99-353 SolidWorks and Laser Cutting

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1.0 Units / 3 days (Micro course)

http://courses.ideate.cmu.edu

Goals For This Course

At the conclusion of this course, you will know:

1. How to design objects using SolidWorks.
2. How to safely operate a laser cutter.
3. How to work with a variety of materials (wood, acrylic, paper, cardboard).
4. How to incorporate mechanical elements into your design (screws, nuts, standoffs, etc.)

Communication

- The syllabus and all assignments are posted on the course Canvas site.
- We will use Canvas for announcements, question answering, and discussions.
- If you have questions about an assignment, SolidWorks, etc., use Canvas instead of email.
  - Other students may have the same question.
  - Fellow students may be able to answer your question more quickly than the instructor or TA.

Assignments

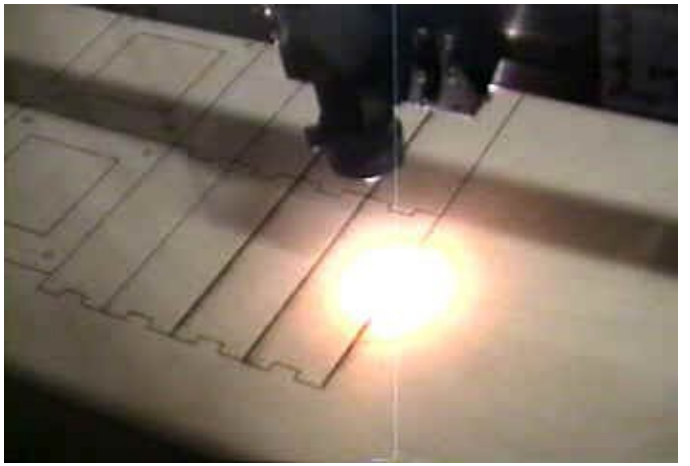
- During each class meeting, you will generate a SolidWorks file to cut on the laser cutter. You will upload the file and a picture of your part to the Canvas site
- You get to keep the parts
- The final assignment is a part of your own choosing

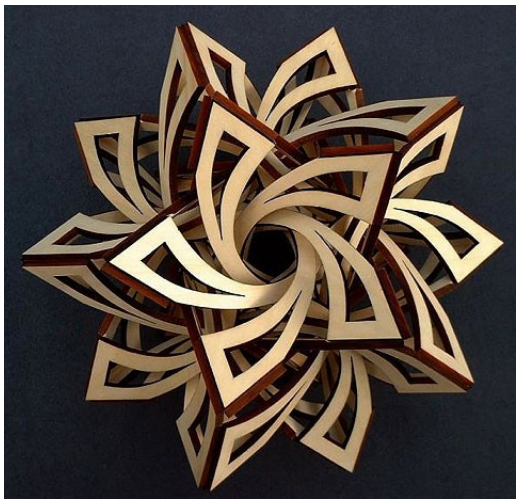
Rapid Prototyping Fabrication Technologies

- Computer-controlled
- Requires little skill to operate the machinery Generally safe to use
- May have limitations on materials or production capacity,
- But may also offer capabilities not previously available.

