Additive Manufacturing at 40–03

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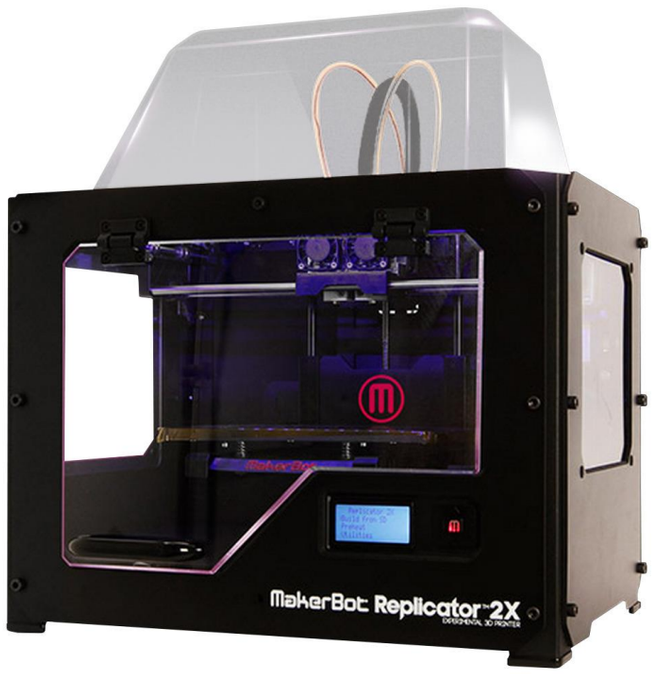
Overview.

- MakerBot Replicator 2X
- Maximum print = 9.7”L x 6.0”W x 6.1”H
- Layer resolution of 100 microns (.0039”)
- ABS plastic most commonly used at 40–03, but can also build with PLA plastic.

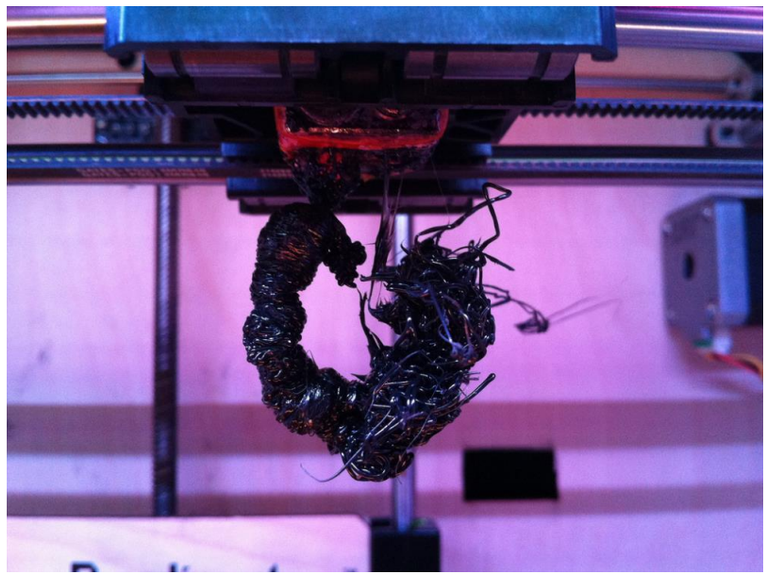


How it works.

- FDM (Fused Deposition Modeling)
- Made of hundreds of stacked layers of plastic
- Each layer about 0.2mm (.008”) thick
- As short as 15 min or as long as 24 hour build
- “It is the future”

