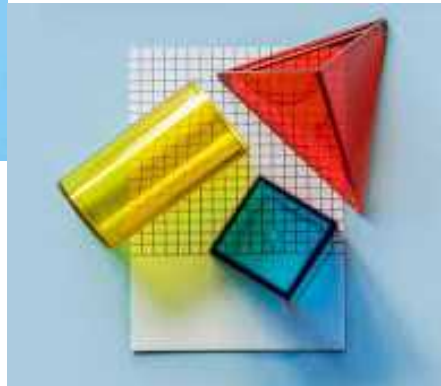




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Erasmus+ Call: 2019 - KA2 -



Erasmus+

This project is funded by the European Union.



3D printing technology aims students understanding maths and recycling procedure

*Curricula 1: 3D Printing Technology and Application  
"Introduction to basic 3D concepts"*

Output 3 (O3) - 3D Printing and Maths

# Overview (1/2)



The context of this session concerns the introduction of 3D sector, presenting information regarding the correspondent processes, i.e. modeling, rendering, scanning, printing. By this way, the audience will be aware on the application and several 3D techniques, in order the 3D printing, the discussed topic of this part, to be understandable. Consequently, main information concerning 3D printing, e.g. its benefits, will be discussed.

# Overview (2/2)

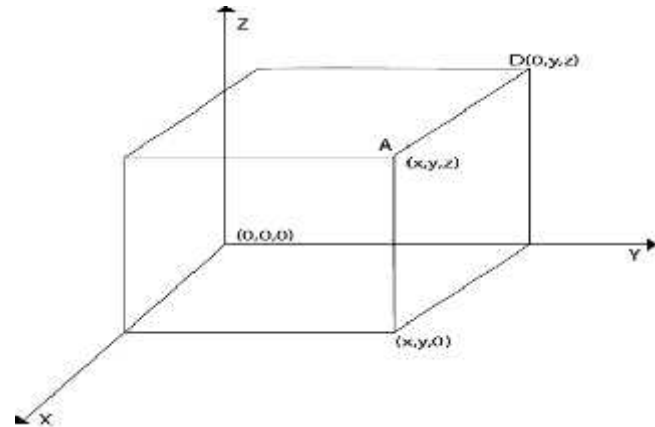
- 3D Computer Graphics
- 3D Modeling
- 3D Animation
- 3D Rendering
- 3D Scanning
- 3D Printing



