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Intro to CAD Modeling for 3D Printing

http://makerden.io

December 5th, 2015

Brayden DeVito

About Makerden

We’re an Educational Makerspace where we combine the necessary tools, equipment, and instruction for hands-on learning through building things.

Members of our group vary both widely and wildly in terms of skill level and age range (10 to 68).

About Makerden

Events organized at our Educational Makerspace:

[DIY] These events include show-and-tells by our members followed by a work-on-your-project(s) and ask-for-help sessions.

[Workshop] An instructor leads a hands-on workshop for learning or polishing a practical skill useful for Makers (including schematic-drawing, PCB design, 3D-Printing, soldering).

[Class] An instructor leads a formal lecture featuring instructor-led activities that allow participants to learn, develop, or refine a technical skill.

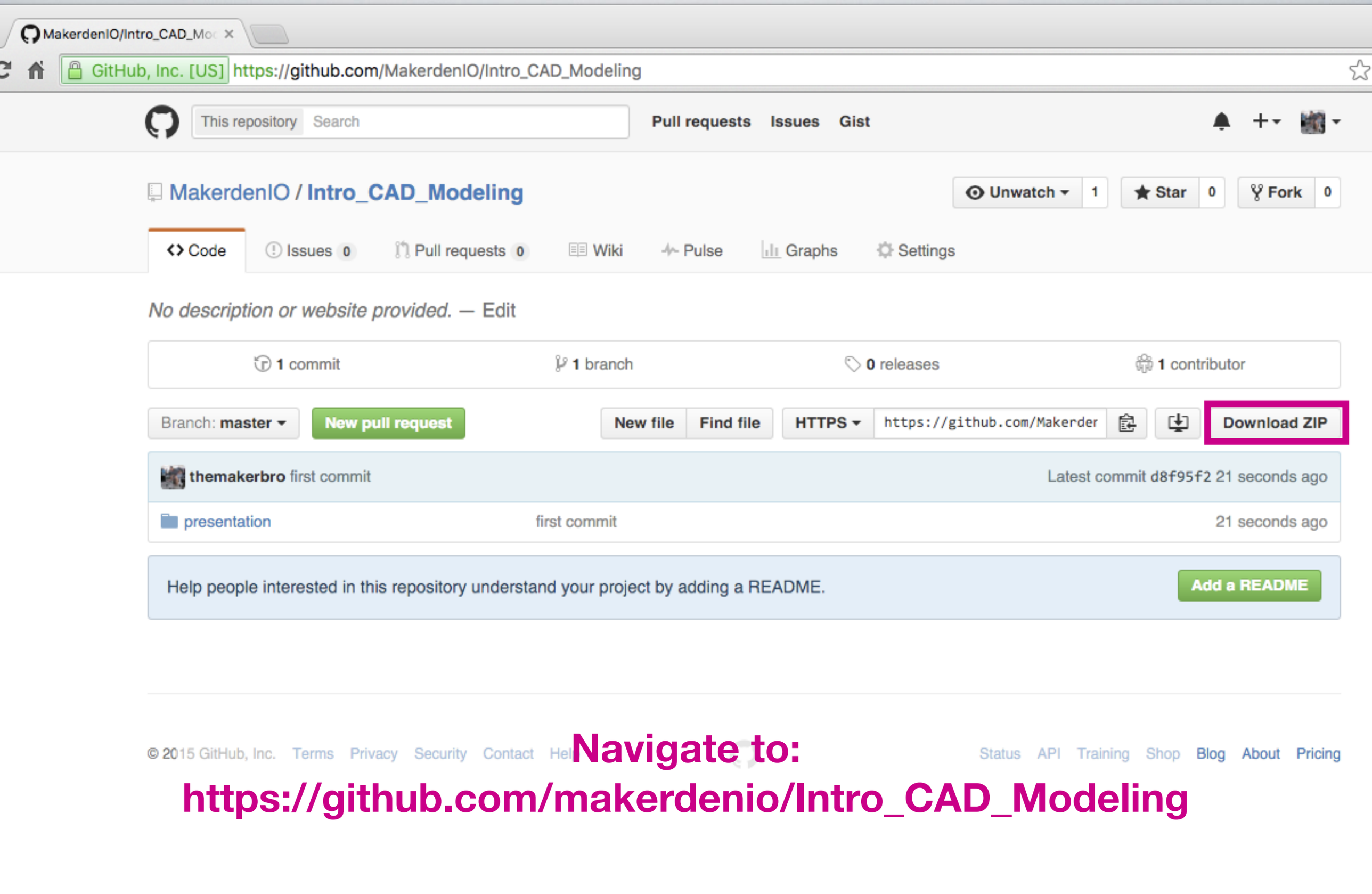
About ACROBOTIC

Makerden's Educational Electronics partner

Small, bootstrapped Open-Source electronics startup dedicated to the design of hardware and software products for use in education, DIY, hobby, arts, science, and more!

- Online store: **https://acrobotic.com**
- Develops online tutorials: **http://learn.acrobotic.com**
- Supplies all the electronic components for this class!
- Helps Makerden members take their ideas from concept to implementation

Downloading this presentation



Intro

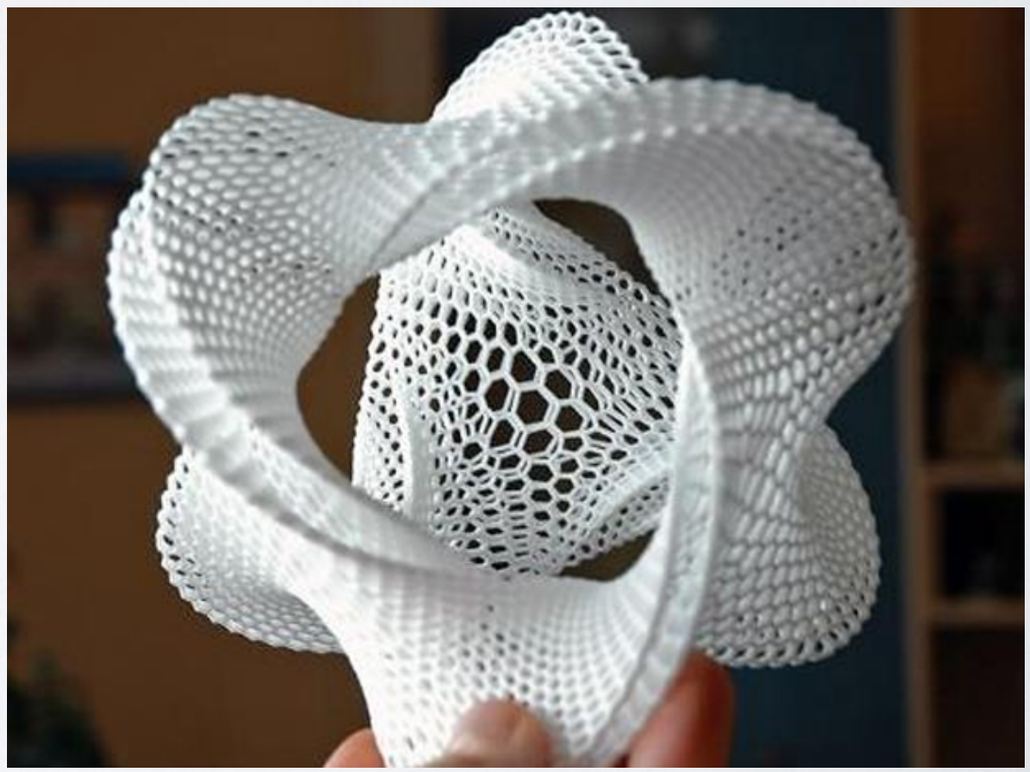
History and Applications of 3D printing

Types of 3D printing technologies

Materials used for 3D printing

What is 3D Printing?

- A process of joining materials to make objects from 3D model data.
- AKA additive manufacturing (opposed to subtractive processes).
- Involves layering material(s) on top of each other under computer control.
- 3D-printed objects can be (almost) any shape or geometry!

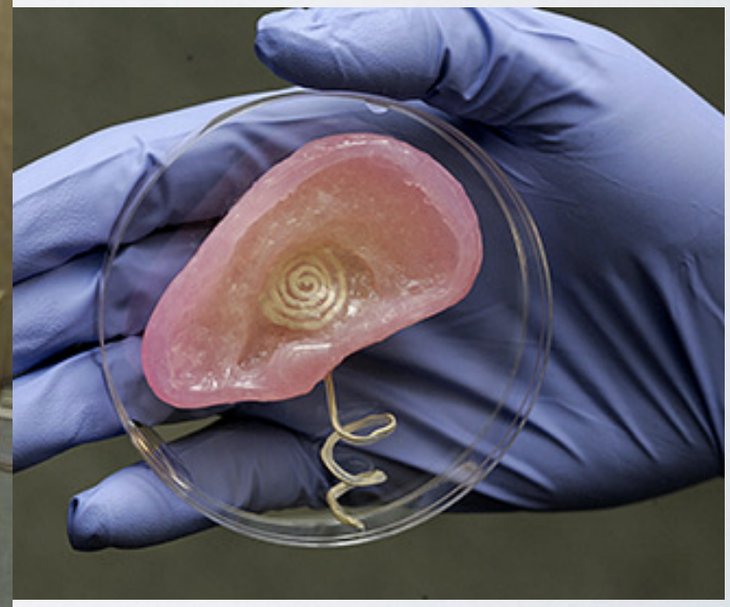


History and applications of 3D Printing

- Originated in the 80s but didn't pick-up steam until ~2010 (affordability).