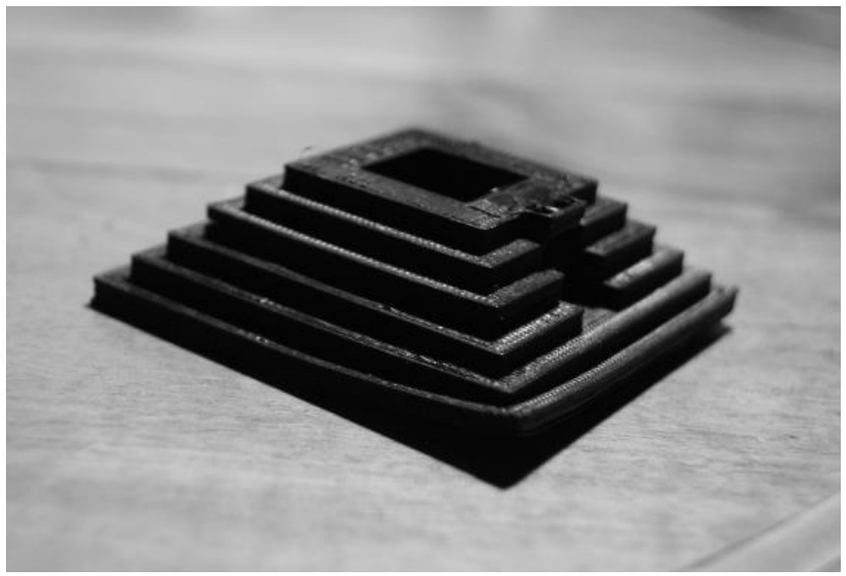
If it works.

Extruder Jamming



Axis Misalignment

Layer Peeling



Deliverable parts being sent to Seattle instead of being made at 40–03 because of errors and low quality.

So how would we fix the printer?

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Trial and (a lot of) error.

Before: 6th time's the charm... if you're lucky.

Now: A final product in one or two prints.

So, what's the trick?

Small changes in how you set up your print make all the difference.

Nomenclature.

Before going further, here are words to know.

Extruder: The small nozzle that lays down layers of material

Build Plate: Flat plate that the part is built on (heated for ABS)

Heat tape: Helps conduct heat and adhere the part to the build plate.

PLA: Polylactic Acid. One of two common build materials, biodegradable

ABS: Acrylonitrile butadiene styrene (Lego bricks are made of this)

Infill: How dense the inside of the part is.


MakerBot
Replicator 2X
>Build from SD
Preheat
Utilities
MakerBot Replicator™2X
EXPERIMENTAL 3D PRINTER

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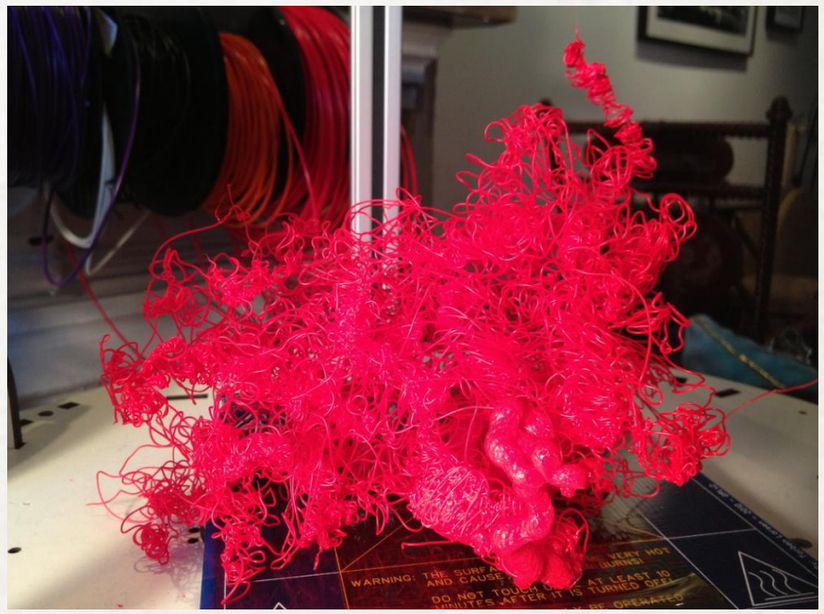
Jamming.

