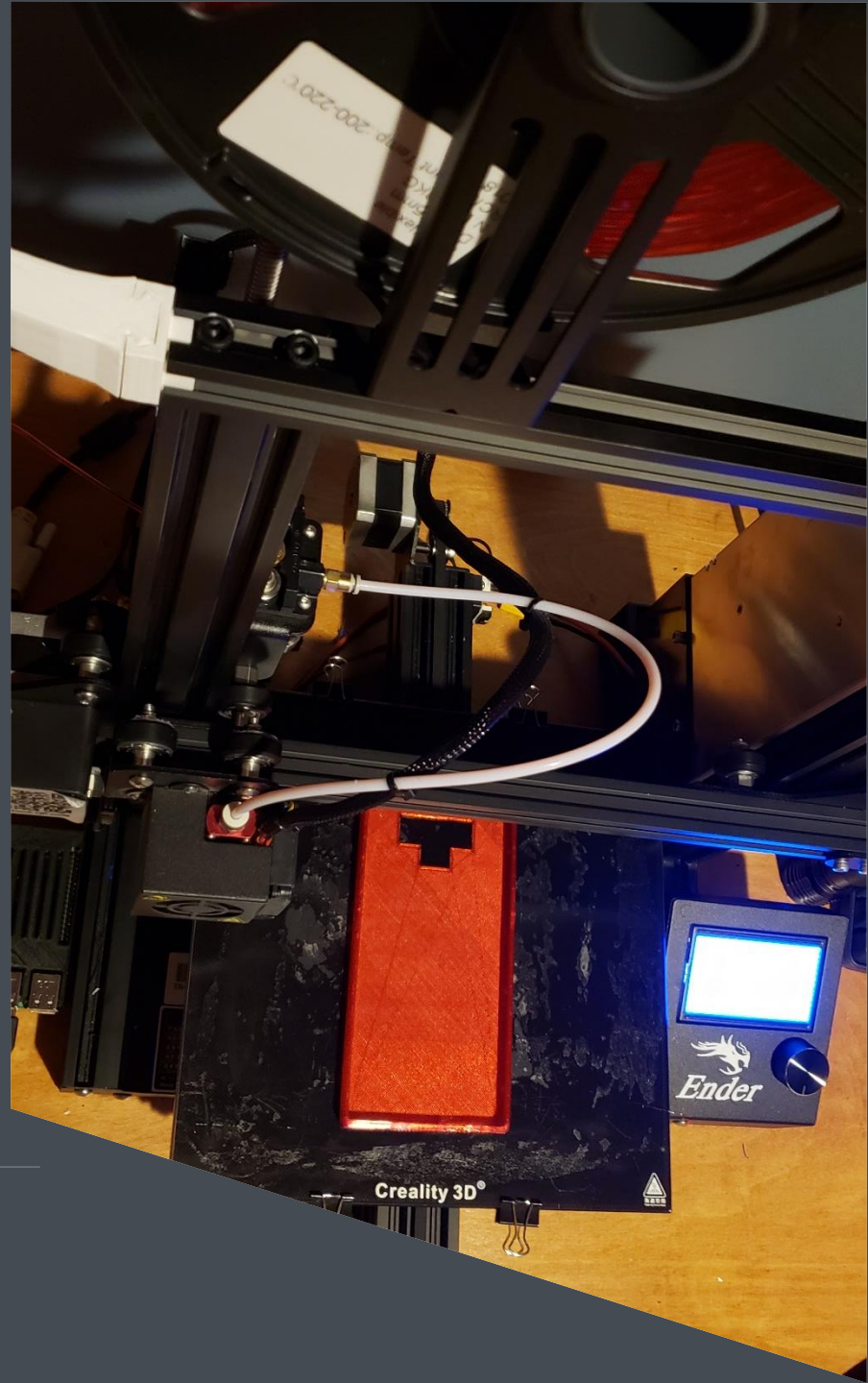
Orlando Code Camp

3D Printing Basics



Presented by
Jeremy Huckeba

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Overview

- Getting set up
- Slicing models
- Building a print server with OctoPi
- Creating your own model

