Maker Culture in CMU SCS
Part I: Overview & Laser Cutter

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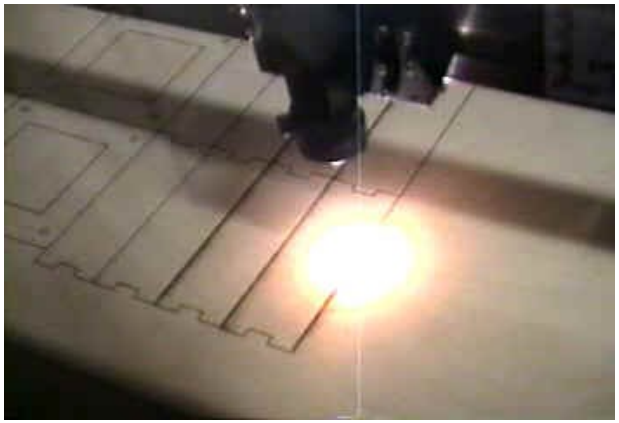
http://www.cs.cmu.edu/~dst/Maker

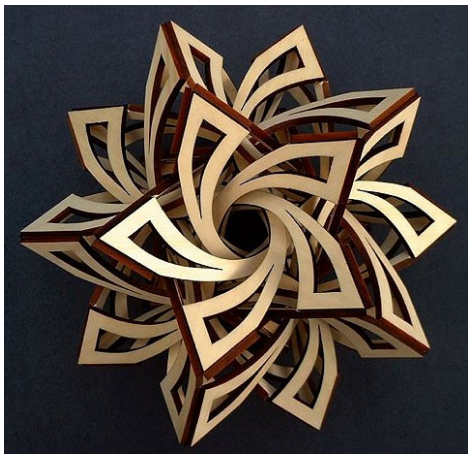
What Is Maker Culture?

- “Do it yourself” meets high technology and open source movements.
- The high tech part:
  - CAD software
  - Laser cutters, 3D printing, CNC machining
- Why is this good?
  - Rapid prototyping: hold your ideas in your hand!
  - Extreme customization / personalization
  - New modes of artistic expression

Laser cutter / Water jet

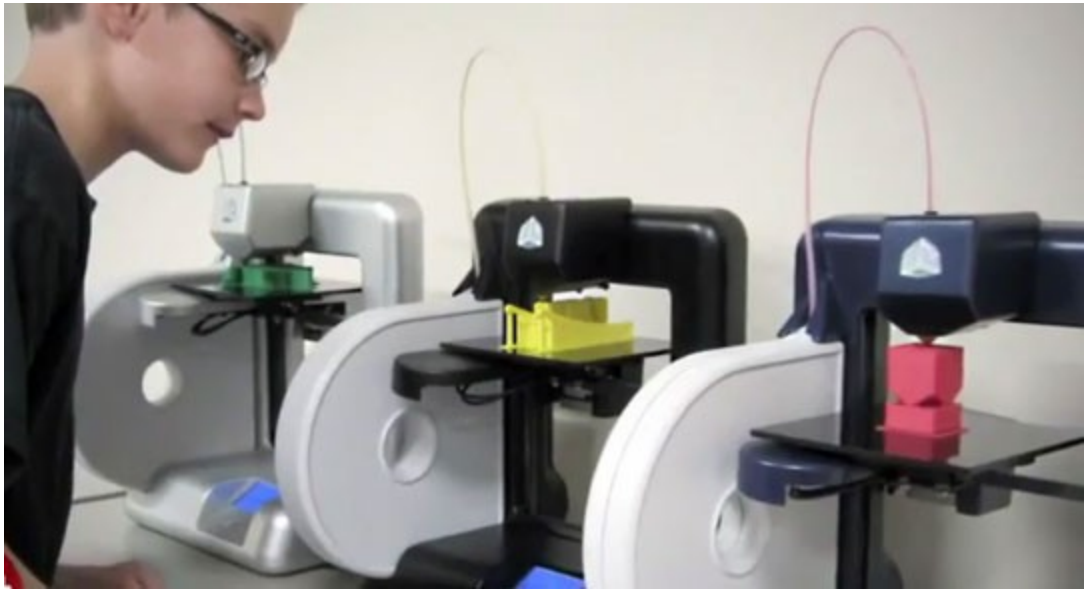
- ✓ Fast
- ✓ Precise
- ✓ Cheap
- ✓ Wide choice of materials
- X Parts are only 2D (but assemblies can be 3D) →