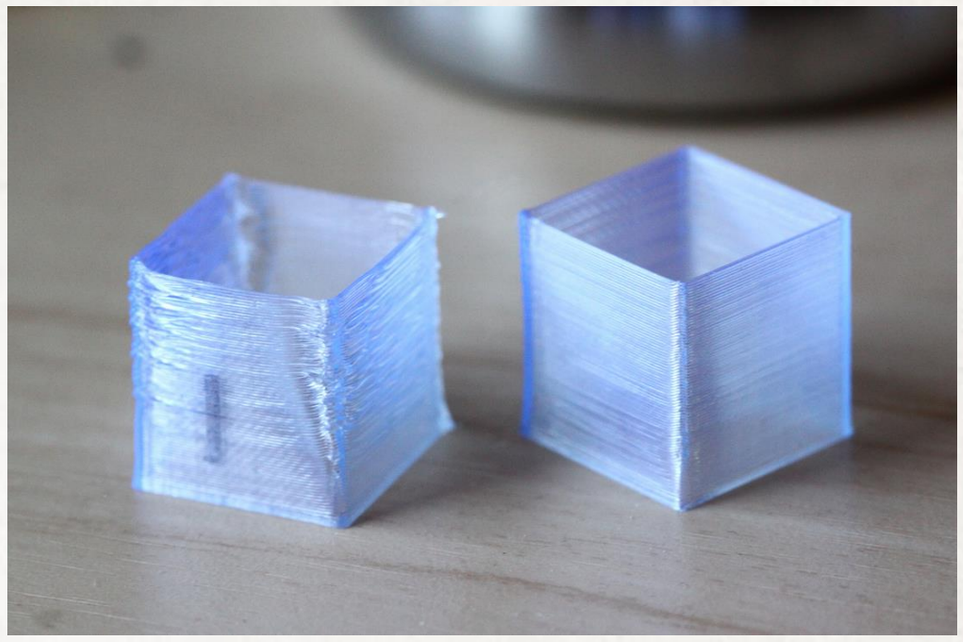
Problem: Extruder loses its positioning and level, usually caused by jamming. Makes “spaghetti”.

Solution:

- Precise leveling. Filament buildup possible from improperly leveling.
- Regular cleaning of nozzles.
- If noticed almost immediately, you can reload filament.



Misalignment



Problem: Parts should be smooth, but look like a stack of pancakes.

Solution:

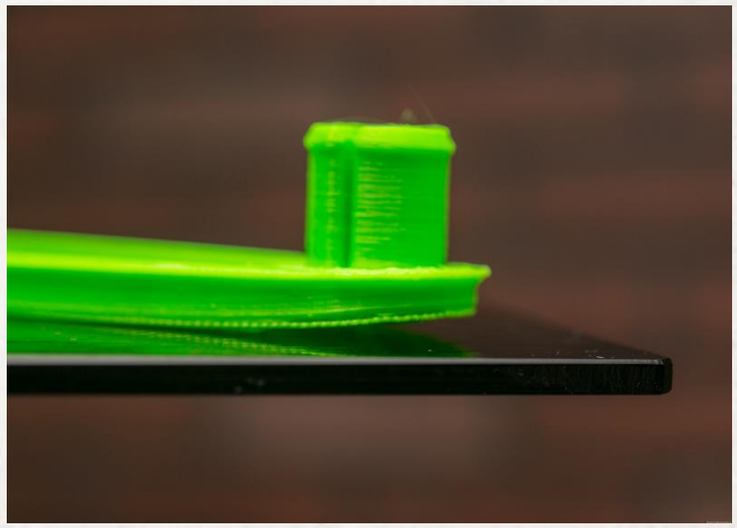
- Off-brand filament is less uniform than official brand.
- Too low a build plate and filament makes blobs and a gooey mess.
- Allow more cooling on smaller objects between layers (slower extrusion speed)

Peeling.

Problem: Parts should be flat when intended. Improper cooling can make a curved base.

