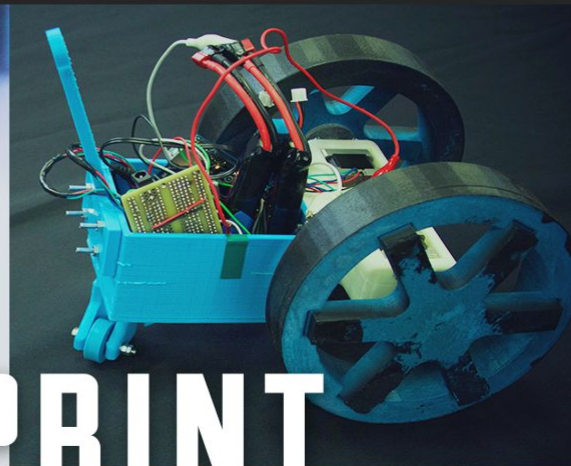
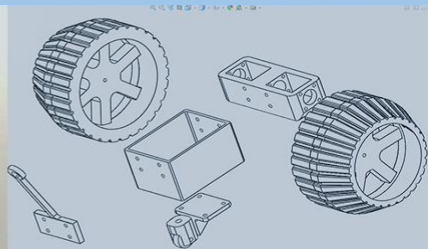
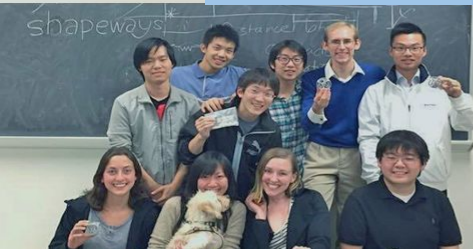




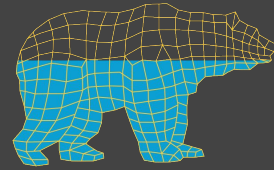
UCLA3D4E

# DESIGN. TINKER. PRINT.

Workshop Series - Week 7 - Advanced Printing

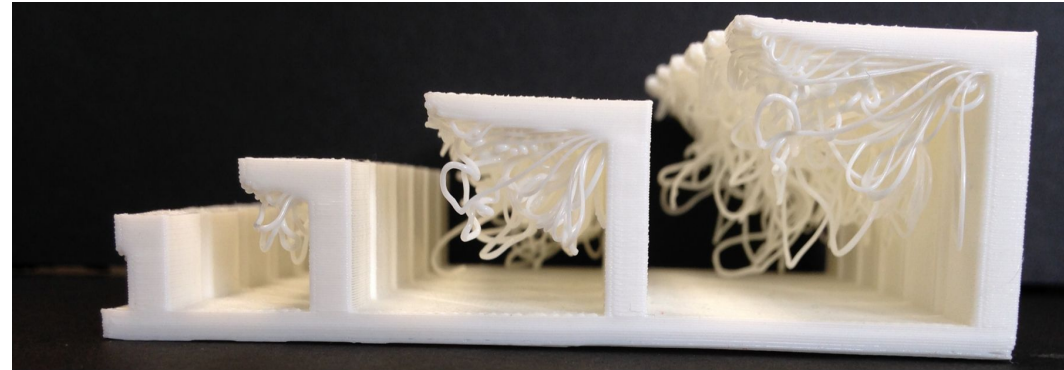


# Workshop Flow



Overall flow of this workshop:

1. Design Phase
2. Pre-Print Phase
3. Printing Phase
4. Waiting
5. Post-Printing Phase
6. Maintenance + Troubleshooting

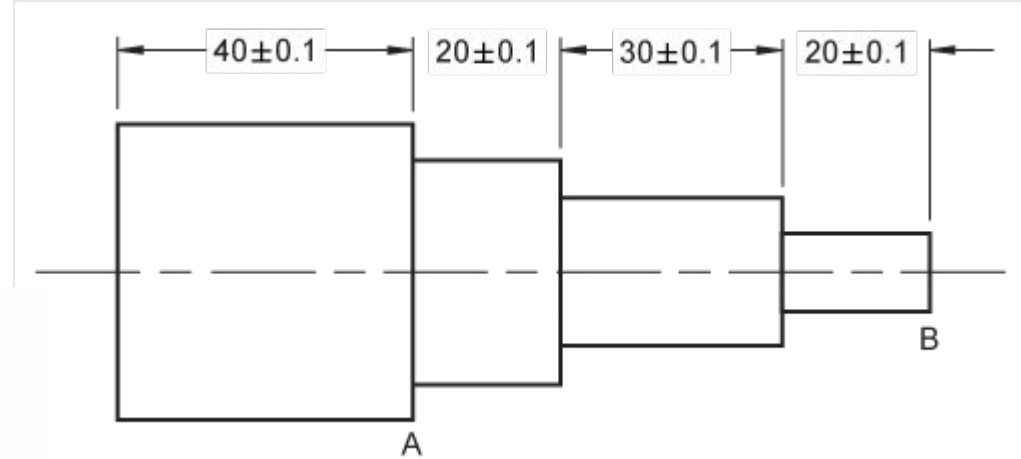


Failed Horizontal Overhangs

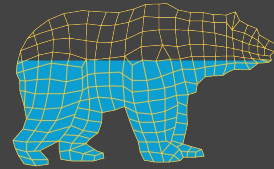
# 1. Design Phase

## a. Tolerances

### i. Why need them



# 2. Pre-Print Phase



## a. Part design tips

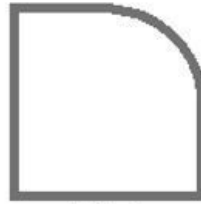
i.



