

3D Printing For FTC

#16461 Infinite Turtles

Introduction

#16461 Infinite Turtles

- 2x North Carolina State Championship Inspire Award Winner
- 2022 World Championship Innovate Award Winner
- 2023 World Championship Division Inspire Award Finalist
- 5th year team

Lucas

- 2023 Design Lead
- 4th Year FTC

Juliet

- Hardware Team
- 4th Year FTC

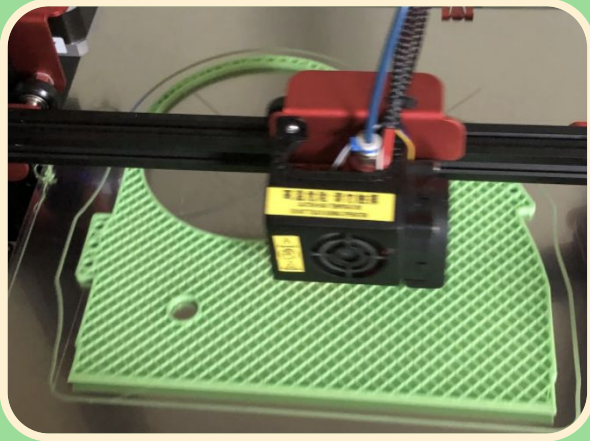
Avi

- New to 16461
- 2nd Year FTC



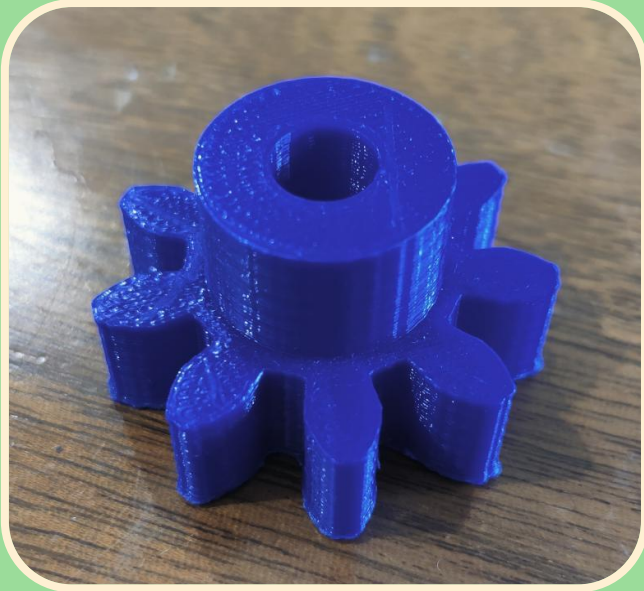
What is 3D Printing?

An additive manufacturing technique utilizing melted material (typically plastic) to create custom parts layer by layer.