Laser cutter / Water jet

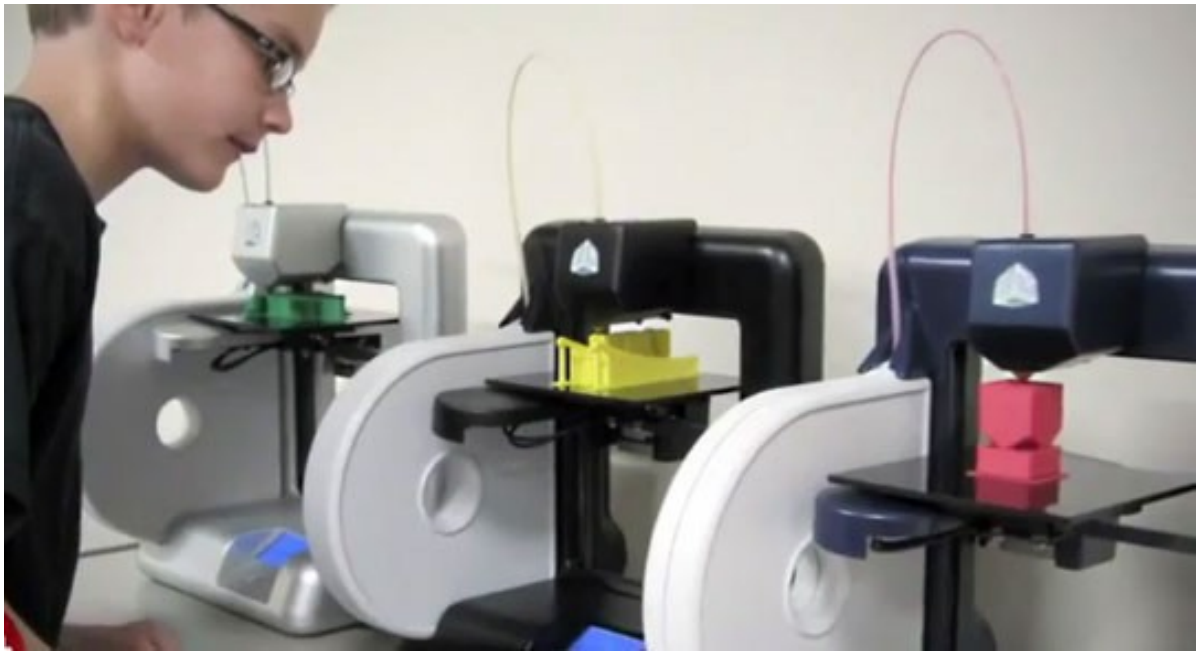
- ✓ Fast
- ✓ Precise
- ✓ Cheap
- ✓ Wide choice of materials
- X Parts are only 2D (but assemblies can be 3D)