Edge

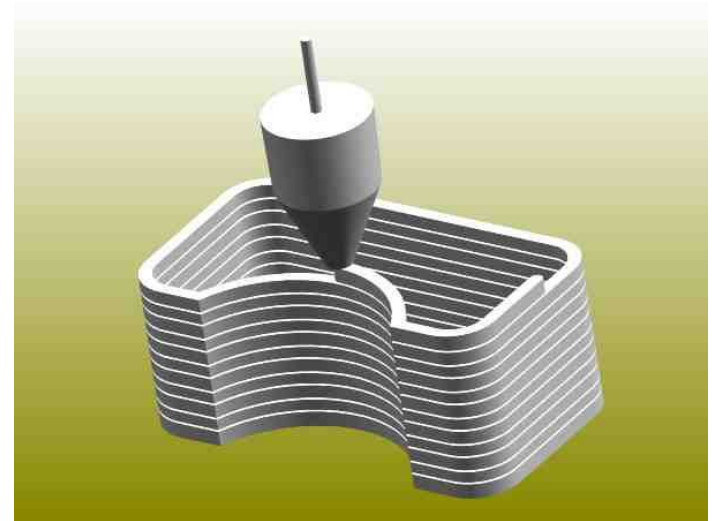
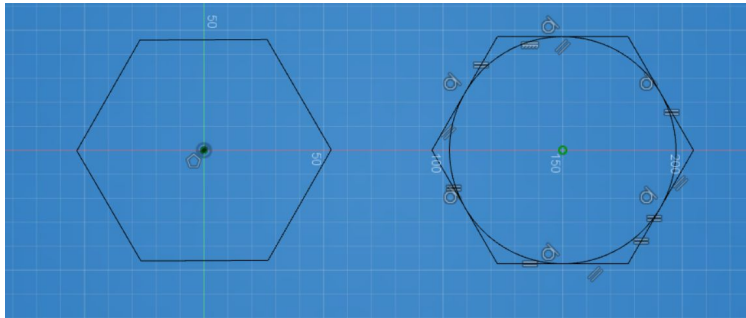


Chamfer



Fillet

ii. **Ex:** Circle to create hexagon example (multiple ways to make same design, but there are more efficient ways)



## 2. Pre-Print Phase

### a. Assembly and Part Interaction

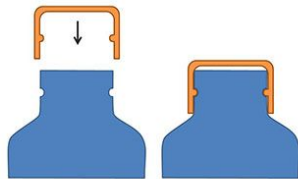
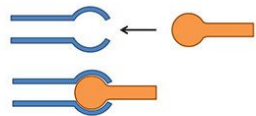
#### Tips

