Mechanical Design

Mark Jennings and Meera Wakim

Download, install, and log in to the UT Virtual desktop (for engineering students):
http://www.engr.utexas.edu/itg/facilities/virtualdesktop

Mark Jennings

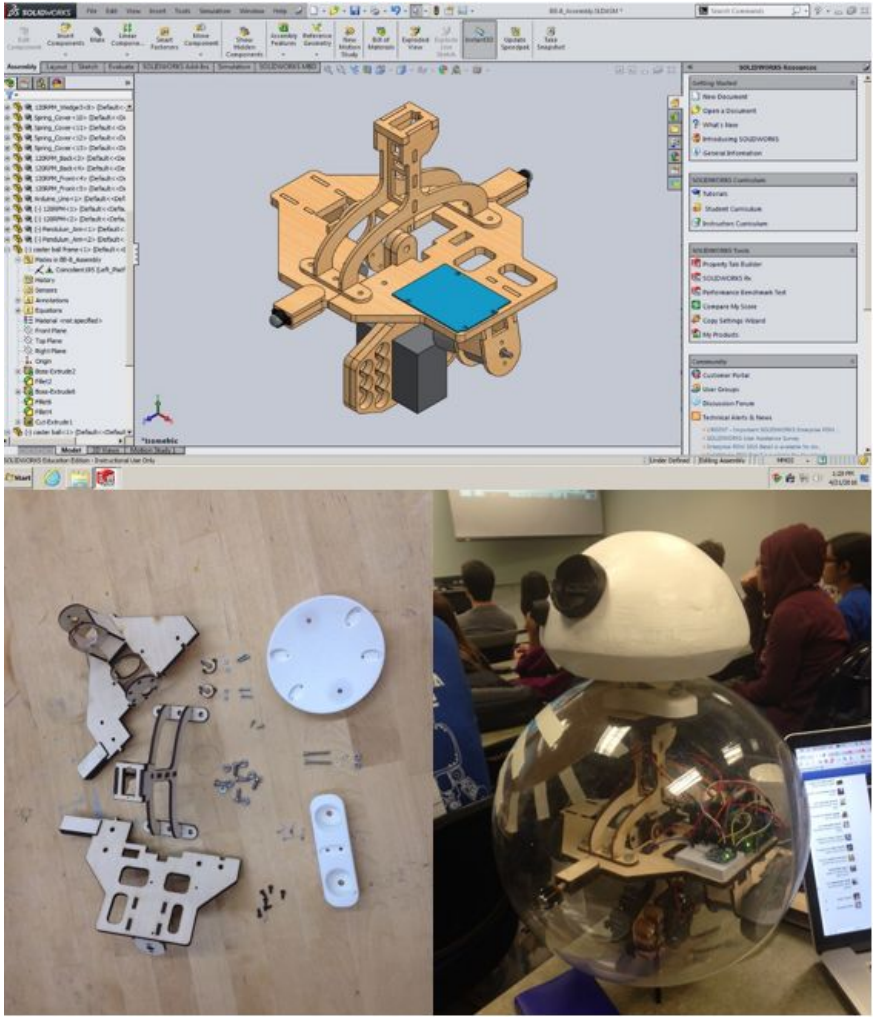
- 3rd year mechanical engineer
- I learned most of what I know about robotics from the members of RAS
- I liked board games, sports, and existential dread
- I work in the **Rehabilitation Neuromuscular (ReNeu) Robotics Lab**

Meera Wakim

- 3rd year mechanical engineer
- I learned the most about robotics through research positions around UT and personal projects
- I am the VP of RAS and Region V team lead

Goals of this Talk

- Pass on knowledge to design, model, build, and assemble a robot
- Introduce new students to the resources available at UT
- Make as many EE's transfer to ME as possible



First, CAD

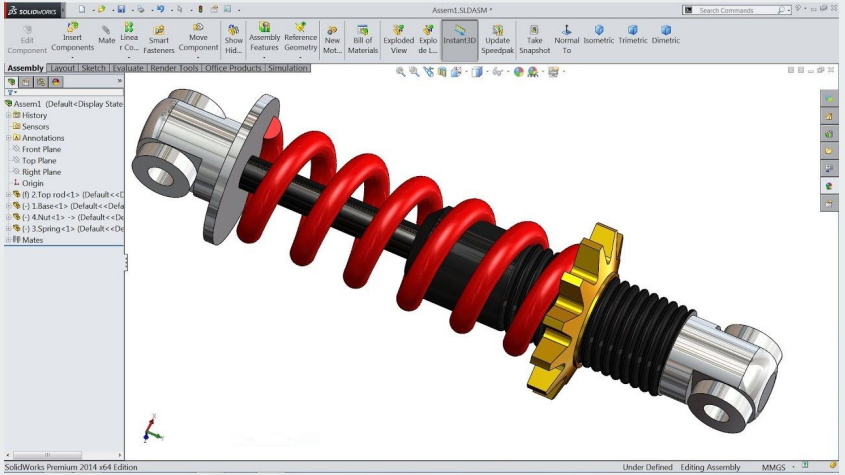
- Webster dictionary defines cad as: “a man who behaves dishonourably, especially towards a woman”
- Ex. “her adulterous cad of a husband”

Not that CAD.

