



IO2-A2: DUAL EDUCATIONAL PACK



3D2ACT

3D2ACT:

FOSTERING INDUSTRY 4.0 AND 3D TECHNOLOGIES
THROUGH SOCIAL ENTREPRENEURSHIP: AN INNOVATIVE
PROGRAMME FOR A SUSTAINABLE FUTURE

Author (s): **NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"**

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PROJECT INFORMATION

PROJECT ACRONYM:

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PROJECT TITLE:

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PROJECT NUMBER:

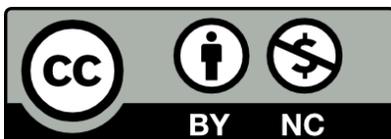
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WEBSITE:

<https://3d2act.eu/>

CONSORTIUM: PARTNER LIST

- NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS" (GREECE)
- EUROPEAN DIGITAL LEARNING NETWORK (Italy)
- POLITEKNIKA IKASTEGIA TXORIERRI S.COOP (Spain)
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- UNIVERSITY OF CRETE (Greece)



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LESSON PLAN 1.2.1

TEACHING MODULE 1.2.1	
Chapter 1.2	Designing and Acquiring 3D Models
Equipment (if needed)	PC with Internet connection Optional: Projector
Duration	1 Hour
Short Description	In this Worksheet students will learn about the different ways available for acquiring 3D Models
Learning Outcomes	How to search for specific 3D Models based on our needs
	What is 3D Scanning and the different methods of doing it
	What is Photogrammetry and how it works
	How to create a Free Account on Thingiverse
	Imagination, Problem Solving, Critical Thinking, Adaptability, Experimentation, Improvisation, Patience
Activities	
Activity 1	Presentation 1.2.1.1
Aim of the Activity	Familiarize students with the different ways for acquiring 3D Models
Duration	30 Minutes
Type of Activity	Presentation
Teaching Objectives	Create a Free account on an online repository, Navigate through the menus, What is 3D Scanning, What is Photogrammetry
Resources	Worksheet 1.2.1 / Presentation 1



Activity 2	Exercise 1.2.1.1
Duration	15 Minutes
Type of Activity	Worksheet
Teaching Objectives	Search for specific solutions to a given problem
Resources	Worksheet 1.2.2 / Exercise 1
Further Reading	
	https://3space.com/blog/advantages-disadvantages-of-3d-laser-scanning/ https://www.youtube.com/watch?v=tap6NbuGeeg&t=238s https://www.3d-scantech.com/what-is-photogrammetry-and-how-can-it-help-in-3d-scanning/ https://www.youtube.com/watch?v=IWG_Zdsqyro&t=14s

Activity Worksheet 1.2.1 (Teacher Version)

Level 1 (Novice Level: Basic Competences)

Chapter 1.2: Designing and Acquiring 3D Models

Activity Worksheet 1.2.1

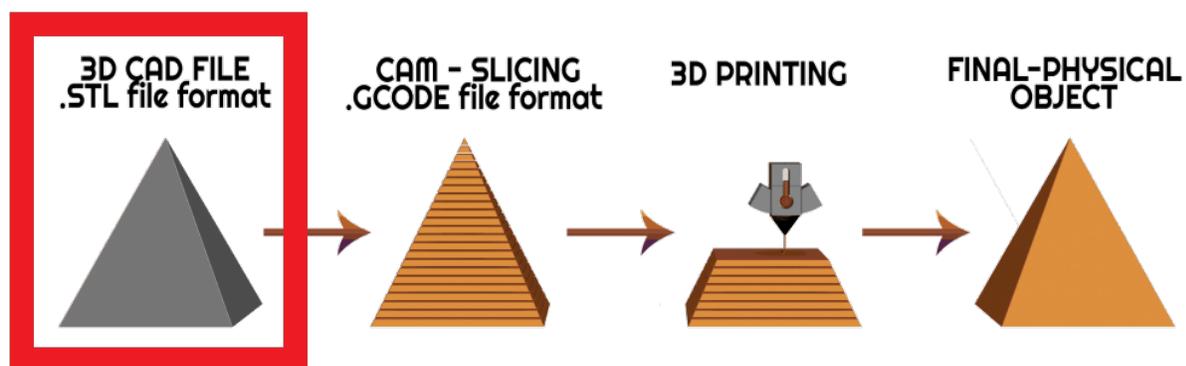
In this Activity worksheet we will learn all the different ways in which we can obtain .stl files. We will learn how to use free online repositories and the basic principles of 3D Scanning. More specifically, we are going to learn:

- How to create a Free Account on Thingiverse
- How to search for specific 3D Models based on our needs
- What is 3D Scanning and the different methods of doing it
- What is Photogrammetry and how it works

Presentation 1

Different Ways of Acquiring 3D Models

As we saw in the previous chapter the first thing we need to start the process of 3D printing is a 3D model. In this section we will look at different ways in which we can obtain one.



