





Design for 3D Printing

A FAST AND EASY GUIDE TO
DESIGN AND PRINT 3D MODELS

CONNECT TO WI-FI

-  Select the **network icon** in the taskbar
-  Select the **ConcordiaUniversity** network
-  Click **Connect**
-  Enter your **Concordia netname and password**

 Click the **network icon** to connect to WI-FI

☰ Type here to search

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2023-09-22

FutureBound

Communication and Digital Capabilities Certification

- Undergraduate students
- Complete 4 activities
- Please sign registration sheet

OCT 7 **What's in a prompt - In-person**
Monday, 2 p.m. – 3:30 p.m.

OCT 22 **Intro to Python: Start programming - Online**
Tuesday, 5:30 p.m. – 7:30 p.m.

NOV 6 **AI in action: Insights from the workforce - In-person**
Wednesday, 3 p.m. – 5 p.m.

NOV 13 **Algorithmic bias - In-person**
Wednesday, 2 p.m. – 4 p.m.

Digital Capabilities & Mindsets Activities

Complete 4 activities and get the Digital Capabilities & Mindsets certificate.

SEP 10 **Design for 3D Printing**
Tuesday, 2 p.m. – 4 p.m.

SEP 12 **Arduino 101**
Thursday, 2 p.m. – 4 p.m.

SEP 17 **Expand your Excel skills: Beginner - Online**
Tuesday, 5 p.m. – 6:30 p.m.

SEP 18 **Thinking critically about AI tools - In-person**
Wednesday, 2 p.m. – 3:30 p.m.

SEP 24 **Expand your Excel skills: Intermediate- Online**
Tuesday, 5 p.m. – 6:30 p.m.

SEP 25 **Design for 3D Printing**
Wednesday, 2 p.m. – 4 p.m.

OCT 2 **Design for 3D Printing**
Wednesday, 2 p.m. – 4 p.m.



Intro

5 min

Theory

35 min

Activity

25 min

**Recap &
resources**

15 min

Questions

10 min

Workshop Objectives

By the end of this workshop, you will be able to:

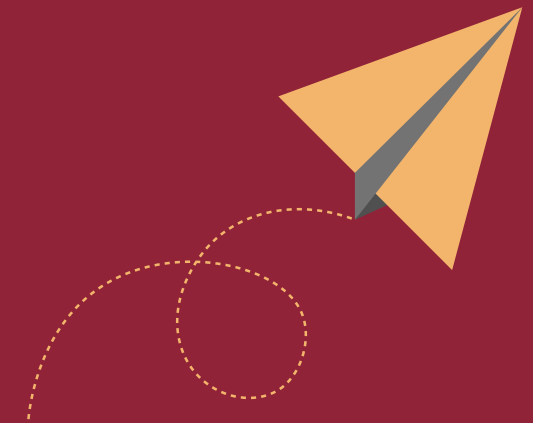
Explain the basics of:

- 3D Printing
- 3D Design

Design appropriately for 3D printing

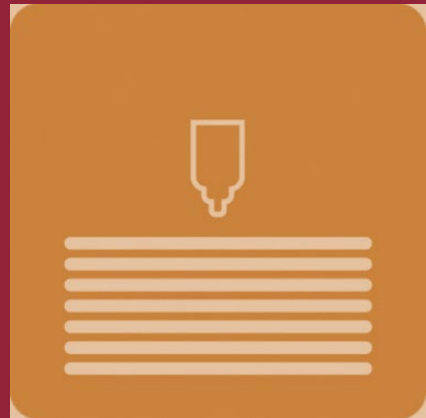
Modify an existing 3D design

Export model for 3D printing

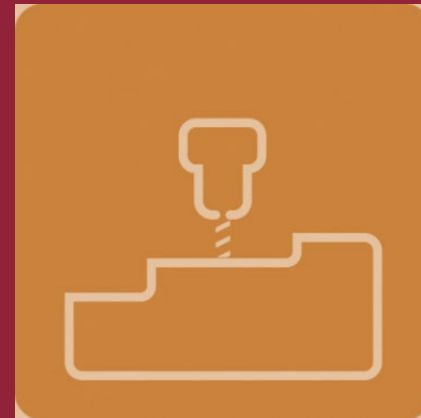


What is 3D Printing?

