

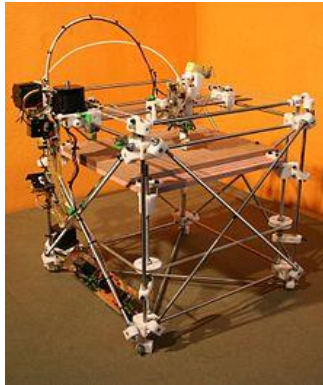
RepRap 3D Printers

RepRap X2

3D Printing Introduction

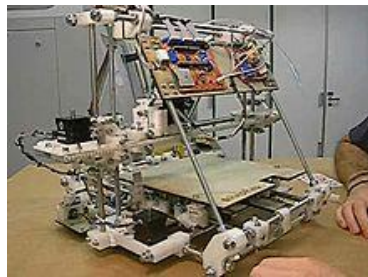
What's RepRap?

The **RepRap project** is an initiative to develop a [3D printer](#) hardware that can print most of its own components.

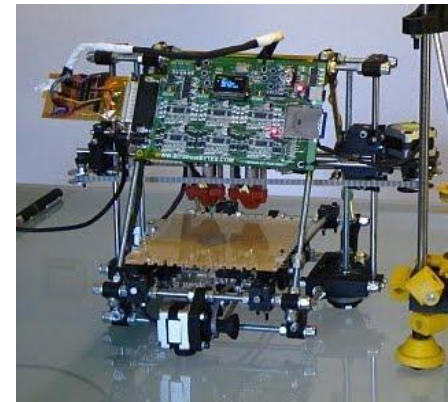


2007

2009



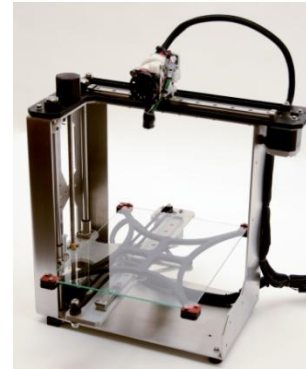
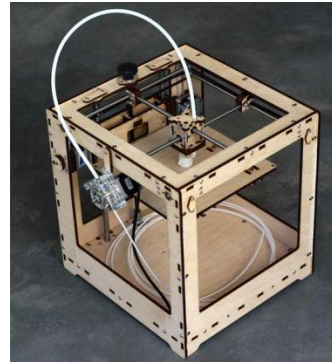
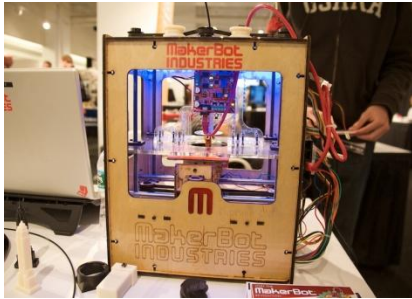
2010



RepRap History

Project started in 2005

Commercial, based on RepRap

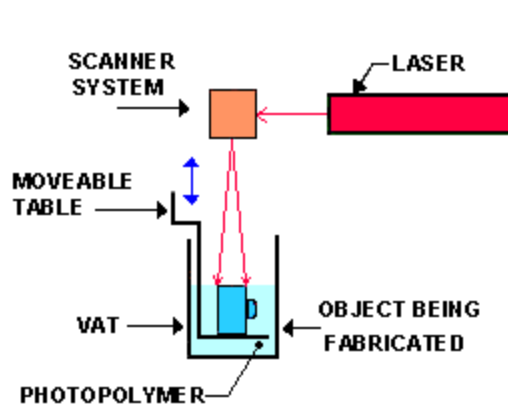


...

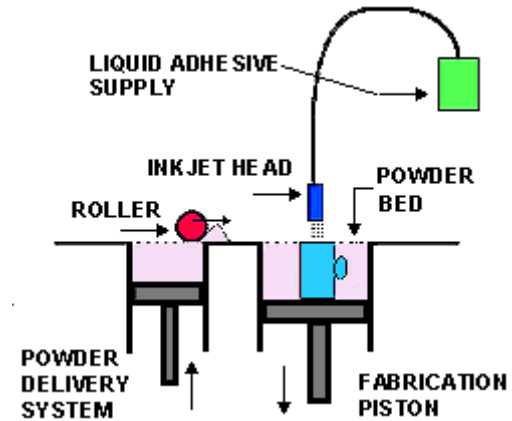
and much more:

[3D Printers Under \\$20K](#) (~20 entries, kits and complete printers, many are pre-order only)

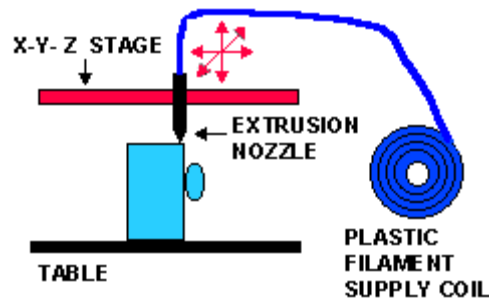
How Do They Print



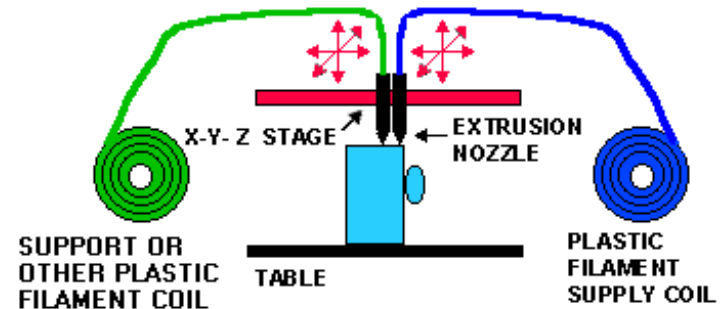
Stereolithography



3DP

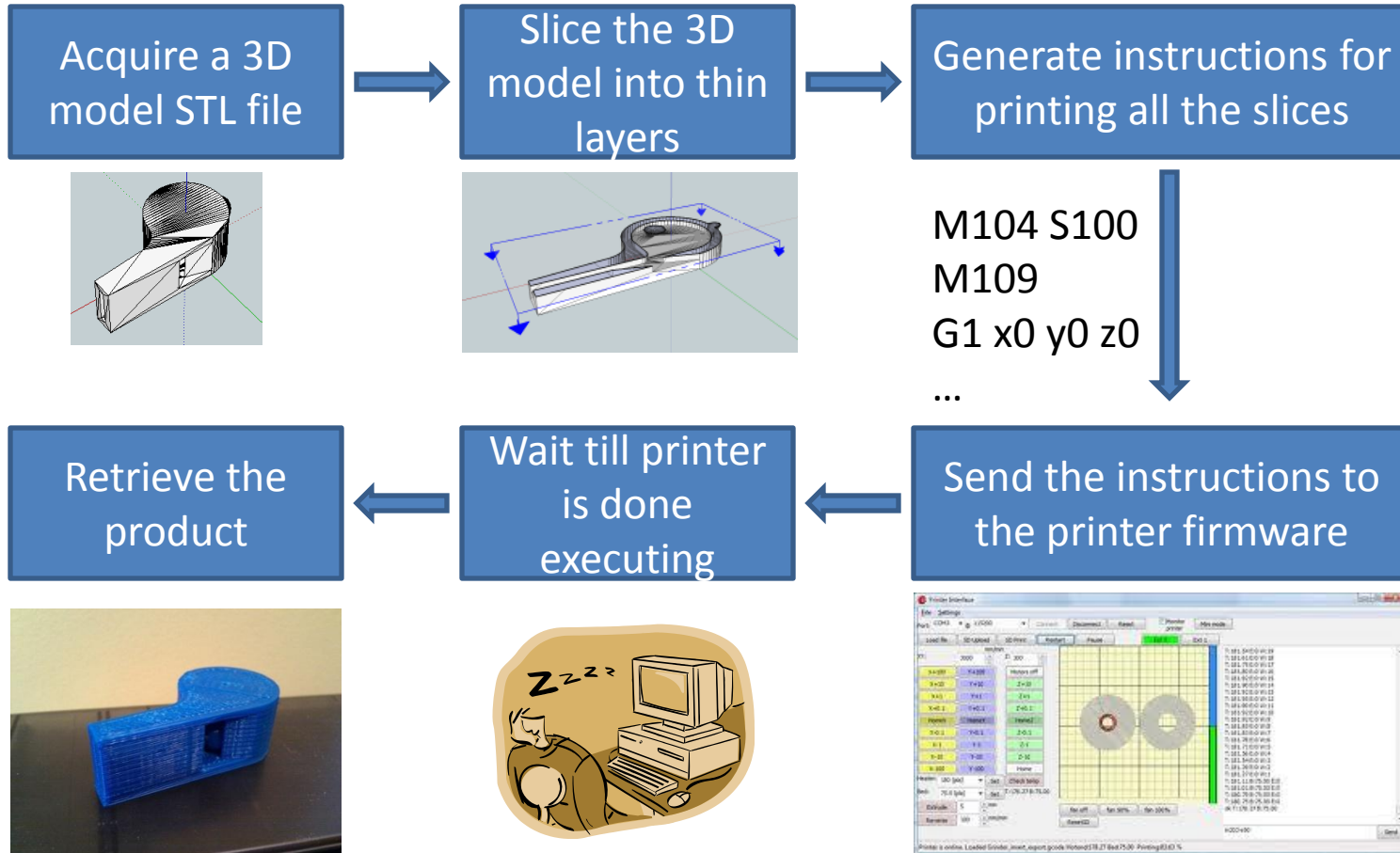


FAD (Fused Deposition Modeling)



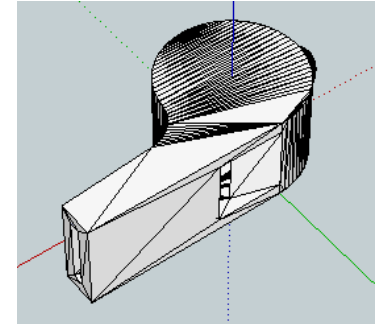
FAD X2

Making Workflow



Acquiring a 3D Model STL

- Design it yourself
 - Google Sketchup (free, easy)
