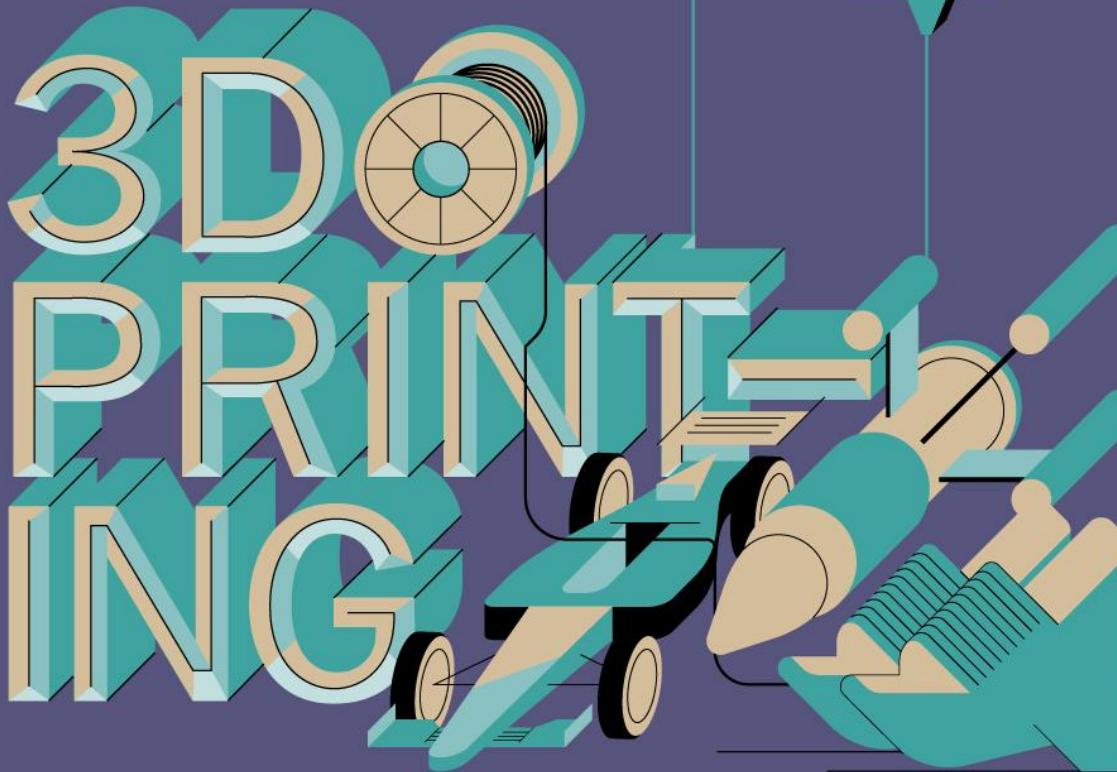


Foundations of



# Welcome!



# Who am I?

- Vice President of the ANU Maker Club
- **Bachelor of Science**
  - Major Science Communication
  - Engineering, Management, Business, Computer Science, Physics, Maths, Science Communication
- Manage, maintain and built the Club's 3D Printer
- 3D Modelling for 3D Printing, Games, Animation.
- CNC Machines, Electronics, Programming, Metal/Woodworking
- Book Collector
- Watcher of Netflix
- Petter of Cats



# Workshops

3D Modelling

- Blender
- OpenSCAD
- Sketchup

Foundations of 3D Printing

Advanced Design for  
3D Printing

Electronics

Build your Own Board  
3D Printer Electronics

# Foundations of 3D Printing

- ❖ Not a technical workshop
- ❖ Not about how a printer works or how to build one
- ❖ What 3D printing is
- ❖ Where it stands in the world
- ❖ How to design for 3D Printing
- 3D Printing, Planning and Design
- 3D Modelling
- Printing a design`



## What is design? .... Wikipedia?

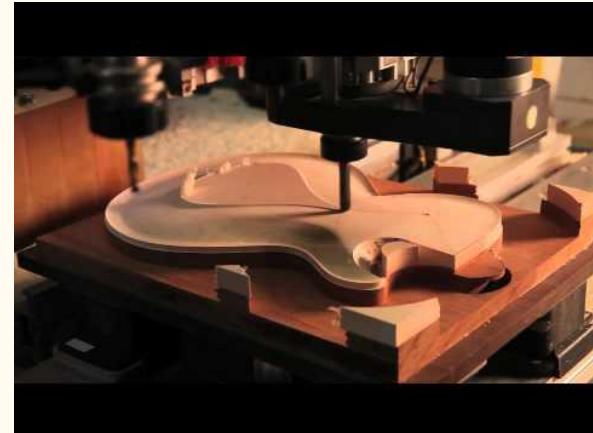
- Design is the creation of a plan or convention for the construction of an object or a system
- verb for the process of creation
- involves considerable research, thought, modeling, interactive adjustment and re-design.
- Design is everywhere in art, engineering, computer science, chemistry, politics, philosophy.

A vibrant field of yellow flowers with dark, seed-filled centers, likely cornflowers or daisies, is silhouetted against a warm, golden sunset or sunrise sky. The background is a soft-focus blend of orange, yellow, and blue, creating a peaceful and inspiring atmosphere.

Learn something new.