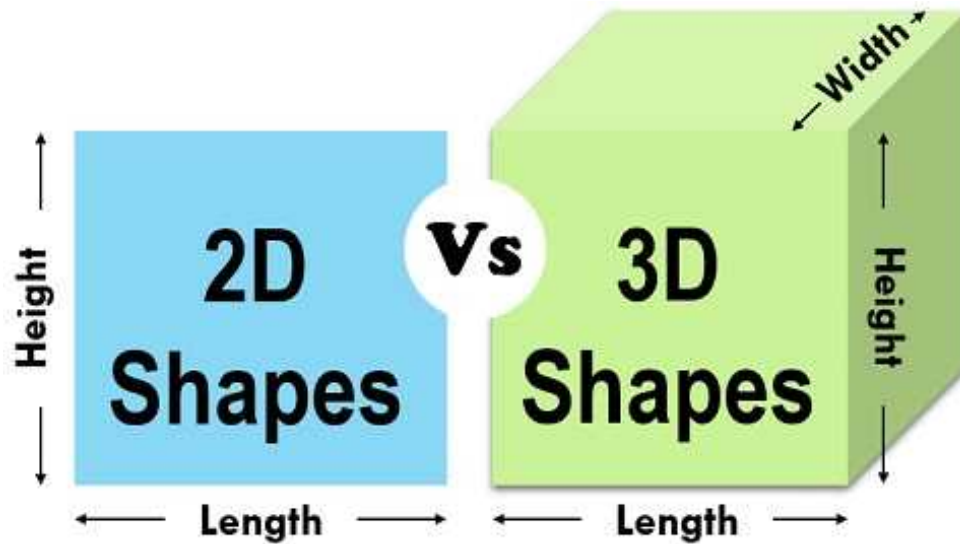


# 3D Computer Graphics (1/5)

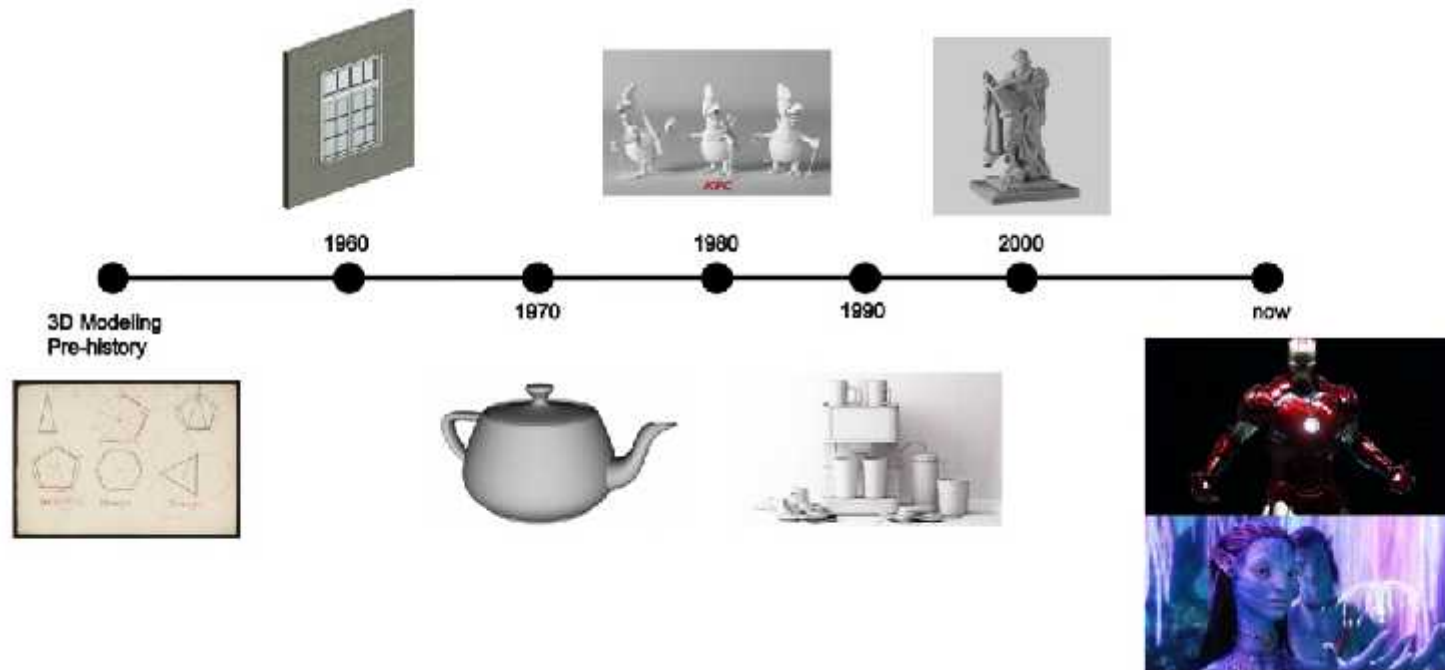
- In computers, 3D (three dimensions or three-dimensional) describes an image that provides the perception of depth.
- When 3D images are made interactive so that users feel involved with the scene, the experience is called virtual reality.
- The three-dimensional transformations are extensions of two-dimensional transformation. In 2D two coordinates are used, i.e.,  $x$  and  $y$  whereas in 3D three co-ordinates  $x$ ,  $y$ , and  $z$  are used.



# 3D Computer Graphics (2/5) - 2D Vs 3D



# 3D Computer Graphics (3/5) - History



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# 3D Computer Graphics (4/5) - Benefits



- Better design quality
- Documentation made easy
- Saving data and drawings for future
- Design time reduction
- Cost Optimization
- Design flexibility
- Global standard compliance
- Better visualization for clients
- Making the design ready for the prototyping