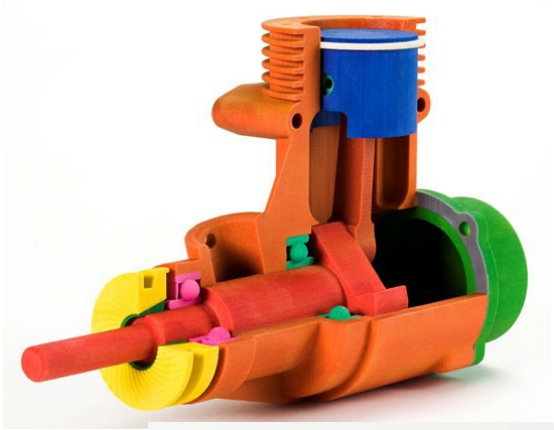
Cheap 3D Printing

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

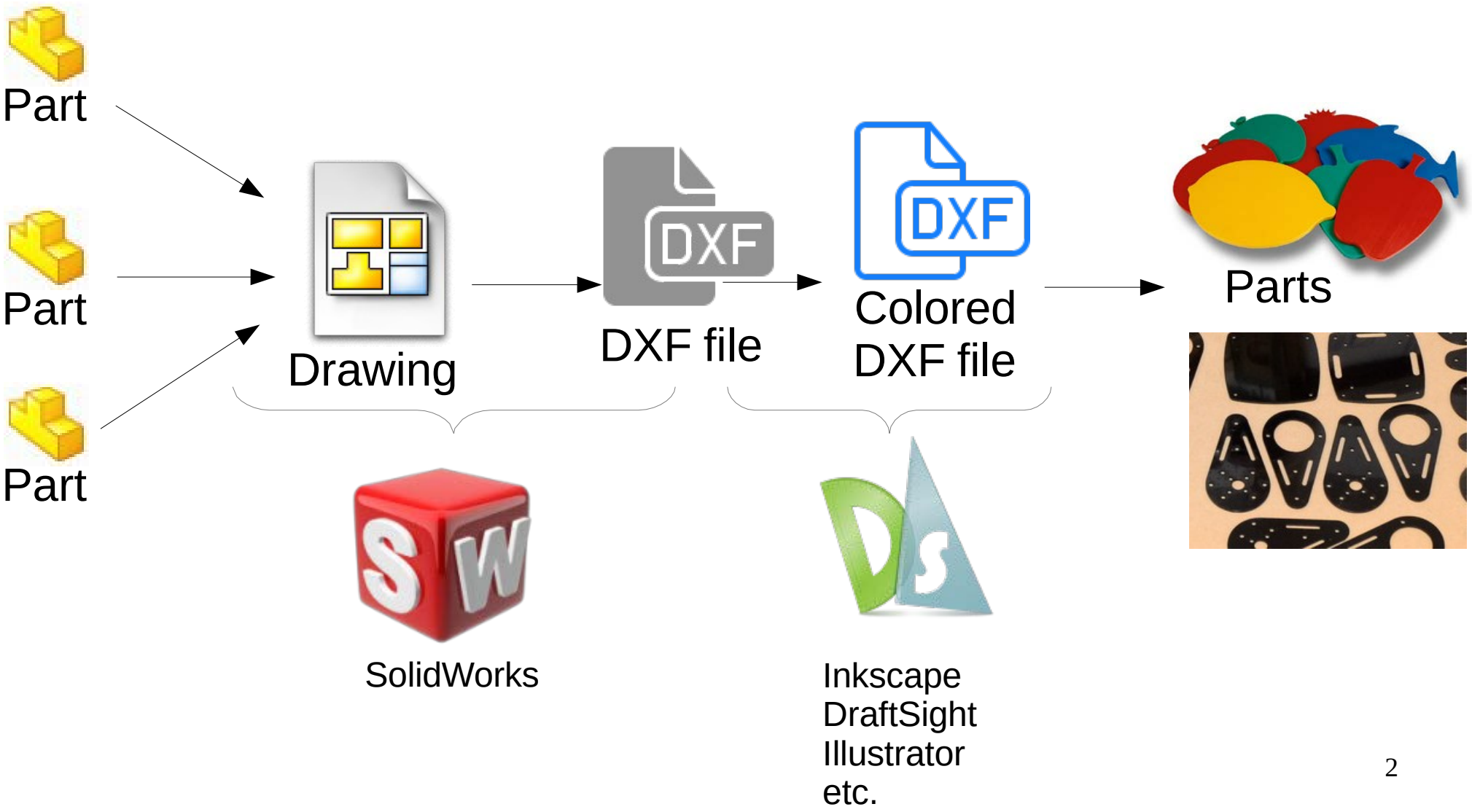


High End 3D Printing

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

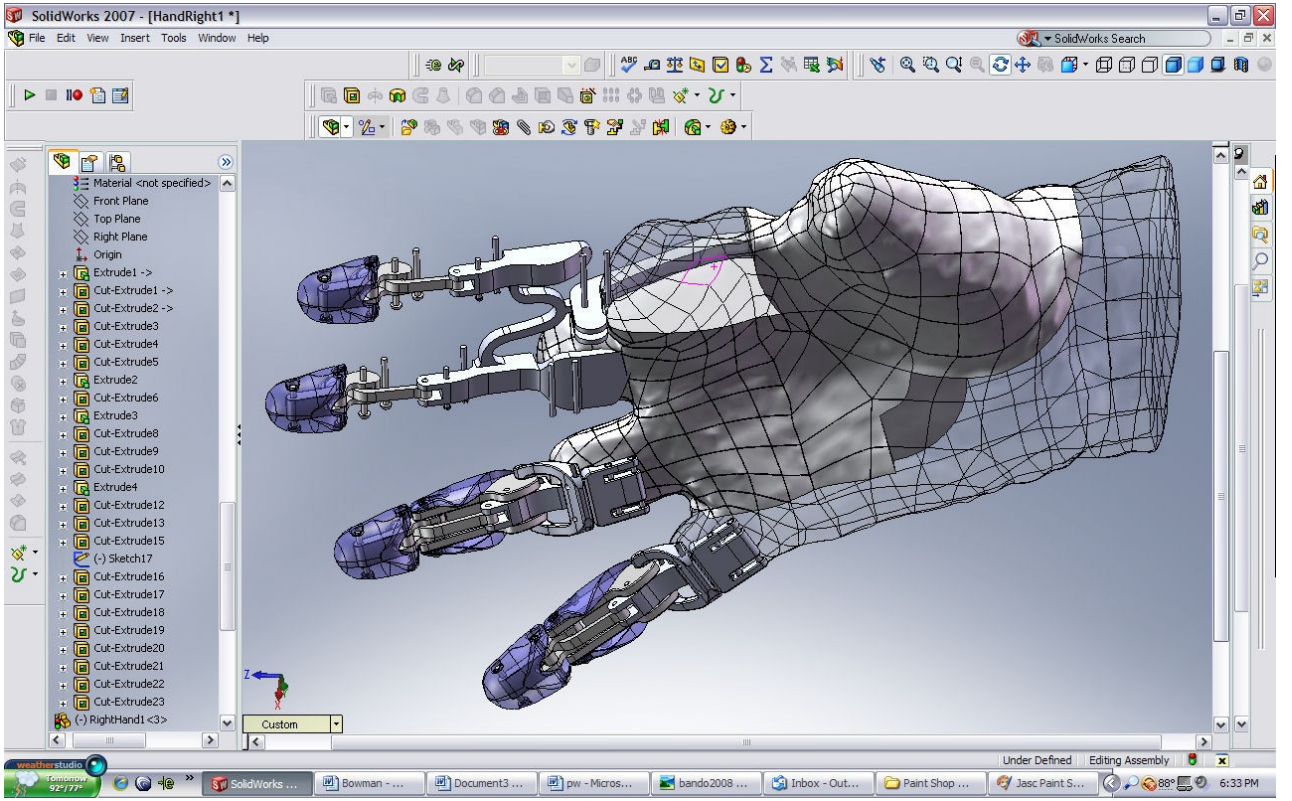


From Design to Part