Getting set up

Selecting a printer

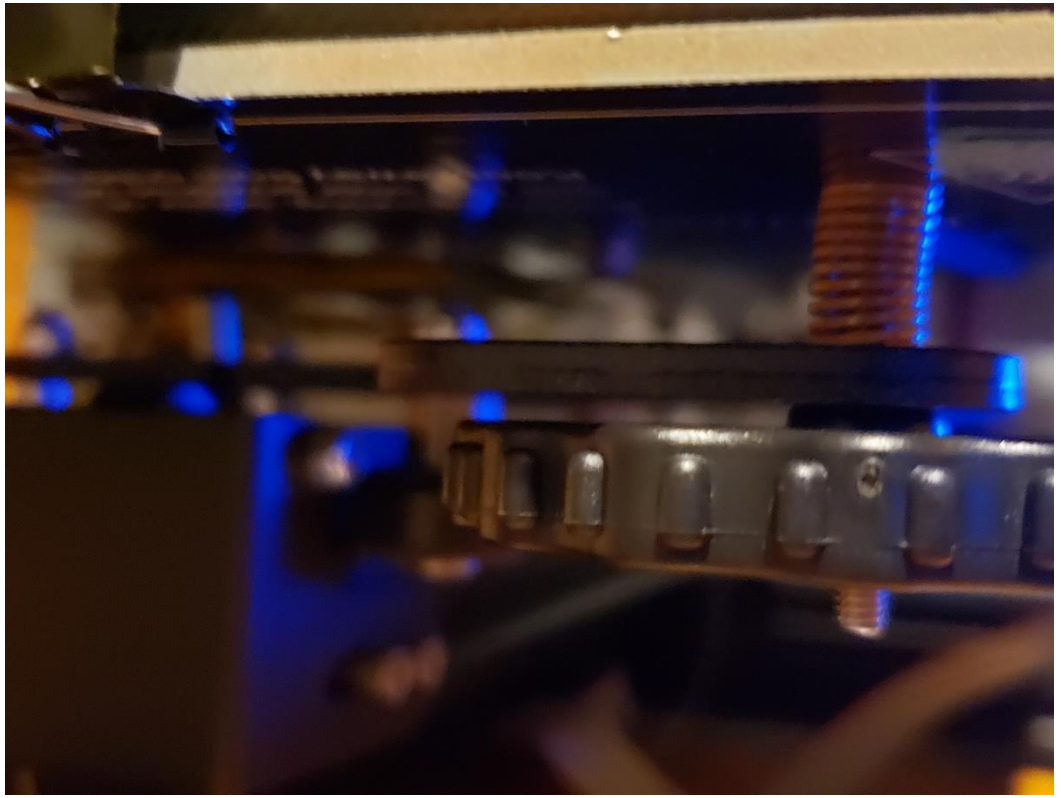
- Start simple, you can always upgrade later
- A heated print bed is imperative
- Higher temps are better but again, you can always upgrade later
- Look for a robust community for the model you select

Assembly Tips

- When assembling extrusion rails tighten slowly and ensure rails are square
- Place your printer on a level surface
- Don’t overtighten concentric nuts
- Watch several assembly videos on YouTube before you begin assembling your printer. The printer instructions may not tell you everything you want to know
- Update your firmware!