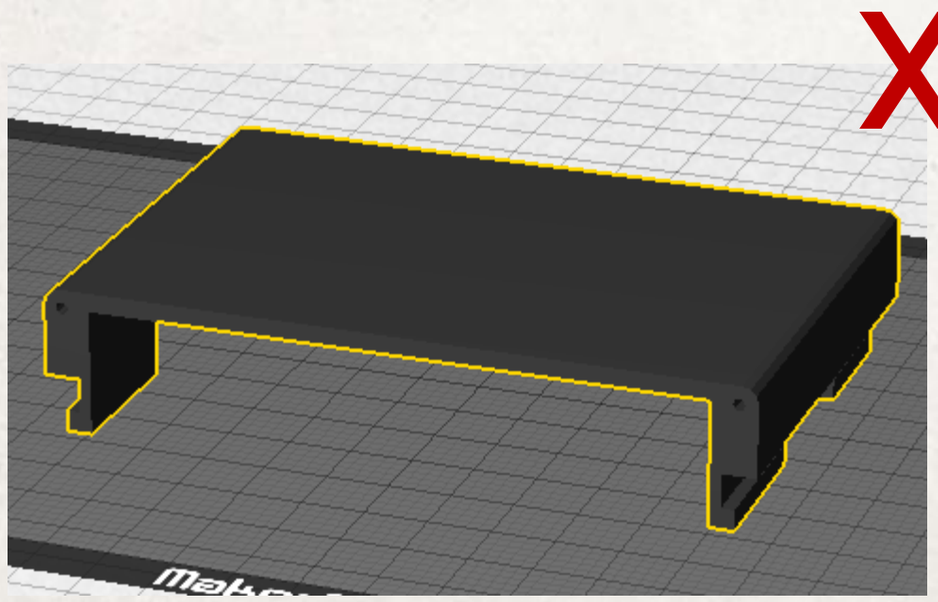
Solution:

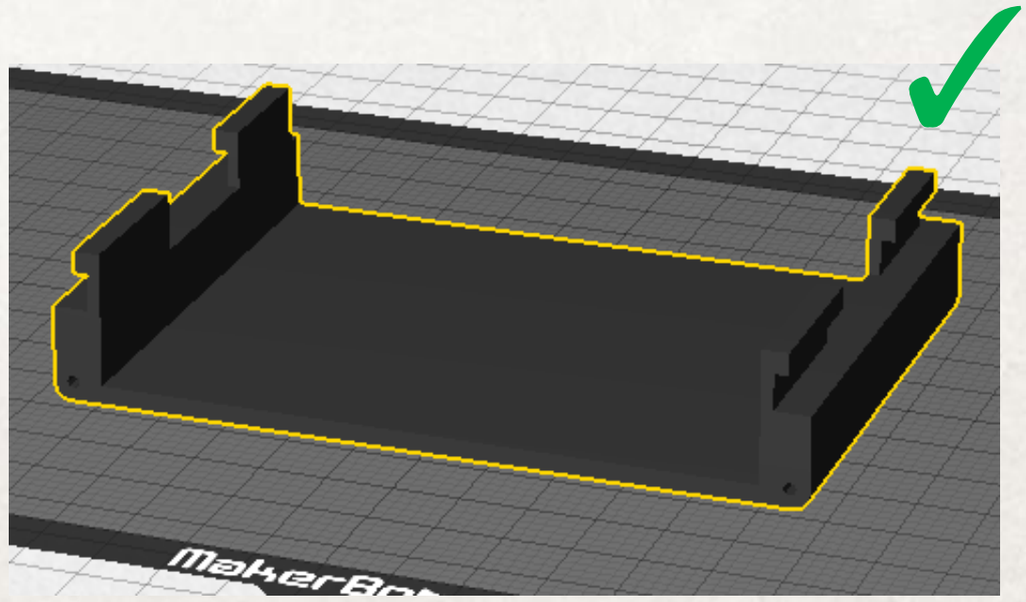
- Hot build plate (~120C)
- Slow extrusion on “small” parts
- Use a raft if surface smoothness is not important
- Sand or use hairspray on heat tape for more adhesion.