Applications

Gears

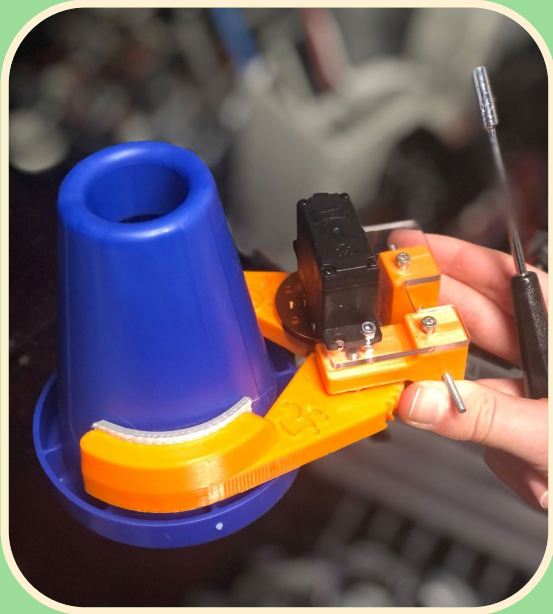


Pulleys



Applications

Claws and Arms



Spacers + Shims



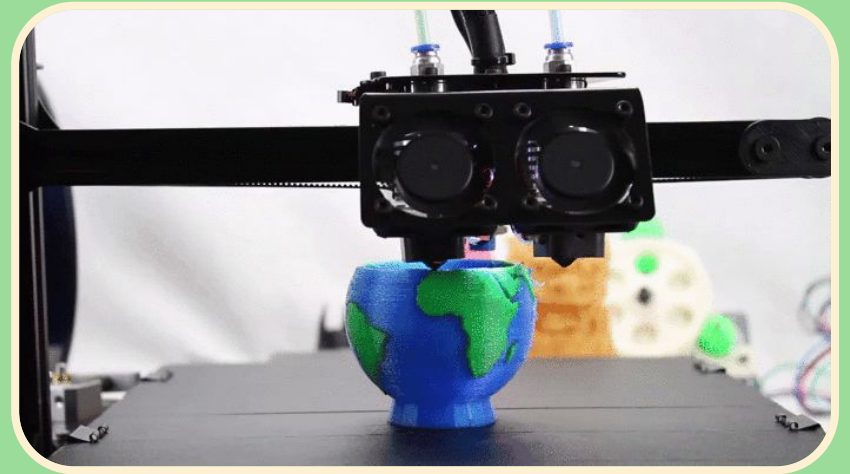
Applications

Aesthetics



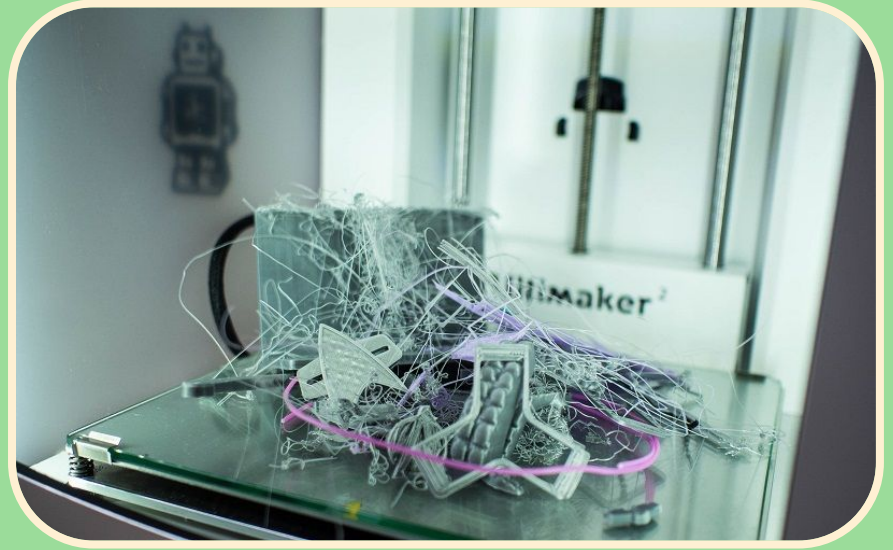
Advantages of 3D Printing

- Rapid Prototyping + Quick Turnaround Time
- Precision Details
- More Mounting Options than Commercial Parts
- Design Experience and CAD Skill Development



Disadvantages of 3D Printing

- Prints Still Take a Long Time
- Less Strong than Metal Parts
- Somewhat of a Learning Curve
- Can be Expensive



Printer Choice

Ender 3 Series



Price: \$150-250

Bed Size: 220*220*250mm

Pros: Price, Upgradability

Cons: Reliability

Bambu Lab P1P



Price: \$599

Bed Size: 256*256*256mm

Pros: Speed, Reliability

Cons: Replacement Parts

Prusa MK4



Price: \$1099

Bed Size: 210*210*250mm

Pros: Reliability

Cons: Price



Filament

PLA

Pros: Price, Partial Strength

Cons: Brittleness, UV Resistance

Good Brands: eSun, Polymaker, Hatchbox, Overture

ABS

Pros: Strength

Cons: Styrene Fumes and Warping

Good Brands: eSun, KVP, Polymaker

PETG

Pros: Durability and Impact Resistance

Cons: Tough to print, Hygroscopic

Good Brands: eSun, Polymaker, Hatchbox, Overture

TPU

Pros: Flexibility

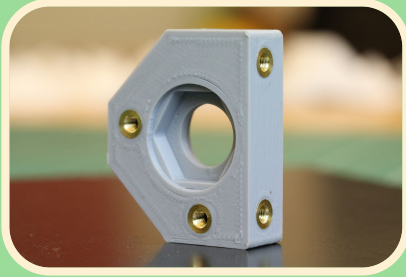
Cons: Tough to print, heavily Hygroscopic

Good Brands: NinjaFlex



Post Processing/Add-Ons

Heat Set Inserts



Used to add threads to 3D printed parts. Used for screws and won't round out mounting holes.