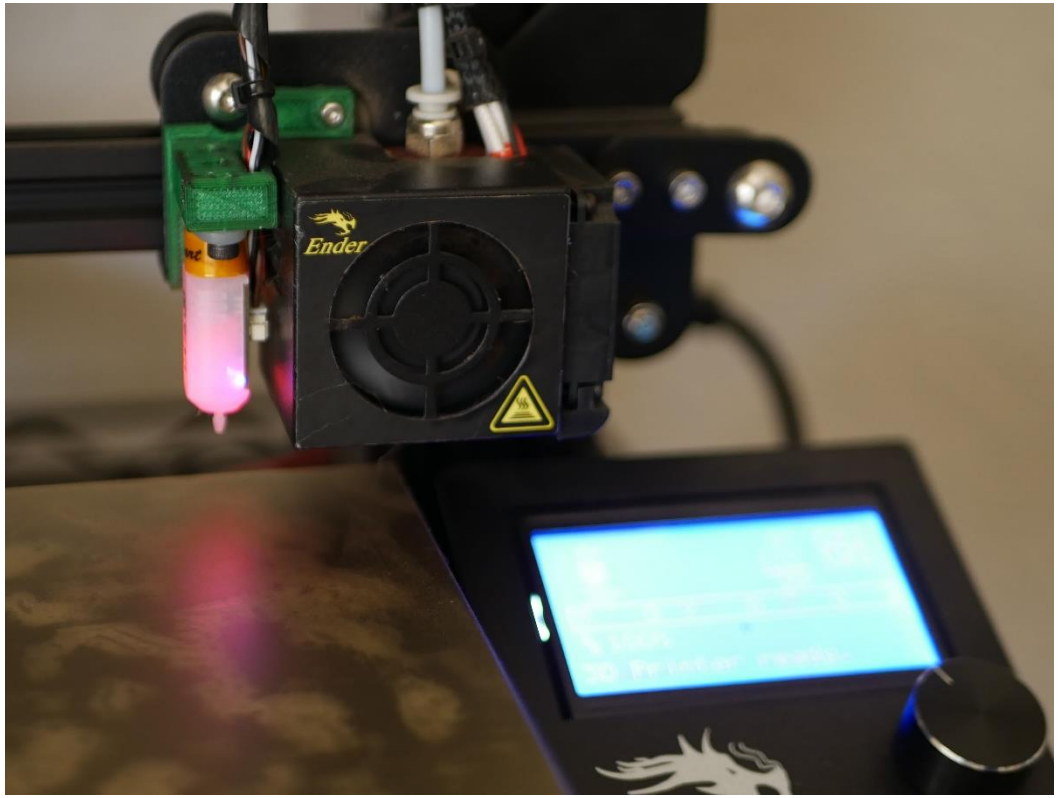
Manual Bed Leveling

- Demo
- Stiff springs are really helpful



Automatic Bed Leveling Methods

- Auto-leveling
  - Touch sensor (BL-Touch)
  - Inductive sensor
  - Optical sensor
- May require custom firmware (such as Marlin)



Choosing a filament

A little about filament

- Mind your diameter
- Type of plastic
- Quality matters
- Start with a common, brand name PLA
- Many types of plastics to choose from

PLA – Polylactic Acid

- Most common material
- Biodegradable
- Large diversity of colors
- Large diversity of specialty blends (wood, metal, carbon fiber, etc)
- Low printing temperature (190°-220°C)
- Low glass transition temperature (60°-65°C)
- Moisture issues
- Not suitable for high temperature applications
- Not UV-resistant
- Brittle
- Little or no fumes

ABS – Acrylonitrile Butadiene Styrene

- Second most common material
- Lower friction coefficient than PLA (easier to extrude)
- Large diversity of colors
- Few specialty blends
- Higher printing temperature (200°-250°C)
- Higher glass transition temperature (~105°C)
- No moisture issues
- Not suitable for high temperature applications
- Not UV-resistant
- Temperature sensitive, prone to warping and layer separation
- Brittle
- Mild fumes possible. Ventilation recommended

TPE/TPU – Thermoplastic Elastomer / Thermoplastic Polyurethane

- TPU is a type of TPE but is firmer
- Common material
- Higher friction coefficient than PLA (harder to extrude)
- Large diversity of colors
- Flexible and/or stretchable
- Similar printing temperature (210°-240°C)
- Similar glass transition temperature 20°-70°C)
- Higher chemical resistance
- Not suitable for high temperature applications
- Prone to stringing
- Think flexible and impact resistant
- Little or no fumes

ASA – Acrylonitrile Styrene Acrylate

- Less common material
- Similar to ABS
- Large diversity of colors
- Few or no specialty blends
- Higher printing temperature (230°-250°C)
- Higher glass transition temperature (~110°C)
- No moisture issues
- Not suitable for high temperature applications, but better
- UV-resistant, great for outdoor applications!
- Temperature sensitive, prone to warping and layer separation
- Higher cost
- Mild fumes possible. Ventilation recommended

PET – Polyethylene terephthalate

- Several variants: PETG, PETE, PETT
- Less common material
- Large diversity of colors
- Glossy and smooth finish
- Few or no specialty blends
- Higher printing temperature (230°-250°C)
- Higher glass transition temperature (75°-90°C)
- No moisture issues
- Not suitable for high temperature applications, but better
- Some grades have UV-resistance, may be suitable for outdoor applications
- Good bed and layer adhesion
- Food-grade (FDA approved) filaments available
- May create intense fumes that are dangerous to people and pets. Ventilation recommended.

Nylon

- Less common material
- Large diversity of colors
- Few or no specialty blends
- Very high printing temperature (>240°C)
- Wide range of glass transition temperatures, depending on bed material (55°-80°C)
- Extremely moisture sensitive, should be dried before printing
- More suitable for high temperature applications
- Some grades have UV-resistance, may be suitable for outdoor applications
- Temperature sensitive, prone to warping and layer separation
- Extremely tough and impact resistant
- May create intense fumes that are dangerous to people and pets. Ventilation recommended.

