

Introduction to 3D-Printing

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Uniform Chicago

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Topics

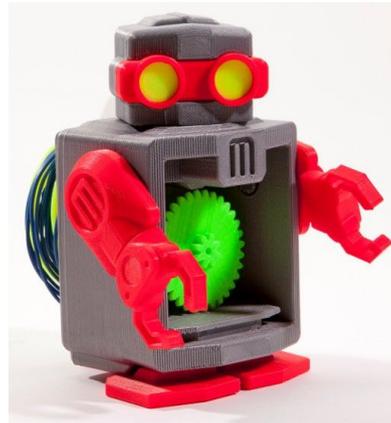
- Overview of 3D-Printing
 - Only a brief overview
 - Hobbyist perspective
- Technology and Tools
 - Concepts and getting started
- Demo of creating a new design

What is 3D-Printing?

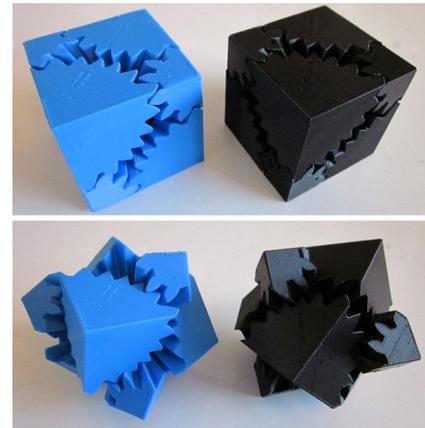
- Build arbitrarily shaped 3-Dimensional objects
- Typically used to describe additive methods (the opposite of subtractive methods like a CNC machine)
- Many applications: industrial, medical, artistic, hobbyist, and more



<http://www.3dsystems.com>



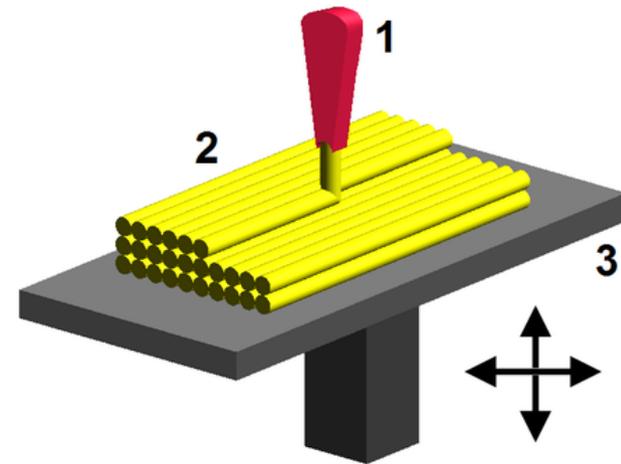
<http://www.instructables.com/id/3D-Printing-1/>



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Technologies - FDM

- “Fused Deposition Modeling”
- Most popular with hobbyists due to simplicity, low cost, and wide support
- Proprietary term owned by Stratasys - Equivalent terms used by the community include Fused Filament Fabrication (FFF) and Plastic Jet Printing (PJP)



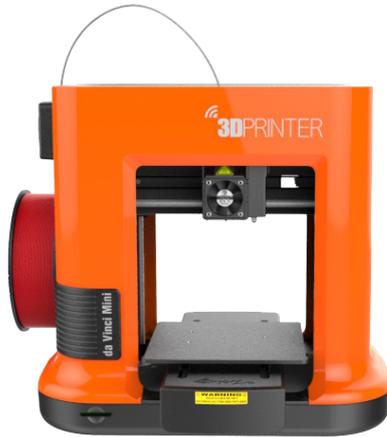
https://en.wikipedia.org/wiki/3D_printing

Other Technologies

- Selective Laser Sintering (SLS) – Laser melts “selected” areas in a layer of powder
- Powder Bed and Binder (PBB) - “ink-jet” spreads the layer of powder to correct location
- Stereolithography Apparatus (SLA) – ultraviolet laser hardens each layer in a vat of resin
- More complex/costly industrial methods