- CAD stands for “Computer Aided Design”
- It is how modern engineering projects are designed
- There are several options:
  - **SolidWorks** via the Virtual Desktop (for engineers)
  - **Fusion 360** (free for students)
  - AutoCAD (similar to Fusion)
  - OnShape (browser based, but rather limited)
- Pro Tip: Use a mouse!

SOLIDWORKS

- We'll use SolidWorks for this talk as it's most common in industry
- Feel free to direct questions about other programs to Daniel or Mark (@dteal, @mark)



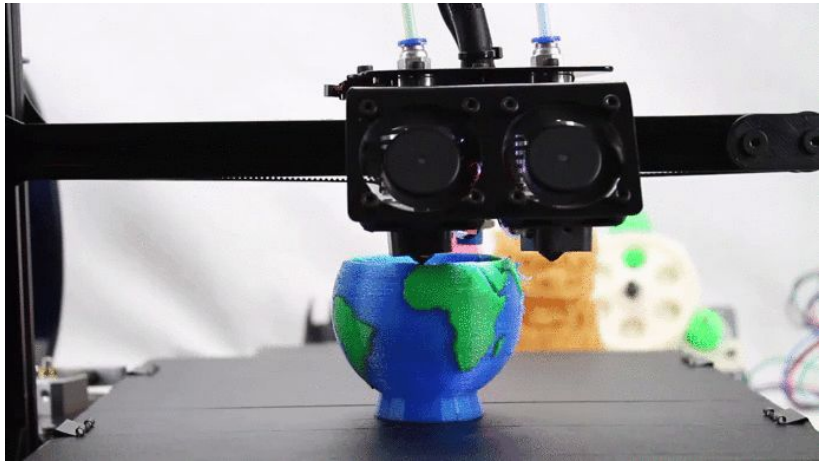
UT Virtual Desktop

- Engineering students have access to the UT virtual desktop with SolidWorks and other useful software
- Register here: https://goo.gl/fDrmH0
- Visit https://appd.engr.utexas.edu and install client if necessary

http://www.engr.utexas.edu/itg/facilities/virtualdesktop

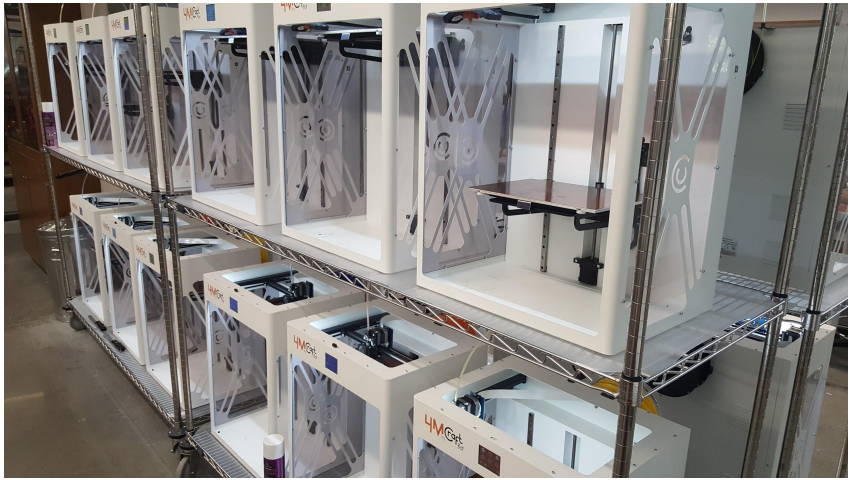
CAD -> real life

- Now that you've designed a part, you need to make it.
- This next segment will cover:
  - Resources
  - Material selection
  - Mechanical design tips



Maker Studio

- Maker Space (3D printers, laser cutters, and various tools) in the EERC
- Wood Shop on the basement of ETC, room 1.122
- The machine shop is currently limited to Mech. E's for metal work.