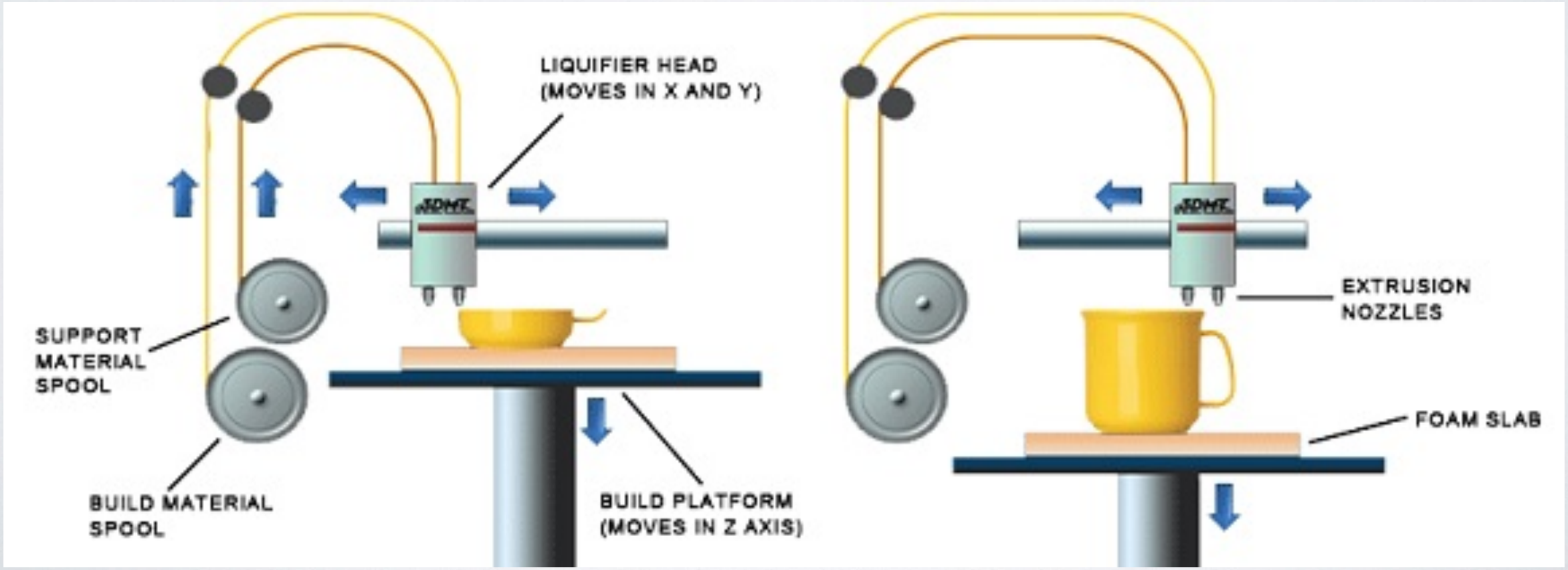
- Conceived as fast cost-effective method for creating (industrial) prototypes. Termed Rapid Prototyping.

- Typical applications (today) involve:
  Concept Modeling, Physical Testing, End Use (e.g., artwork, **diy**, hobby)



Common 3D Printing Technologies

- Most common 3DP technologies are: Laser Sintering, Stereolithography, and **Fused Deposition Modeling (FDM).**
- FDM machines build objects layer by layer from the very bottom up by heating and extruding thermoplastic filament until the desired 3D model is complete.



What materials can you 3D print?

- PLA (Polylactic Acid) – environmentally friendly, safe to use (biodegradable, derived from renewable resources).
- ABS (Acrylonitrile Butadiene Styrene) – Strong, and widely used for things like car bumpers, and legos!
- Nylon, PVA (Polyvinyl Alcohol Plastic), other plastics with lifelike textures.

PLA (today)

3D printer operation

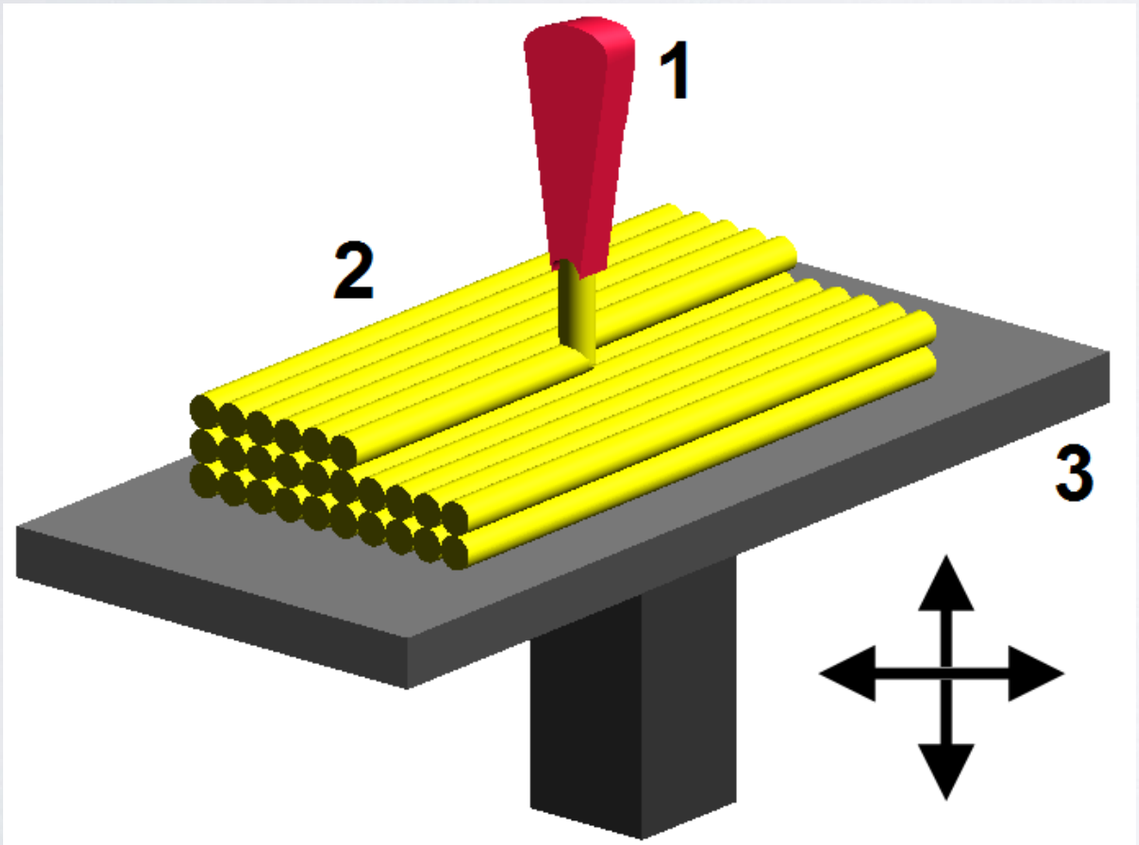
How a 3D printer works

Software alternatives for 3D printing

Common parameters of a 3D printing job

How a 3D printer works

FDM works on an "additive" principle by laying down material in layers; a plastic filament is unwound from a coil and supplies material to a 3D printer nozzle, that melts and ejects the molten plastic to produce a part.