Printers

- Arbitrary Sample – not a complete list



Da Vinci Mini
xyzprinting.com
\$270

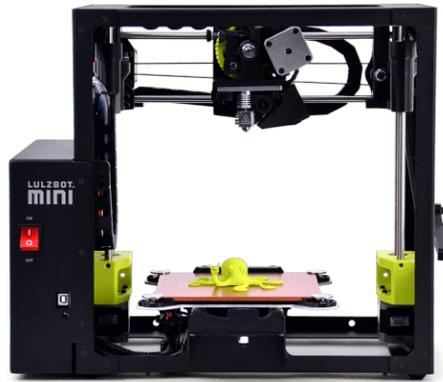


Micro
printm3d.com
\$350

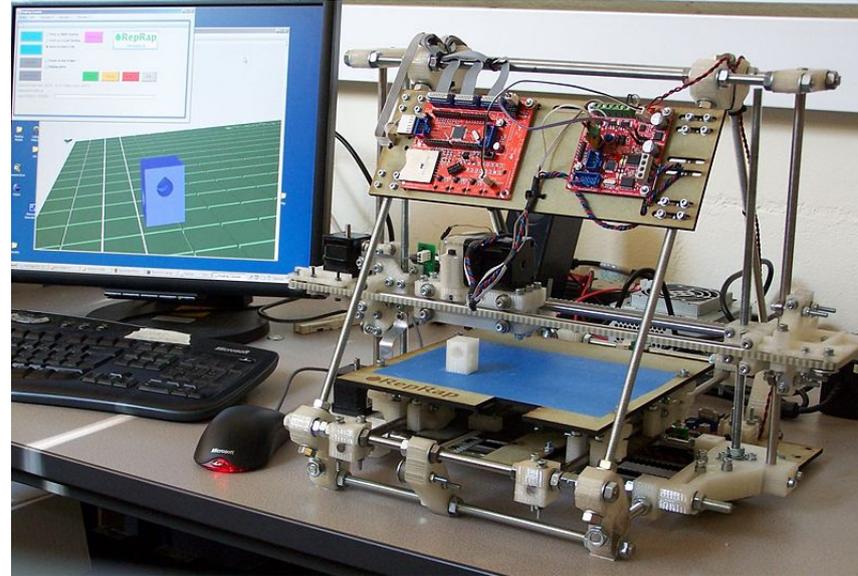


Replicator+
makerbot.com
\$2,500

Printers (cont.)



LulzBot Mini
printedsolid.com
\$1,250



<http://barkengmad.com/tag/cnc-routers/>

“RepRap”
Open-Source Printer
Price Varies

Printers (cont.)



XYZ Nobel 1.0 (SLA)
xyzprinting.com
\$1,500



ProX SLS 500
3dsystems.com
\$250,000

- ALSO:
The Best 3D Printers of 2017
<http://www.pcmag.com/article2/0,2817,2470038,00.asp>

Common Materials for FDM

- PLA (PolyLactic Acid)
 - biopolymer, i.e., a biodegradable plastic. made from renewable raw materials such as cornstarch or sugarcane.
 - Inexpensive and easy to use
- ABS (Acrylonitrile-Butadiene Styrene)
 - An oil-based plastic. Harder and more durable than PLA. (Think Legos)
 - heating, particularly ABS, can release small quantities of harmful VOCs.
<http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b04983>

On-Line Communities

- Manufacturer Supported:
 - Thingiverse (Makerbot) - “github” for 3d designs <http://www.thingiverse.com/>
 - 3Dvia Content Warehouse (3dvia.com) <http://www.3dvia.com/search/>
 - 123D (Autodesk) <http://www.123dapp.com/content>
 - 3D Warehouse (Google) <https://3dwarehouse.sketchup.com/index.html>

Printing Services

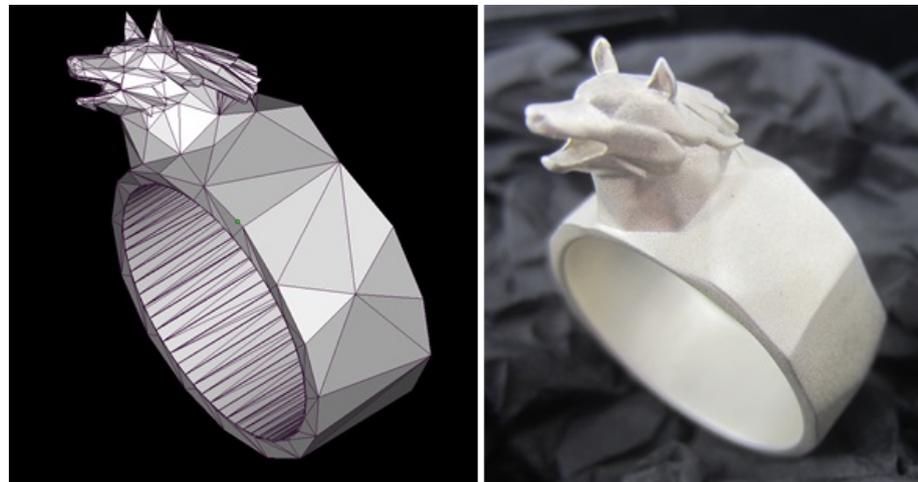
- Catalog parts or your own design
- Variety of technologies and materials
- Examples:
 - Libraries – Naperville, and ??
 - UPS Store – still pretty new
 - Shapeways – Gold anyone?
 - Ponoko – high end for artists
 - 3dhubs.com – Local “service bureaus”