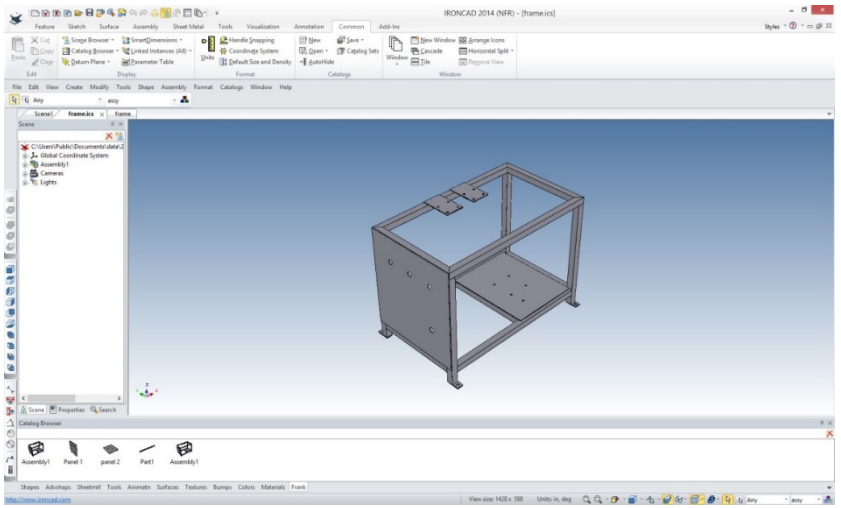
CAD Tools

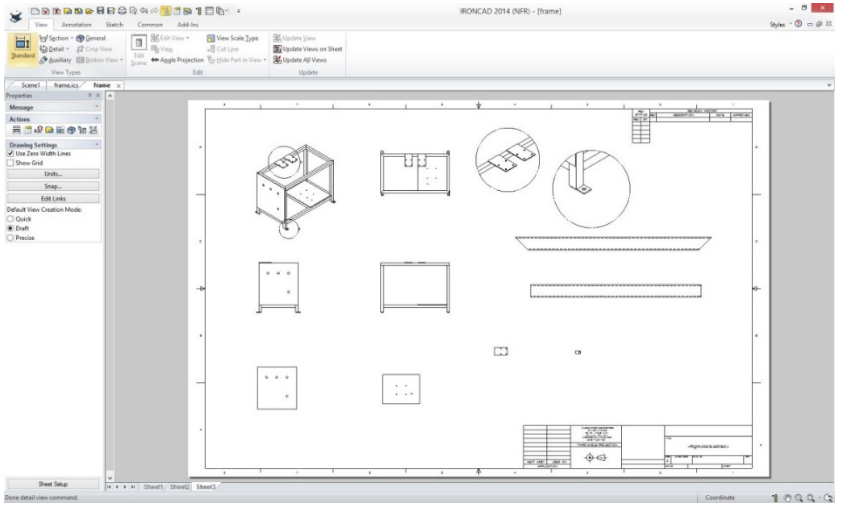
- The big two:
  - AutoCad from AutoDesk
  - SolidWorks from Dassault Systemes
- Alibre/Invent
- Sketchup
- Blender
- CorelDraw, Inkscape, Rhino
- Sketch It Make It (developed at CMU)
- Many more...