# 3D Computer Graphics (5/5) -Sectors



Entertainment



Architecture



Education



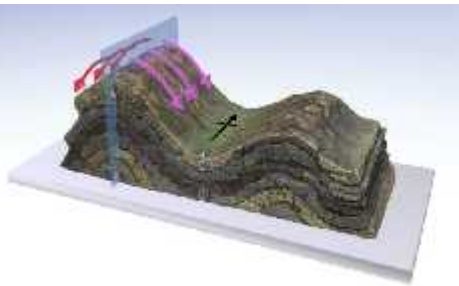
Marketing



Games



Geology



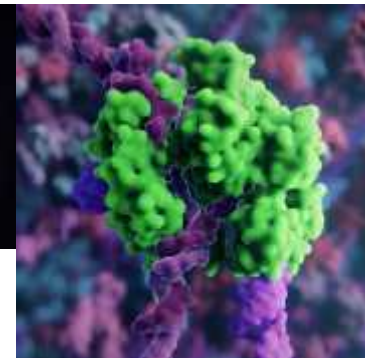
Mechanical Engineering



Medicine



Science





# 3D Modeling (1/5)



- In computer graphics, 3D modeling is the creation of the three-dimensional model for producing a 3D digital representation of a physical object in the three-dimensional space, using special modeling programs.
- Modern technologies and computer programs allow creating the models of varying complexity and size, testing the created prototypes and making both technical and design changes in the model.
- For three dimensional images and objects, three-dimensional transformations are needed. These are translations, scaling, and rotation. These are also called as basic transformations are represented using matrix. More complex transformations are handled using matrix in 3D.

# 3D Modeling (2/5)



## 3D models consist of:

- Simple polygons
- 3D primitives - simple polygon-based shapes, such as pyramids, cubes, spheres, cylinders and cones
- Spline curves
- NURBS (non-uniform rational b-spline) - smooth shapes defined by bezel curves, which are relatively computationally complex