Design/Creating

- Analogous to Word Processor or Graphics package like Word or Photoshop
- Powerful, feature-rich, but each has its own internal storage format
- Commercial (e.g. Autocad)
- Free and/or Open-Source
 - Sketchup, Blender, 123D, FreeCAD, NetFabb, TinkerCAD (browser)

Export STL File

- Analogous to PDF - standard file format supported across many platforms
- Triangular Mesh - must be be "watertight"



<https://i.materialise.com/blog/how-to-choose-the-perfect-file-resolution-when-turning-your-3d-model-into-a-3d-print/>

Slicer

- Analogous to printer driver - where do the “pixels” go?
- But there are special cases for 3D:
 - Layering
 - Infill
 - Supports
 - Rafts

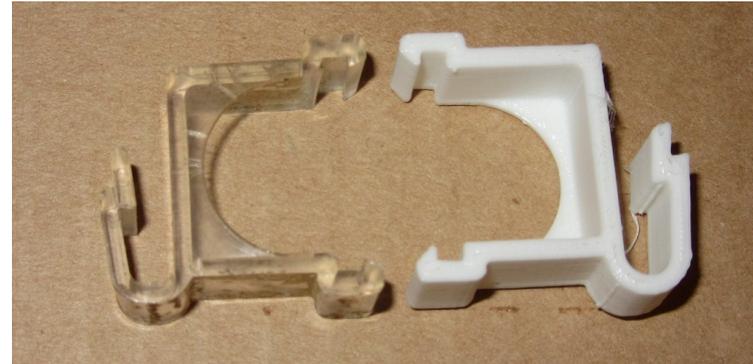
Videos

- Time-lapse 3d-print: Detail and infill
https://www.youtube.com/watch?v=8_vloWVgf0o
- Time-lapse Makerbot Replicator
<https://www.youtube.com/watch?v=XMil8GVmNYo>