1. An additive manufacturing technology



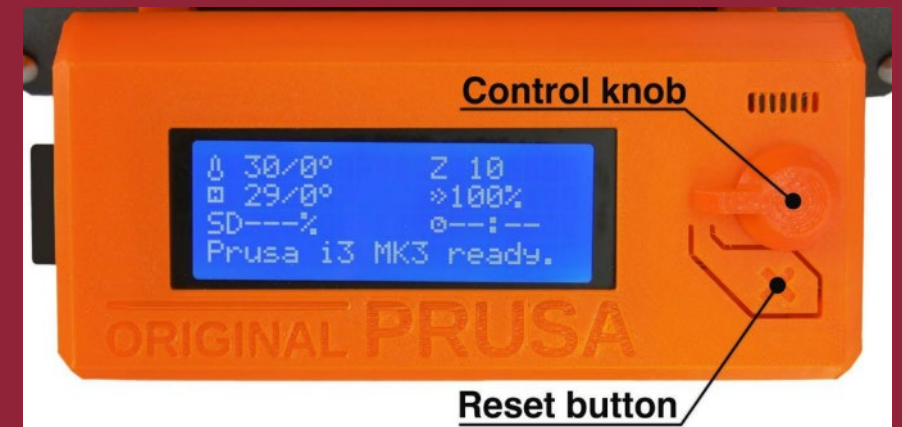
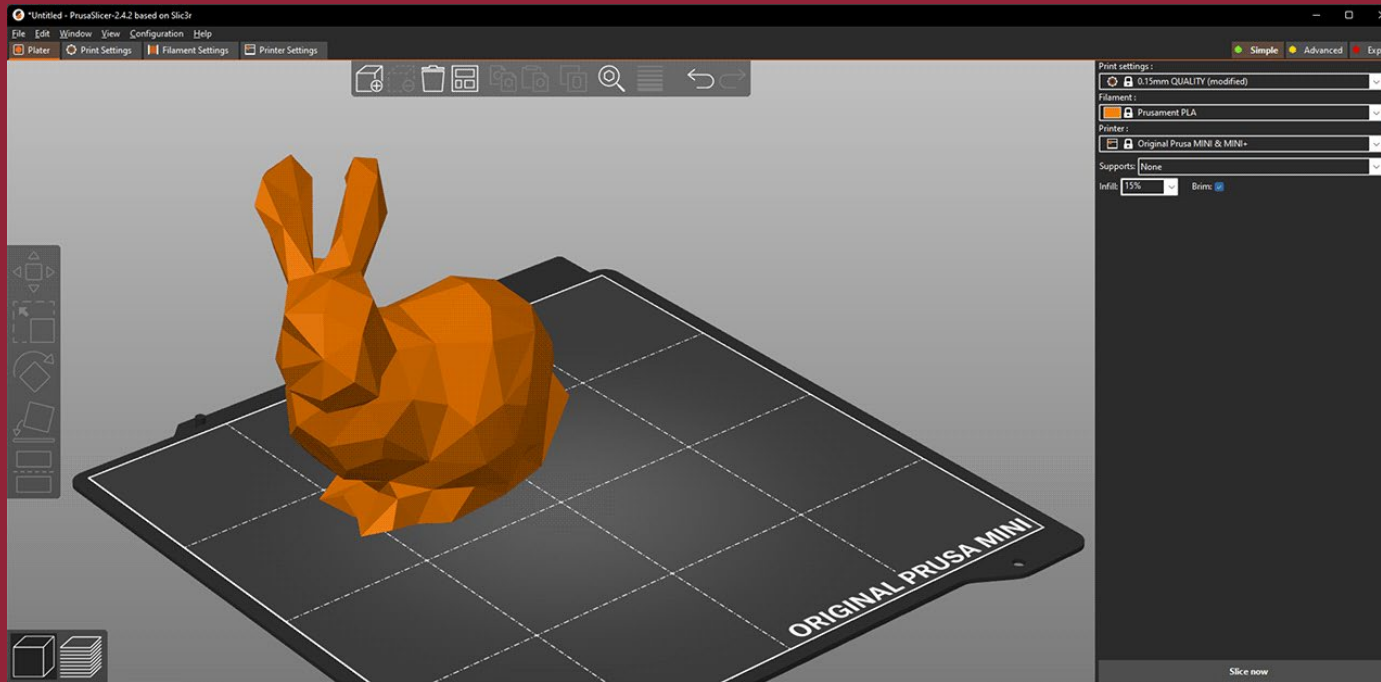
Additive