Annealing



Increases part strength by up to 2.5x in Z-axis. Worthwhile for structural prints. Often messes with tolerances quite a bit.

Vapour Smoothing



Requires specific chemicals for plastics used in prints. Smooths out parts greatly and is useful for low friction parts.
ABS: Acetone
PLA: THF or Ethyl Acetate

Epoxy Coating

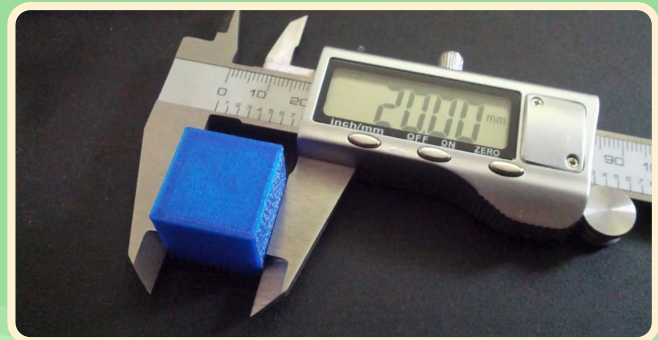
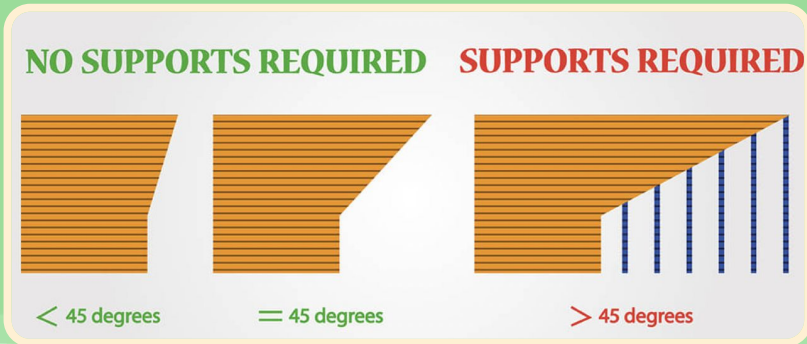


Useful for adding strength and smoothness. Make sure to use an epoxy that doesn't react with your filament.