 - SolidWorks 3D CAD (\$\$, good refs)
 - OpenSCAD (free, non-interactive)
- Download from <http://thingiverse.com>
- Buy online <http://shapeways.com>



Who's Making What?



Created by:
[Zomboe](#)

Chainmail

[Chainmail](#)

Made by [bfabry](#)
30 minutes ago



[Castle](#)

Made by [Tertzoid](#)
41 minutes ago



[Bukobot Fly - 1 piece printable glider that flies!](#)

Made by [HeavyRotation](#)
51 minutes ago



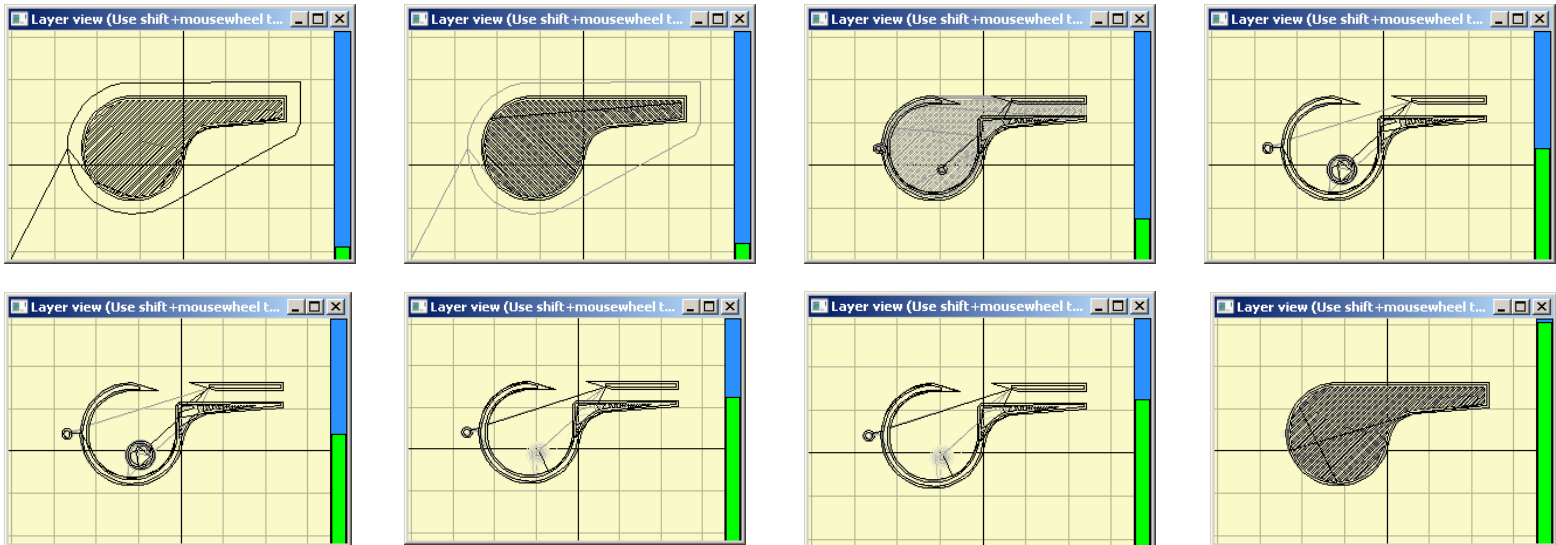
[Ghost Bookmark](#)