Subtractive

What is 3D Printing?

2. Computer controlled



What is 3D Printing?

3. Printers use G-code, the most widely used computer numerical control programming language

```
G0 X12 ; move to 12mm on the X axis
```

G Codes

G0, G1 - Coordinated movement X Y Z E **G0 & G1: Move**

In Prusa Firmware G0 and G1 are the same.

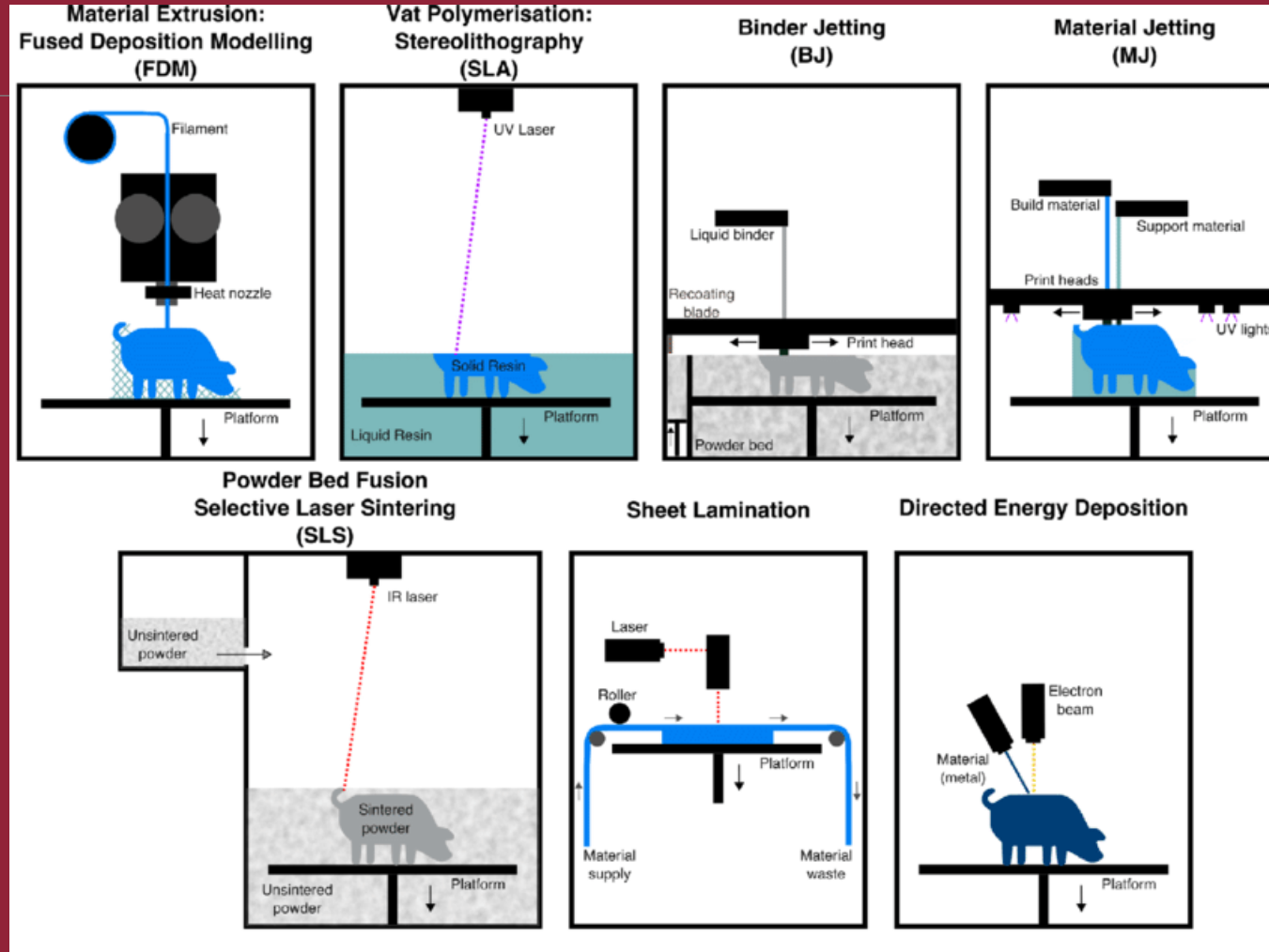
Usage

```
G0 [ X | Y | Z | E | F | S ]  
G1 [ X | Y | Z | E | F | S ]
```