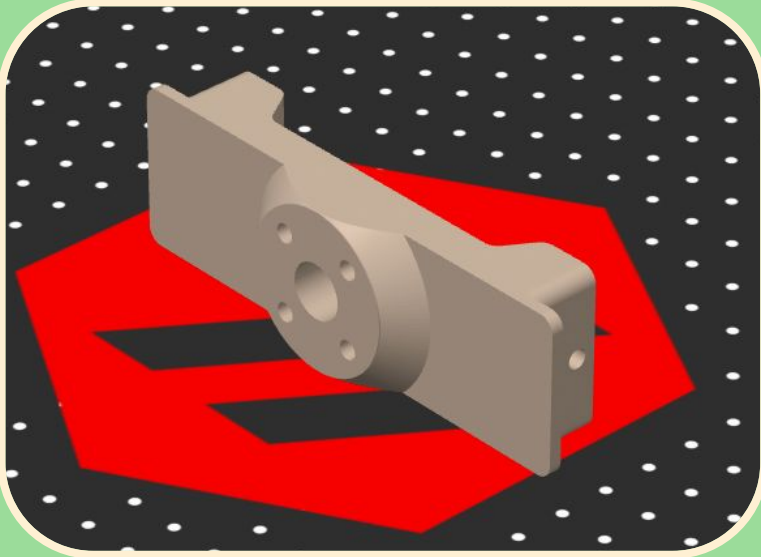


Designing

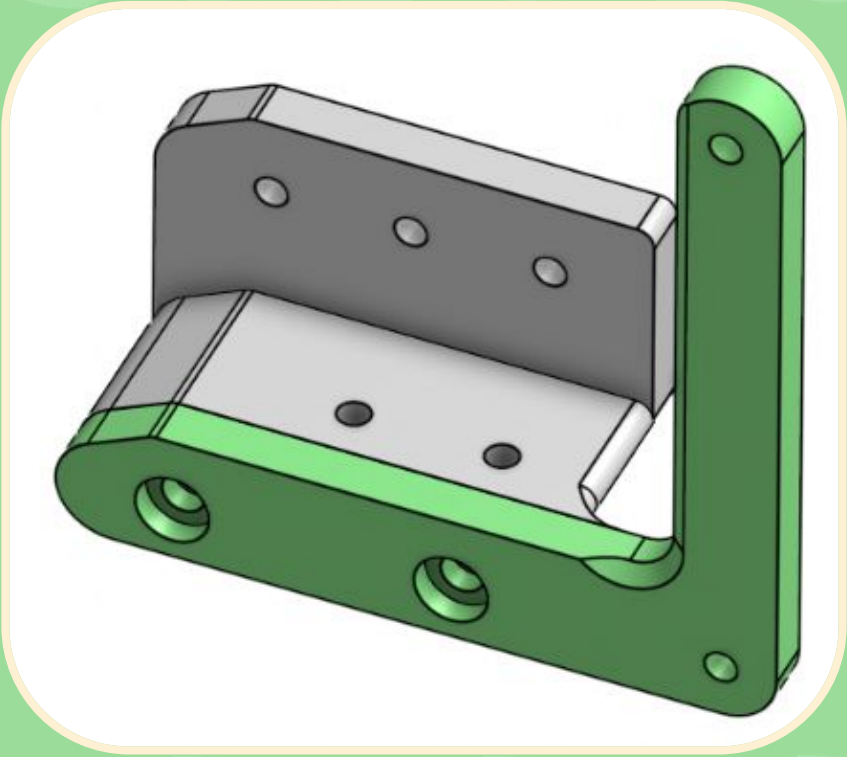
In order to 3D print parts, you need **CAD files** of your parts. You can use any software (**Onshape**, Fusion 360) to design prints. Parts should be designed to use as few (or no) overhangs **>45 degrees** (can result in excess support material to be removed). Parts also often need **tolerances** added in as no printer is perfect (A 4mm hole in CAD can end up bigger/smaller once printed).



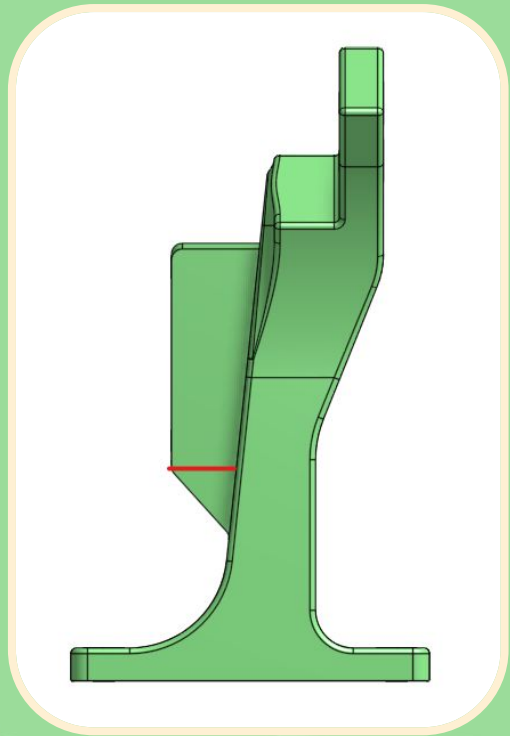
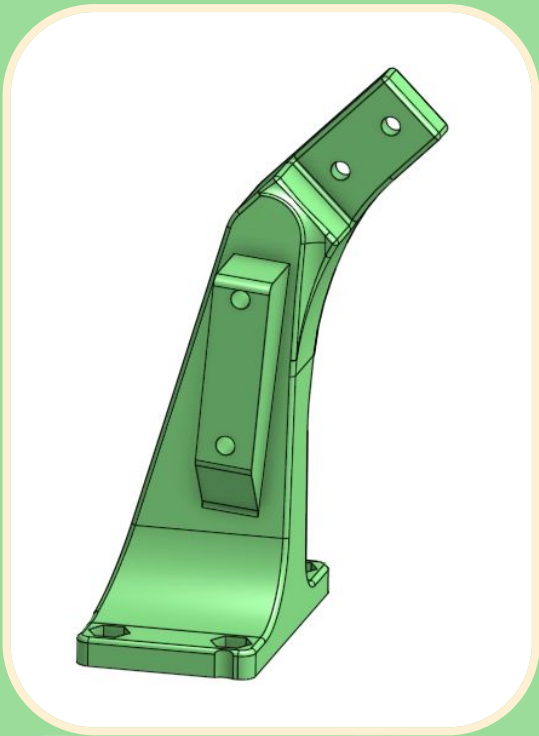
Case Study 1