3D models are created using 3D modelling software, usually referred to as CAD (Computer-Aided Design) software. However, most 3D printing beginners don't have the skills required to use such software, but fortunately there are other solutions.



The main ways we can get 3D models suitable for printing are:

- To obtain ready-made 3D models which are available in various repositories
- To 3D Scan a real object
- To design a 3D model using a CAD Software

Of course, we can always use a combination of the above ways. For example, we can download a ready-made 3D model from a repository, which we can modify by importing it into a CAD software. In the following sections, we will see in more detail these different ways of obtaining 3D models.

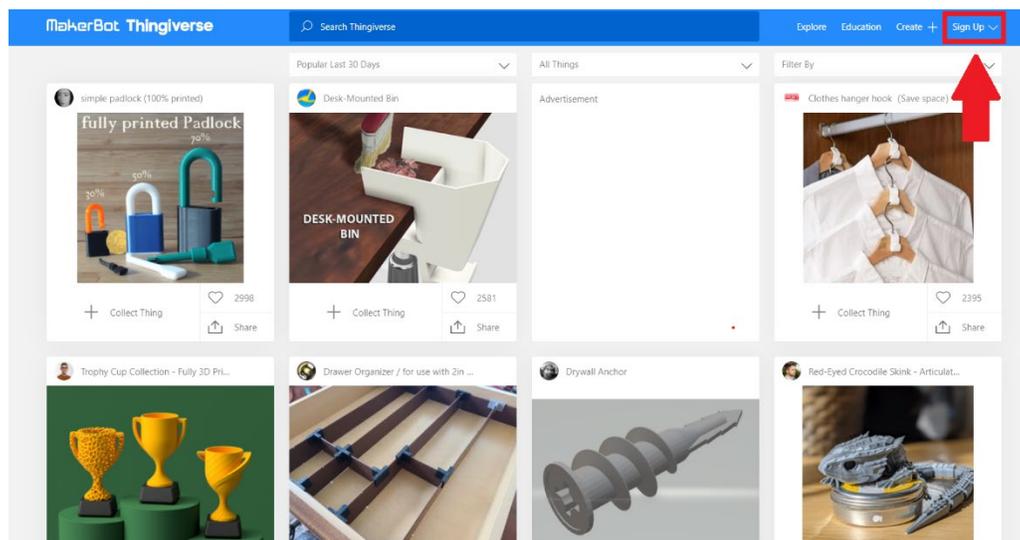
3D Models from (Free) Repositories

With so many people gaining access to 3D printers in recent years, several sites have emerged as repositories for 3D models. This way, anyone can get their hands on a model without any modelling skills.

Here are some of the most popular ones:

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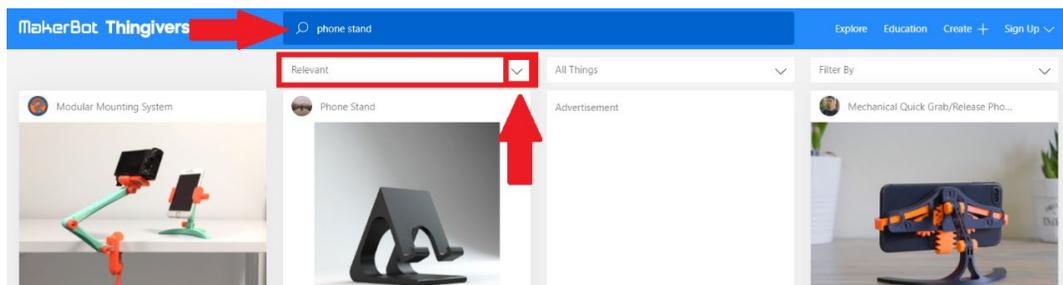
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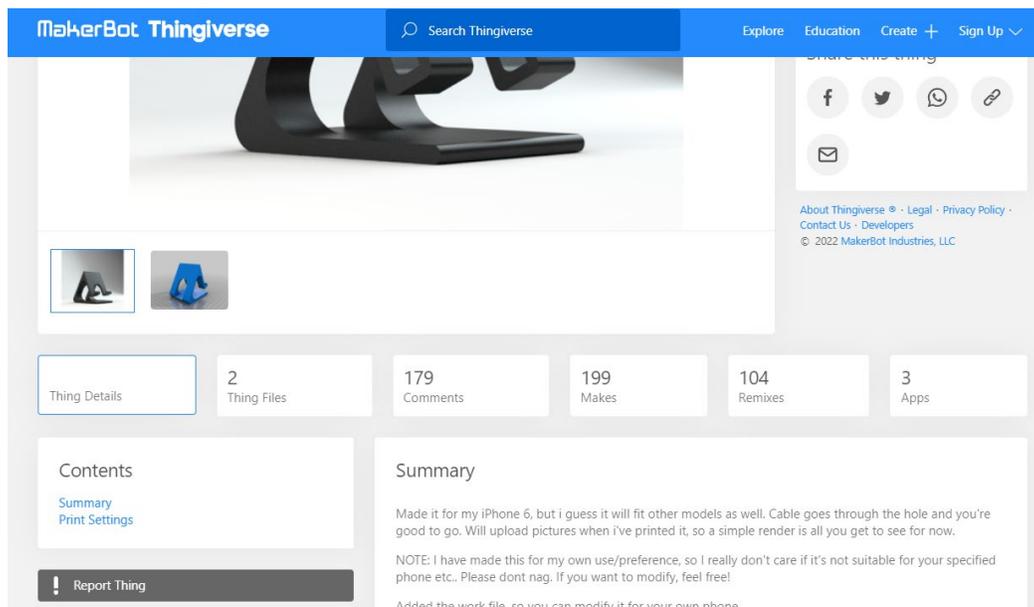


At the top right of the website, you can create a **free account**. This step is not necessary, as you can access all the models without having an account, but we recommend making one as it is very helpful. With one account you will be able to store and manage your favorite models, communicate with creators and other community members, but most importantly you will be able to **share your own models** with the community.

In the first page you can find the most popular 3D models of the last month. You can scroll down in order to discover as many ideas as you want but you can also search for something specific. Let's assume that you want to find a model of a **phone stand**. The only thing you need to do is to type it in the search area.



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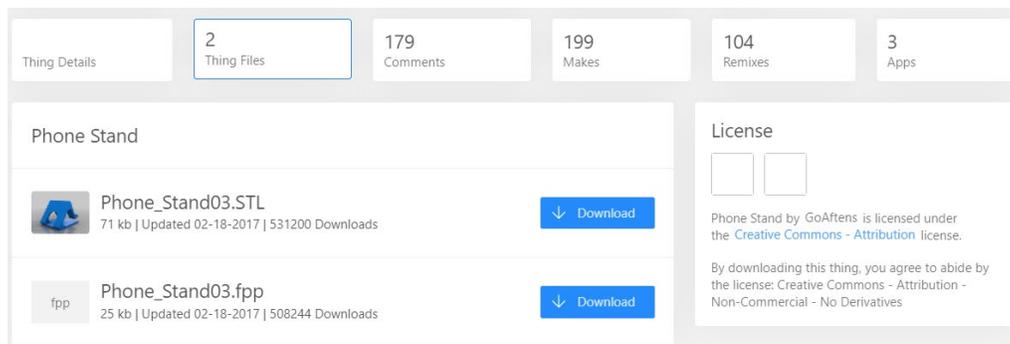


You can find many details about each model. Details like printing tips, recommended materials etc. can be found on the “Thing Details” button. On the “Makes” button you can see printed



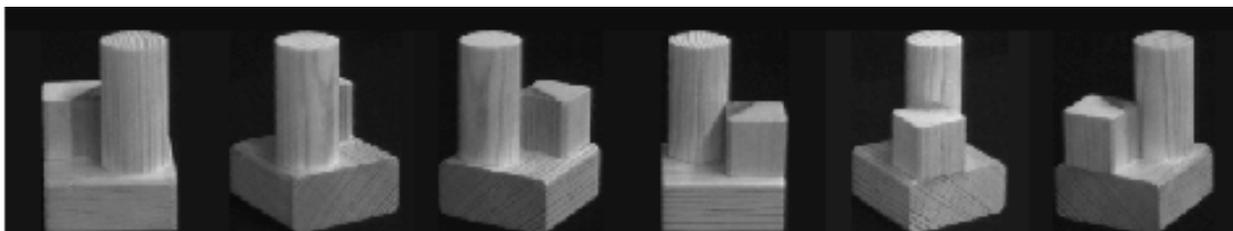
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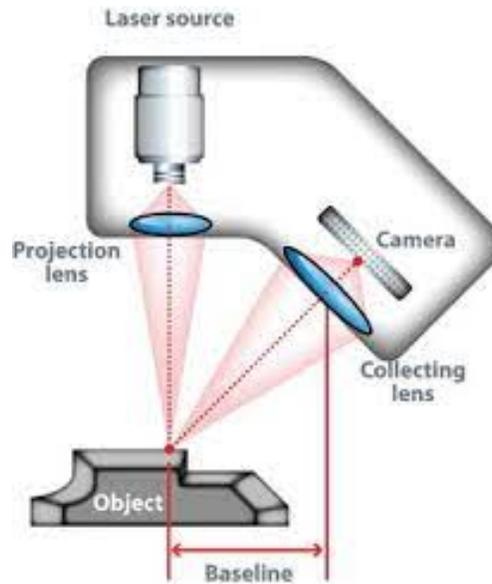