- i. Tolerances/constraints
- ii. Snap fits
- iii. Gears
- iv. Fasteners

Annular Snap-Fits

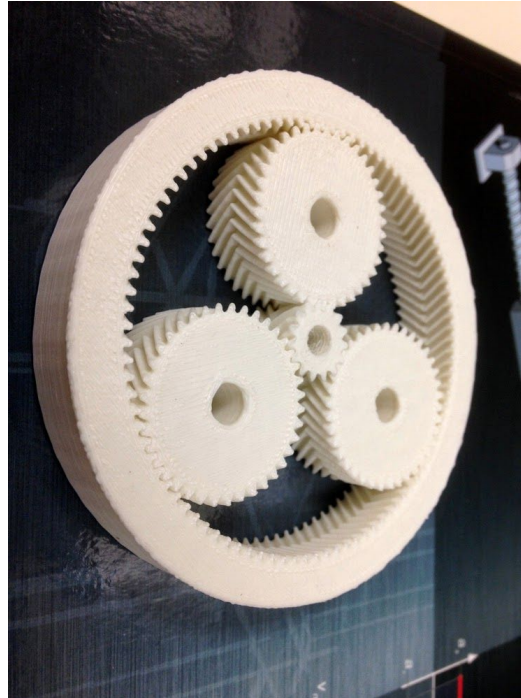


A pen utilizes an annular snap fit to retain the cap

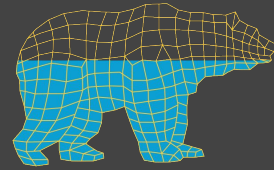


Bottle cap uses an annular snap fit

annular snap fit



## 2. Pre-Print Phase

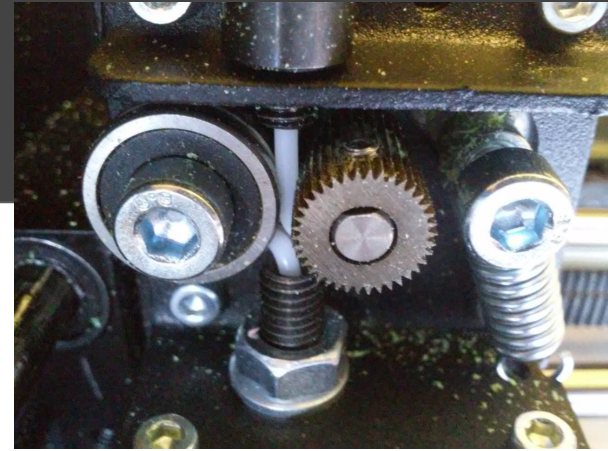


- a. Materials differences
  - i. **Ex:** Resin vs Thermoplastics vs flexible filament vs wood vs metals

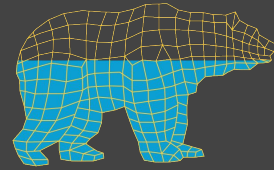


## 2. Pre-Print Phase

- a. Materials differences
  - i. **Ex:** Resin vs Thermoplastics vs flexible filament vs wood vs metals
- b. Filament types
  - i. Temperature/speeds for various filaments
  - ii. Methods to handle removal of filaments
  - iii. Methods to handle adhesion of first layer of filaments
  - iv. Heated bed vs non heated bed
  - v. **Ex:** PLA, ABS, PTEG, SLA, NinjaFlex



## 2. Pre-Print Phase

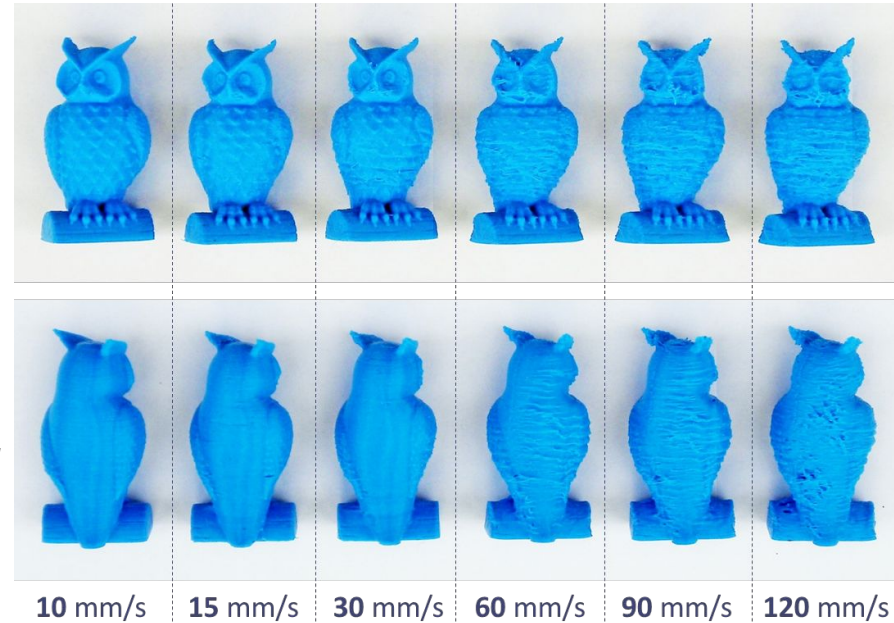


a. Big 5 (Deep dive from week 4 workshop)

- i. Layer Height
- ii. Fill Density
- iii. Print speed
- iv. Print temperature
- v. Supports

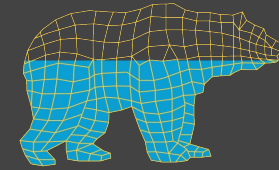
b. Resolution

- i. Qualitative vs Quantitative meaning of
- ii. Differences across printers
- iii. **Example:** Evaluating various printers, and their cost