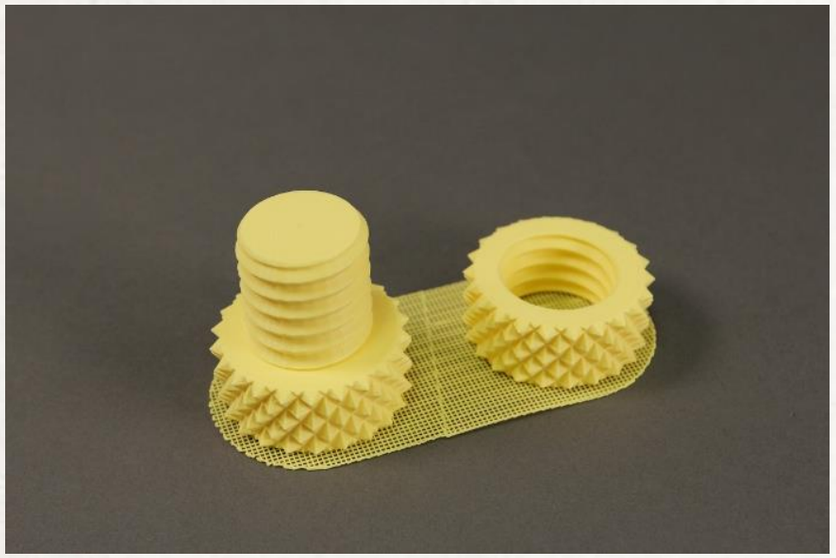
So, How do I get started?

1. Model an object with minimal overhangs and no dimension smaller than .0006” (0.015mm)
2. Get your model saved as an .stl or .obj
3. Import into MakerWare (free download!)





Raft or no raft?



Use a raft when a flat base is essential.

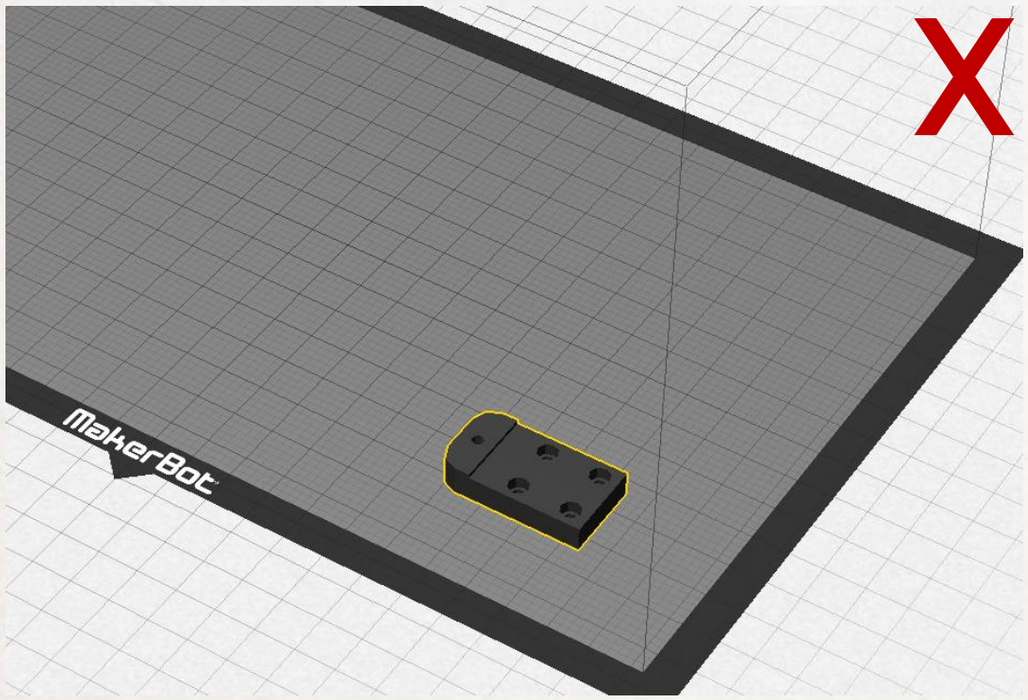
With Raft:

- Controlled flatness
- Easier to remove
- Longer print time

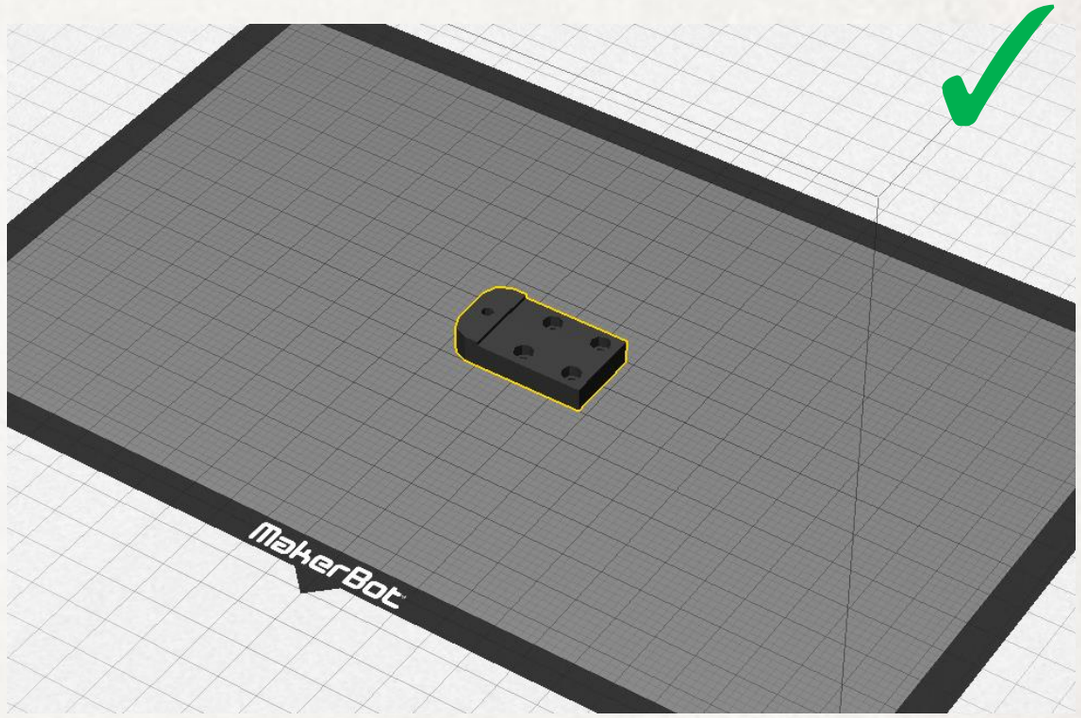
Without Raft:

- Smoother surface
- Higher peel tendency

Plate Position.



- Unequal heating
- At extremes of extruder boundaries



- Center provides equal heating

Setting up your print.

These settings are a good starting point.

Print position: As centered as possible, oriented for minimal overhang and/or Z height
Plate temperature: 115–120 C
Infill: 10%, up to 3” x 3”
For every additional 3” in any XY dimension, add 10% to infill.
Speed: 75–90 mm/s. If you have many small features, consider going as low as 35mm/s (trial and error to be expected)

How do I use the printer?

That's a little too in depth for this power point.

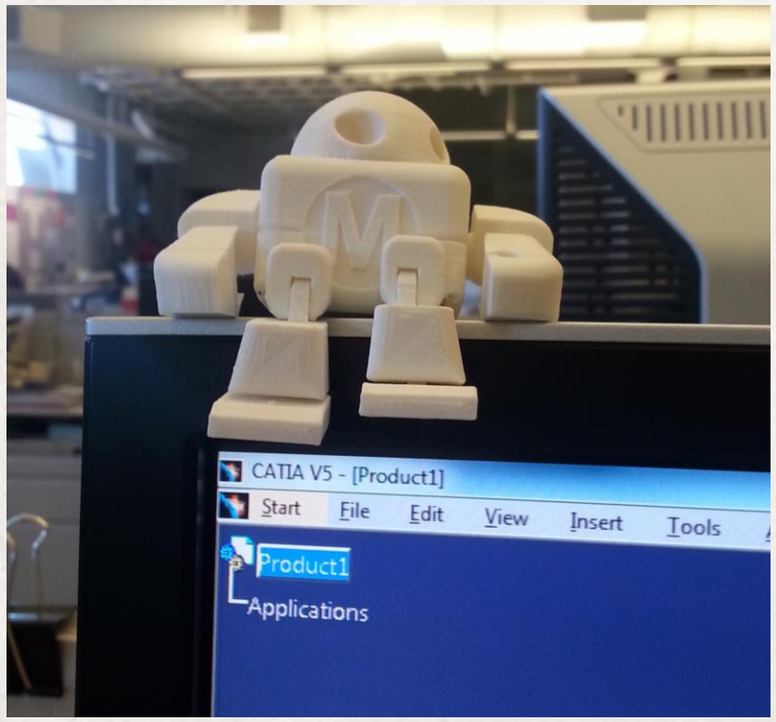
Calvin Ting is a good resource for a quick tutorial.
Or, consult the user manual on Makerbot.com

