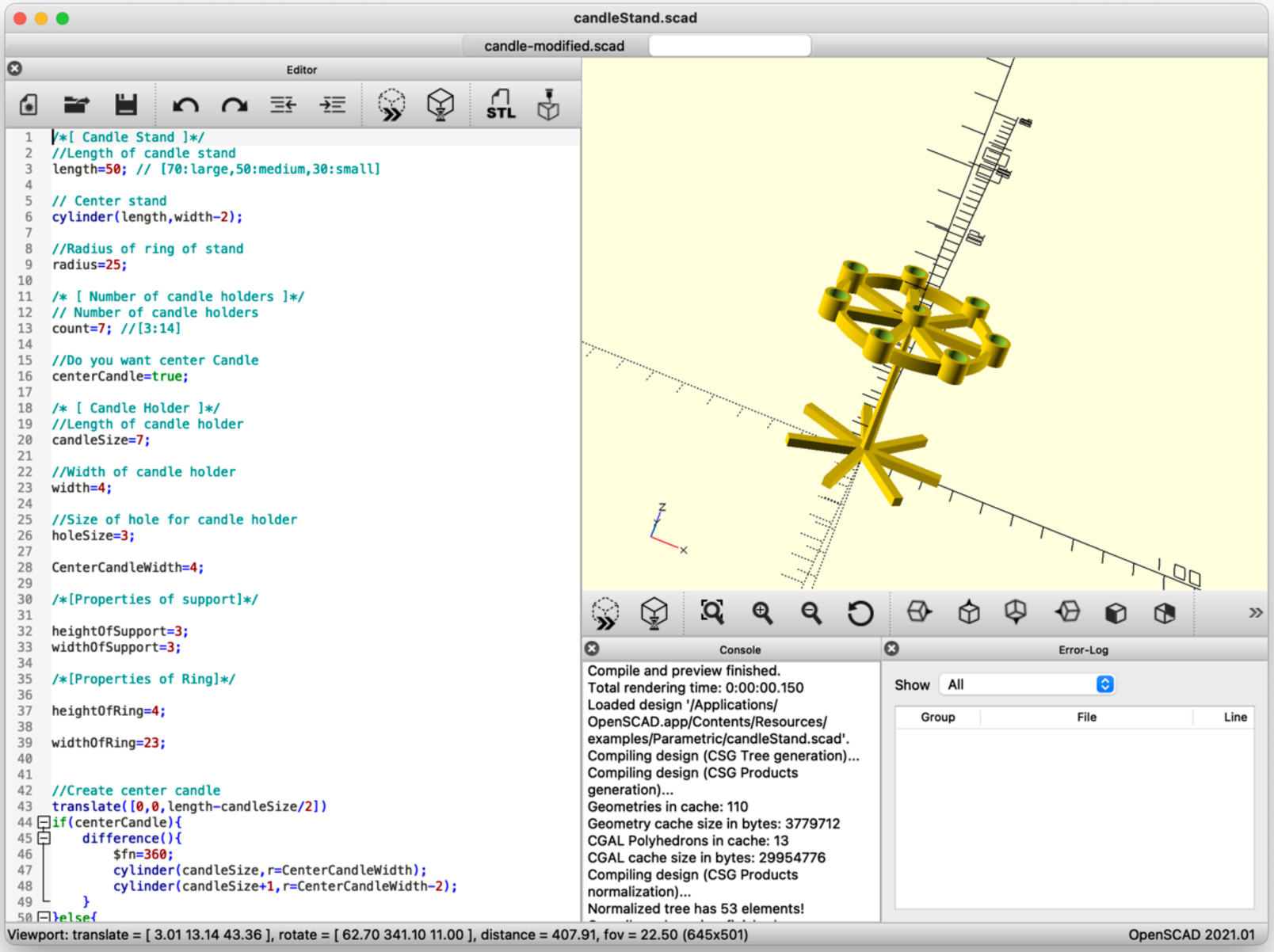
https://www.thingiverse.com/thing:512797