# 3D Modeling (3/5)



Youtube. Future Engineers. "3D MODELING CONCEPTS".2014

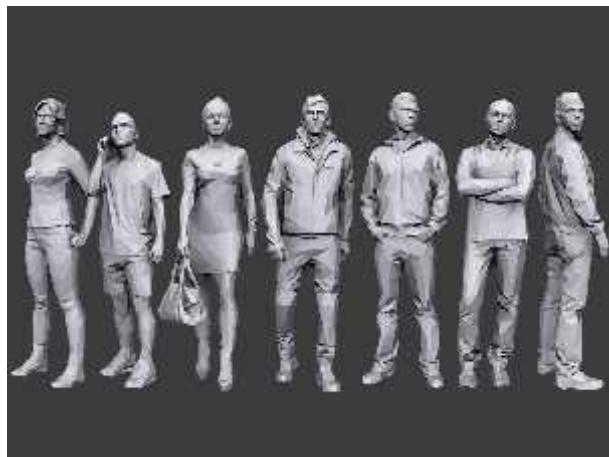




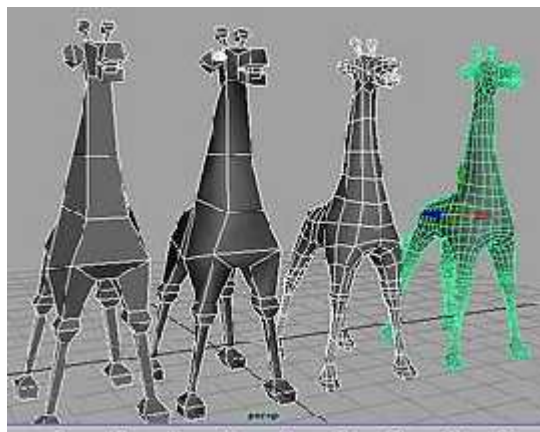
# 3D Modeling (4/5) - Techniques

1. Shell or Boundary
2. Solid

Curve Modeling



Polygonal Modeling



Digital Sculpting



## 3. Computer-Aided design (CAD)

# 3D Modeling (5/5) - Software



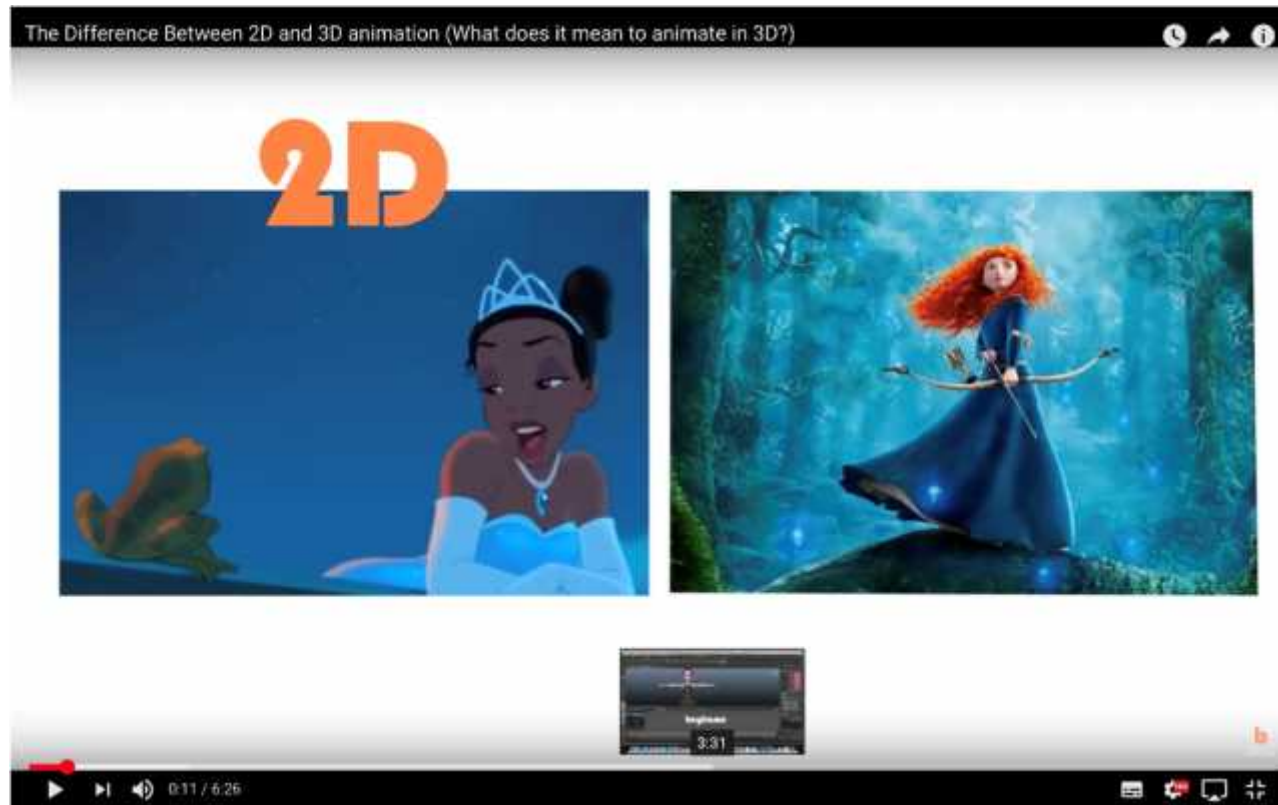
- Maya
- Houdini
- Cinema 4D
- Autodesk 3ds Max
- Modo
- Blender
- Lightwave 3D
- ZBrush
- 3DCoat



## 3D Animation (1/2)

- Often referred to as CGI (Computer Generated Imagery)
- The process of generating three-dimensional moving images in a digital environment. Careful manipulation of 3D models or objects is carried out within 3D software for exporting picture sequences giving them the illusion of animation or movement.
- It is generated by changing the placement and the poses of the 3D models that have already been created. Generated scene can easily be viewed from a number of angles.
- 3D Animation involves the use of techniques like appearance sketching, arena building, appearance modeling, abating, camera setup, texturing, alteration and bond and rendering.

# 3D Animation (2/2)



Youtube. Bloop Animation. "The Difference Between 2D and 3D animation (What does it mean to animate in 3D?)". 2013



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## 3D Rendering (1/4)

- 3D rendering is basically the process of creating two-dimensional images (e.g. for a computer screen) from a 3D model. The images are generated based on sets of data dictating what color, texture, material and lighting a certain object in the image has.
- In concept, 3D rendering is similar to photography. For instance, a rendering program effectively points a camera towards an object to compose a photo. As such, digital lighting is important to create a detailed and realistic render.
- Over time, a number of different rendering techniques have been developed. Nevertheless, the goal of every render is to capture an image based on how light hits objects, just like in real life.