Maker Space

- 3D Printers
  - 24 CraftBot XL’s
  - 24 Ultimaker 2x’s
- Laser cutters
  - 4 new, 3 old
  - Require training
- PCB mills, soldering, and electronic fabrication
- M-F 8am-9:30pm, weekends 12-7pm

Wood Shop

- Basement of ETC, room 1.122
- Equipped with a table saw, band saw, drill press, router, sander, planer, X-carve, and hand tools
- M-F 8am-5pm

Other options

- RAS has a huge amount of robotics parts that you can access
- If you need to 3D print something at an odd time, dm me on Slack and I can do it on my own printer

3D Printing

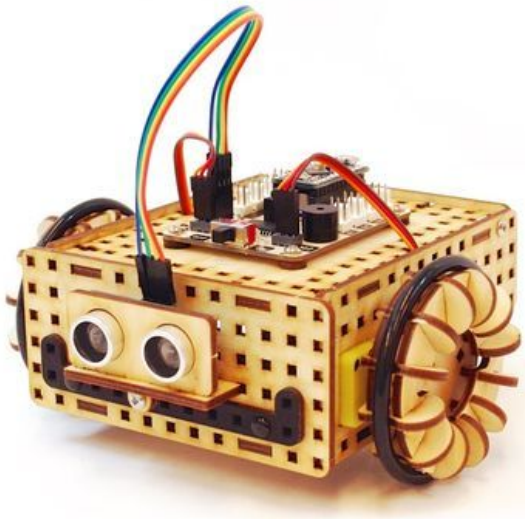
- “Stacks” layers of melted filament
- Great for complex parts, but takes a long time
- **Rafts:** Creates a flat section that easily removes from the part and increases adhesion with the print bed
- **Supports:** If your part has overhangs and bridges, you may need to add removable towers for support
- **Filament:** ABS is stronger but requires higher temperatures. PLA can fracture but will print more reliably.

How to 3D Print

- Export your part as a .stl file
- Now you need to “slice” the part to tell the printer what to do
  - Use CraftWare for CraftBots: https://craftunique.com/craftware/
  - Use MakerBot Print for MakerBots: https://www.makerbot.com/print/
- Save to an SD card or USB, depending on the printer

How to Lasercut

- A great alternative to 3D printing due to speed and material strength
- Make your CAD part into a drawing and save as a pdf or other vector-based file type.
- Laser cutters require **training** to use.
- Currently you can only use the machines in the Wood Shop.

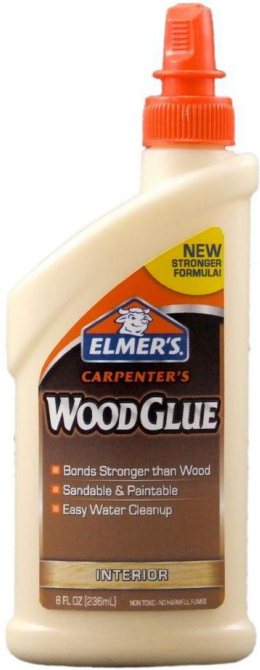


Material Selection

- The maker studio sells **plywood** and **acrylic** at widths of ⅛”, and ¼”.
- Wood:
  - Strong when the load is applied correctly
  - Can be cut and drilled with hand tools if necessary
  - Can be joined easily with wood glue/ wood screws
- Acrylic:
  - Transparent
  - Looks cool

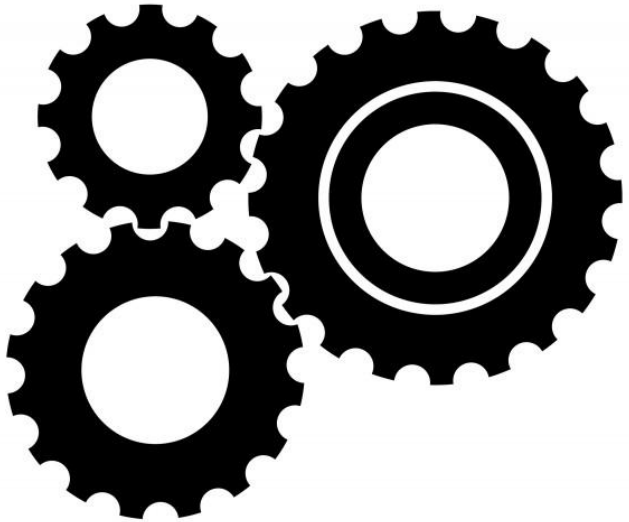
Fastening

- Any time you attach two parts together:
  - Nut and bolt
  - Wood screw
  - Wood glue
  - Zip tie
  - Epoxy
- These are all good alternatives to hot glue and duct tape.



Mechanical Design Tips

- Think about the overall assembly
- Make every part of a sketch defined
- Think about what kind of loads each part will take when designing



Conclusion

- Use the Maker Space and the talented RAS leaders!
- No matter how incredible your programming is or your sensors are calibrated, a mechanically broken robot won't be effective.
- If a Robotathon challenge ends in a draw, judges will give style points often for looks and construction, so a swanky robot helps
- Good luck!