Made by [shoragan](#)
2 hours ago

Slicing

Slicing and G-code generation are combined in the same software. The most widely used are:

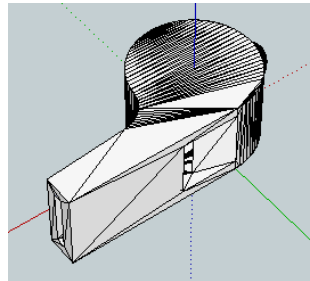
- Skeinforge (Python, reliable, feature-rich, very hard to master, very slow)
- Slic3R (Perl, pretty new, fast)



G-code Generation

G-code is the common name for the most widely used [computer numerical control \(CNC\) programming language](#), which has many [implementations](#). Used mainly in [automation](#), it is part of [computer-aided engineering](#). G-code is sometimes called G programming language.

```
...
G1 X74.137 Y101.017 Z0.3 F751.8758 E6.1573
G1 X76.666 Y105.089 Z0.3 F742.3022 E6.2799
G1 X78.559 Y106.94 Z0.3 F761.4033 E6.3476
G1 X82.631 Y109.362 Z0.3 F742.5702 E6.4688
G1 X85.987 Y110.302 Z0.3 F751.0277 E6.5579
G1 X127.371 Y110.44 Z0.3 F722.514 E7.6162
G1 X127.371 Y100.98 Z0.3 F731.129 E7.8582
G1 X126.321 Y98.189 Z0.3 F756.5367 E7.9344
G1 X95.904 Y81.455 Z0.3 F722.9989 E8.8222
G1 X92.678 Y80.12 Z0.3 F750.9663 E8.9115
G1 X87.923 Y79.523 Z0.3 F742.3069 E9.0341
G1 X83.245 Y80.405 Z0.3 F742.4561 E9.1558
G1 X79.183 Y82.566 Z0.3 F743.2627 E9.2735
G1 X76.61 Y84.971 Z0.3 F750.6904 E9.3636
G1 X75.106 Y87.071 Z0.3 F762.5124 E9.4296
G1 X73.259 Y91.8 Z0.3 F741.0192 E9.5595
G1 X72.923 Y95.018 Z0.3 F753.5377 E9.6422
G1 F3000.0
```