1 – nozzle ejecting molten material

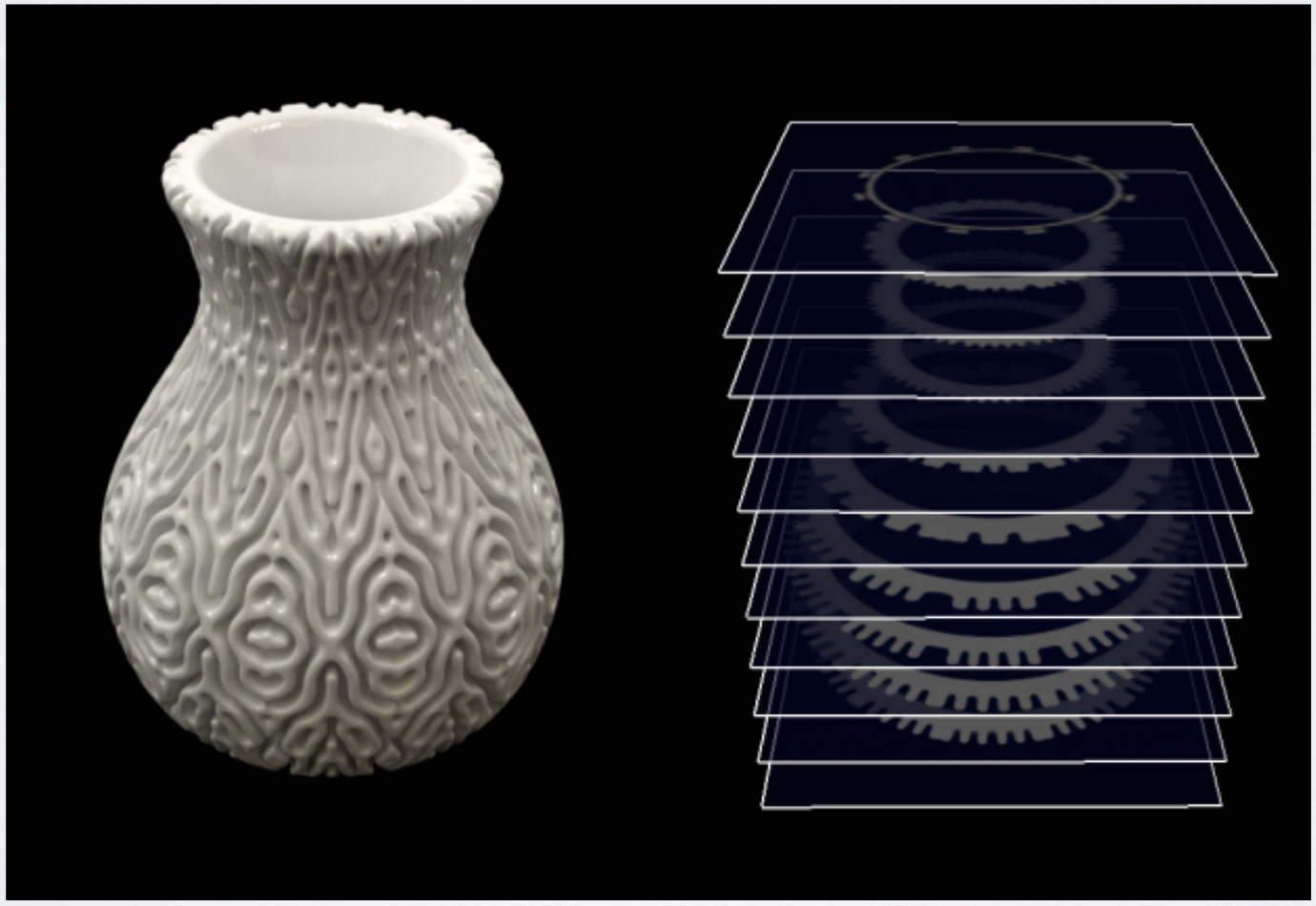
2 – deposited material (modeled part)

3 – controlled movable table

Software alternatives for 3D Printing

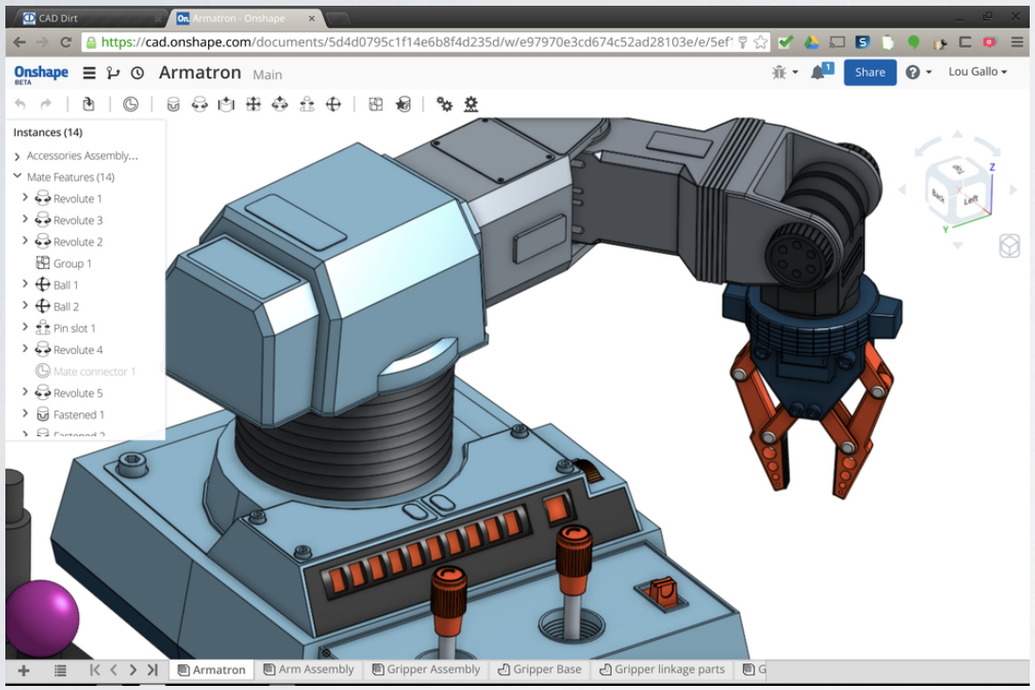
In order to produce a 3D printed object, you must first use a 3D modeling program, or sculpting program to generate your physical model.

After your model is generated, you must use a slicing program to prepare each layer so the 3D printer can recognize how to prepare each layer of plastic.

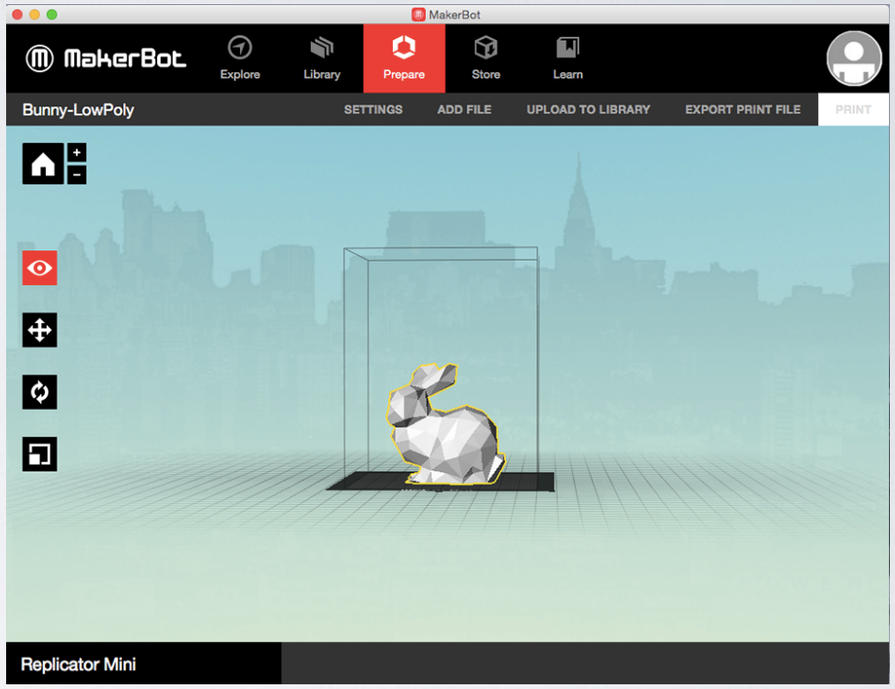


Software for 3D Printing

1 – CAD Modeling Software



3 – Complete Software (just prints!)



2 – Slicing Software (generates ‘G-Code’ file)

Parameters of a 3D Printing ‘Job’

Common parameters that should be taken under consideration:

- Extrusion Temperature – How hot the extruder is heating the plastic to (ABS vs. PLA).
- Printing Speed – Feeds and Speeds.
- Quality of the Filament – As with anything, quality matters.
- Design and Part Orientation – Make sure the part can fit onto your stage.
- Layer Thickness – Also depends on the diameter of your filament!

CAD modeling

Software alternatives (free and non-free)

Hands-on modeling of a real-world object using Onshape

Slicing software options to create 3D printable objects

Software alternatives for CAD modeling

CAD modeling can be a daunting task. Luckily, a variety of software programs (free and paid) are available:

Sketchup – Free software for simple to intermediate 3D models. Also comes with a great community following for sharing models.