Parameters

- X
- The position to move to on the X-axis
- Y
- The position to move to on the Y-axis
- Z
- The position to move to on the Z-axis
- E
- The amount to extrude between the starting point and ending point
- F
- The feedrate per minute of the move between the starting point and ending point (if supplied)

Types of 3D printing



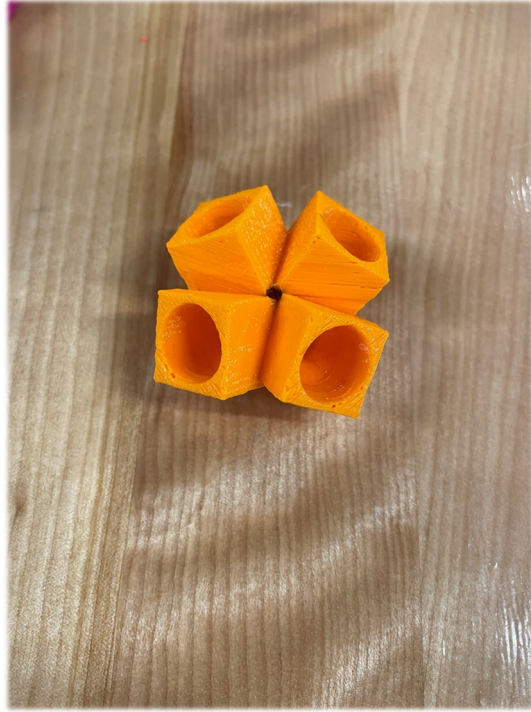
Why 3D Print?

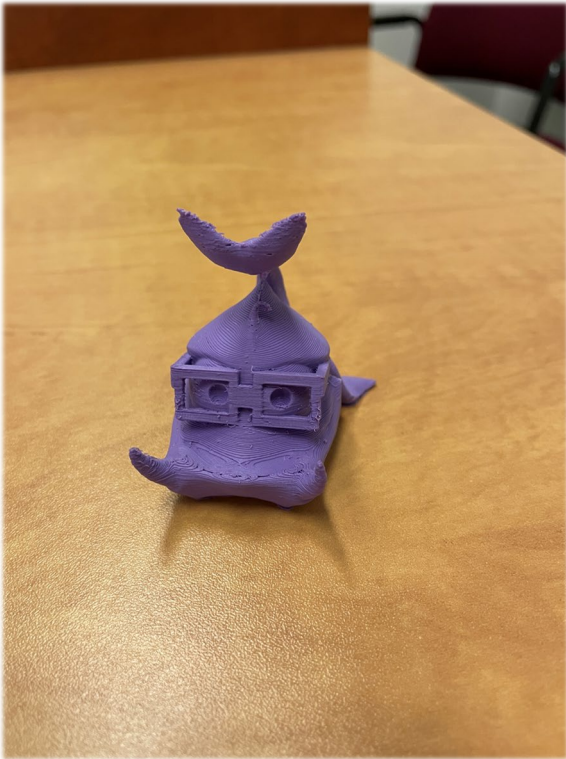
- Prototype a design for larger production
- Solve a unique one-off problem
- Reverse engineer a broken part
- Aesthetics
- Troubleshoot your 3D design
- Print a test in PLA before producing in a more expensive material