The whistle
needs about
20000 G-code
lines

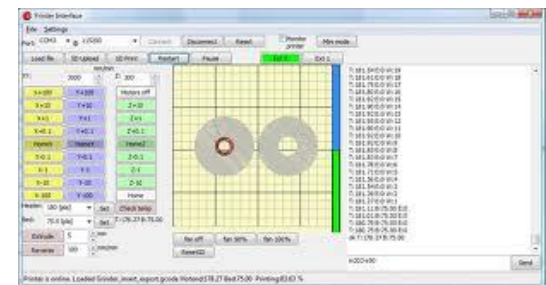
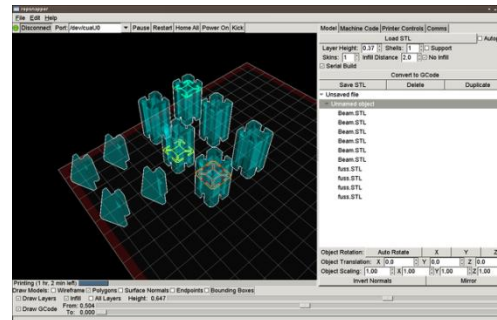
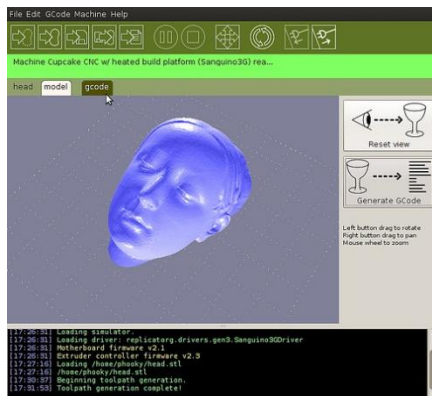
```
G1 E3.6422
G1 F720.0
M103
M108 S50.0
M108 S30.0
M108 S12.0
G1 X79.674 Y86.439 Z0.3 F4200.0876
G1 F3000.0
G1 E9.6422
G1 F3900.0
M101
G1 X80.973 Y85.282 Z0.3 F784.968 E9.6867
G1 X82.568 Y84.248 Z0.3 F779.0225 E9.7353
G1 X84.304 Y83.474 Z0.3 F779.0307 E9.7839
G1 X86.139 Y82.978 Z0.3 F779.0237 E9.8325
G1 X88.028 Y82.773 Z0.3 F779.0287 E9.8811
G1 X89.927 Y82.863 Z0.3 F779.0259 E9.9297
G1 X91.788 Y83.246 Z0.3 F779.0241 E9.9783
G1 X93.568 Y83.912 Z0.3 F779.0295 E10.0269
```

...

Printer Interface Console

Control the printer, test, start the printing job, etc..

- ReplicatorG (Java, open source)
- Reprsnapper (C++, open source, slicer too)
- Pronterface (Python, open source)



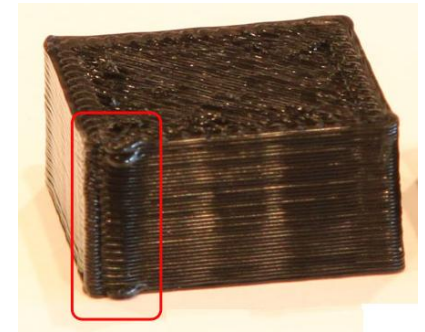
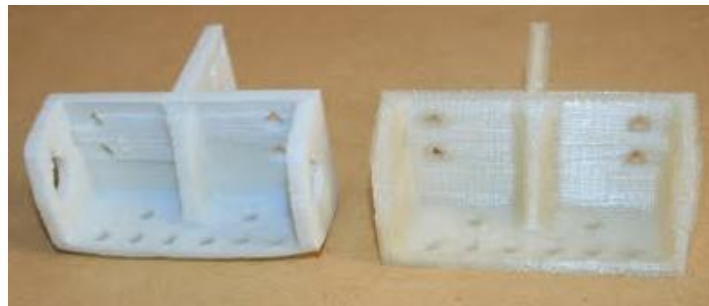
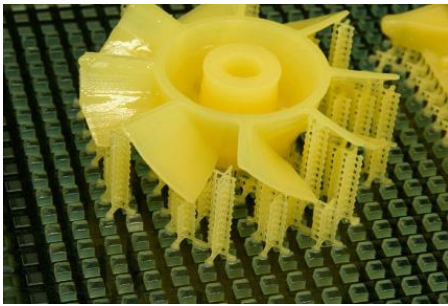
Printing Materials

- Materials (come in two major wire diameters 3mm and 1.75mm). List of suppliers (all 45, USA 10):
http://reprap.org/wiki/Printing_Material_Suppliers
 - **PLA** (polylactide, biodegradable, low temperature, many colors, fluorescent, etc.) \$35/kg retail
 - **ABS** (acrylonitrile butadiene styrene, petroleum based, colors, fluorescent, etc.) \$35/kg retail
 - **PVA** (polyvinyl alcohol, water soluble, low temperature) \$90/kg retail



Problems and Limitations

- Overhangs (over 50 degrees) require support
- ABS warping when cooling down
- Small blobs of plastic at the extrusion start/end points
- Cumbersome print initiation procedure
- Complex tuning procedures
- Printing is slow



Questions