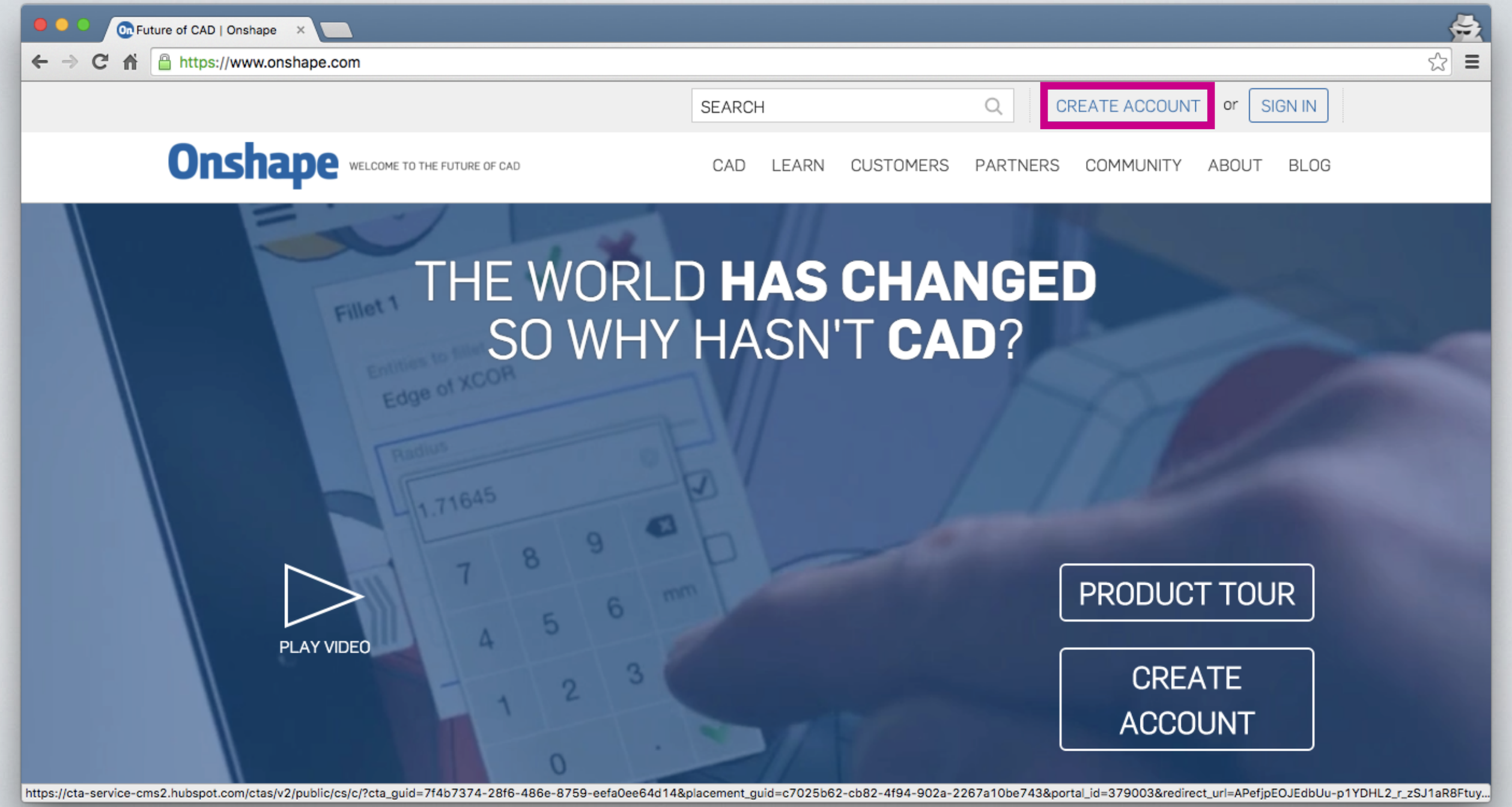
Solidworks / Inventor – Intermediate to Expert level engineering quality modeling software.

Blender – An open source 3D modeling / Sculpting software package. This is great for creating more freeform artwork.

Onshape – A new 3D modeling software that runs directly in your browser (no installation needed)!

Create an Onshape account

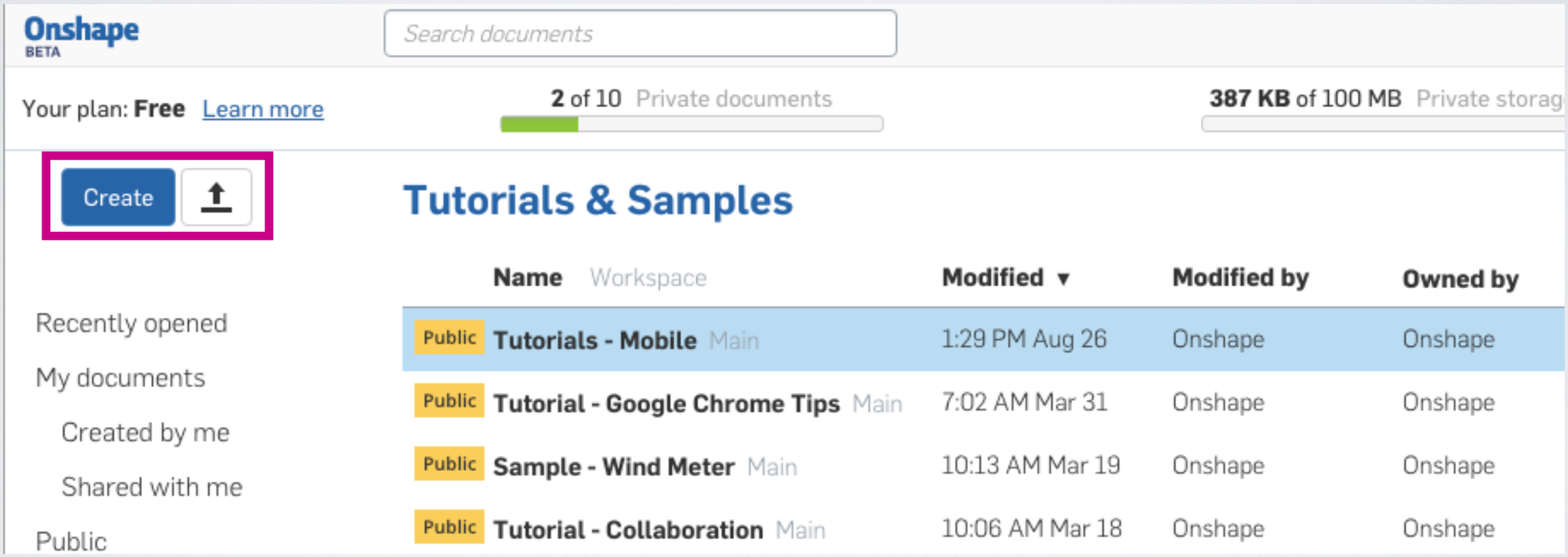
Let’s get started!



Hands on with Onshape

After getting your hands on your very own Onshape account, you're ready to get started with your first 3D Model!

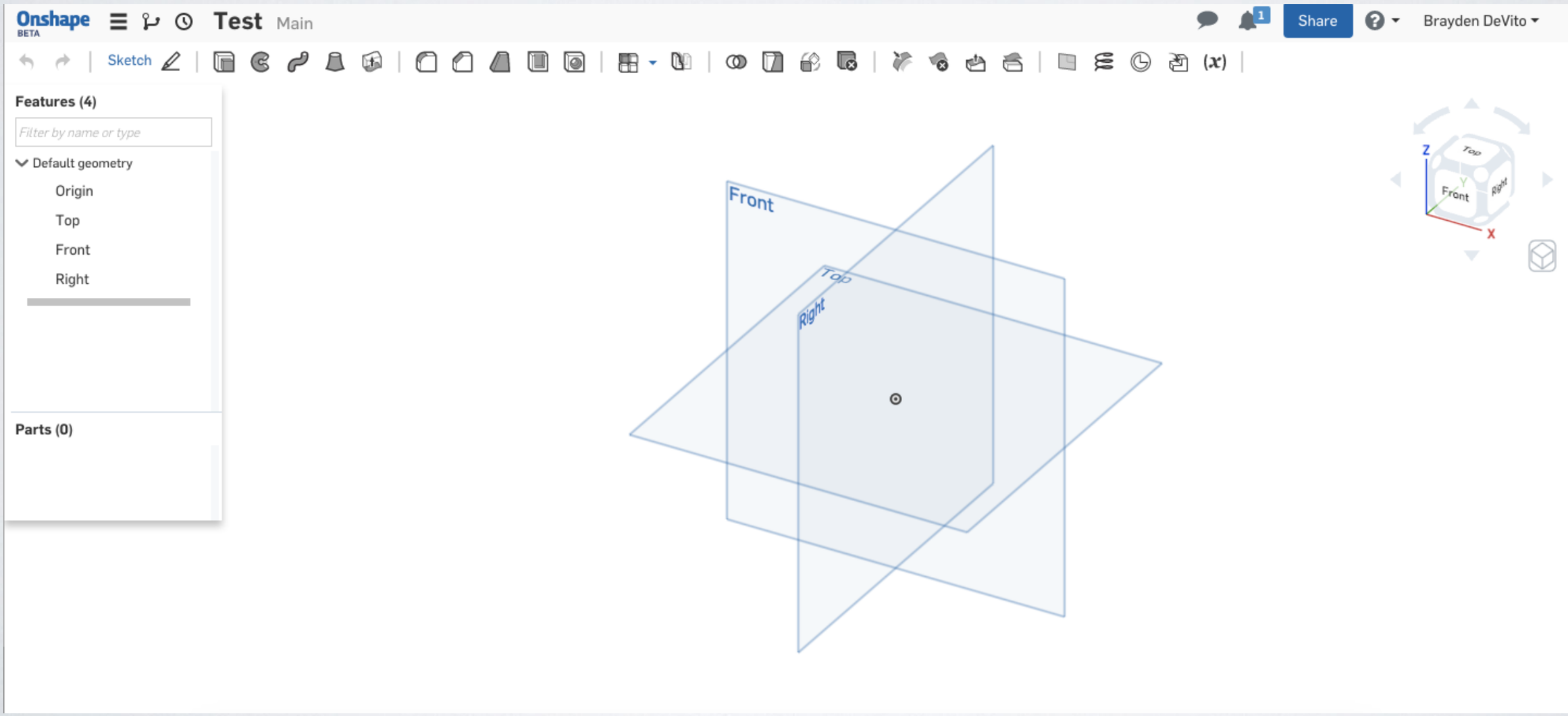
First, click 'Create'



Choose a name for your document to continue.

