Linux and 3D Printing 101

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I post photos of my prints on Instagram (it a public page, no account required to view)
https://www.instagram.com/lorentzjeff/

What is 3D Printing?
It is taking a 3D computer made (or CAD) 3D file and making it into a physical object where the printer builds an object using thin layers.

The most common type of 3D printing for hobbyist is called Fused deposition modelling (or FDM) which uses a plastic that is melted down similar to a hot glue gun to form an object.

Tools & Equipment required to do print your own items:
- Computer
- 3D Printer
- Filament (roll or plastic)
- 3D Slicer software
- Some misc tools

Components:
Printer Bed (surface types, heated vs non-heated)
    - Aluminum, Spring Steel, Glass/Mirror

Used to help print stick to bed:
    - Blue Tape
    - PEI / Buildtak / Custom Sheets
    - Magnetic Sheets
    - Glue Stick

Bed Level probe / Manual adjustment knobs
Build Volume = printable area

- Linear Rons & Bearings
- Nema 17 Stepper Motors (most common)
- Hot End
- Extruder (single vs dual drive gears)
- Nozzles (sizes and material types)
    - Brass (most common)
    - Steel (stainless & hardened steel)
    - Titanium
    - Ruby Tipped
- Stop end Switches
- Cooling Fans
- Drive Belts (GT2 belt is most common)

Getting ready to print:
Files are normally printed using a printer to computer via USB or SD

- Bed Setup / Levelling (blue tape, IPA, glue stick, hair spray)
- Slicer software (more info/details later about software & settings)
- Printer Setup / Profiles (built in profiles easiest best for new users)
- Loading filament (preheat nozzle to temp & cut filament end to 45 degree angle)

Things to watch for when starting a print:

How should layers look. The 1st layer should look a little squished into the bed and the rest of the layers should look similar just less squished down.
Are Layers sticking well to bed / if not Nozzle distance may need adjustment.

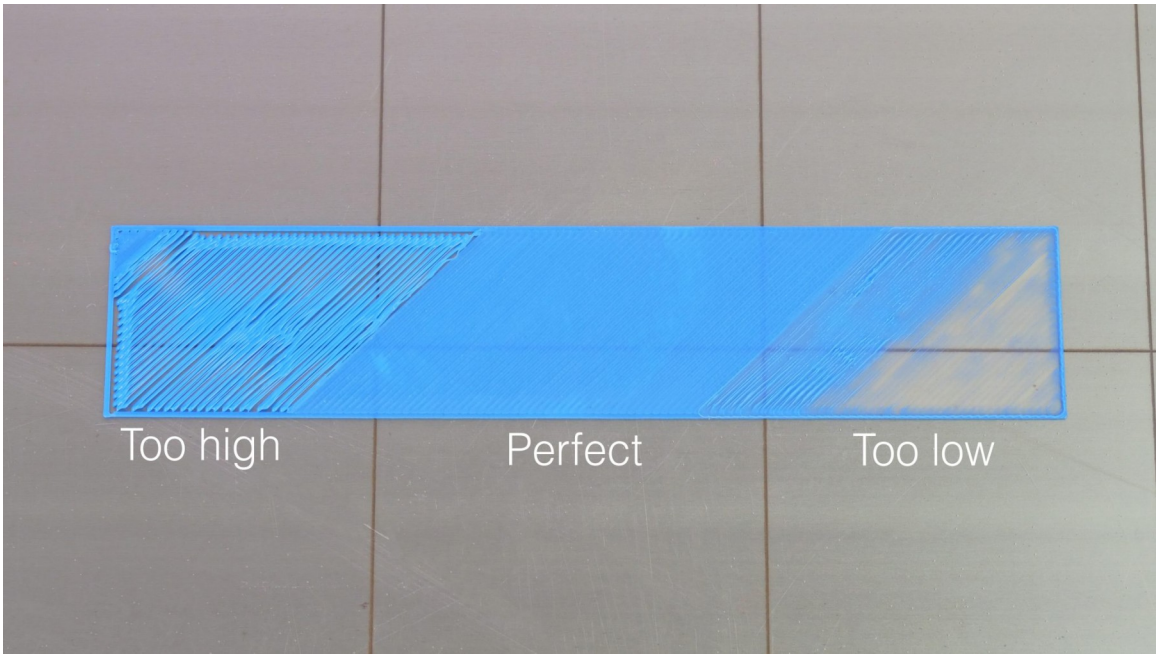


Image from Prusa Research website

1st Print should be quick and simple (to see it anything doesn't look right)
Watch layer adhesion (as above photo)