# 3D Rendering (2/4) – Rendered image



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# 3D Rendering (3/4) – Successful Rendering



Youtube. xianfang liu. “Lumion 9.5 Rendering Landscape animation”.  
2019

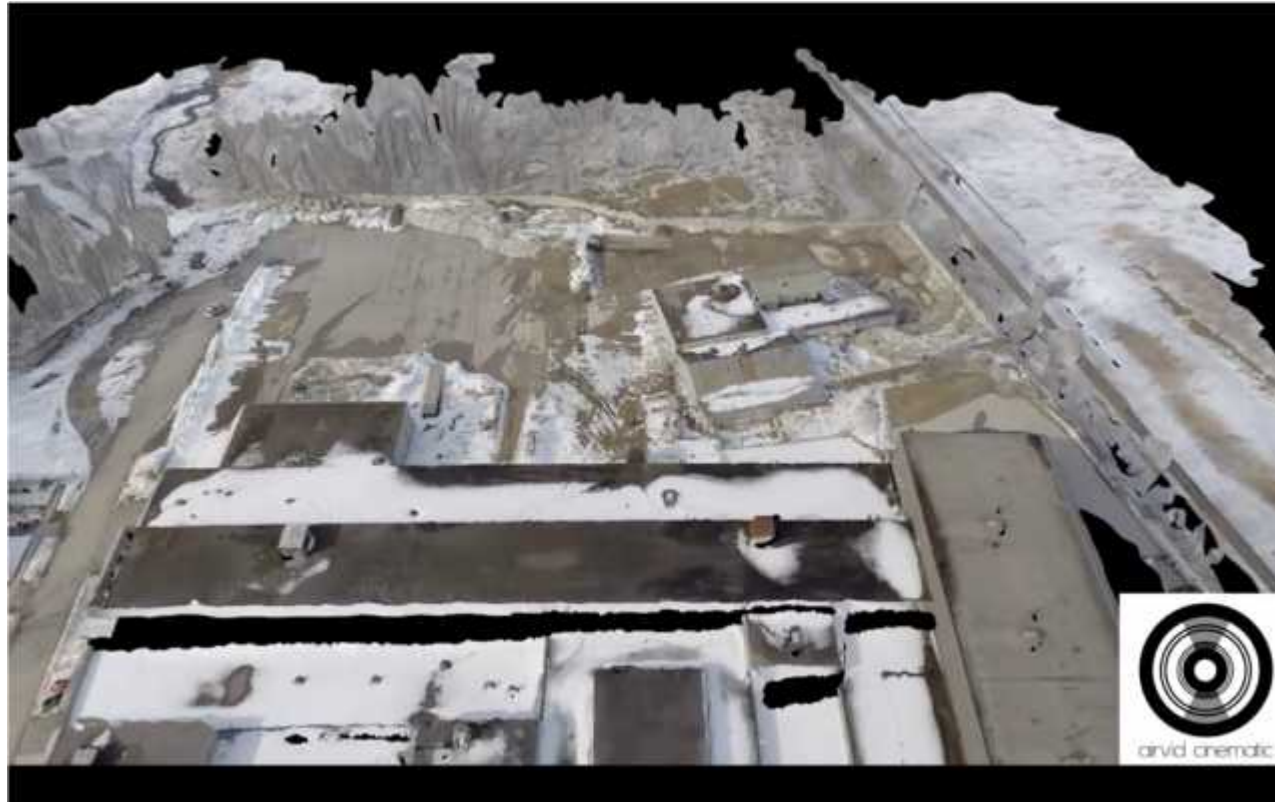


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# 3D Rendering (4/4) – Not Successful Rendering



Youtube. CGSCAPE. "3D render of Warehouse Test Flight AirVid Cinematic". 2015



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# 3D Scanning (1/4)



- 3D scanning is a technique used to capture the shape of an object using a 3D scanner. The result is a 3D file of the object which can be saved, edited, and even 3D printed.
- Many different 3D scanning technologies exist to 3D scan objects, environments, and people. Each 3D scanning technology comes with its own limitations, advantages, and costs.

# 3D Scanning (2/4)



- The basic principle is to use a 3D scanner to collect data about a subject. The subject can be:
  1. an object
  2. an environment (such as a room)
  3. a person (3D body scanning)
  4. Some 3D scanners can simultaneously collect shape and color data. A 3D scanned color surface is called a texture.
- 3D scans are compatible with Computer Aided Design (CAD) software and also 3D printing, after a little preparation on the computer software. A 3D scan can give a lot of information about the design of an object, in a process called reverse engineering.