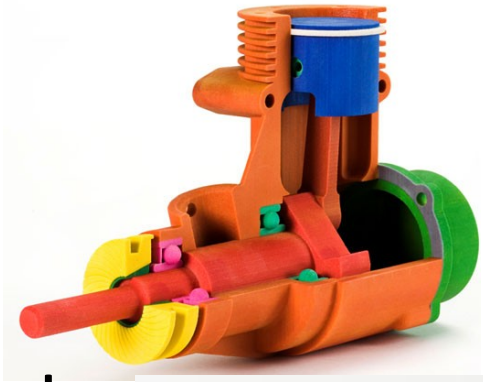
Cheap 3D Printing

- X Slow
- X Less precise
- X More expensive
- X Limited materials
- X Support material may be required
- ✓ Complex 3D structures!



High End 3D Printing

- ✓ Precise
- ✓ Multicolor
- ✓ Complex materials
- X Slow
- X Expensive

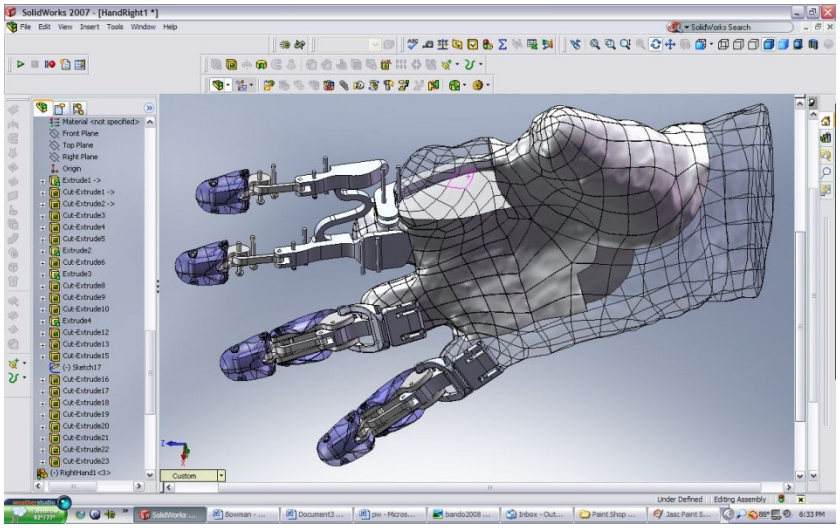


SCS Maker Culture Experiment

- Funded by Jeannette Wing and Matt Mason
- Laser cutters:
  - Laser cutter time is $10-$15 per hour at the CMC
  - CSD/RI will pay for your laser cutter time
  - You purchase your own materials (except today)
- 3D printer:
  - SCS now has a public 3D printer in GHC 9206
  - Frank & Matt are paying for the plastic – for now
  - Heavy users should purchase their own plastic cartridges ($50 each from Cubify.com)

CAD Software

- AutoCAD
- ✓ SolidWorks
  - DraftSight
- Google SketchUp
- Blender (open source)
- Alibre/Cubify Design
- SIMI (Sketch It, Make It)
- Many, many more…



Plan For Today

- Learn SolidWorks basics
- Design something
- Other useful stuff you'll need to know
- Visit the Collaborative Machining Center
  - Doherty Hall B211: Larry Hayhurst's shop
  - 3 laser cutters plus milling machines, lathes, etc.
- Cut some plastic

SolidWorks

- CMU has a 500 seat license (Windows version)
- SCS has purchased 50 seats
- Contact Help@cs.cmu.edu to install on your workstation or laptop.
- Runs on Macs under Boot Camp, Parallels, or VmWare.
- No Linux version.
- Student version for $25 at CMU bookstore.
- The built-in tutorials are excellent.

Four Modes + 1 Post-Processing Step

- **Assembly**: a collection of mated parts
- **Part**: a collection of features
  - Often instantiated more than once
  - Example: identical sides for a jewelry box
- **Sketch**: a 2D representation of a shape
  - Used to construct features of parts
- **Drawing**: 2D layout of the required parts
- **DXF** file: post-processed drawing that is sent to the laser cutter. (Drawing eXchange Format)

Getting Started

- Log in using your Andrew id
- Create a folder named Maker
- Download and unzip these files in your Maker folder:
  - http://www.cs.cmu.edu/~dst/Maker/PenHolder.zip
  - http://www.cs.cmu.edu/~dst/Maker/PhoneStand.zip
- Go to Start > Program Files and run SolidWorks
- Open Maker/PenHolder/PenHolder.SLDASM