3D Scanning

3D scanning is exactly what it sounds like, it is the process of **scanning three-dimensional objects or models into a computer**. Off course, it is a little more complicated than the old scanner but the general principle of operation is actually similar. The scanner takes **many samples** of whatever it's looking at and **stitches them together** to **produce a coherent image** or, in this case **a 3D model**.



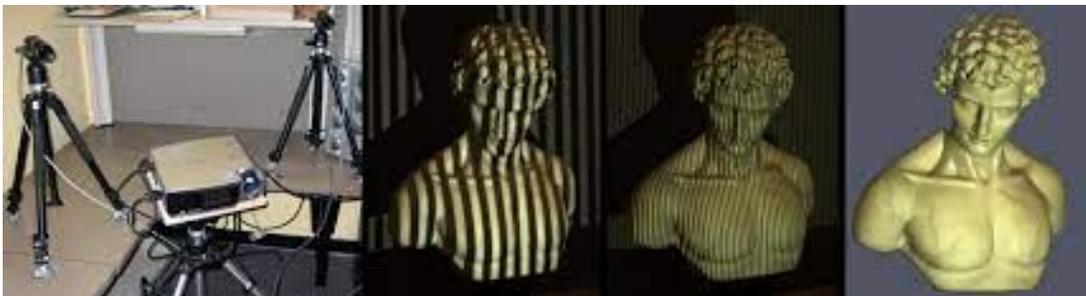
Similarly, to regular 2D paper scanners **many 3D scanners use light** in some way, such as with **laser scanners**, which can acquire the shape of an object by firing laser beams at their targets. Laser scanners capture shapes by calculating **how long it takes** the laser beam to **leave** the scanner then **hit** the object and **reflect back** to the scanner. Others **use lasers in conjunction with a camera** to figure out the laser marks exact location, which the scanner uses to construct an image.



However, **not all light-based scanners use laser beams**. For example, you might have one 3D scanner on top of your TV. Some **gaming console kinetic systems use infrared light**; invisible to the eye, on your body while you are playing then it uses a **small infrared camera to determine your body's position** and whether it moves.



Another method is called **structured light scanning** which uses **plain white or blue light fired at the object in thin lines** to figure out the shape based on the distortion of the lines from other viewing angles.





However **light based 3D scanning** has its limits. Take optical mice for example, they **have a hard time tracking on glass or shiny surfaces**. Similarly, 3D scanners that use light **can have issues scanning objects that are transparent or made of highly reflective material**.

In these situations, it is often better to use a **contact scanner**. These scanners actually “touch” whatever it is that you are trying to scan in order to figure out what it looks like. By using different kinds of probes attached to either hinges or joints, they can send a position back to the computer to generate a super precise image of an object’s surface.



Another limitation of Laser 3D scanning is the Line of Sight. Given the optical nature of 3D laser scanning, it is impossible to measure any surface that is out of the scanner’s line of sight. This means that hidden or internal geometry that is not visible to the scanner is unable to be measured. Scans are taken from many different angles in order to ensure a complete model, but complex geometry may still prove to be a problem, such as commonly occurs with holes or threads.

Photogrammetry

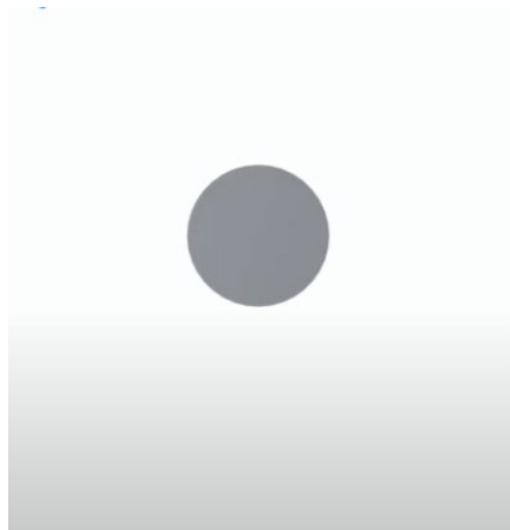
One very interesting method to 3D scan objects is called **Photogrammetry**. Photogrammetry is a method that **uses pictures** of an object in order to create or extract 3D coordinates and geometries.