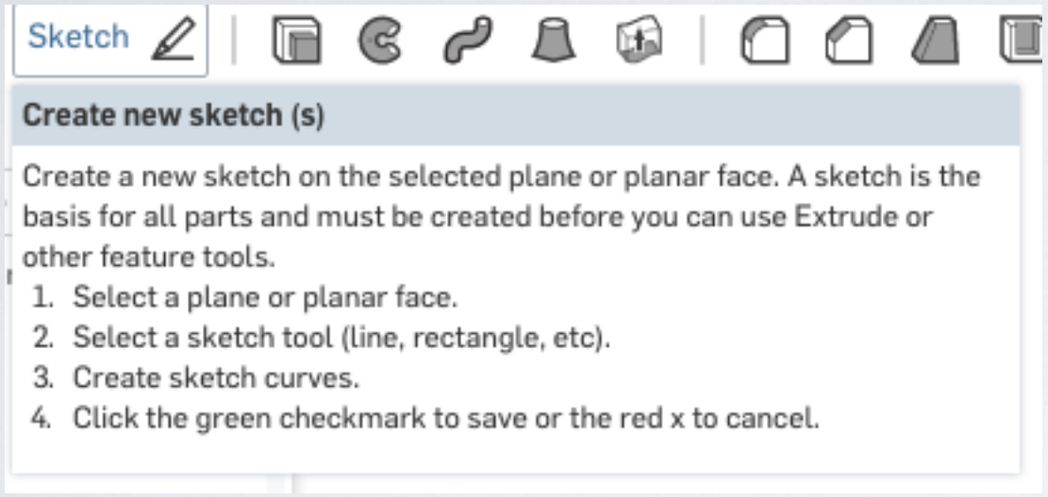
Hands on with Onshape

You will see this next, this will be your main working field for your 3D model!
The 3 planes you see represent a viewpoint you will begin your sketch on.



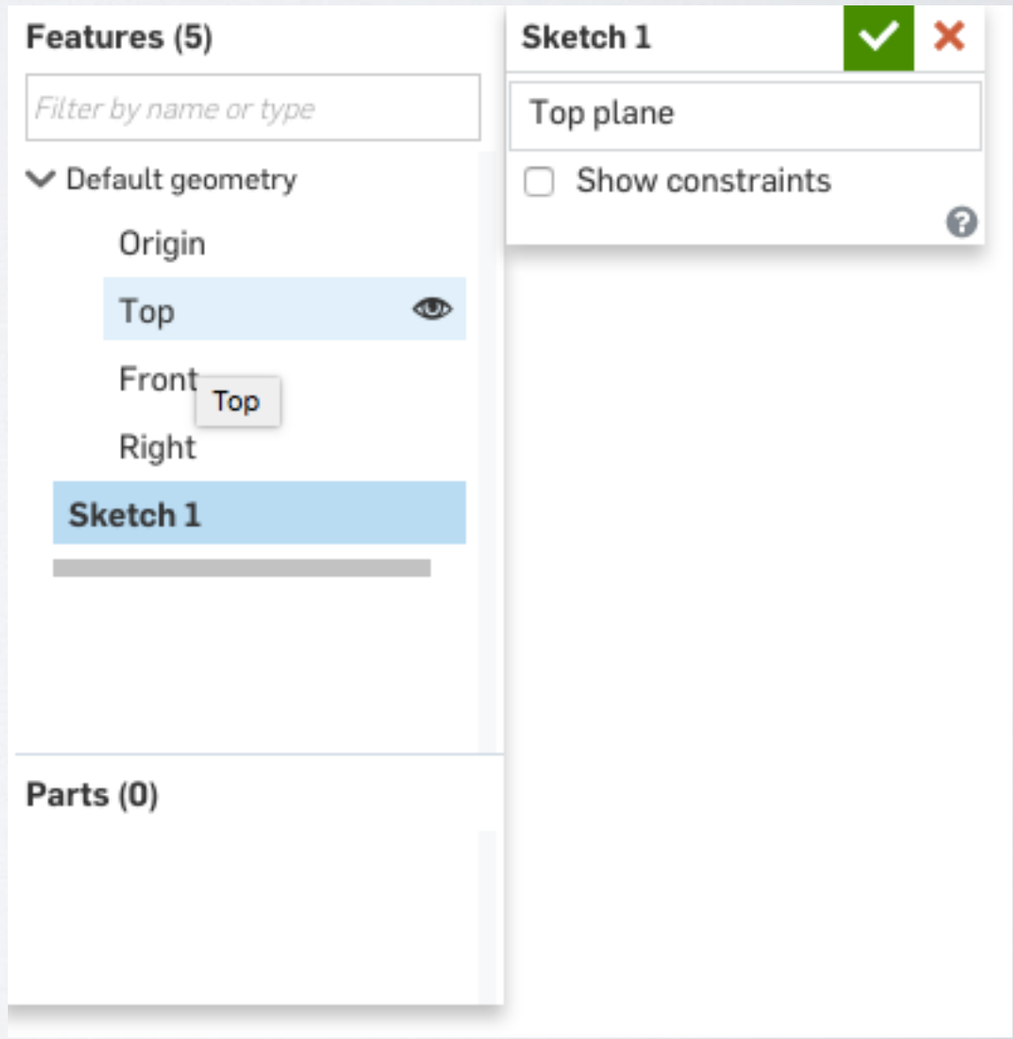
Hands on with Onshape

First click ‘Sketch’ to create a new sketch.



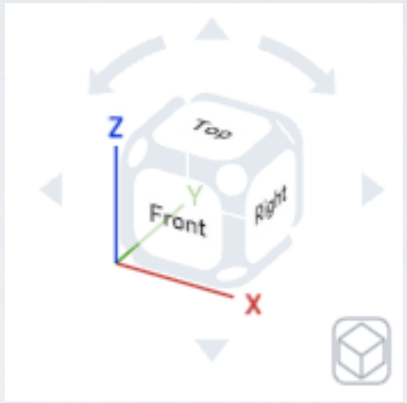
You will be prompted to choose a plane.

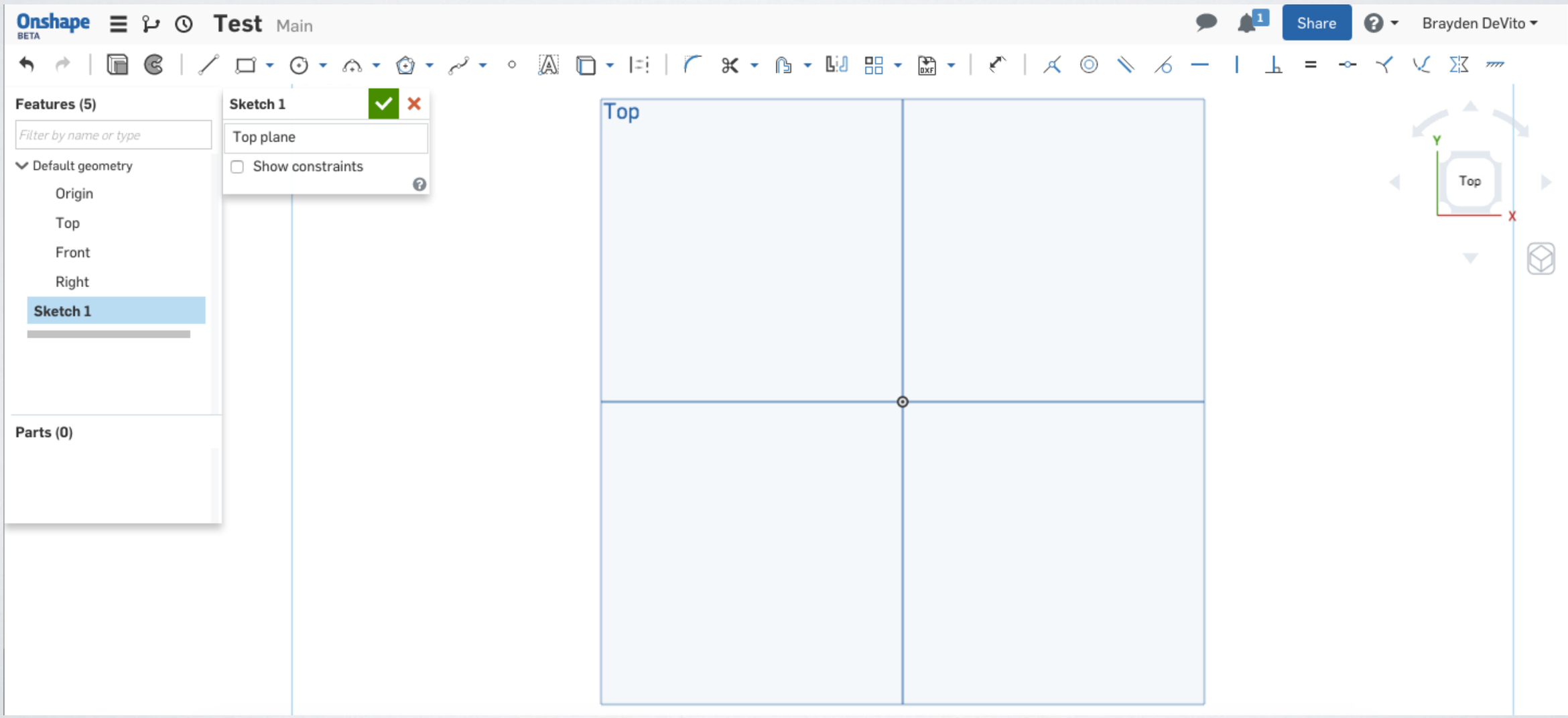
Choose the top plane for now, as we will be modeling from the top of the model.