If it does not look like the above perfect range or if print is not sticking then adjust Z offset accordingly if using a probe (with the G-Code setting or in the slicer software)
If your printer has manual bed levelling adjust level the bed using paper or feeler gauge of some sort.

Filaments:
Plastic Types (basic types): PLA, ABS, PET/PETG
- PLA easiest to print with and safe for indoors use.
(PETG usually fine for indoor prints as well)

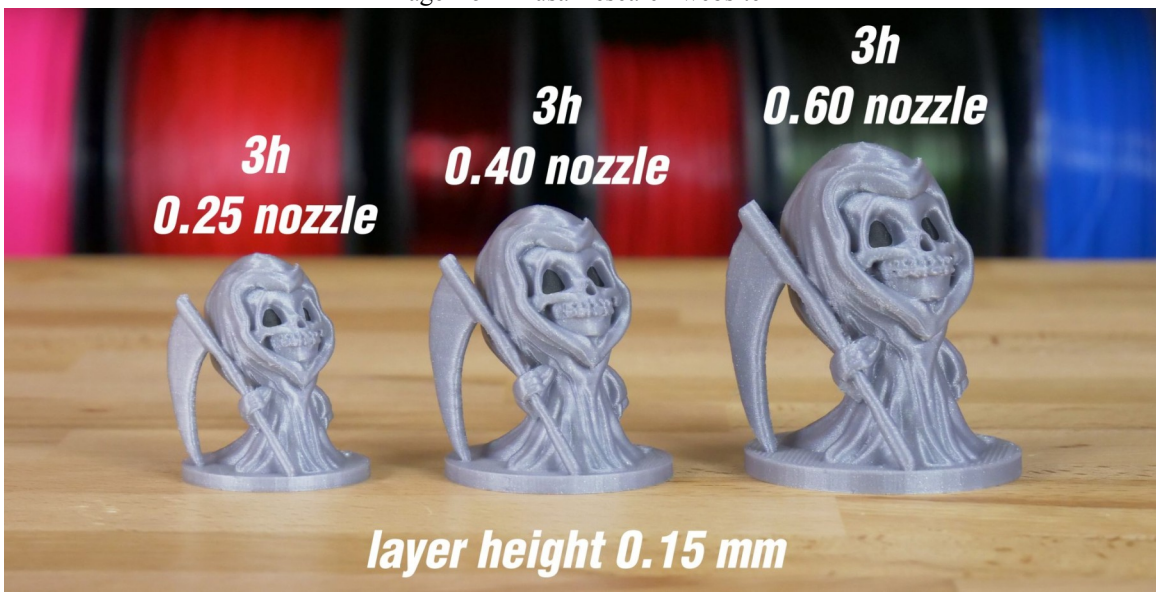
TPU – flexible filament
Nylon – high temp / very strong
There are many other filament types for FDM printers available

Tools:
- Scraper / Spatula
- Blue Tape (depends on print bed)
- Glue Stick / Hairspray
- 99% Isopropyl alcohol
- X-Acto Knife
- Pliers (useful for removing support material)
- Small wire cutter tool (to cut filament ends off)

Slicer Software Settings:
(Most common 3D print file type .STL)