# 3D Scanning (3/4) - Technologies



- Laser triangulation 3D scanning technology
- Structured light 3D scanning technology
- Photogrammetry
- Contact-based 3D scanning technology
- Laser pulse

# 3D Scanning (4/4) - Sectors



Medical Industry



Forensics



Archeology and Heritage Preservation



Art & Design



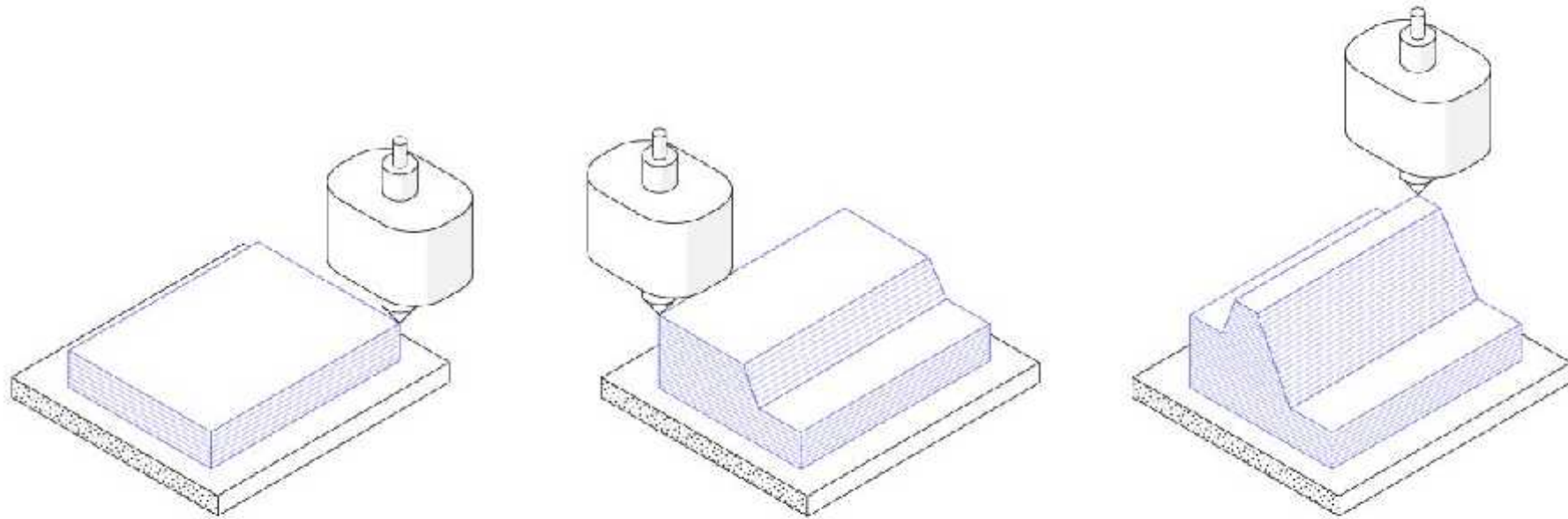
# 3D Printing (1/5)



- Every 3D printer builds parts based on the same main principle: a digital model is turned into a physical three-dimensional object by adding material a layer at a time. This where the alternative term Additive Manufacturing comes from.
- 3D printing is a fundamentally different way of producing parts compared to traditional subtractive (CNC machining, sculpting etc.) or formative (Injection molding) manufacturing technologies.
- In 3D printing, no special tools are required (for example, a cutting tool with certain geometry or a mold). Instead the part is manufactured directly onto the built platform layer-by-layer, which leads to a unique set of benefits and limitations.



# 3D Printing (2/5)



# 3D Printing (3/5) - 1st 3D printer



# 3D Printing (4/5) - Benefits



- Geometric complexity at no extra cost
- Very low start-up costs
- Customization of each and every part
- Low-cost prototyping with very quick turnaround
- Large range of (speciality) materials

# 3D Printing (5/5) – Uses of 3D printing



## Uses of 3D printing

- prototyping
- lightweight parts
- functionally enhanced products
- custom medical implants
- tooling, jigs, and fixtures
- metal casting patterns



Thank you!!

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