Hands on with Onshape

Once you click the top plane, move the viewpoint to where we are looking at the canvas from the top view.





Hands on with Onshape

You are ready to begin sketching!

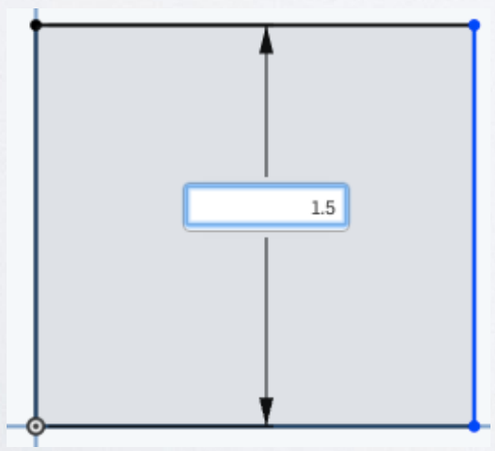
First, click the rectangle line tool: 

Next, click on the center of the top plane to begin sketching a rectangle.

Move the cursor to create a square, and click to complete.

Next, click the dimension tool 

We want to make a 1.5 inch square, so click one side and you will see a box to manually enter your dimension. Repeat this so you have a perfect 1.5 inch square.



Hands on with Onshape

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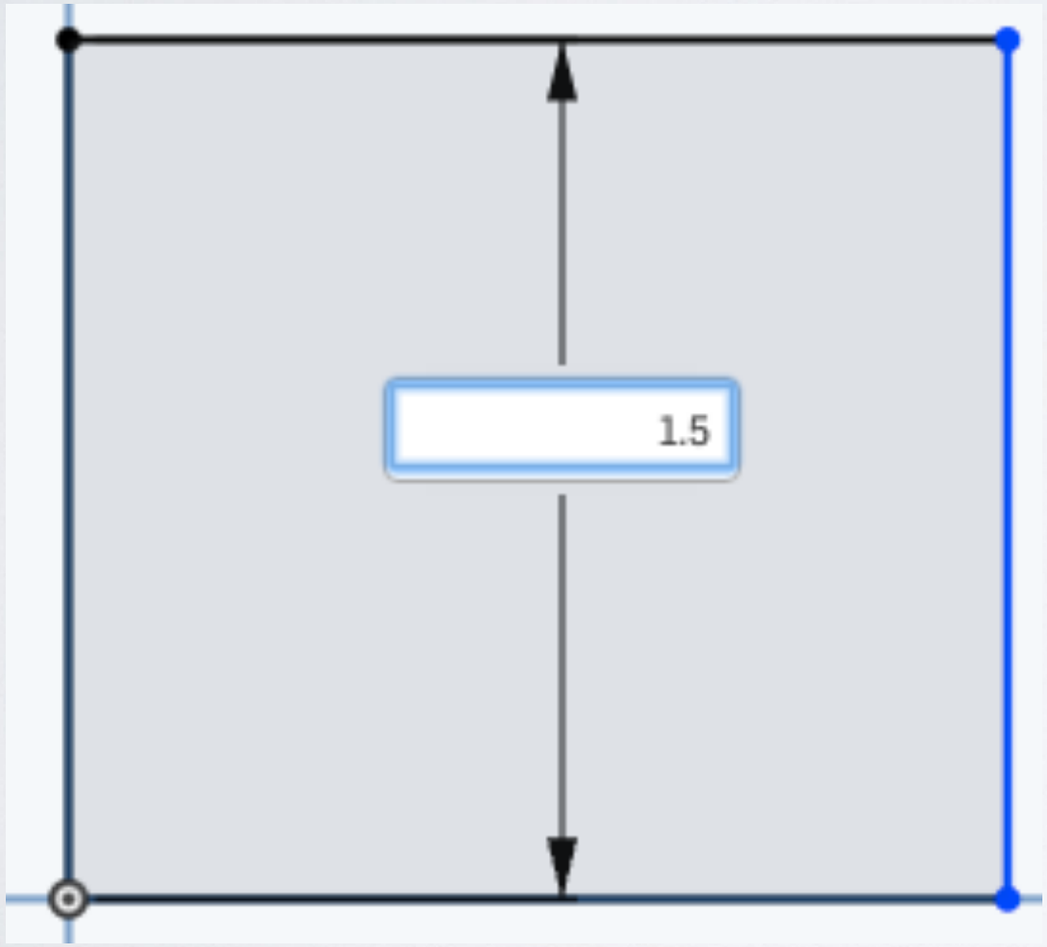
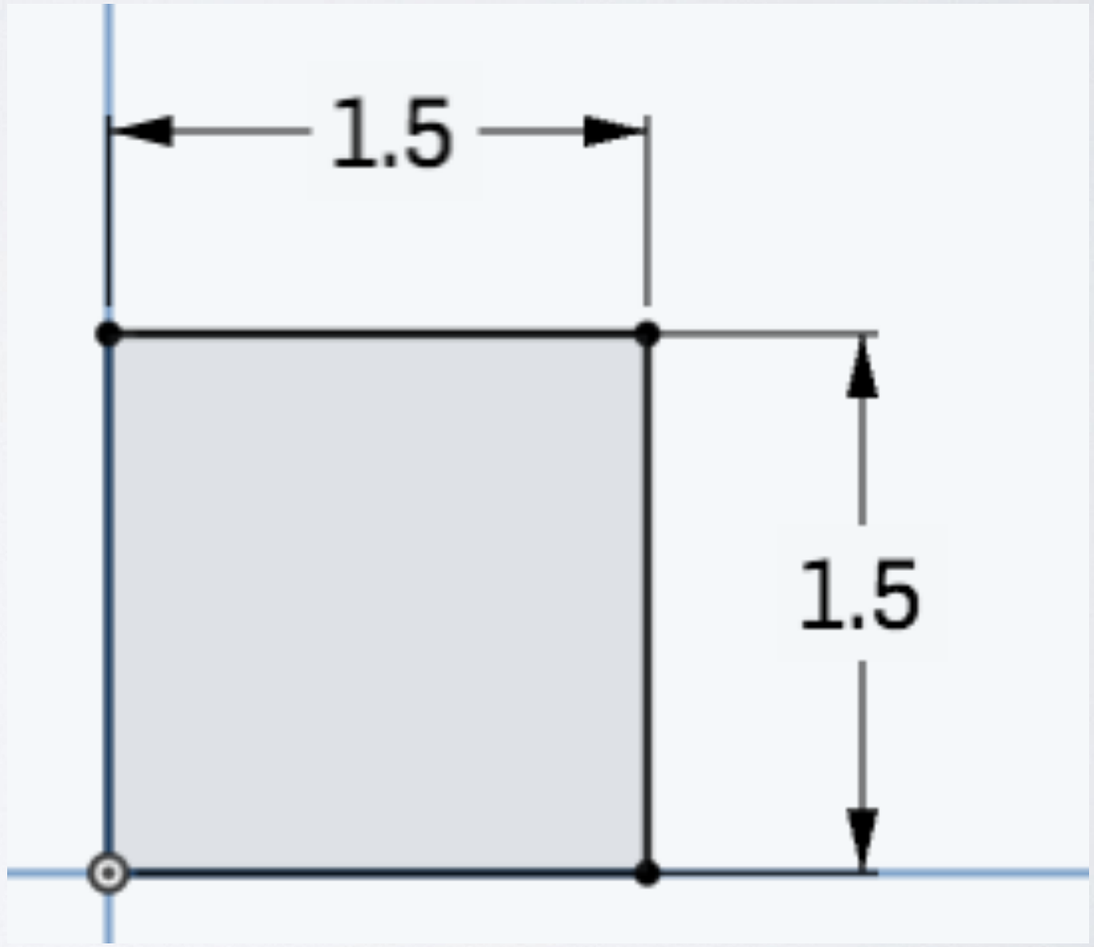
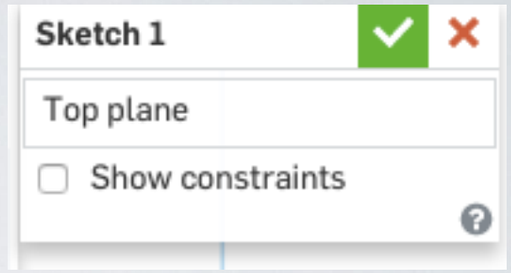