Protip: holding down ctrl + click pans the viewport



File > Examples > Basics > CSG-modules.scad

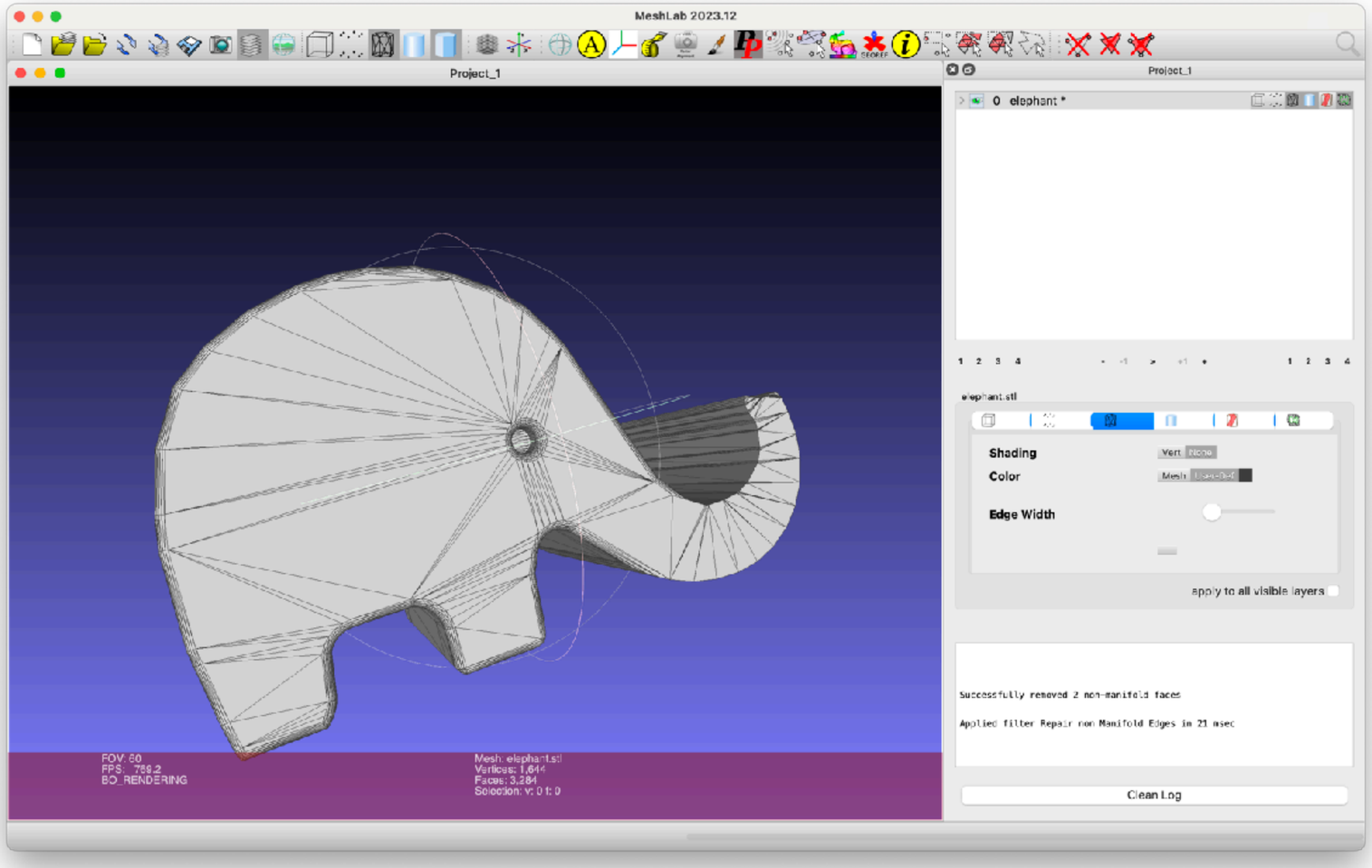
https://openscad.org/documentation.html
Confused? Read the docs!!