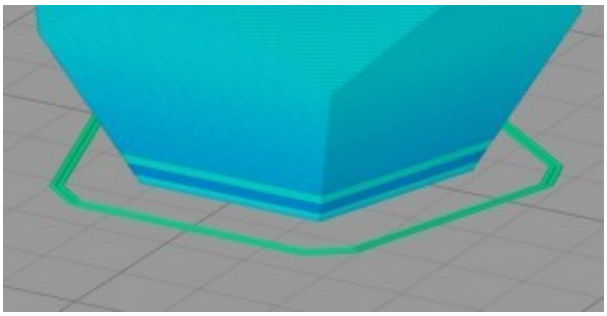
- Some slicers have basic settings available - High, Med, Low quality settings if you not interesting in fine tuning settings or it your just starting out.
- Hot End Temperature setting (some slicers have presets) check filament for temp range & test to find what temp works best for your printer.
- Heat bed Temp setting (not required for printing PLA filament)
- Layer Height setting (depends on nozzle size)
    * Layer height should not exceed 80 % of the nozzle diameter
    * Layer height of 0.1mm or less the 1st layer difficult to stick to bed
- Top/Bottom Layers
- Perimeters (outside walls how many)
- Infill percentage & type (rectilinear, triangle, honeycomb, line, etc)
    Most cases only require (10% - 25% infill)

Image from Prusa Research website

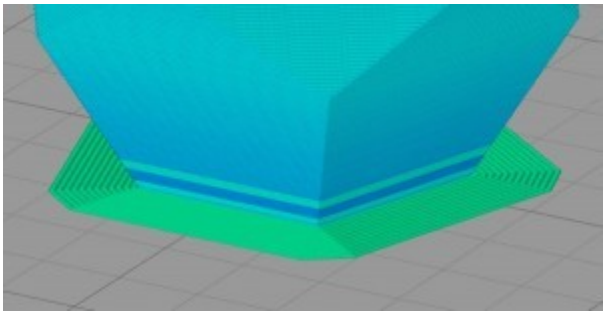


Large nozzles can cause issues on smaller prints though gaps, etc.

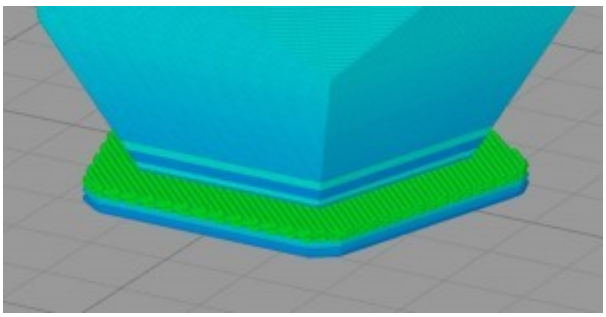
Skirt - helps to ensure nozzle is extruding plastic properly to bed before beginning a print.
Brim - helps a part to stay stuck to the bed and can prevent edges from curling.
Trimming afterwards can leave some of an unwanted look on the prints edge.
Rafts - helps part stick to bed and breaks off after print.
May leave unwanted material stuck to bottom of the print



Skirt



Brim



Raft

- Supports for overhangs (normally for angles more then 45 degrees)
  (Reason to print part a certain position of design a certain way)

Linux Slicers:
Simplify 3D (paid software)
https://www.simplify3d.com

Cura
https://ultimaker.com/en/products/ultimaker-cura-software

MatterControl (this is the software I used in the demo)
https://www.matterhackers.com/store/l/mattercontrol/sk/MKZGTDW6

Slic3r
https://slic3r.org

Repetier Host
https://www.repetier.com

OpenSCAD (design 3d models using programming/coding)

You may have to edit some permissions for Linux to allow USB connection to your printer (if your are tethering your printer)
Here is a link to a video tutorial
https://www.youtube.com/watch?v=UXAKhWqI_No

* PLA best starter material & most inexpensive ($20-$50 a 1kg spool average)

Printer Costs: (hobbyist more open usable)

My Printers (total costs include taxes, duties, etc.)
Printrbot **$800** (6" x6" x6")
Prusa i3 MK3 **$1700** (9.8" x 8.3" 8.3") - fully assembled
3D pen **$50** (on Amazon)