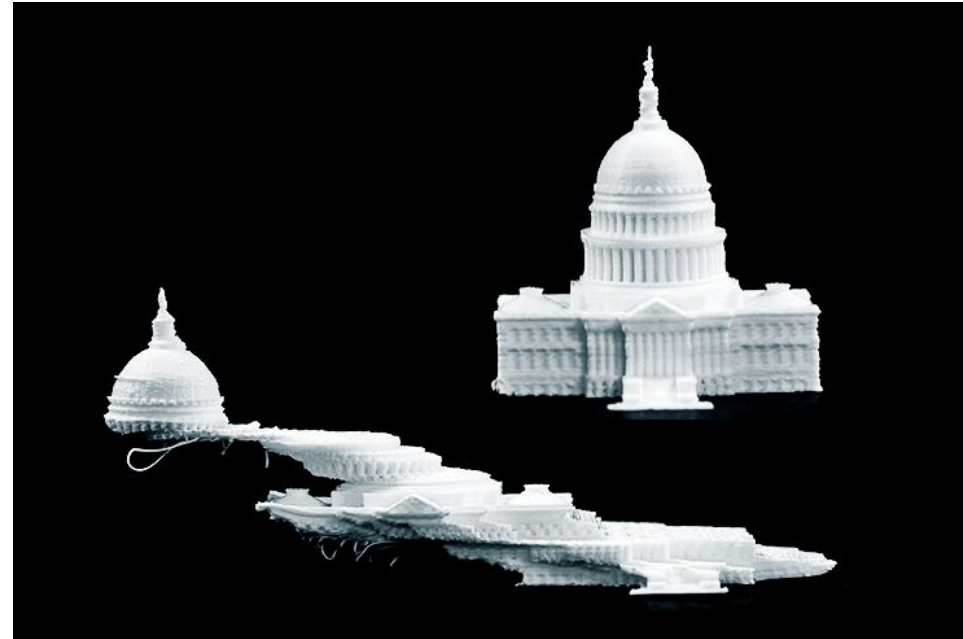
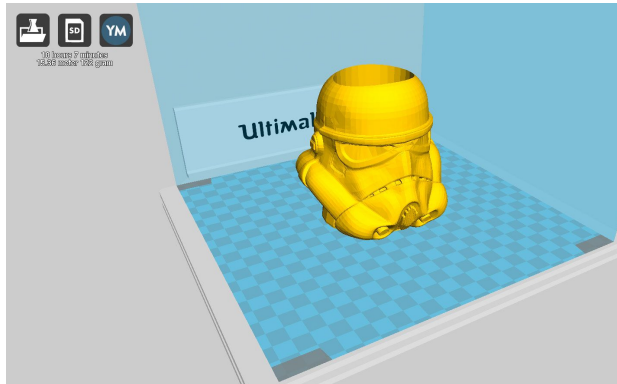




## 2. Pre-Print Phase



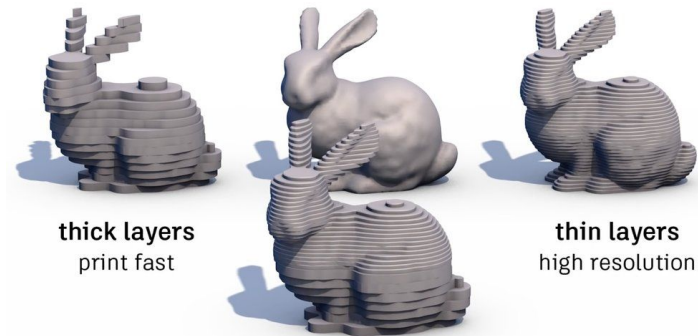
- a. Thickness of parts
  - i. flexible parts using rigid plastic
  - ii. Infill strength curves
- b. Third party slicing software
- c. Overhangs (maximum and when to use supports)



# 2. Pre-Print Phase

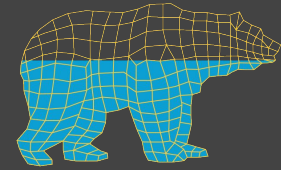


- a. Thickness of parts
  - i. flexible parts using rigid plastic
  - ii. Infill strength curves
- b. Third party slicing software
- c. Overhangs (maximum and when to use supports)
- d. Supports
  - i. CADing them rather than having the slicer generate it  
prosthetic arm good example
- e. Printer limitations
  - i. **Case Study:** Zeus vs Mod-T vs Robo3D
- f. Other Campus printers
  - i. Locations
  - ii. Type of printers (SLA, FDM mainly),
  - iii. Who to talk to for access
  - iv. METAL PRINTER???????