Play around and see if you can understand the parameters

File > Examples > Parametric > CandleStand.scad

STL file appearing in preview, not render - fix the STL file in MeshLab

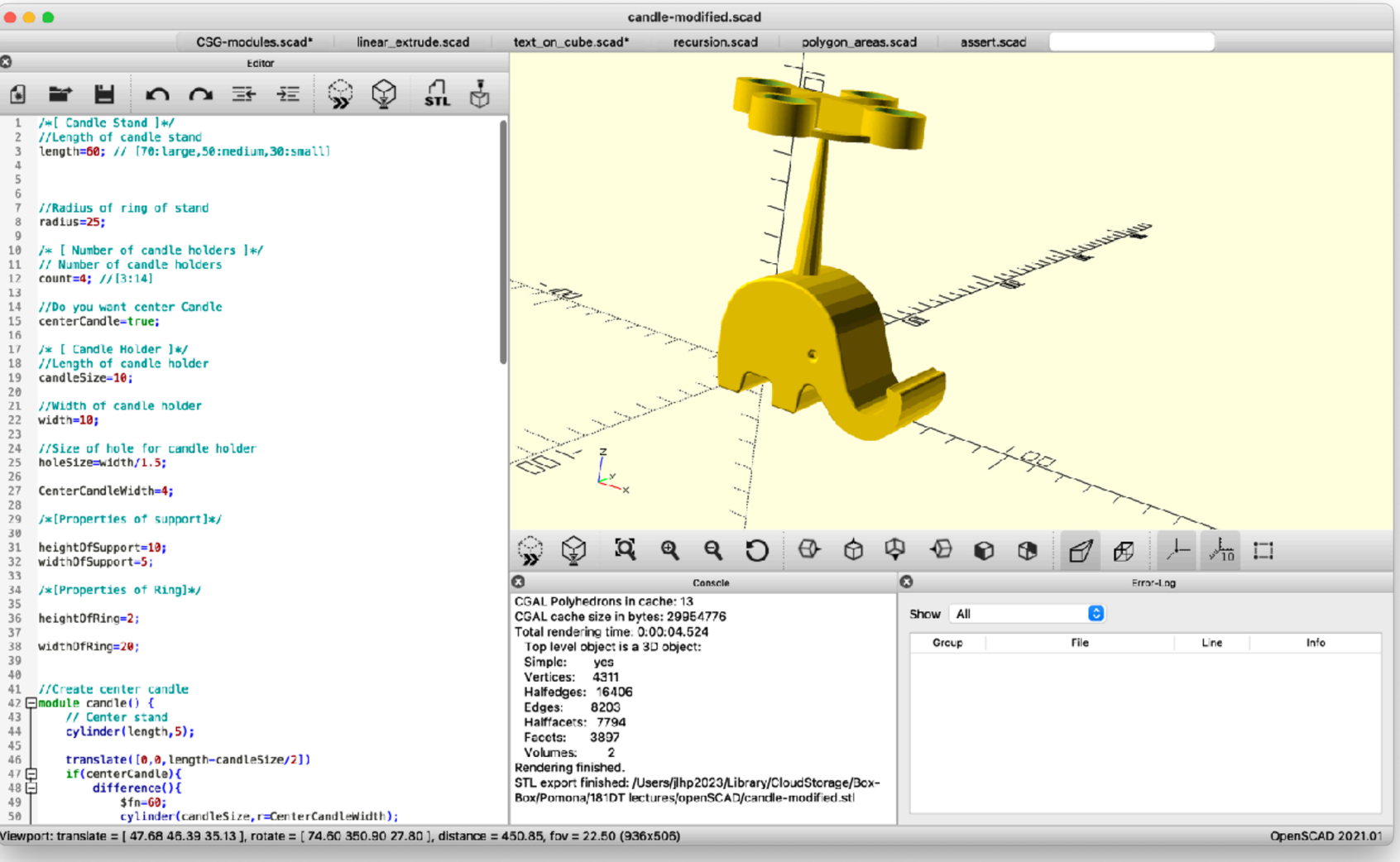


Filters > Cleaning & repairing

Here, it was specifically fixing non-manifold edges

In general, just click through the options until you see it do some action to > 0 vertices/faces/edges