What can you 3D Print?

- Figurines and models (architecture, DnD)
- Joining devices, hooks, attachments
- Artwork, sculptural pieces
- Organizers, containers, holders
- Puzzles and toys
- Casing and stands







Material choices

PLA – Safe, Cheap, Easy (free for students)

Outside the Sandbox:

- Other plastics (stronger, flexible, high rez) and resins
- Metals (cast or direct)
- ‘Sandstone’
- Colors

Constantly evolving – look for local then Canadian options to save \$\$



What is 3D Design?

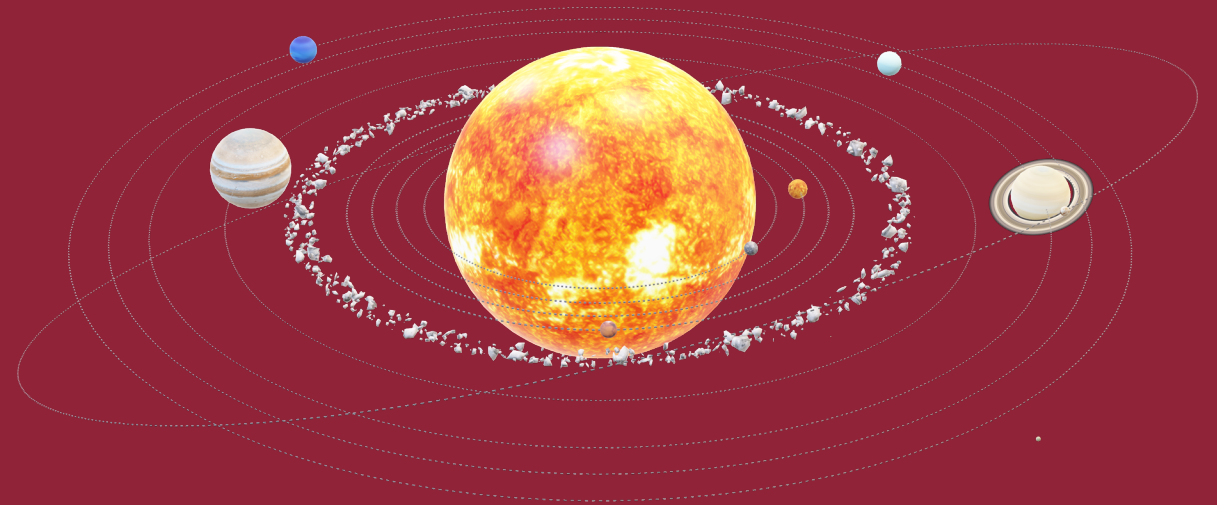
- Process of using computer-modelling software to create an object within a three-dimensional space
- Representation of a 3-dimensional object or shape
- End result is a 3D model

Why 3D Model?

- For 3D printing
- Other design applications, e.g., CNC mill, laser cutter, etc.,
- Video games
- CGI
- VR experiences
- Architecture
- Simulation purposes

What are some 3D file types?

- STL
- OBJ
- GLTF/GLB
- PLY (point cloud)
- FBX (Autodesk Filmbox)
- Many more – conversions generally possible to some extent



How does a printer understand 3D files?



G-code!