A Few Examples



Replacement piece for board game



Curtain rod valence clip

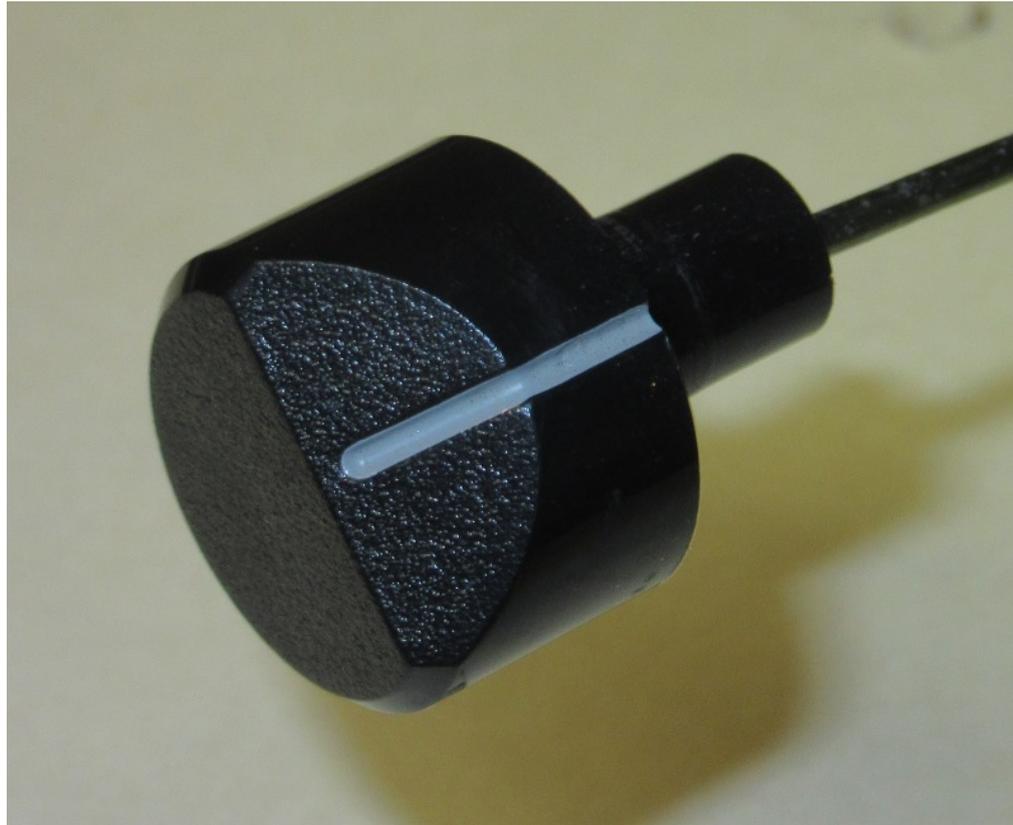


Raspberry Pi Case



Table Saw "cursor"

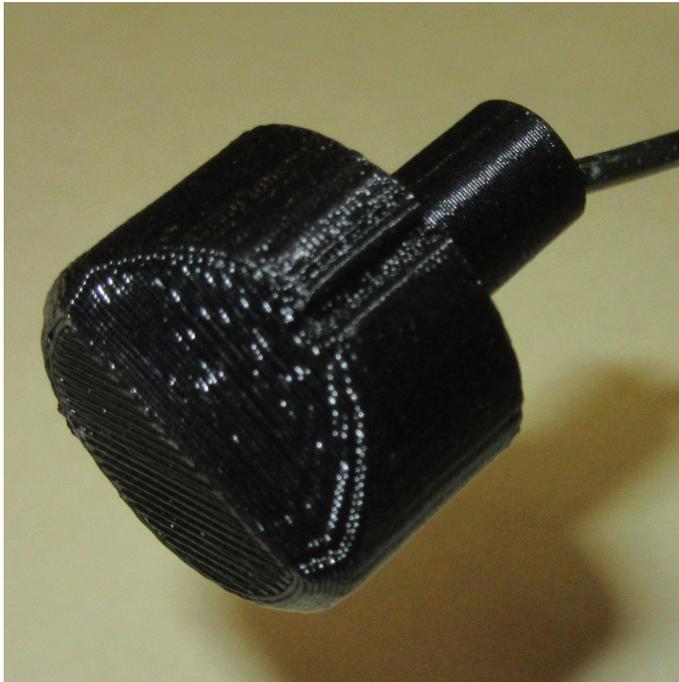
Live Design Example



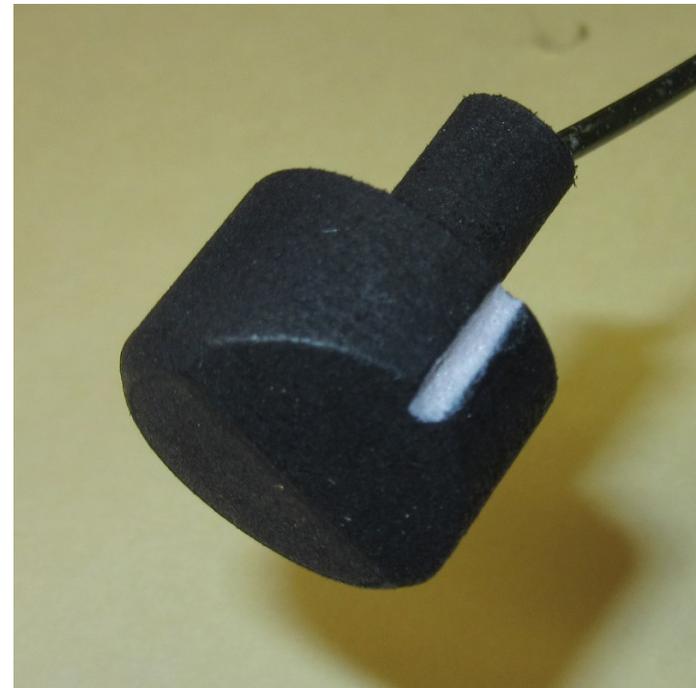
Live Design Example (Cont.)

- Using FreeCAD on Linux

Live Design Example (Cont.)



Naperville Library (Makerbot PLA)



Shapeways (SLS Nylon)

Q & A