

Design and Implementation of 3D Modeling for Teaching Abstract Concepts

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THE PROBLEM

Many college subjects, such as computer science, have abstract concepts which can be difficult to illustrate. By using modeling software and a 3D printer however, abstract ideas can be physically represented and printed to become real-world learning aids. There are many software options available that are sufficient to achieve our goal of creating digital models. The purpose of this project is to design and develop digital 3D models for teaching abstract concepts. We are currently designing and fabricating learning tools that assist with learning in various subjects including computer science and engineering while also aiding other subjects with printed artifacts.

3D PRINTING

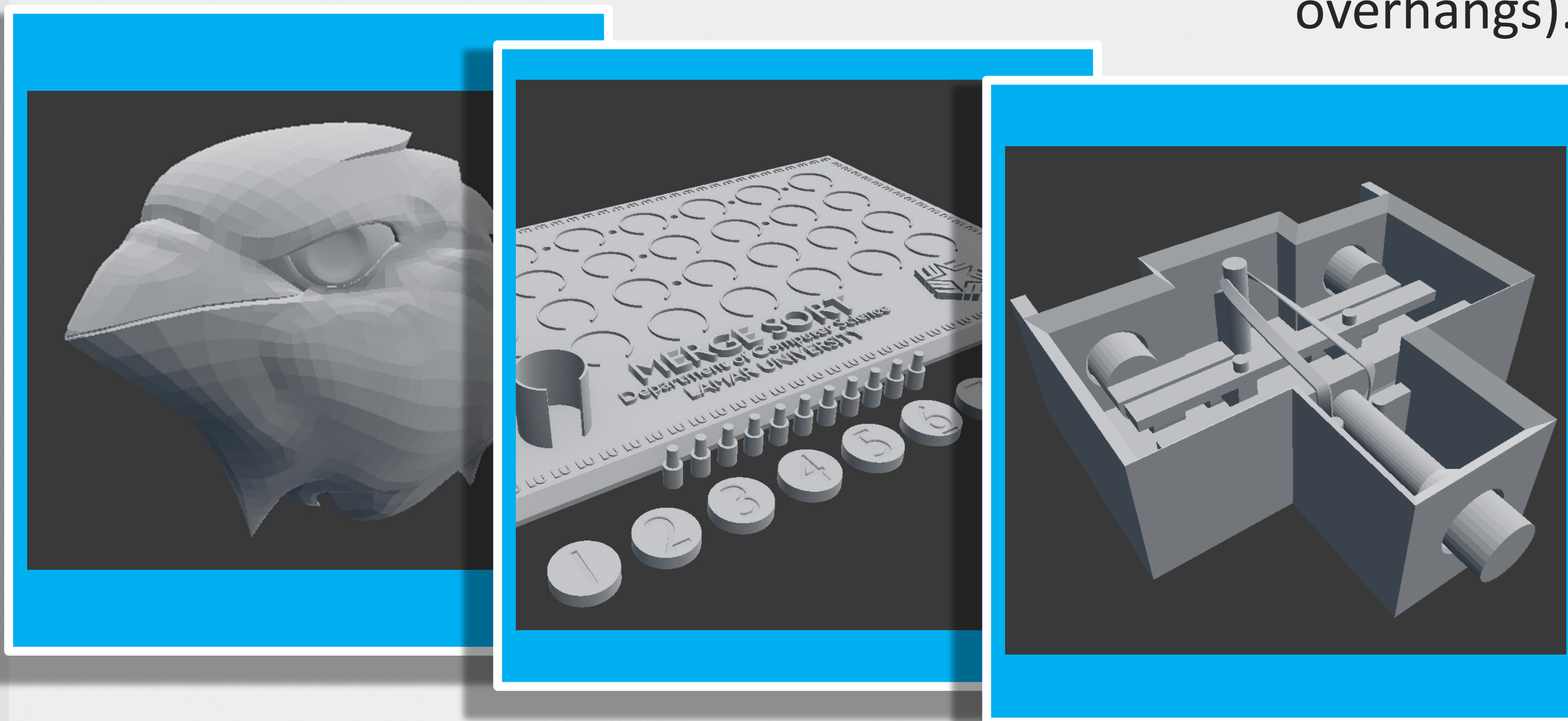
A 3D printer is a machine that constructs 3D objects from digitally created 3D models. The type of 3D printers we have are melt plastic based filament and extrude it through a nozzle while moving according to the digital 3D model's file. Building the 3D object layer by layer.

THE PRINTING FILAMENT

- Most 3D printers use a plastic filament to produce models.
- Polylactic Acid (PLA) or polylactide is the most commonly used plastic.
- PLA is a biodegradable plastic made from corn starch.
- PLA has a low melting-point which is useful for 3D printing.