Exploring the Pen Holder Assembly

- Changing the view:
  - Middle button to rotate
  - Scroll wheel to zoom
  - Control-middle button to translate
  - Left button to select
  - View menu icon
  - Section view icon; how to exit section view
- The object tree
  - Click for basic operations
  - Right click for full context menu
- Press ‘Escape’ to cancel a selection or mode

Exploring Deeper

- Open “Front” to examine the part
- Open “Extruded Boss”:
  - Opening a feature
  - Exiting the feature dialog
  - Opening the associated sketch
  - Exiting the sketch editor
- Open PenHolder.SLDDRW to examine the drawing
- Use DraftSight to open PenHolder.DXF

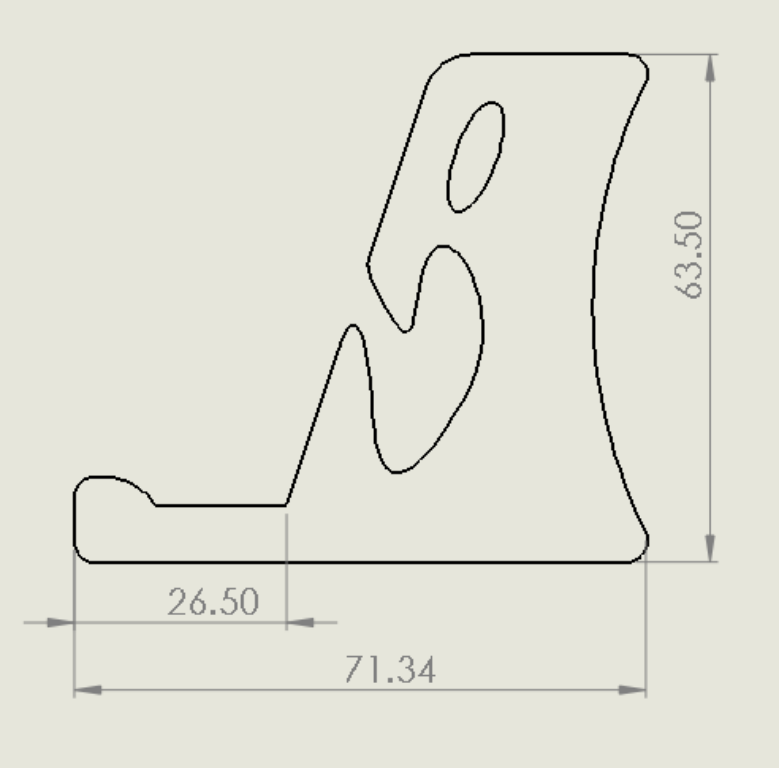
Let’s Design Something!

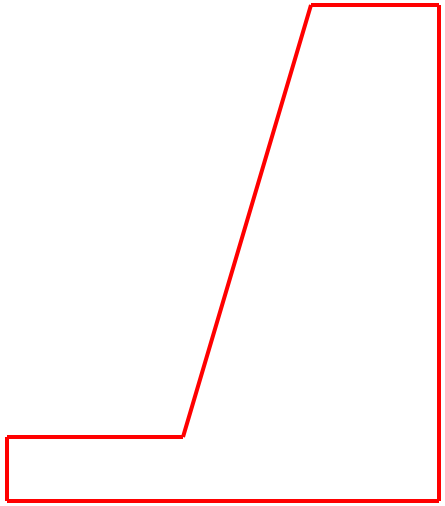
- Phone Stand
- Mobile
- Holiday decoration
- Name plate

Roughly one sheet of acrylic per person, but share amongst yourselves so you can have multiple colors if you need them.