How does photogrammetry work?

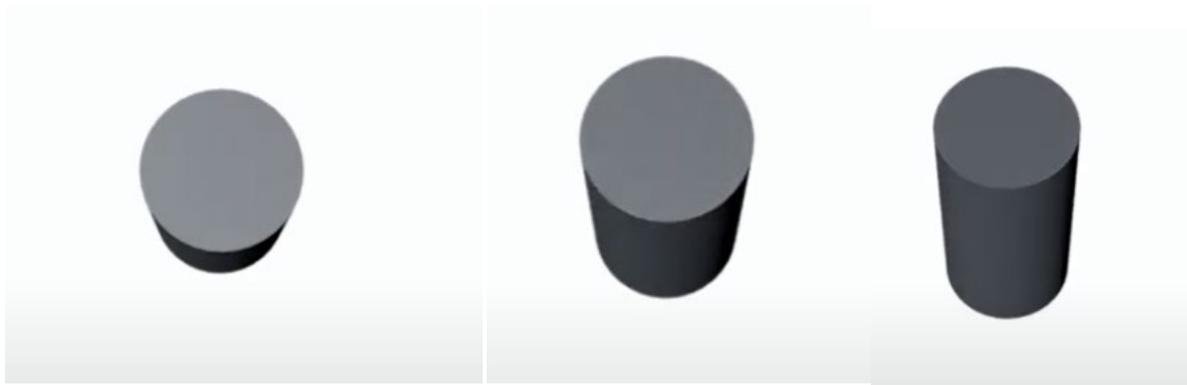
First, we take a set of pictures from different angles or vantage points. Then we obtain 3D coordinates of the targeted object by triangulation.

Why do we take photos from different angles?

Take for example the next set of photos. What do you see? Is it a cycle?

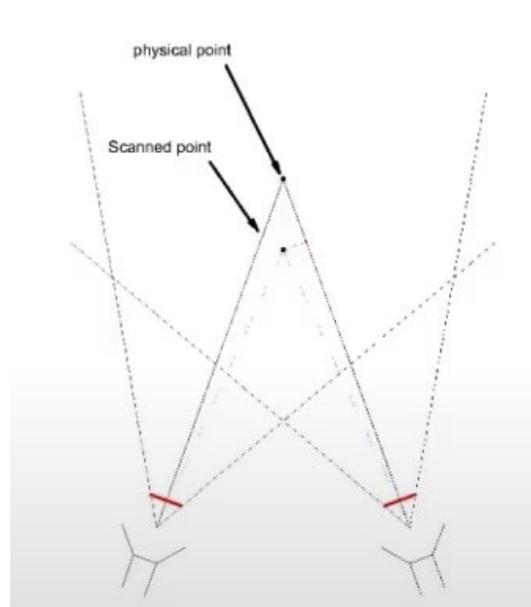


Maybe a cylinder?



Observing an object from different angles helps us get a full view. The displacement of an object caused by a change in the point of observation is called **stereoscopic parallax**. It is caused by taking photographs of the same object but from different points of observation.

Triangulation can be then used to **compute unknown values** with a limited set of angles and lengths of a triangle.



That way, by photographing one object from different angles and by adding that photo on a computer, we can obtain an accurate 3D model of the object.

3D Scanning with your Smartphone

3D Scanning is something that you can even do with your Smartphone!

If you already have a smartphone, you can download one of the many 3D scanning apps that already exist in the market. In all 3D scanning applications, the same guidelines apply for a successful 3D scan. More or less, the procedure of the 3D scanning goes as following:

- First, you place the object or the person you want to scan to stand somewhere where you can walk around it/her/him.
- Then, you start the scanning procedure as indicated by the app, and the sensors of the camera of your mobile phone collect all the needed data.
- Once the 3D scanning is finished, and the data is collected, the app turns them into your digital 3D model. After that, you can save the result and 3D print it and use it as an avatar in Virtual Reality games or other applications.





In the next activity worksheet, we are going to see how we can design a 3D Model from scratch by using a CAD Software.