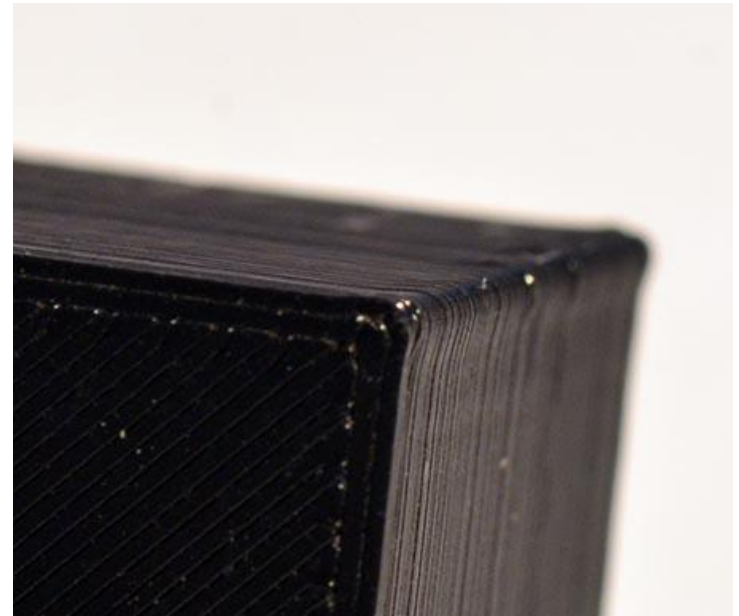


Strength [MPa]	Infill %						
	10	30	50	70	80	90	100
0.1	8	12	17	25	29	33	39
Layer	0.15	9	14	20	28	33	44
Height	0.2	10	15	21	30	35	46
[mm]	0.25	10	15	22	31	37	49
	0.3	10	15	22	31	36	48

## 2. Pre-Print Phase

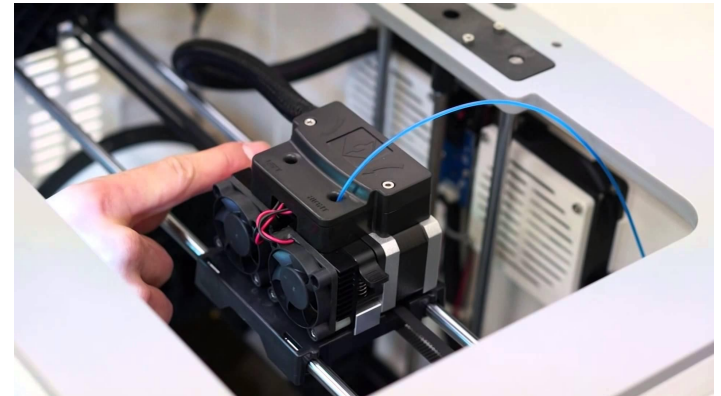
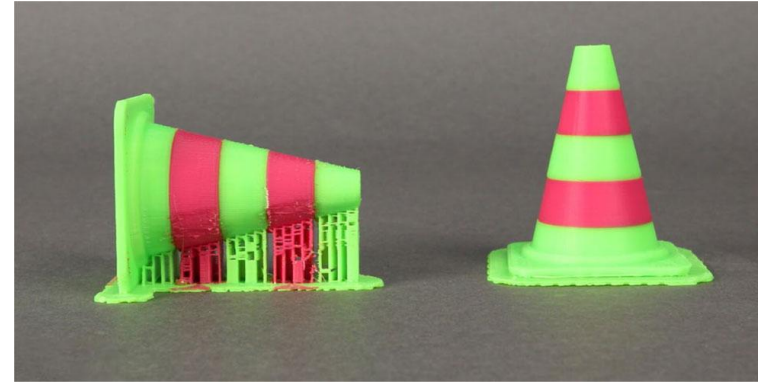


- a. Part design tips
  - i. Fillets and chamfers (removing sharp corners)
  - ii. **Ex:** Circle to create hexagon example (multiple ways to make same design, but there are more efficient ways)
  - iii. **weak shear strength of FDM layers for long thin objects,**
  - iv. **multiple protrusions on flat surface without joining,**

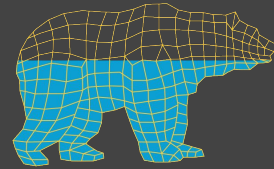


# 3. Printing Phase

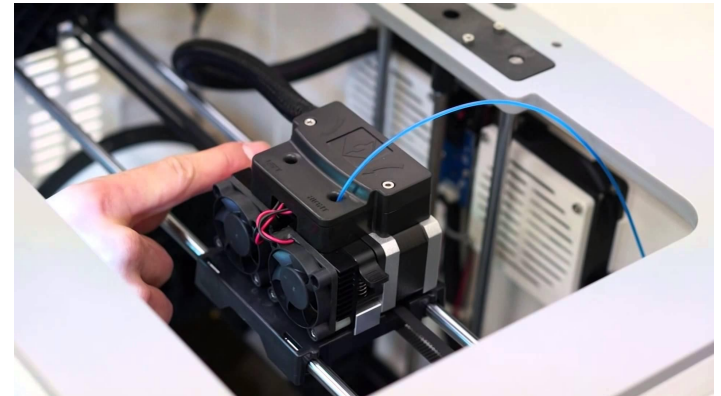
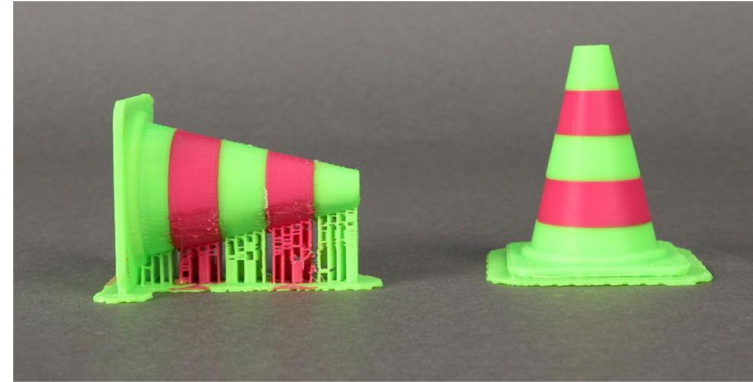
- a. Printer tips
  - i. **Print direction**
  - ii. Part orientation (i.e. horizontal holes okay, less support is not necessarily better, etc).
  - iii. Support orientation
  - iv. 1st layer adhesion (Tape vs Glue for 1st layer)