Case Study 2



Case Study 3



Slicer Settings

Wall Count: minimum of 2 walls, 3-4 for strong parts

Infill: 5-90%, Cubic or Gyroid infill (don't use grid or 2D infills)

Speed: Printer dependent, (ex. don't run Ender printers above 80mm/s)

Temperature + Cooling: Research your filament brand and adjust

Software: Cura for beginners, PrusaSlicer for more advanced users.



Print Bed Adhesion

Print Not Sticking:

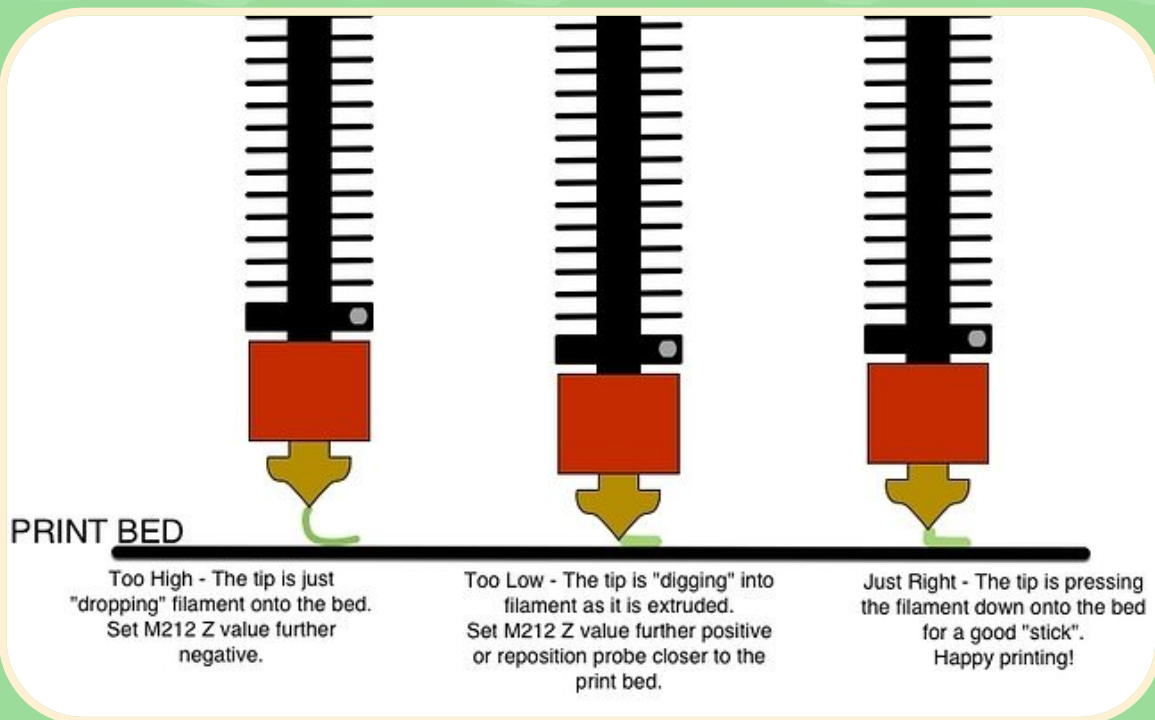
- Adjust height down
- Wipe bed with Rubbing Alcohol or Windex
- Light layer of Gluestick
- Spray bottle with half PVA glue/water
- Hair spray
- **LEVEL YOUR BED!!!**

Print Sticking too Much:

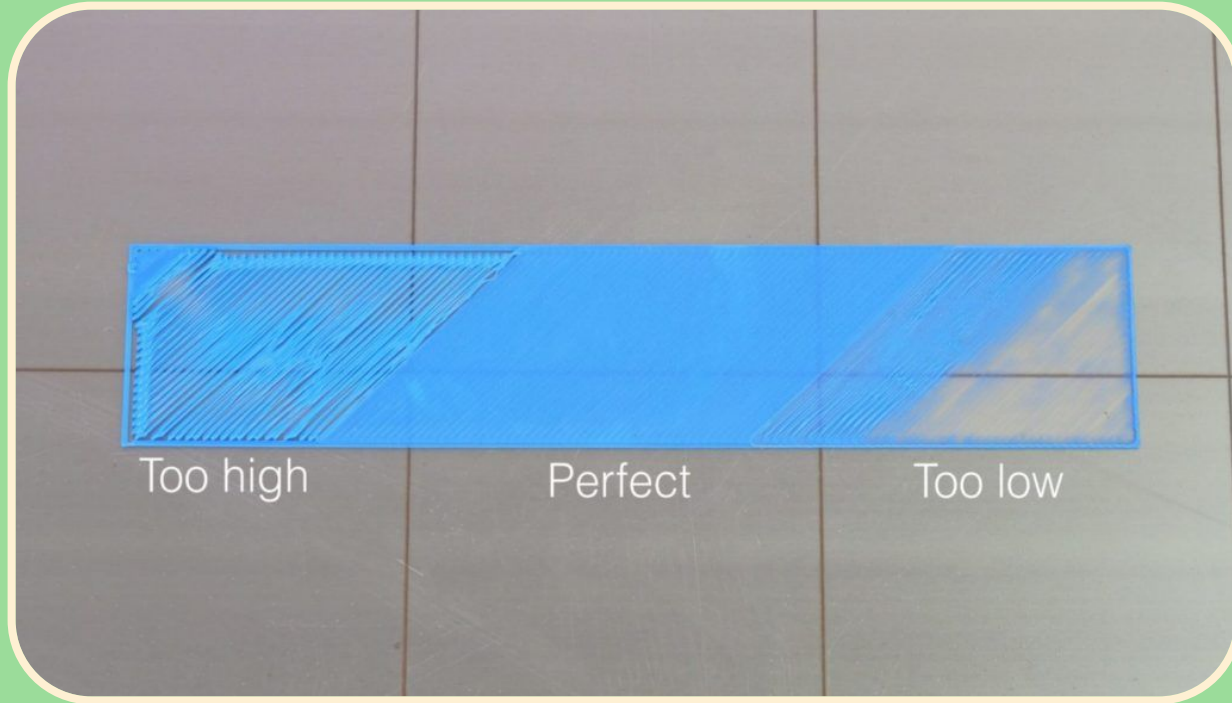
- Adjust height up
- Light spray of water around the edges to take prints off
- Bed scraper and tap lightly with a mallet
- Wait for the bed to cool
- Put the bed in a fridge or freezer



Bed Leveling



Bed Leveling



Printing Resources

[FTC Docs](#) - Official FIRST Documentation (We donated CoreFTC info here!)

[All3DP](#) - Good filament data and printer reviews

[CNC Kitchen](#) - Great scientific videos on filaments and print settings

[FTC Discord](#) - #Manufacturing channel is Lucas's home :)

[COREFTC](#) - Cool new stuff coming soon ;)



Contacts and Help

We are all from 16461, a team based in Southeast Charlotte, and are occasionally able to help in-person in the Charlotte Metro area.

We can be contacted with our emails at **lucas@mcr.club** **juliet@mcr.club** and **avi@mcr.club**, please CC a coach on your communications. We can be contacted on discord **@stimcanisters** **@dog_of_doom** and **@glasshouses**, preferably being pinged on the NCFTC/16461 discords.

Teams can join our discord and gain access to a help channel at <https://discord.gg/nEFb7X5BUR>

We recommend teams join the NCFTC discord for help from other state teams at <https://discord.gg/cEhWHYBmvU>

We also recommend teams join the global FTC discord, partially moderated by our team, at <https://discord.gg/first-tech-challenge>

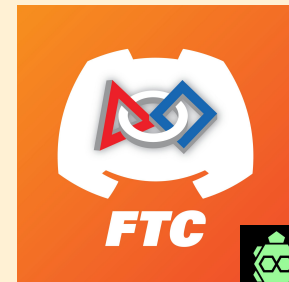
This presentation and all other 16461 kickoff presentations can be found on 16461's website at <https://16461.mcr.club>



<https://discord.gg/cEhWHYBmvU>



<https://16461.mcr.club>
<https://discord.gg/nEFb7X5BUR>



<https://discord.gg/first-tech-challenge>