Finding and Making Models

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About printable models

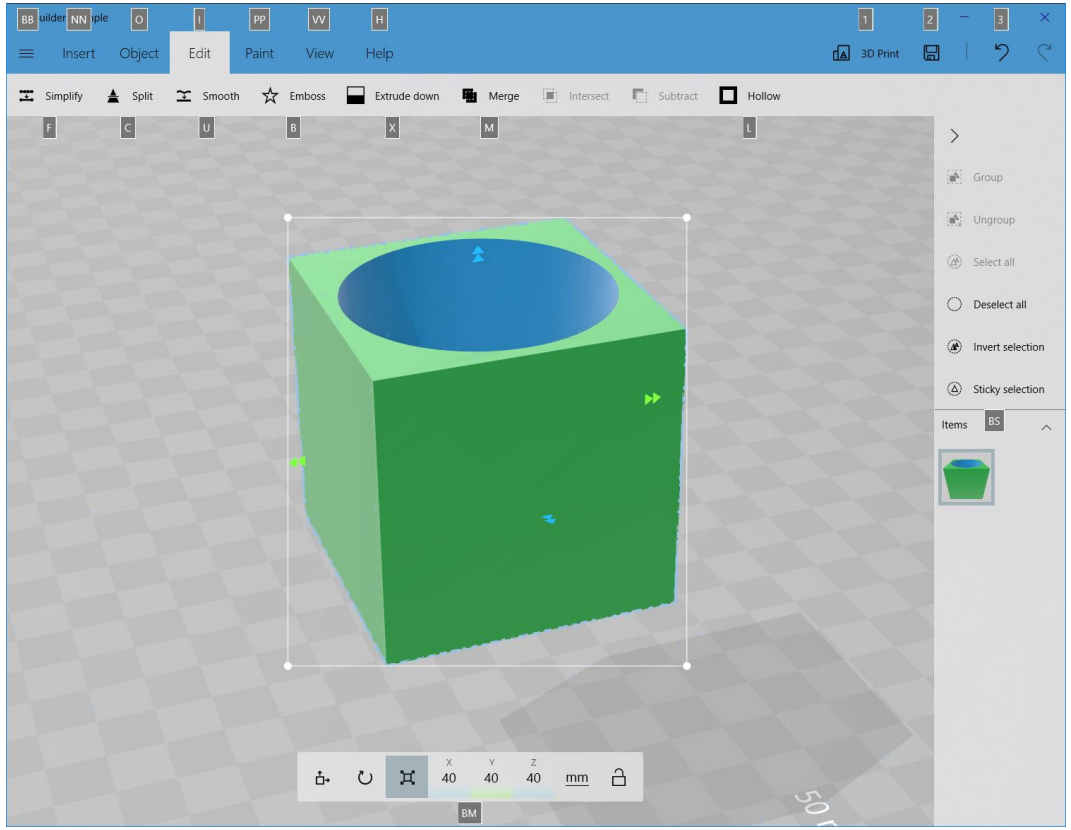
- STL Format
  - (STereoLithography, Standard Triangle Language, Standard Tessellation Language)
  - Created by 3D Systems
  - Common format for 3D-printable models
  - Also common for CNC Routing
  - See http://www.fabbers.com/tech/STL_Format
- 3MF Format
  - 3D ManuFacturing
  - Common format for 3D-printable models and slicers
  - Contains all necessary model, material, and property information
  - See https://3mf.io/
- Many 3D design apps can output to STL or 3MF

- Finding models
  - thingiverse.com
  - turbosquid.com
  - cgtrader.com
  - myminifactory.com

Creating 3D Models

- SketchUp
  - Has plugins for importing/exporting STL files
  - Free version
- Autodesk Tinkercad
  - All online
  - Free
- Microsoft 3D Builder
  - Free for Windows 8.1/10
- Others
  - Autodesk AutoCAD
  - Blender
  - FreeCAD
  - More