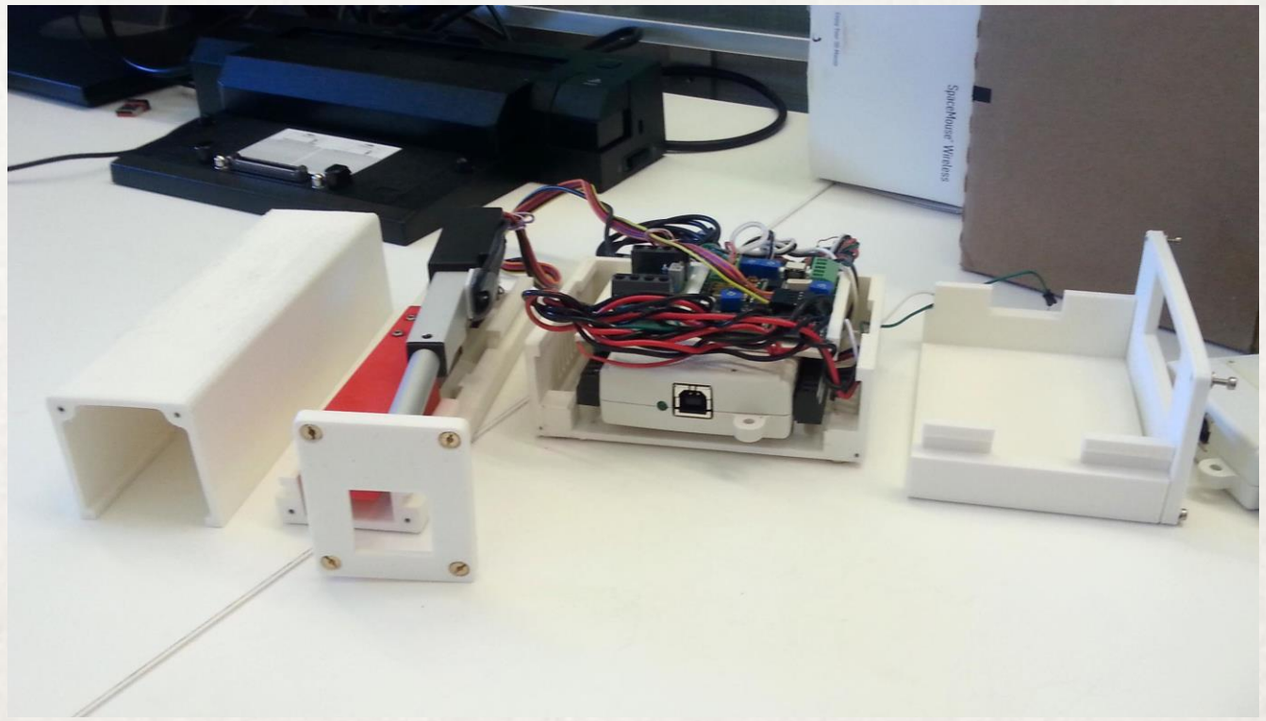
I learned in about 5 minutes... so can you! Additive manufacturing is very simple to learn.

What have we made?

All sorts of things; from robots, to electronic packages, to scaled models to bin latches.

The possibilities are endless.





DESIGN THIS DAY.

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