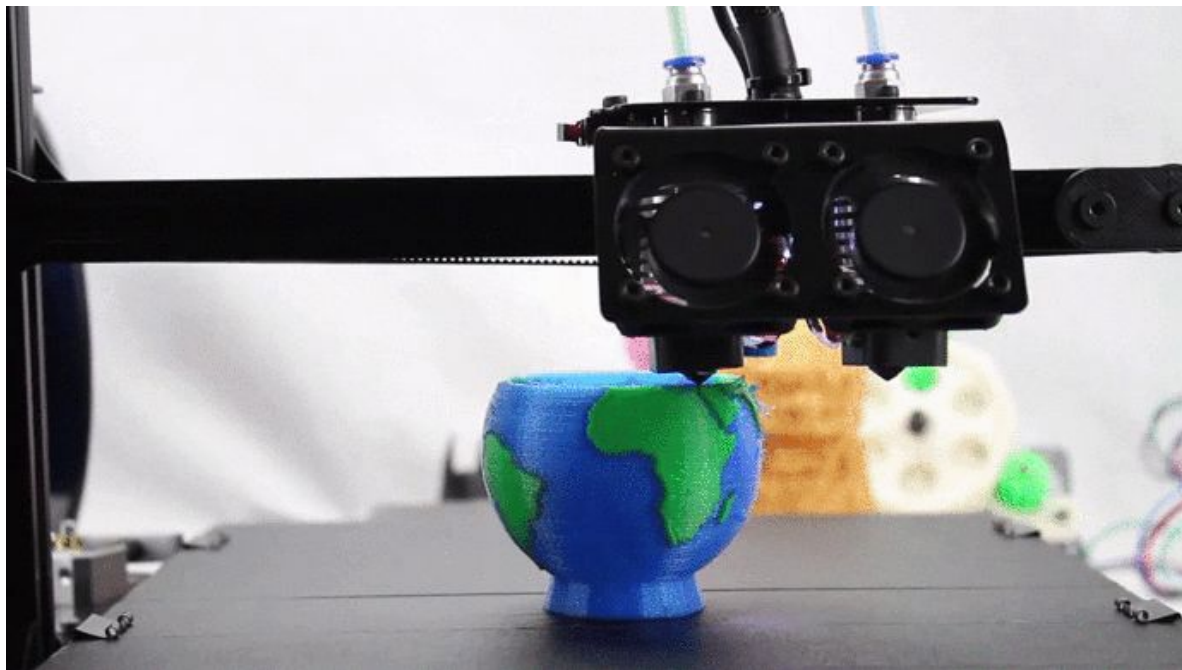
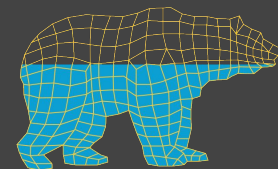
# 3. Printing Phase



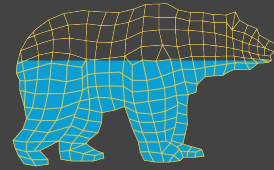
- a. Printer tips
  - i. **Print direction**
  - ii. Part orientation (i.e. horizontal holes okay, less support is not necessarily better, etc).
  - iii. Support orientation
  - iv. 1st layer adhesion (Tape vs Glue for 1st layer)
- b. Making sure the printer is ready for use
  - i. 3 things to check for:
    - 1. Is the printer on
    - 2. Is the filament in
    - 3. Will my part fit (part sliced and oriented properly)