Demonstration



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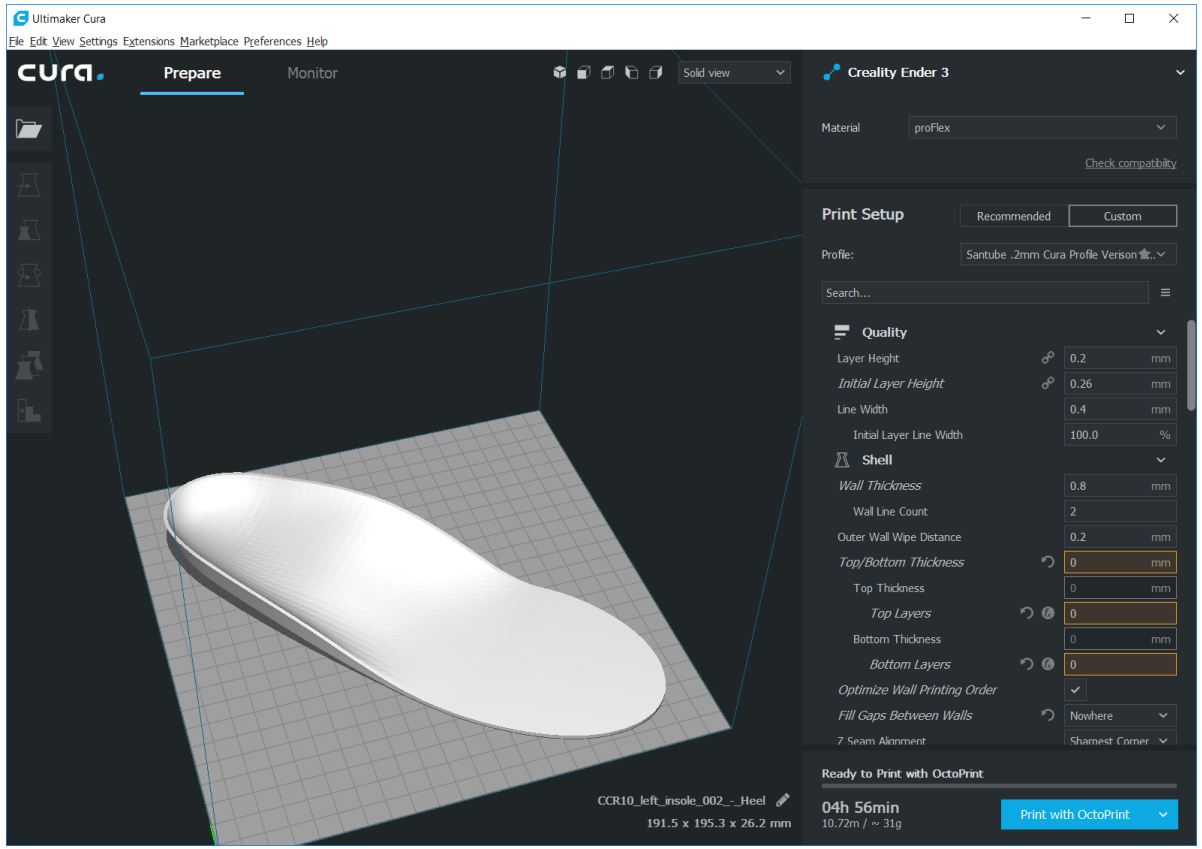
Preparing the Model

Slicing

- Applies printer and material-specific parameters to the model
- Slices the model and produces optimized instructions for the printer to follow
- Allows the user to customize parameters to produce better prints

- Some Popular Slicers
  - Ultimaker Cura
  - Slic3r
  - Repetier-Host
  - Raise3D ideaMaker
  - Many others

Slicer Demo



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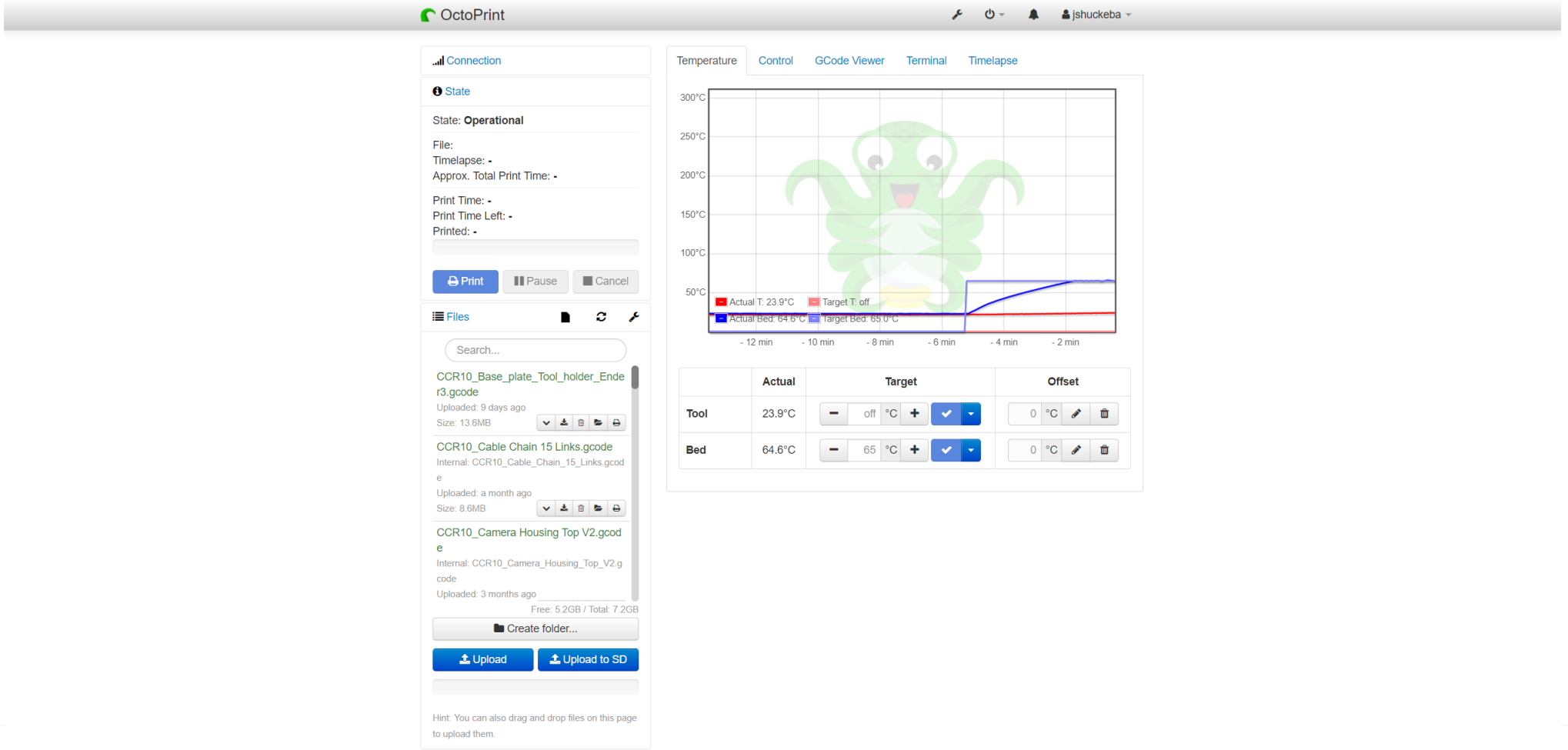
Adding a Print Server