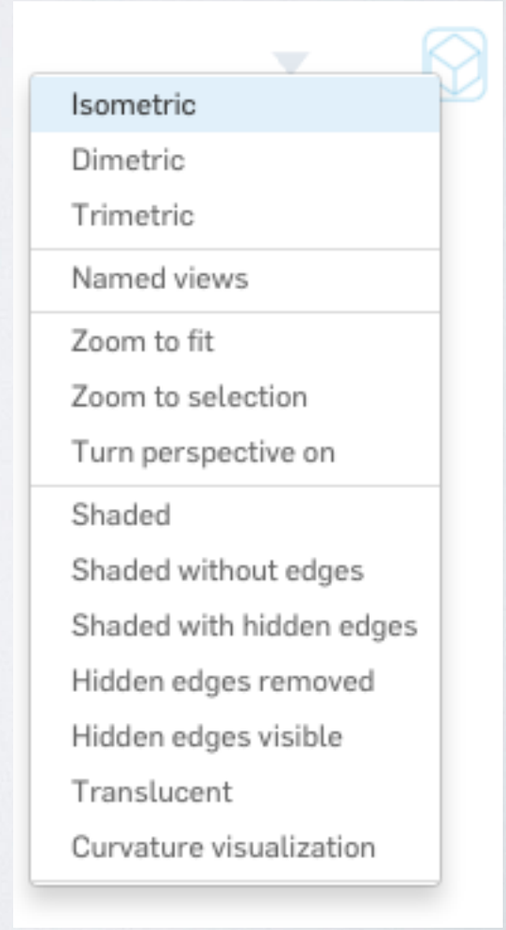
Hands on with Onshape

After you have your perfect square sketch, we want to take this 2D sketch into the 3D world.

Click the check mark, signifying you are ending sketch mode.



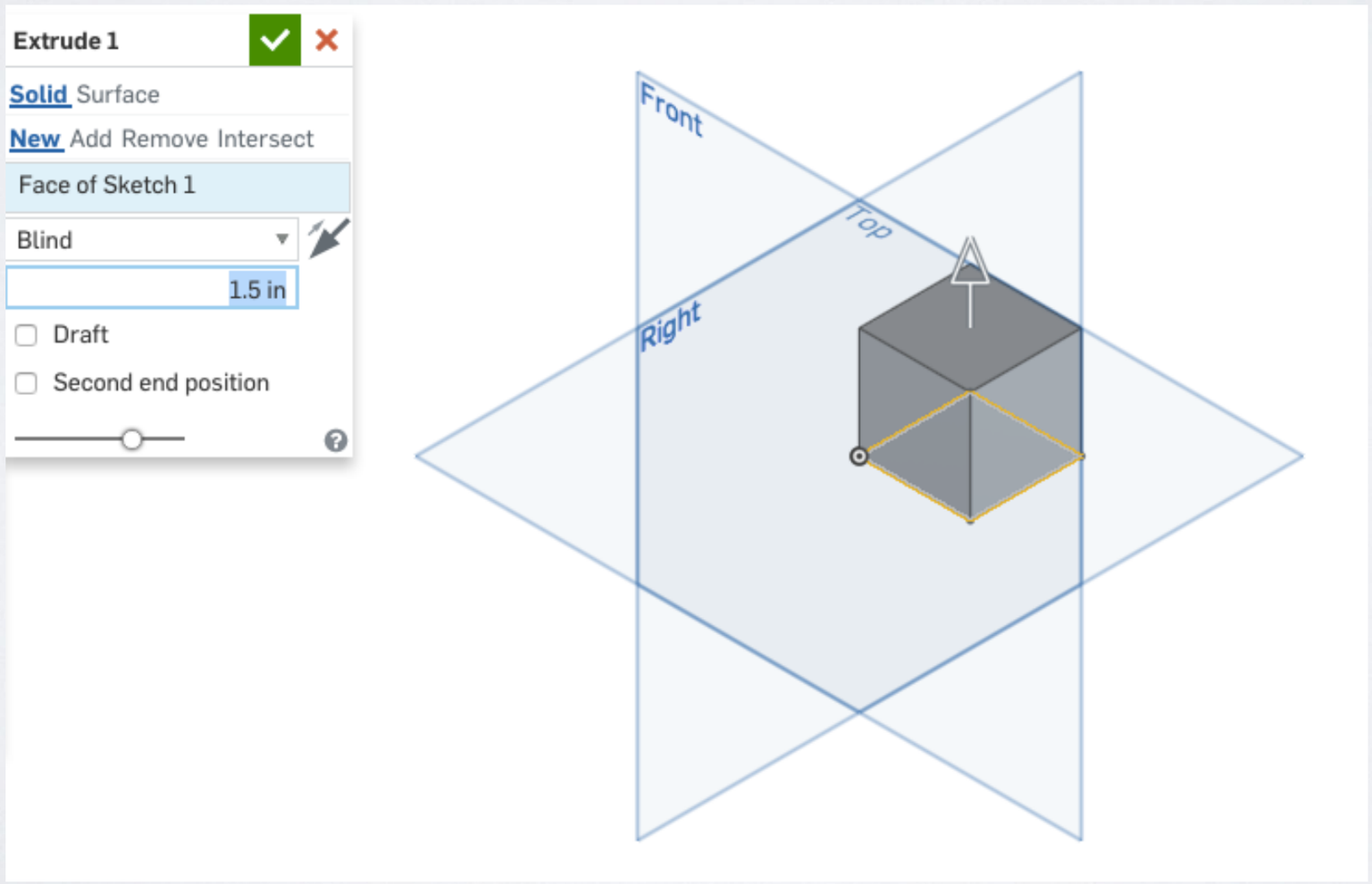
To see whats happening, go into Isometric view by clicking the cube next to the viewpoint.



Hands on with Onshape

Next, click to extrude tool. 

Click on your square, and enter 1.5 into the blind setting, meaning you are telling the sketch to extrude 1.5 inches blindly into a direction.



Hands on with Onshape

Press the complete extrude (check mark)

Congratulations, you just created your first 3D model!

<u>Some important keyboard / mouse shortcuts to navigate your model:</u>

Hold down the right mouse button to orbit around your part.

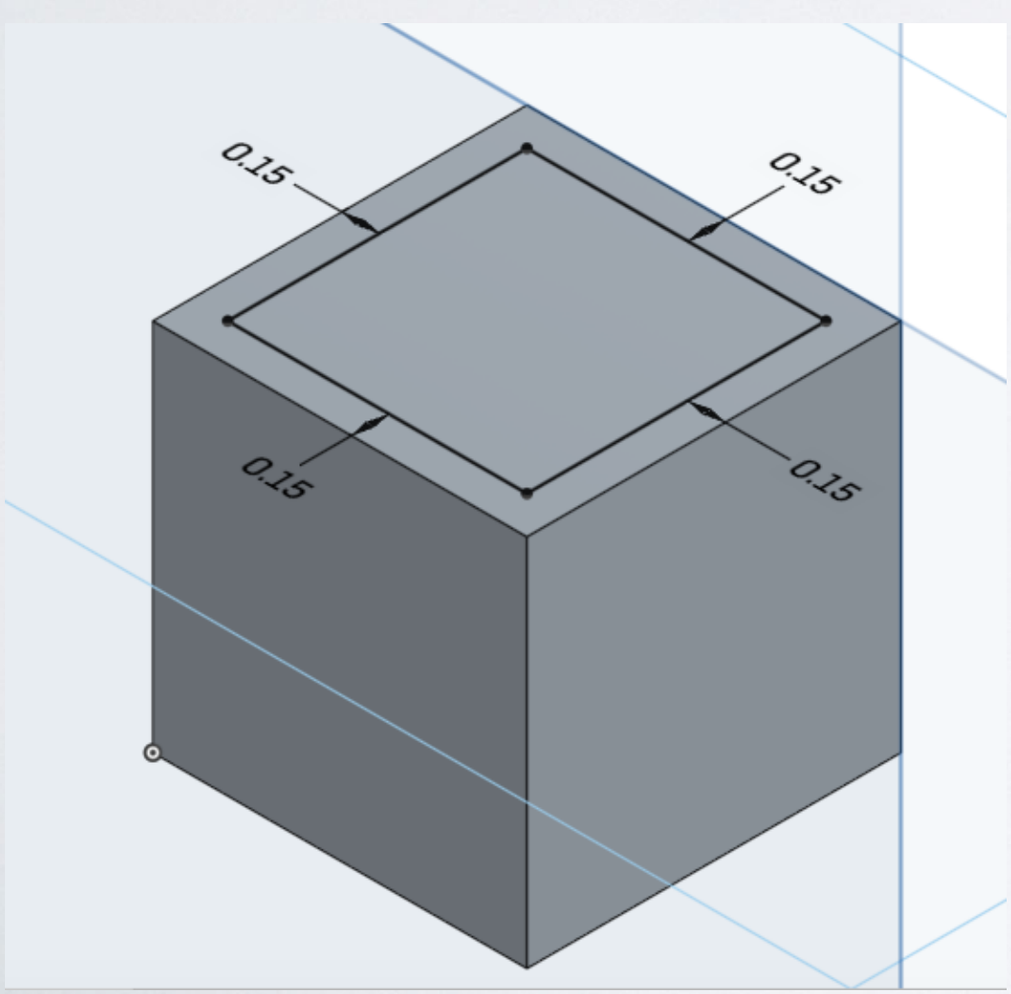
While holding control, you can use the same right mouse button to pan around the part.