Exercise 1

Ask students to look for 3D models that they will save in their personal folder.

These models should belong to some theme. For example, one theme could be "Office Organization" and include a pencil holder, cell phone holders, document boxes etc. Another theme could be kitchen accessories or anything else you can imagine.

References

<https://3space.com/blog/advantages-disadvantages-of-3d-laser-scanning/>

<https://www.youtube.com/watch?v=tap6NbuGeeg&t=238s>

<https://www.3d-scantech.com/what-is-photogrammetry-and-how-can-it-help-in-3d-scanning/>

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Level 1 (Novice Level: Basic Competences)

Chapter 1.2: Designing and Acquiring 3D Models

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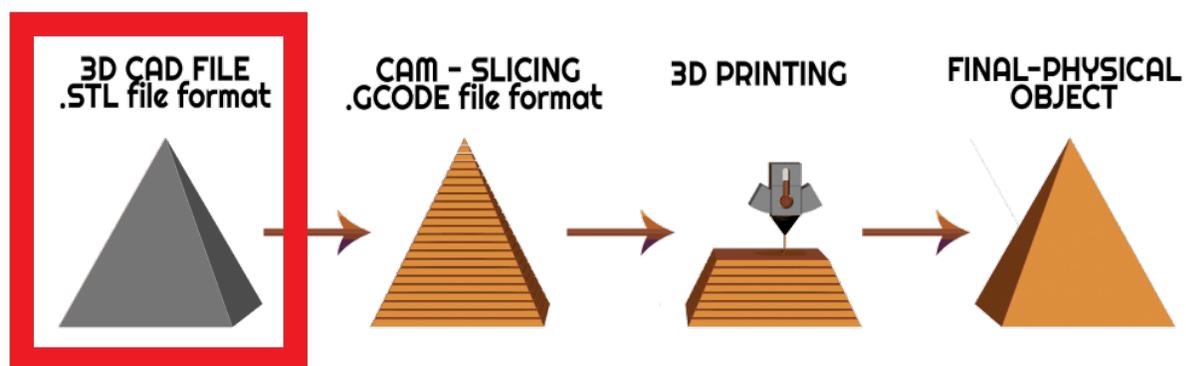
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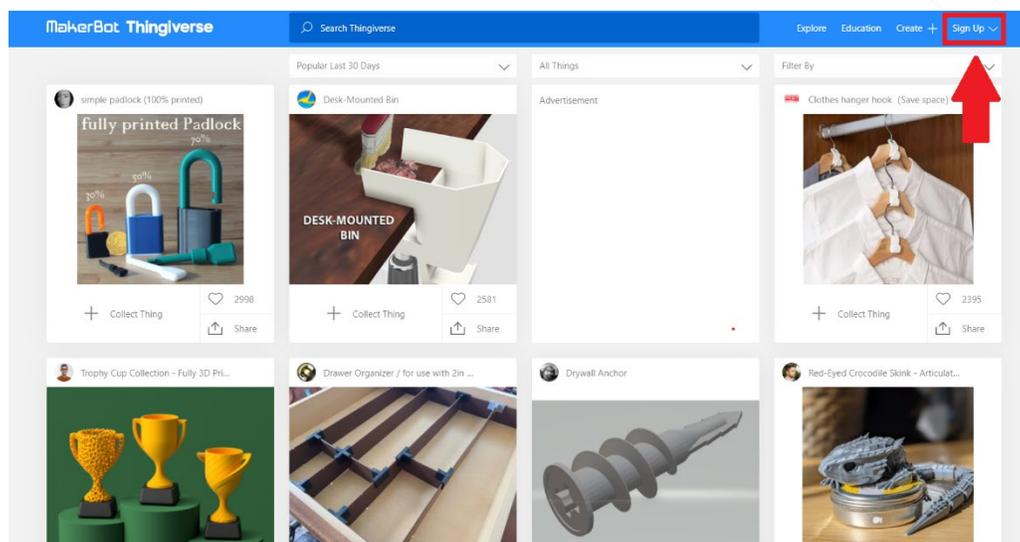
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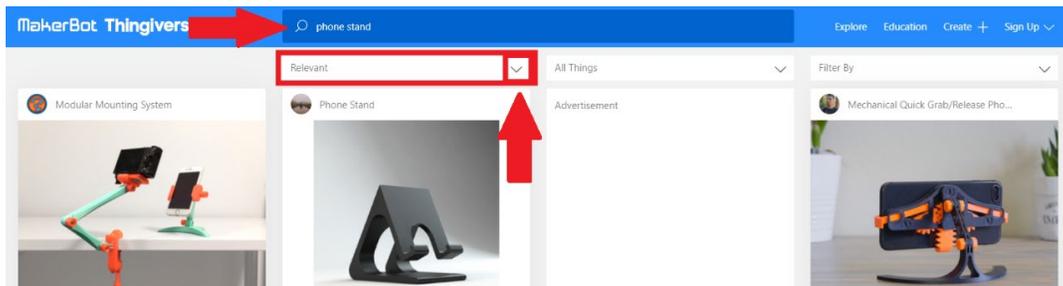
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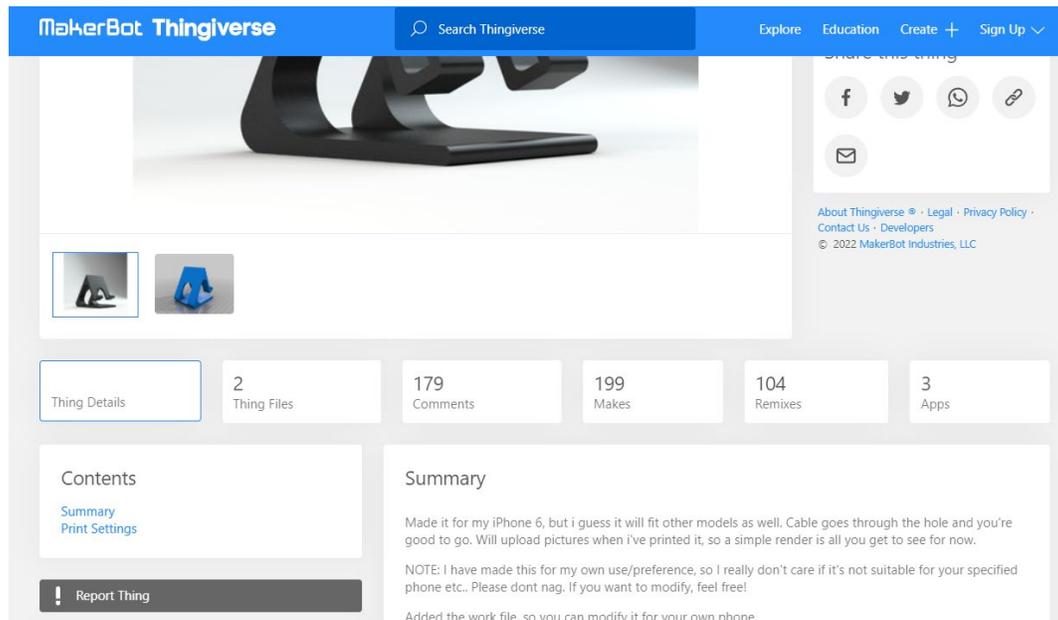