OctoPrint

- Provides a web interface for remote control and monitoring
- Powerful plugin system
- Integration with slicer software (such as Cura) for direct printing

- Can be run on a Raspberry PI using OctoPi
  - Raspberry PI 3B or 3B+ recommended
  - Download at https://octoprint.org/download
  - Note slightly different Wi-Fi configuration
  - Can support web cam or Pi Camera

OctoPrint



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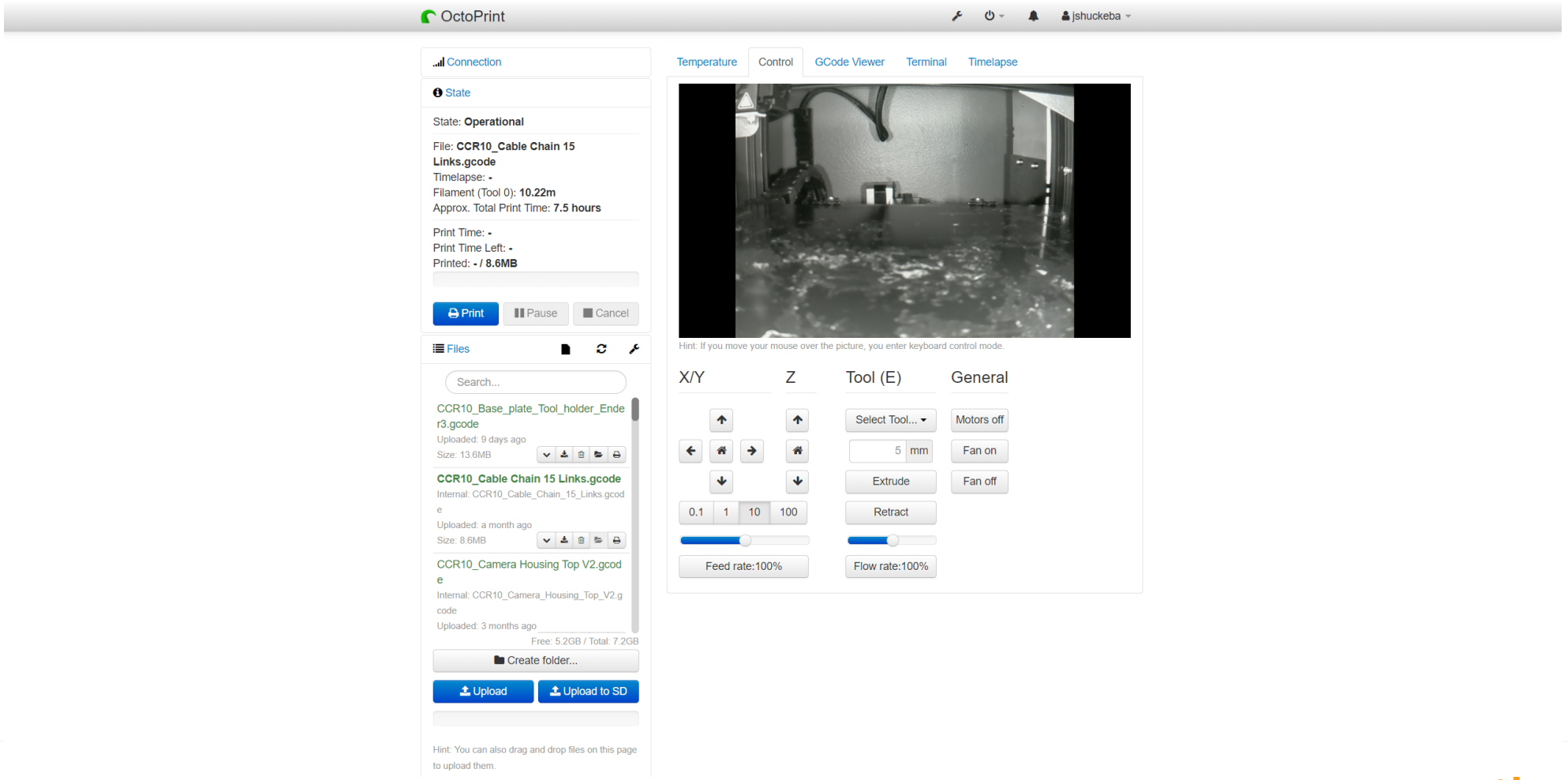
OctoPrint