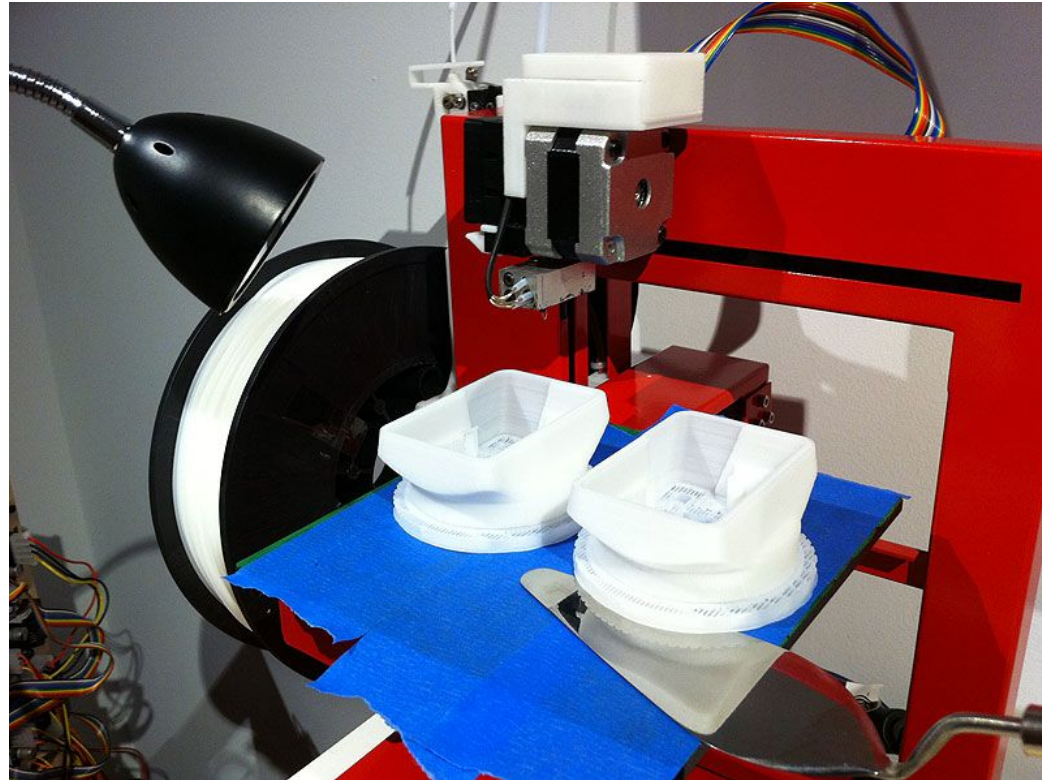
# 4. Waiting



# 5. Post Printing Phase



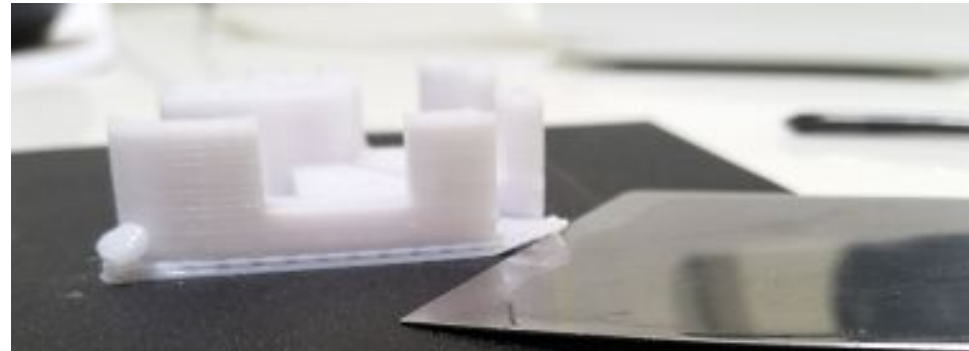
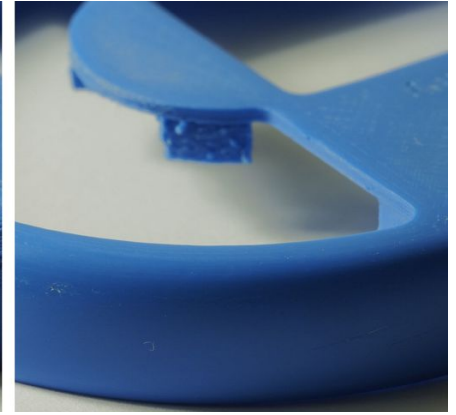
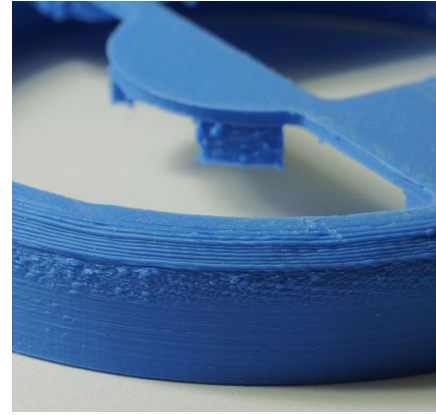
- a. Print is done (successful/failed)
  - i. Removing parts from bed
    - 1. Do's and don't
  - ii. Making printer ready for next person to use
    - 1. Replacing blue tape



# 5. Post Printing Phase

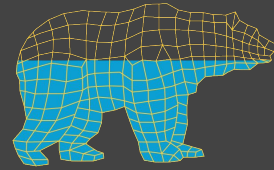


- a. Print is done (successful/failed)
  - i. Removing parts from bed
    - 1. Do's and don't
  - ii. Making printer ready for next person to use
    - 1. Replacing blue tape
- b. "Just do it in post" (making it look nice = the toughest part)
  - i. Cleaning parts
    - 1. Filing
    - 2. Sandpaper