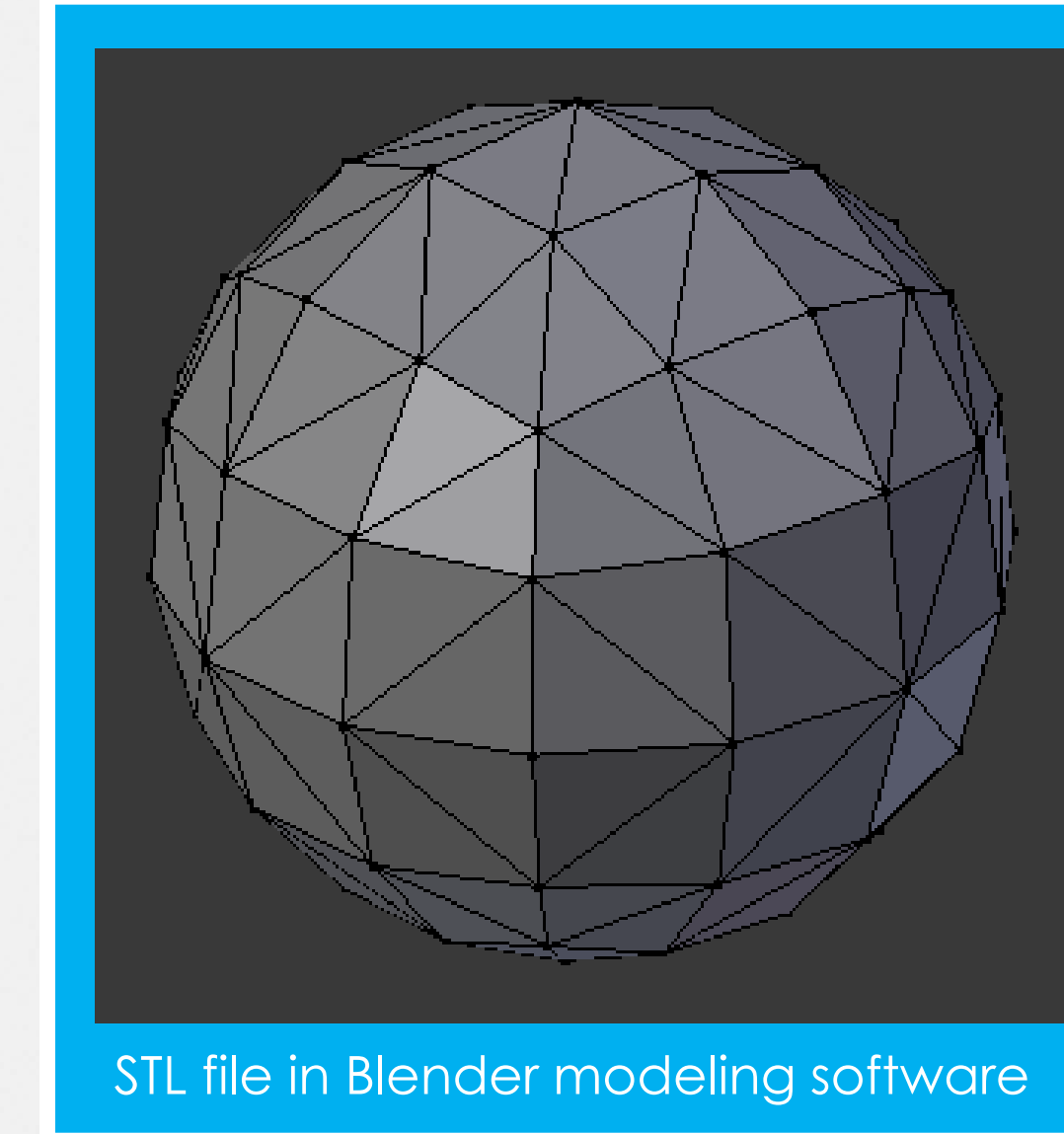
THE DIGITAL MODEL

- Designed using 3D modeling software.
- The 3D model is oriented in most logical position for printing
- If needed support scaffolding can be designed or generated to the model to help the printing process (often required for overhangs).



THE STL FILE

- CAD is a term used for Computer Aided Design.
- Standard Tessellation Language (STL) is common file type for 3D polygonal CAD models.
- STL is the standard format for 3D printing applications.
- STL's contain the vertex information of the model.



THE PRINTER

The Department of Computer Science has several printers which are up to the task Including the LulzBot TAZ.

- Using various PLA based filament
- Objects extruded layer-by-layer



CLASSROOM USES

Teachers and even students can design and 3D print learning tools.

- **Engineering:** 3D printed prototypes for testing
- **Architecture:** 3D printed models
- **History:** 3D replicas of ancient historical artifacts for investigation
- **Graphic Design:** 3D versions of artwork
- **Geography:** 3D printed topographic maps
- **Culinary:** 3D printed cooking-molds
- **Automotive:** 3D printing of modified parts for testing
- **Chemistry:** 3D printed molecule models
- **Biology:** 3D printed models of cells, viruses, organs, and other critical biological artifacts.
- **Mathematics:** 3D printed geometric objects for spatial reasoning and visualization.