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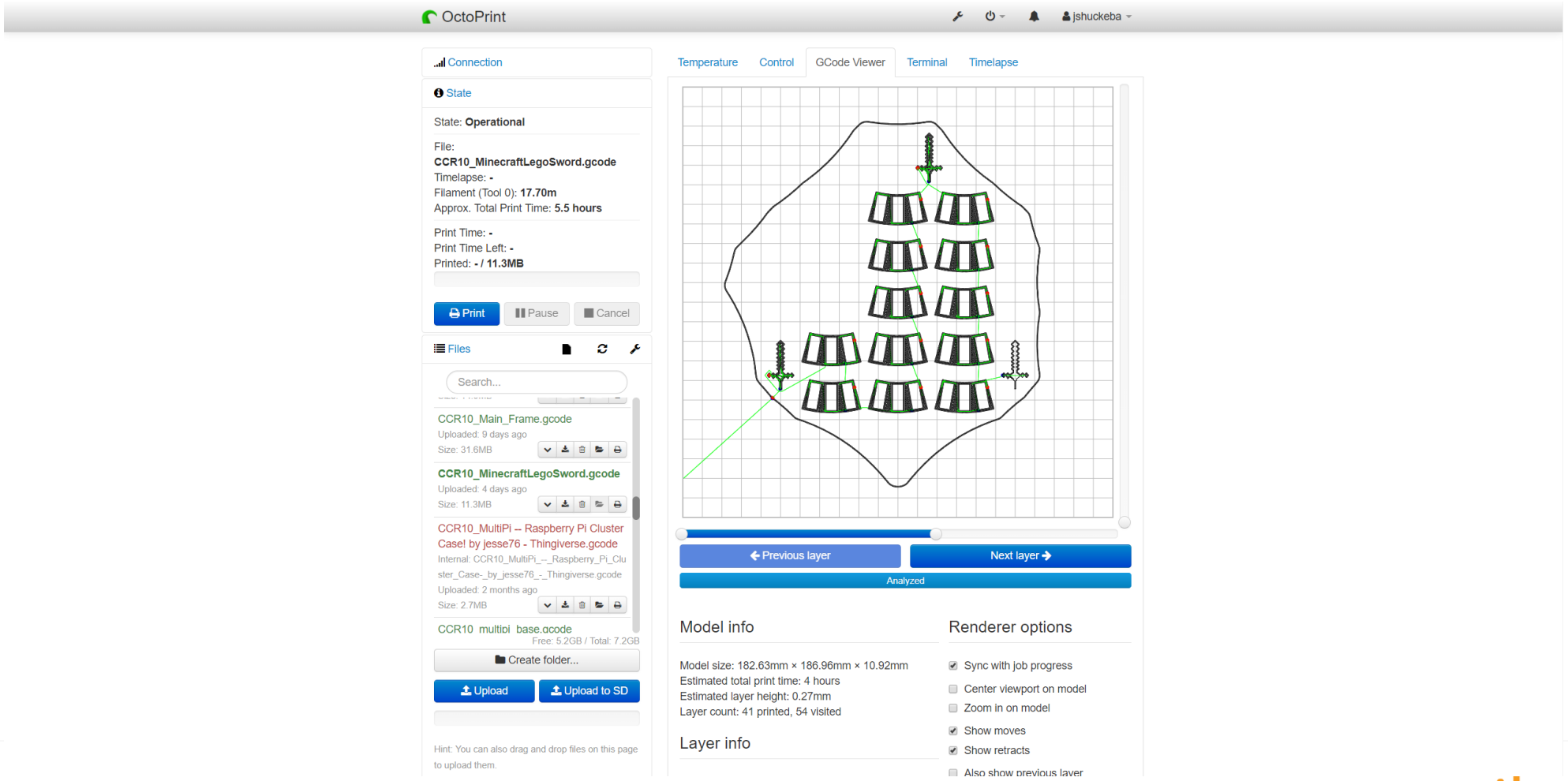