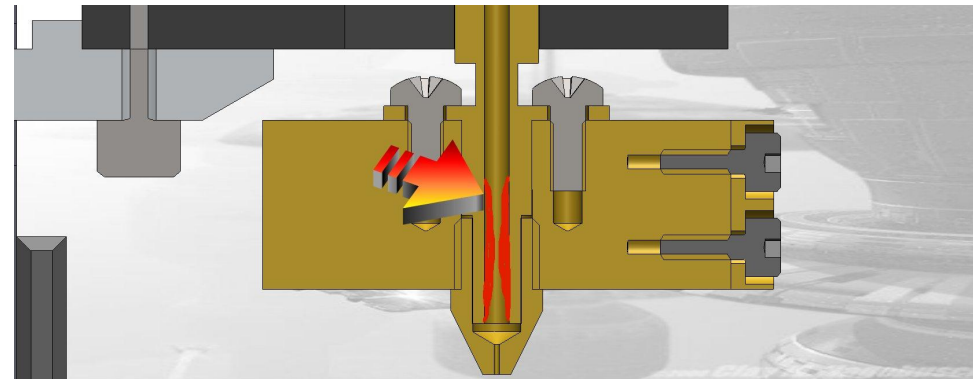




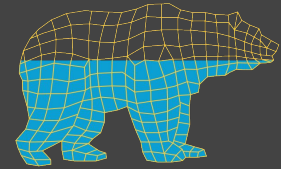
# 6. Maintenance + Troubleshooting



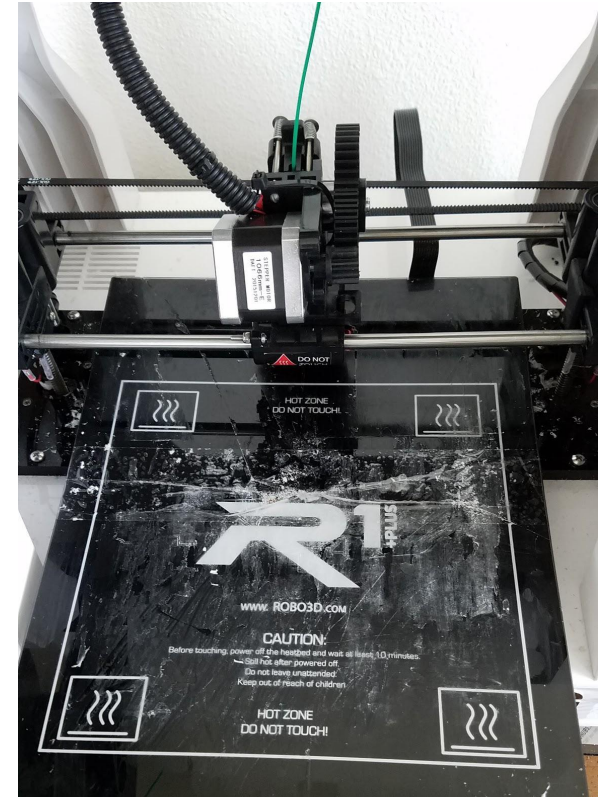
- a. Printer Maintenance
  - i. General cleaning procedures
  - ii. **What parts break often and jams**
  - iii. How to troubleshoot problems with printer
  - iv. Maintenance contacts
    - 1. Company
    - 2. Forums
    - 3. Lab manager - Michael
    - 4. Ryan



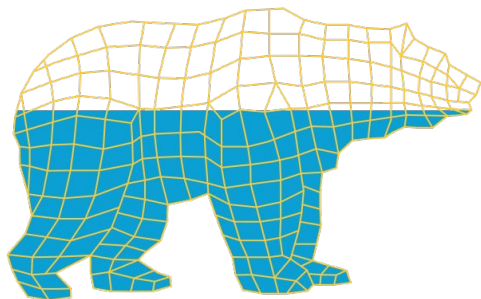
# 6. Maintenance + Troubleshooting



- a. Oops, I broke something
  - i. It does cost an arm and leg (Ryan accepts donations)
  - ii. Make sure you are ok, do First Aid, CPR, MRI, corpus callosotomy
  - iii. Stop printer operations
  - iv. Turn off printer, make sure heated bed and/or extruder are turned off
  - v. Take steps to fix if known error and **you know how to**
  - vi. Contact people
    1. It's completely fine, happens all the time
    2. Better to let us know and have us teach you to fix the problem vs you freaking out



# QUESTIONS?



**DESIGN. TINKER. PRINT.**  
3D FOR EVERYONE

Contact 3D4E: [3d4e.ucla@gmail.com](mailto:3d4e.ucla@gmail.com)

Contact Ryan: [rpooon@g.ucla.edu](mailto:rpooon@g.ucla.edu)

Contact James: [astemoui@ucla.edu](mailto:astemoui@ucla.edu)

Contact Quentin: [Quentintruong@gmail.com](mailto:Quentintruong@gmail.com)