(TeachThought, 2017)

THE PROCESS

STEP 1: Design

- Requests are accepted and requirements evaluated
- Model support systems are planned
- A 3D digital model is created and sent for review
- Export approved 3D digital model into STL file format

STEP 2: Printing

- Load STL into the 3D printing software
- Upload to printer and start the print

STEP 3: Refining

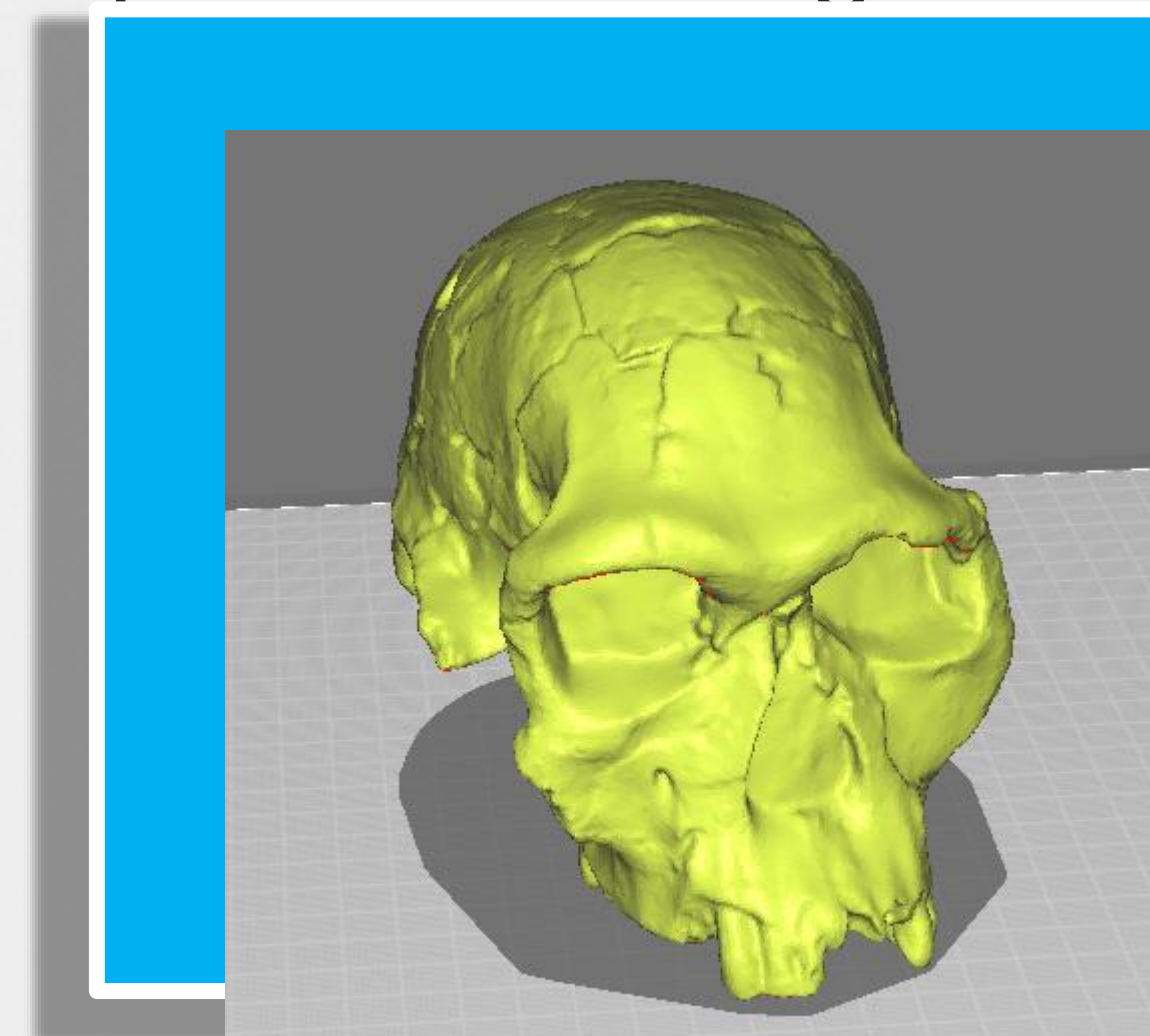
- Remove any support structure or other excess plastic
- Paint object, if necessary

STEP 4: Follow up

- Present the model for classroom use
- Store 3D Digital Model file for future modification/use

CURRENT STATUS

Currently we have a model that has progressed through steps 1-3 for an Antropology class within Lmaar University. It is working towards step 4 of presenting the 3D printed learning tool in the classroom.



Step 1



Steps 2 & 3