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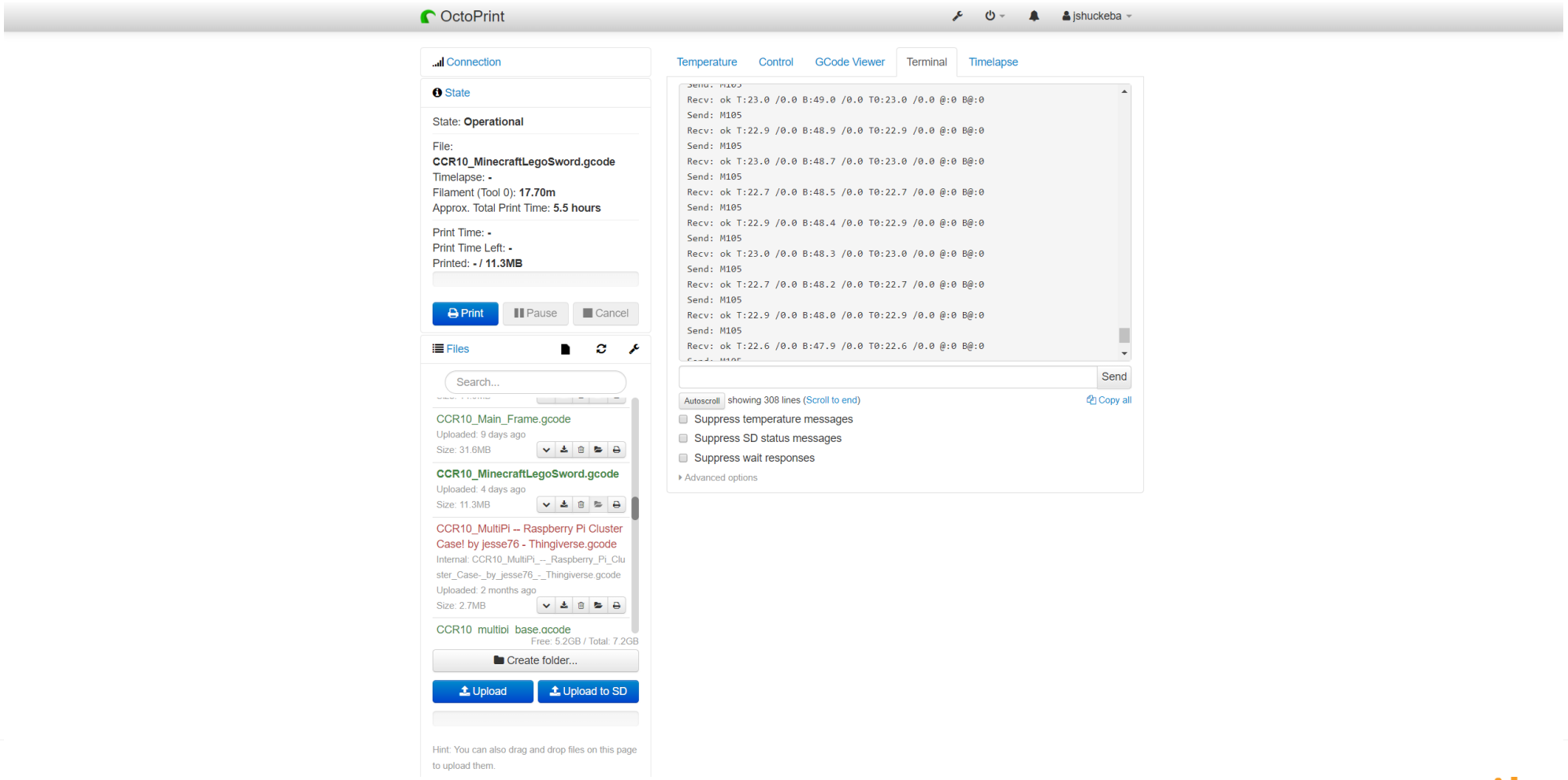
OctoPrint



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A Little About GCode

GCode

- Numerical control programming language for industrial applications
- Is implemented by most RepRap printers
- Is generated by slicer software
- Can be modified to create highly customized prints (allow filament changes, etc)
- Note: Not all firmware supports all commands the same
- See https://www.reprap.org/wiki/G-code

- Numerical units usually millimeters for RepRap
- Useful commands to know
  - M0 (stop / wait for user)
  - G28 (move to origin / home)
  - G1 (Linear Move)
    - X (y-axis)
    - Y (y-axis)
    - Z (z-axis)
    - F (acceleration)
    - E (extruder)

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Jeremy Huckeba
github.com/jshuckeba/3DPrinting
linkedin.com/in/jshuckeba

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