Slicing – Turn a 3D file into a list of G-code instructions

The screenshot displays a 3D slicing software interface. The central 3D view shows a brown, cylindrical tower with a crenelated top, sliced into horizontal layers. The software interface includes a menu bar at the top with options like File, Edit, Window, View, Configuration, and Help. Below the menu bar are tabs for Plater, Print Settings, Filament Settings, and Printer Settings. On the left side, there is a table showing feature types and their corresponding time, percentage, and filament usage. The right side features a settings panel with various options for print settings, filament, printer, supports, and infill. At the bottom, there is a status bar with a view dropdown, a 'Show Options' button, and a progress indicator.

Feature type	Time	Percentage	Used filament
Perimeter	28m	32.7%	1.18 m 0.00 g
External perimeter	26m	31.1%	1.17 m 0.00 g
Overhang perimeter	37s	0.7%	0.03 m 0.00 g
Internal infill	7m	8.2%	0.46 m 0.00 g
Solid infill	13m	14.9%	0.78 m 0.00 g
Top solid infill	5m	5.8%	0.21 m 0.00 g
Bridge infill	5m	5.5%	0.21 m 0.00 g
Skirt/Brim	40s	0.8%	0.03 m 0.00 g
Custom	12s	0.3%	0.02 m 0.00 g

Estimated printing times (Normal mode):
First layer: 3m
Total: 1h24m
[Show stealth mode](#)

Print settings:
0.3mm FAST
Filament: - default -
Printer: (8) Prusa i3 MK3S+ Luke
Supports: None
Infill: 10%
Brim:

Object manipulation
World coordinates: X Y Z
Position: 125 105 28.74 mm
Rotate: 0 0 0 °
Scale factors: 100 100 100 %
Size: 34.34 34.34 57.49 mm
Info
Size: 34.34 x 34.34 x 57.49 Volume: 16284.86
Facets: 50092 (1 shell)
No errors detected
Sliced Info
Used Filament (m) 4.10
Used Filament (mm³) 9860.95
Estimated printing time:
- normal mode 1h24m
- stealth mode 1h25m
Export G-code

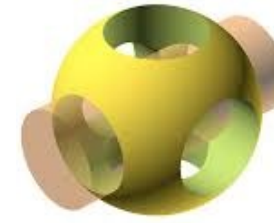
Design considerations - FDM

- Overhang
- Rotation
- Support material
- Total size – modularity
- Movement (Dynamic objects)
- Melt-ability





SCULPTRIS



OpenScad

How can I design files in 3D?





Make a Tinkercad account:

<https://www.tinkercad.com>

... and Sign-IN

Follow the tutorials

- 3D designs, learn
- Starters: Place It!, View It! ...complete as many as you can
- 15 minutes to get to know the interface
- Drag and drop
- Easier with a mouse (but you can survive without)

Modify a Design

- Visit the [Thingiverse.com](https://www.thingiverse.com) site
- Locate a file you would like to modify (i.e. cellphone case you want your initials on)
- Ideally one part
- Download the .stl, import it into TinkerCAD
- Modify
- Export the .STL

Next Steps

- Bring your file on USB to the Sandbox to print
- Complete more tutorials in TinkerCAD
- Work on mods and mashups
- Design something from scratch
- Investigate different 3D modeling options –advantages and limitations

3D PRINTING GUIDE

Do you have a 3D model?

YES

Do you have an .stl?

Export .stl or .obj

NO

SEARCH (thingiverse.com)

-or-

MODEL (TinkerCAD, OpenScad, etc.)

Open in Prusa Slicer (Click ADD)

1. Choose printer
 2. Set layer height (0.1-0.3)
 3. Add support material
 4. Add brim
 5. Change fill density (10-60%)
- if needed

SLICE NOW

preview

EXPORT GCODE

Onto SD card

Change filament

Upload Gcode

PREHEAT

take to printer

PRINT!

(WATCH for 2 layers)



What did we learn?