3D models are represented by vertices + faces

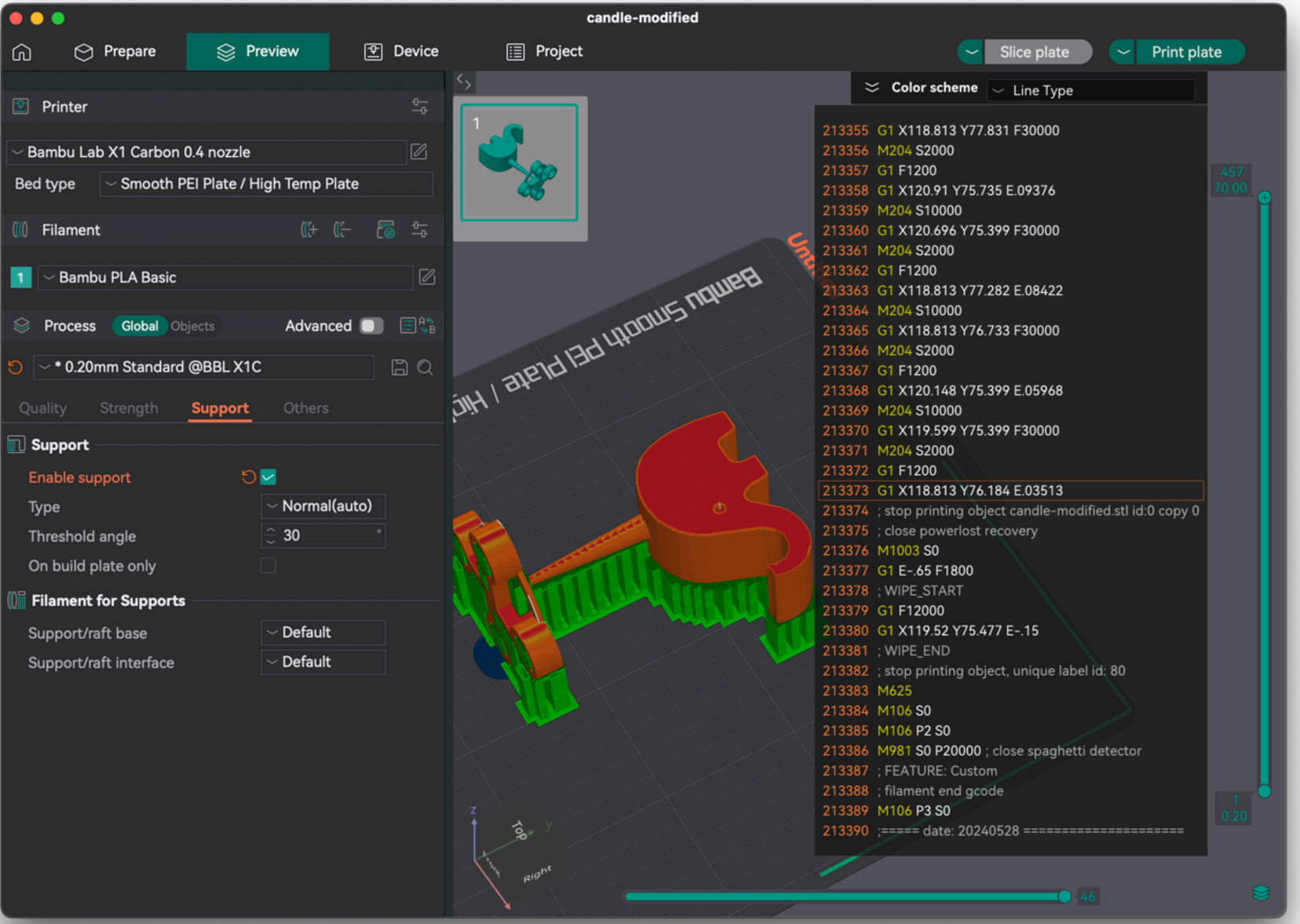


Final code:

```
union() {
   rotate([90,0,0]){
      import("elephant.stl");
   }
   translate([22,-15,40]) {
      candle();
   }
}
```

When importing, make sure the .stl is in the same folder/directory as your .scad file

I've also uploaded the files to Canvas



OrcaSlicer software

Try to design your 3D print (or rotate it on the plate) to minimize supports

Read the HMC 3D printer specific manual for settings

https://docs.google.com/document/d/1Blw20OA6k90Fj1Fr1DcnzEegb925oTB9Lk1SixmsZko/edit#heading=h.p7o03diqftst

Break / Seminar

Class 7 recap

- TODOs:
  - For **Wednesday**'s class:
    - Reading responses for reflection & friction
    - Seminar by Emma & Dylan
    - ZC by Harper & Nicole
  - By **next Monday's** class:
    - PM3: Press Fit Kit (bring to class)
    - Suggested deadline for PM4 storyboard (EOD)
    - ZC by Bryson