Luzbot Mini 2 **$1950** (6.3" x 6.3" x 7") - filaments.ca
Luzbot Taz 6 **$3200** (11" x 11" x 9.8") - filaments.ca
ULTIMAKER 2+ **$3250** (8.7" x 8.7" x 8") - shop3d.ca
Creality Ender 3 / Pro **$300-350** (8.6" x 8.6" x 9.8") – 3dprintingcanada.com
(kit based partial assembly required)
Monoprice Select Mini 3D Printer V2 **$320** (4.7" x 4.7" x4.7") - amazon.ca
(Monoprice US rebrand company)

Has a good selection of Printers:
https://store.makerwiz.com/collections/3d-printers

Others: Dremel, Makerbot (both I believe used proprietary filament)
Chinese manufacturers - FlashForge, Creality, Wanhao, AnyCubic, Craftbot, TEVO.
- For Chinese printers "Thermal Runaway" can be a serious problem, but can usually be fixed upgrading the firmware. (definitely research whatever printer you are looking to buy to see if this issue is a problem with it as it can cause fires)

***Deltabots - 3 arm printer (3 arms usual circle bed and have a tall Z axis)

Things to watch for when buying a printer: (please do your research)

- Avoid no name Filaments
- Proprietary filament Printers
- Printer profiles in slicer software (not necessary but helpful)
- Parts availability (especially nozzles custom thread/size, etc.)
- Firmware (availability & up-gradable) - based on control board used in printer
- Kit or Fully Assembled
- Duty fees, Shipping and Taxes
- Does the printer have issues with "Thermal Runaway"

White, Grey & Wood filaments all are easy to paint (primer style colours)

3D print online resources:

Free models you can download in STL format

Thingiverse
https://www.thingiverse.com

Here is my Thingiverse page
https://www.thingiverse.com/ZDC/designs

Yeggi (3D print search engine)
https://www.yeggi.com

My Mini Factory (some paid models)
https://www.myminifactory.com

Others:
https://pinshape.com
https://cults3d.com

Podcast
3d Printing Today
http://threedprintingtoday.libsyn.com

3d Printing News
https://www.3ders.org
https://twitter.com/3DPrintGirl

Google Group
https://groups.google.com/forum/#!forum/3dprintertipstricksreviews

YouTube Channels
https://www.youtube.com/user/TheMakersMuse/videos

https://www.youtube.com/user/ThomasSanladerer/videos

https://www.youtube.com/channel/UC_7aK9PpYTqt08ERh1MewlQ/videos

Filament/Plastic (These are all places I have used and were all good quality filaments)

https://3dprintingcanada.com
PLA house brand

https://filaments.ca
PLA, Bamboo/Wood house brand, eSun(PLA) & Formfutura HDglass(PetG)

Amazon Basics PLA filament

Misc Info:

Nozzle Sizes:
https://www.prusaprinters.org/everything-about-nozzles-with-a-different-diameter

Print Troubleshooting Guide:
https://www.simplify3d.com/support/print-quality-troubleshooting

Printer Types/Tech
https://penandplastic.com/3d-printer-types/

Modelling/CAD Software:

FreeCAD https://www.freecadweb.org

Online / Web based CAD services:
Tinker CAD https://www.tinkercad.com
Very basic but easy to use from what I seen & heard about the TinkerCAD software and probably the best way to start doing CAD design.

Sketchup https://www.sketchup.com/plans-and-pricing/sketchup-free
OnShape https://www.onshape.com/products/free

Windows software:

Meshmixer
http://www.meshmixer.com

DesignSpark Mechanical
https://www.rs-online.com/designspark/mechanical-software
(not many export file options without buying addon)

Online/Offline:
Fusion360 (Free hobbyist license option)
https://www.autodesk.ca/en/products/fusion-360/free-trial
(user friendly & tons of online help/videos)

Fusion is amazing for those who want to jump into a hardcore CAD software, the below YouTube channels the tutorials make it easy for anyone to make amazing stuff.

Fusion360 video guides:
https://www.youtube.com/user/cadcamstuff/videos
https://www.youtube.com/channel/UCLEVULiWognkczOpDSGSlFg/videos