CAD drawings

- AutoCAD Drawing Exchange Format (DXF), introduced in 1982, converts a CAD model of points and lines in 3D space into a 2D drawing
- DXF enables the generation of line drawings (blueprints) from CAD models





http://tecnetinc.com/The Assembly Defined.html

2d laser cutter

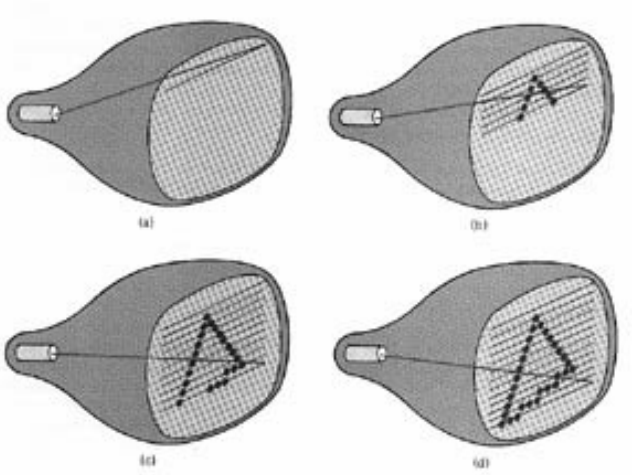
- Based on pen plotters used in architecture studios which accept DXF files from CAD programs to produce 2D drawings
- LaserCAMM (mid-1980s) replaced pen with a laser

Recap

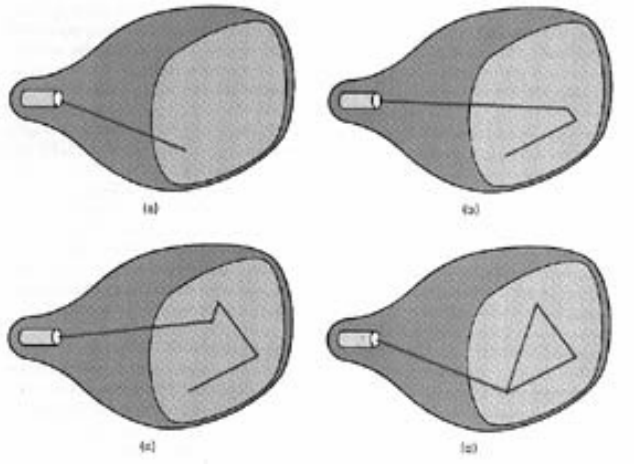
- The laser cutter is driven by a DXF file
- A DXF file uses a line (vector) based format

=> We need a create vector-based file to make our part

Raster versus Vector



Raster – scanned pixels



Vector – drawn lines

Why do TVs use raster technology?

Why do laser cutters use vector technology?

Bitmap (raster) graphics

(not good for laser cutting)

- Bitmap images contain information about the color of each pixel
- Bitmap, raster, or pixel-oriented graphics programs
  - PhotoShop
  - MS Paint
  - Corel Painter
- Bitmap graphic formats include GIF, JPEG, PNG, TIFF, XBM, BMP, and PCX.
- Screen fonts are stored as bitmaps

Vector graphics

(good for laser cutting)

- Vector graphics contain objects with instructions about location, color and size of each object
- Vector or object-oriented graphics programs
  - Adobe Illustrator
  - Corel Draw
  - Any CAD or GIS program (**SolidWorks,** AutoCAD, ProE, SketchUp, ArcGIS, …)
- Vector graphic formats include PICT, EPS, WMF and PDF
- TrueType fonts are stored as vector graphics

SolidWorks

- Solid Model CAD and CAE program
- Windows only
- Parametric
- Feature-based

How To Learn SolidWorks

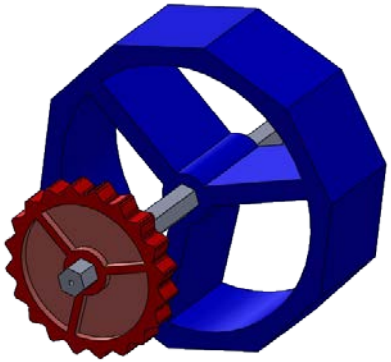
1. We'll teach you, starting now. The tutorials are linked from the class syllabus.