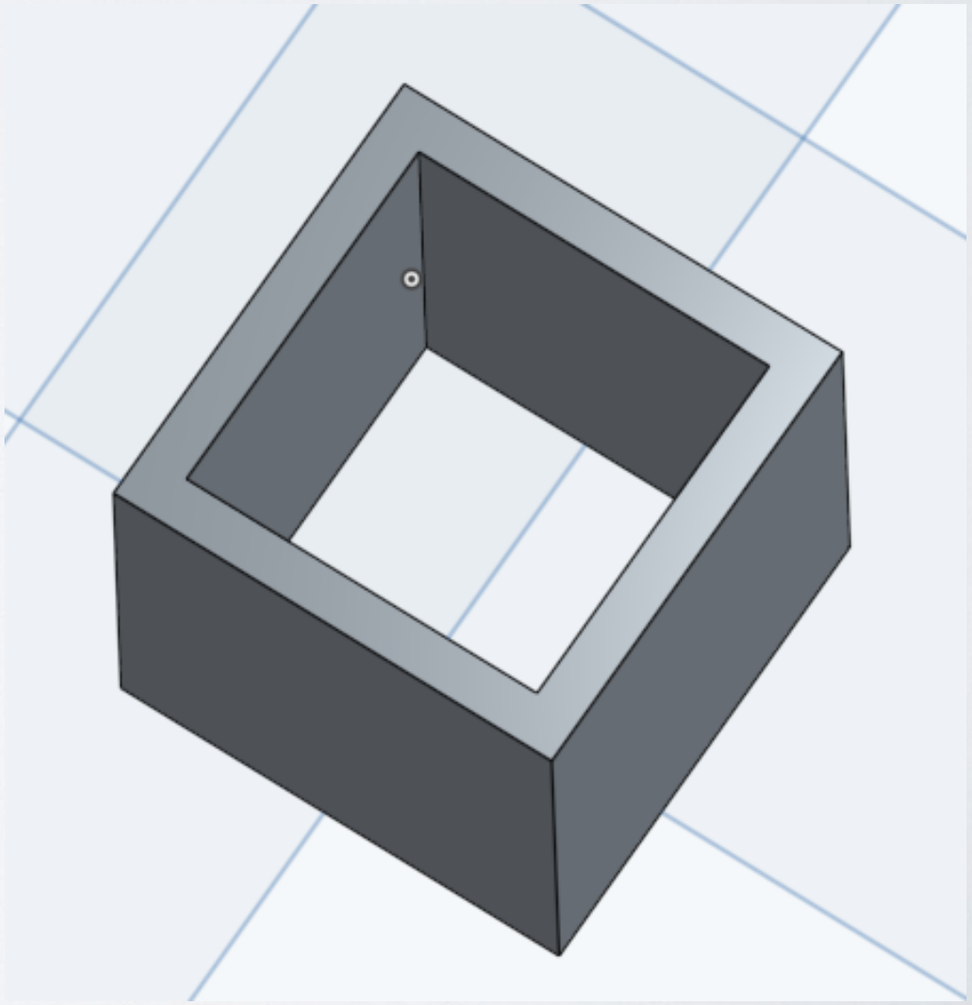
If you get lost, go back to Isometric view!

Hands on with Onshape

From here, you will be able to create new sketches on surfaces of the box you created, and then extrude / cut into those surfaces to create your desired model!

For example, creating a border inside of the current box sketch and extruding will allow you to cut into the part, making a tube!

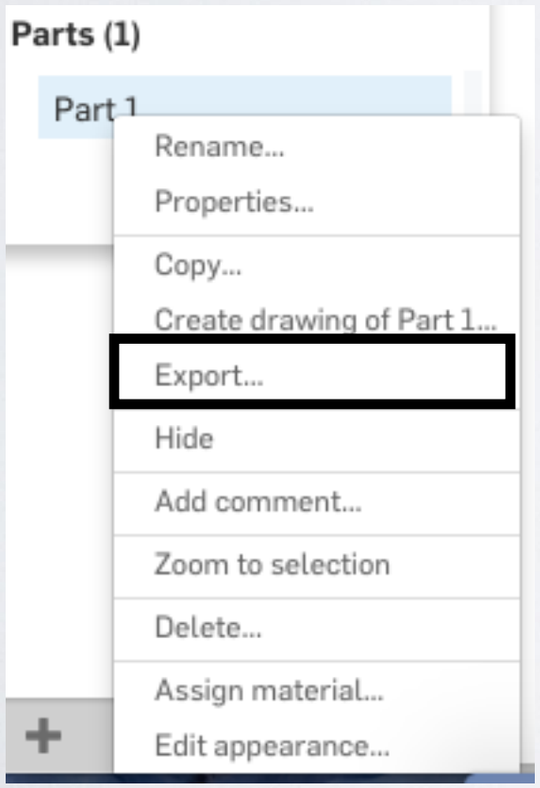


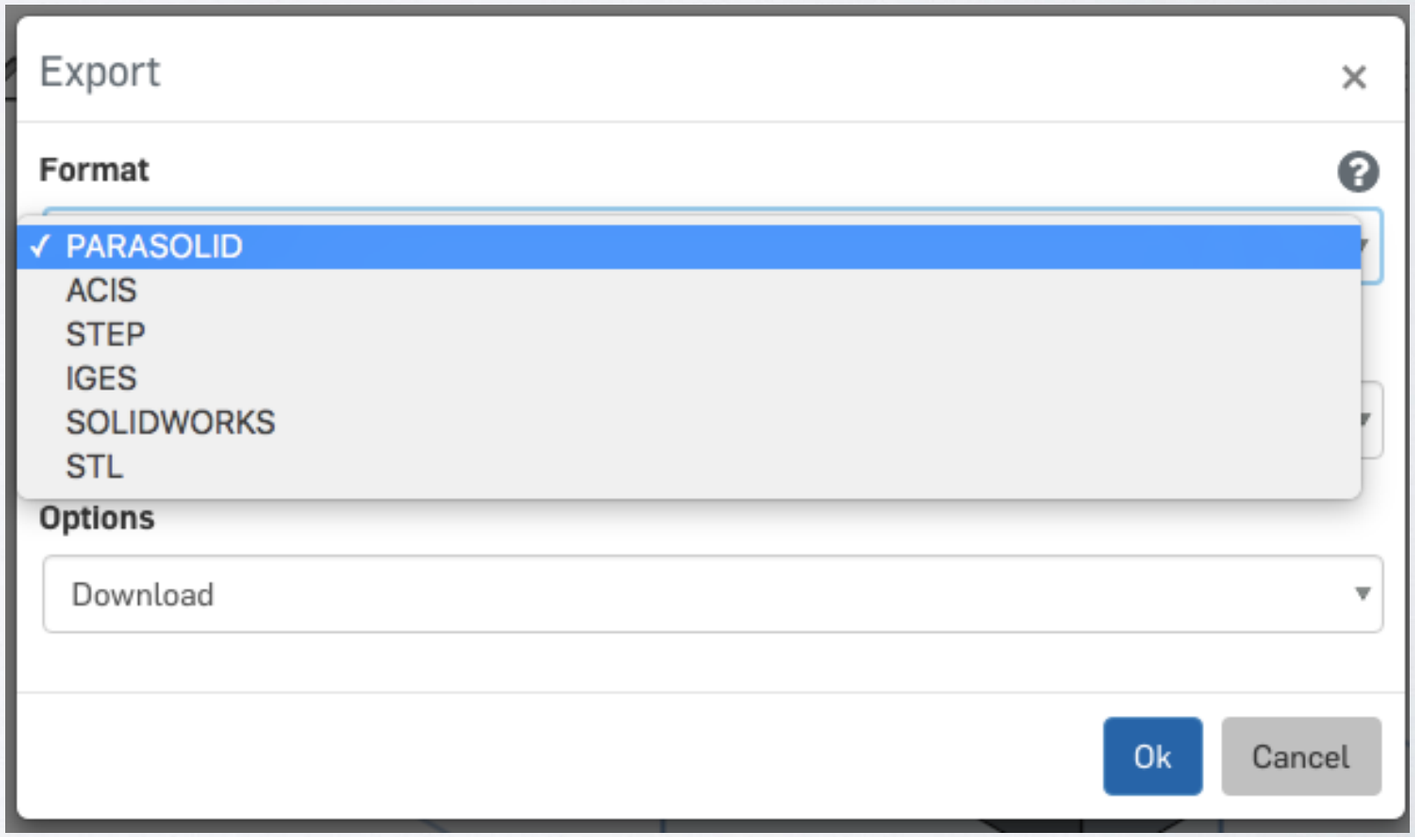


Hands on with Onshape

3D modeling takes extensive practice and patience. Once you are finished with your 3D model, you are going to need to export the file into a known format for the next step in 3D printing - Slicing!

Under the parts tab on the left hand side, right click ‘Part 1’ and go to export.





Hands on with Onshape

3D modeling takes extensive practice and patience. Once you are finished with your 3D model, you are going to need to export the file into an STL format for the next step in 3D printing - Slicing!

Getting started with Slicing.

For this example, I will be using the popular open source slicing software called Ultimaker-Cura.

Once your tool path is created, click save tool path 

you are now ready to print!