- Explain the basics of 3D Printing/3D Design
- Identify some common printer types and file types
- The 3D Printing services offered in the Technology Sandbox
- Identify the applications of 3D modelling; choose software that can meet your needs
- Find and modify 3D models
- Export models for 3D Printing

Continue Learning

[Tinkercad](#)

[OpenSCAD](#)

[Blender](#)

[Sketchup](#) (changed ownership from Google to Trimble)

[Udemy Concordia](#)

[Introduction to SOLIDWORKS](#)

[AutoCAD Beginners Course](#)

[3D printing start to finish with TINKERCARD & CURA software](#)



3D Modelling 102: OpenSCAD

So you want to model things in 3D, but you're unfamiliar with how to do it or the software you're using doesn't give you the fine control you need? Come to our workshop. For this session, we are going to focus on building practical structures for lab environments. OpenSCAD is free, open-source software for detailed, programmatically defined, primitive based rendering software. If that sounds complicated, you will be pleasantly surprised at how easy and intuitive the software is once you get started.

No programming experience required (although it doesn't hurt).

Computer and software are provided, but to walk away even better prepared, feel free to bring your own laptop and have [OpenSCAD](#) installed on your computer before the session.

Speaker: Sean Cooney, Technology Sandbox Technician, Concordia University Library

Sept 17 (2-4 pm)

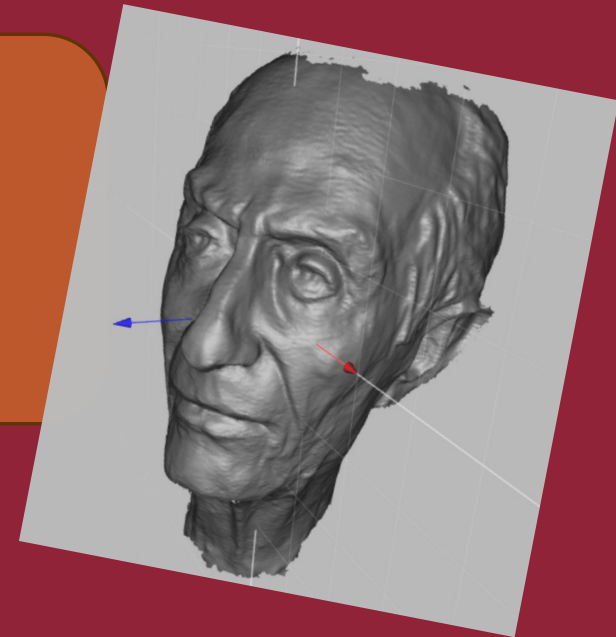
<https://concordiauniversity.libcal.com/event/3813424>

3D Scanning

- Arctec Eva scanner
- iPads (Scaniverse application)

SANDBOX SHOWCASE – Demos for all
scanners

Coming Soon!





Information/inspiration

[Thingiverse](#)

[Sketchfab](#) (3D models, generally less for printing, some are paid)

Designs

[SuperMod Is A 3D Printed Modular Wall System](#)

[Stool - 3D Printable Life Size Furniture](#)

[Space Fabric Cloth](#)

Suppliers + commercial services

Prusa 3D Printers

- Printers in the Sandbox

Creality 3D

- Getting a lot of attention because of the price, Sandbox has not tested the quality

Filaments.ca

- A filament suppliers we use for PLA

Shapeways

- Very large US based printing service. They are one of the oldest – local options would be cheaper and faster. This is a reference for the material selection not a recommendation)



Vocabulary

Fused Deposition Modelling – a very common and inexpensive type of additive manufacturing, building up layers by extrusion

Stereolithography (SLA)– type of vat photopolymerization

Digital Light Processing (DLP) –another type of vat photopolymerization

Selective Laser Sintering (SLS) – additive manufacturing that fuses polymer particles with a laser

Selective Laser Melting (SLM) – additive manufacturing that melts powdered metal into solid objects



TECHNOLOGY SANDBOX INFO AND RESOURCES:

LIBRARY.CONCORDIA.CA/TECHNOLOGY/SANDBOX/

(SUBSCRIBE TO OUR NEWSLETTER!)

Technology.Sandbox@concordia.ca