2. SolidWorks has good built-in tutorials; click on the little “house” icon (Resources) on the right side of the screen, and select Tutorials (mortar board icon).

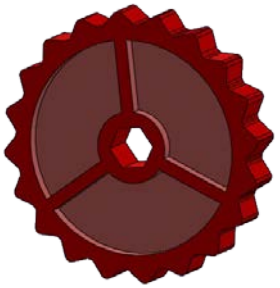
3. Lynda.com offers excellent quality video tutorials. Be sure to login through the CMU portal.

4. Thousands of random YouTube videos, including specialized topics such as how to make involute gears.

A Quick Look at SolidWorks



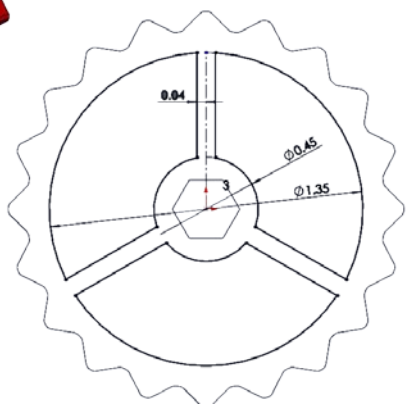
Assembly (SLDASM file)



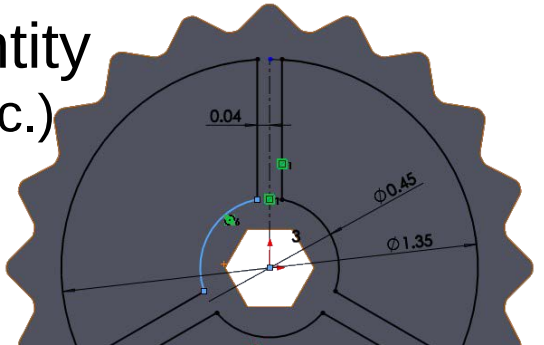
Part... (SLDPRT file)

Feature...

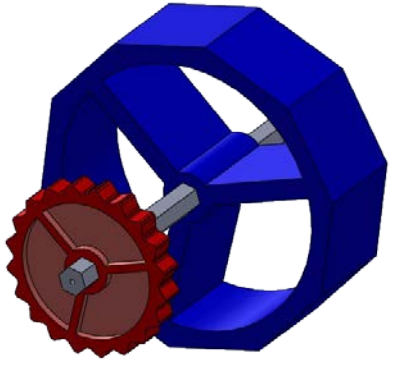
Sketch



Sketch Entity
(line, arc, etc.)

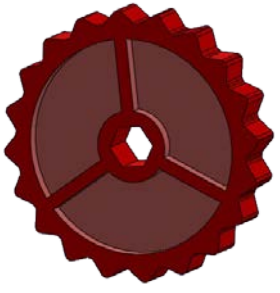


A Little More Detail



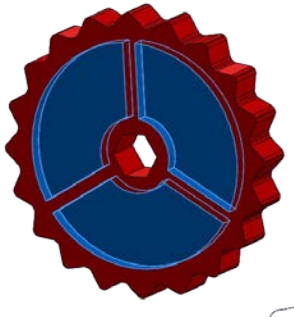
Assembly (SLDASM file)

- Mates
- Reference Geometry
- Subassembly...

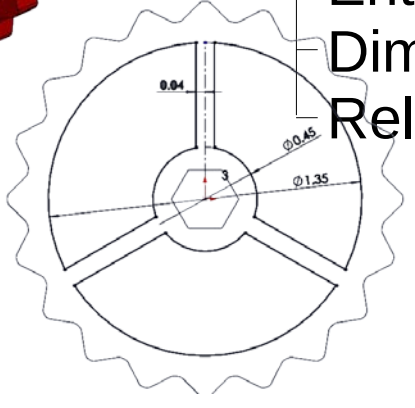


Part... (SLDPRT file)

- Reference Geometry
- Feature...



- Sketch
  - Entities
  - Dimensions
  - Relations



→ Sketch Entity Parameters...