Phone Stand: One Part

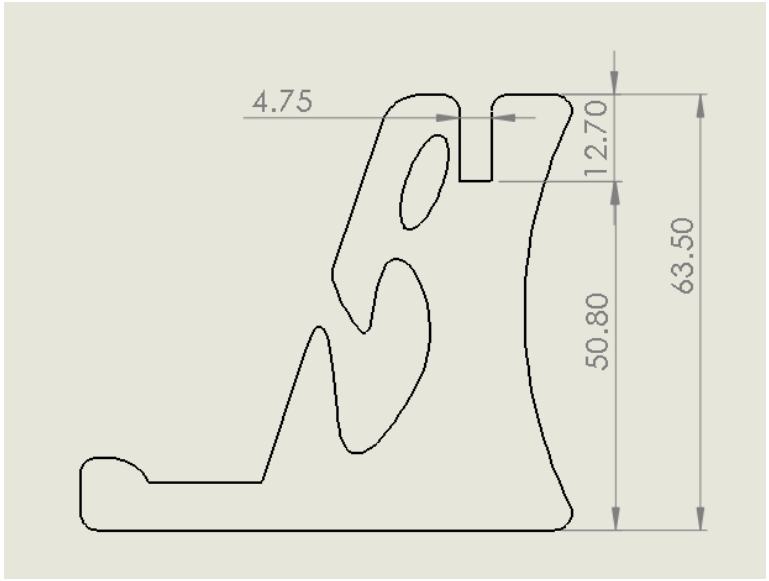
- Set extrusion thickness to 4.75 mm

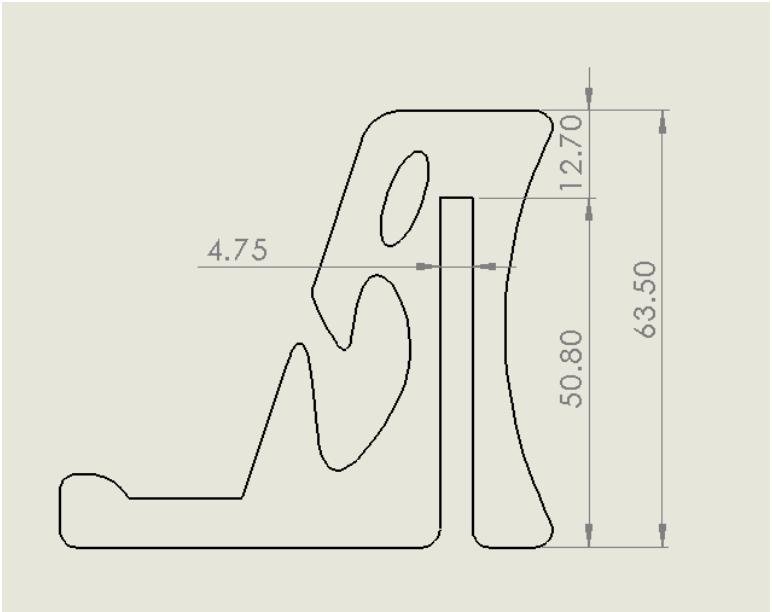




Making the Slot for the Phone Stand

- Make two assemblies; add complementary extruded cuts 4.75 mm wide.





How to Make a DXF File

1. Lay out your parts in a SolidWorks drawing.
2. Save as a SLDDRW file so you can make changes later.
3. Do “Save As” and choose “DXF” file format.
4. Open the DXF file with DraftSight (just double click on it).
5. Click on the “Student version” disclaimer text and hit Delete.
6. Type control-A to select all.
7. Set the color to red. (Use blue for engraving.)
8. Line should be “Continuous” (it is by default)
9. Set the line width to 0.0
10. Hit Escape to cancel selection.
11. Save as R2004-2006 ASCII Drawing DXF
12. Copy the DXF file to your USB drive.

Assembling Your Creation

- Press-fit (if you're careful about tolerances)
- Superglue or acrylic cement
- Nuts and bolts; screws; hinges
- Wire

What About Post-Processing?

- Recessed well; threaded hole; cutting a slot; etc.
- Larry can do machining to order (hourly charge)
- Make friends with someone in the RI machine shop

Where to Buy Supplies

- McMaster-Carr: www.mcmaster.com
  - Acrylic and ABS plastic sheets
  - All manner of hardware fasteners
  - Rubber feet, etc.
- AmazonSupply.com
- Jameco, Pololu, SparkFun, Tower Hobbies, Trossen Robotics, LynxMotion
  - Electronic components (LEDs, switches, battery cables, servos, etc.)

Maker Culture

- Make Magazine
  - Makezine.com
- Hacker spaces; TechShop
- LaserSaur: open source laser cutter
- Makerbot and open source 3D printers
- Thingiverse & similar sites: marketplaces for 3D models (many are free)

Sending Work Out

- 3D Systems makes the Cube but also offers printing services on high-end machines that offer multiple colors and tighter tolerances.
- Shapeways and Ponoko do 3D printing in many types of materials, including metal and ceramics.
- Big Blue Saw does water jet and CNC machining.
- E-MachineShop will make anything (but they're expensive).
- MFG.com lets you put jobs out for bid

What To Do In The Coming Week

- Get SolidWorks running on your machine
  - Also get DraftSight: it's a free download
- Do some SolidWorks tutorials for practice
- Finish designing your holiday ornament or killer attack robot
- Go see Larry to cut some plastic