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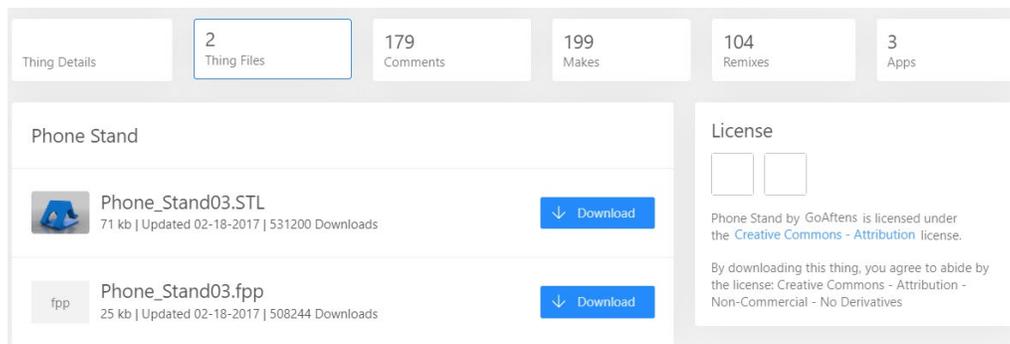


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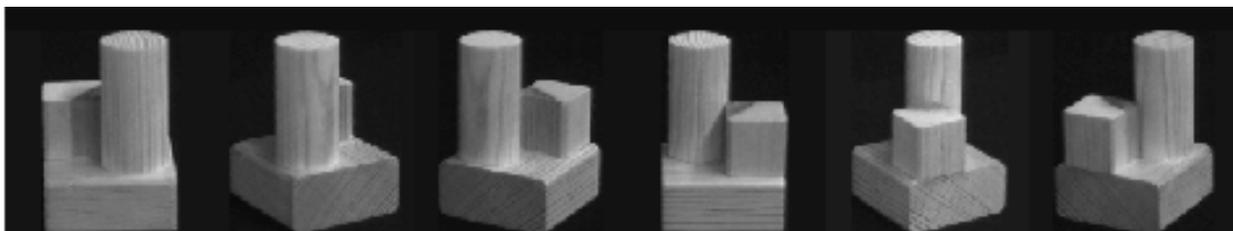
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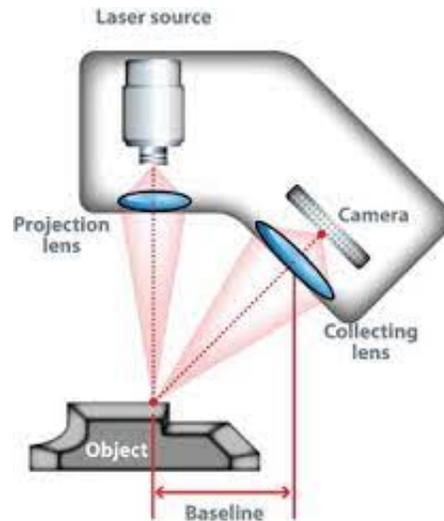


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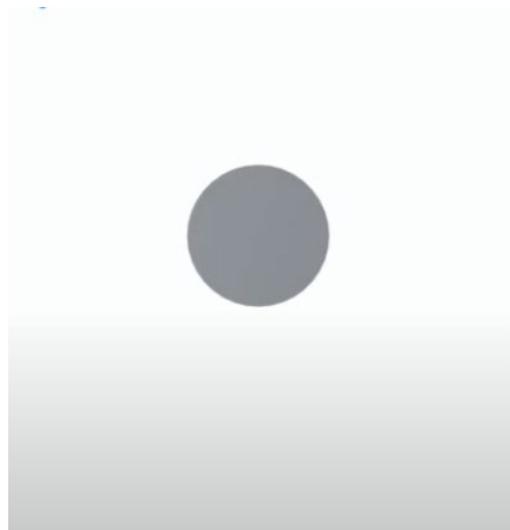
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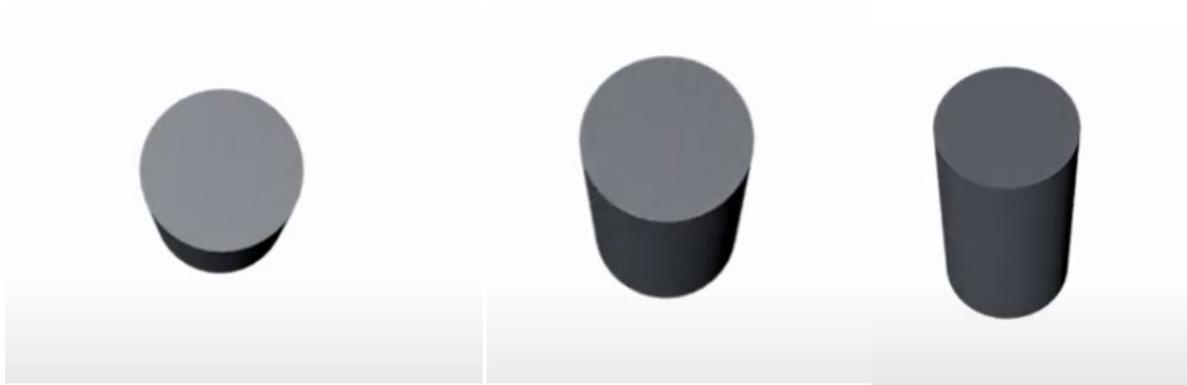
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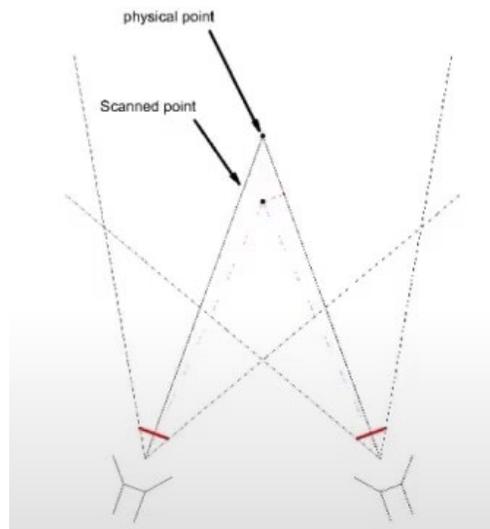


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