# Current Manufacturing Methods

- Subtractive Manufacturing
- Makes a object by removing parts from a raw piece of material
- Lots of waste material
- Wide range of materials
  - Metals
  - Wood
  - Stone
  - Almost anything



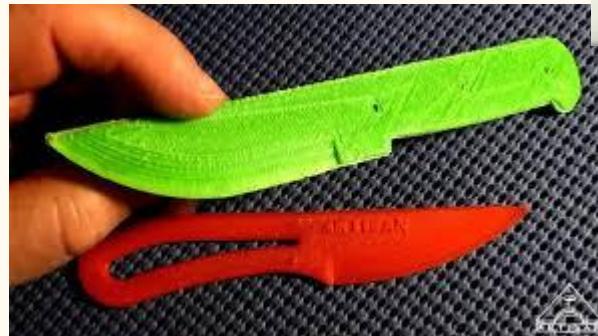
# Whats Been Happening in the world?



# Weapons

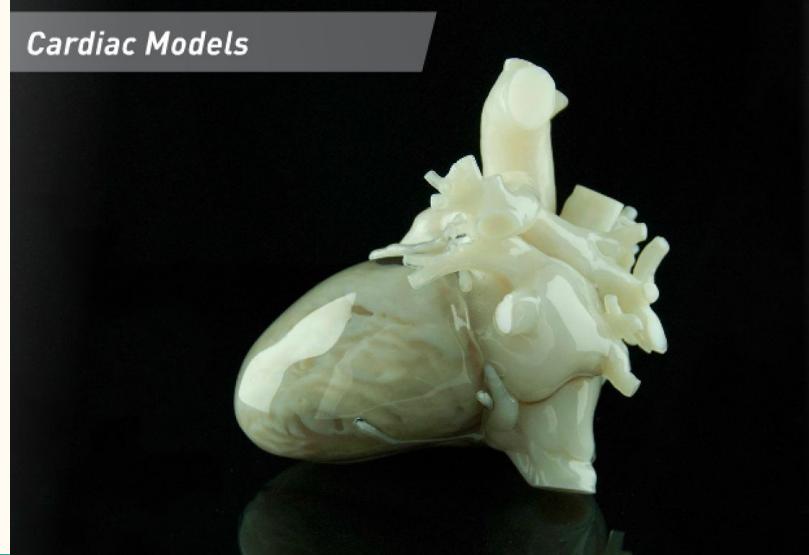
- Controversy
- Seized in australia
- Fully working (mostly)
- Unregulated/able

Don't bring a gun to a drone fight,



# Medicine

- Prosthetics
- Organic Tissue
- Drugs
- Organ Models
- Organs



# Architecture

- World's first 3D Printed Office - Dubai
- Buildings can be printed in as little as 10 hours
- 5 story office building printed in 24 hours



# Transport

- Bikes
- Cars



# Food

- Chocolate
- Pizza
- Pasta
- Sugar Candy



# 3D Printing?

---

- 
- 1981 - Hideo Kodama invented 2 AM Methods
  - 1984 Elaine Le Mehate Filed for a patent
  - 1984 Chuck Hull of 3D Systems filed for a patent
  - mid 1990s multiple techniques developed by universities

# 3D Printing Boom

- Processes Matured  
becoming cheap and more  
affordable
  - Beginning to rival  
traditional methods
  - Metal Printing
  - Desktop Printers
- 
- ❖ Reprap
  - ❖ Makerbot
  - ❖ Form Labs



# 3D Printing Technologies

Additive Manufacturing (AM)

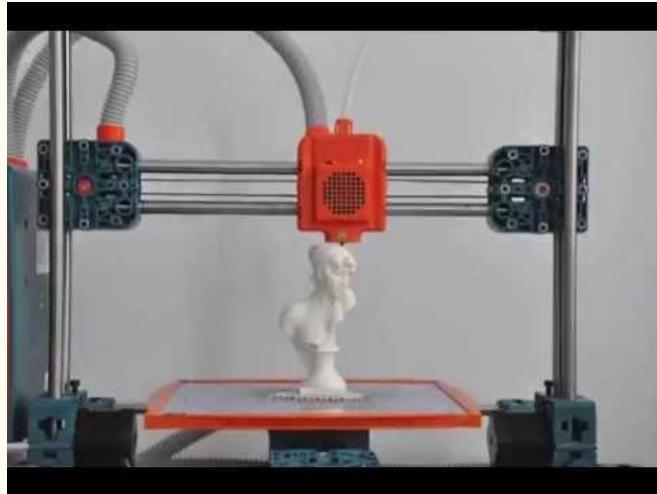
## Most common

- Extrusion
- Light Polymerized

- Powder Bed
  - Laminated
  - Powder Fed
  - Wire
-

# Common Printing Types

FDM - Fused Deposition Modelling  
(Extrusion)



SLA/DLP - Stereolithography  
(Light Polymerized)

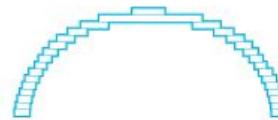


# 3D Printing

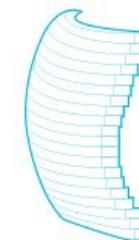
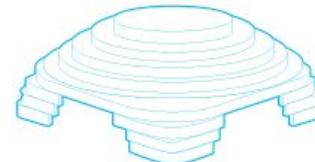
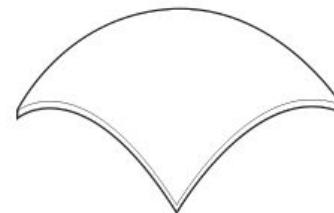
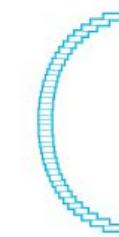
- Layer by Layer



3D Model



3D Print



# Powder Bed Method

- Powder Bed
  - Print in higher quality
  - Greater speed and volume
- Commonly used in commercial and metal/nylon printing machines
- More Materials
  - Metal
- Expensive

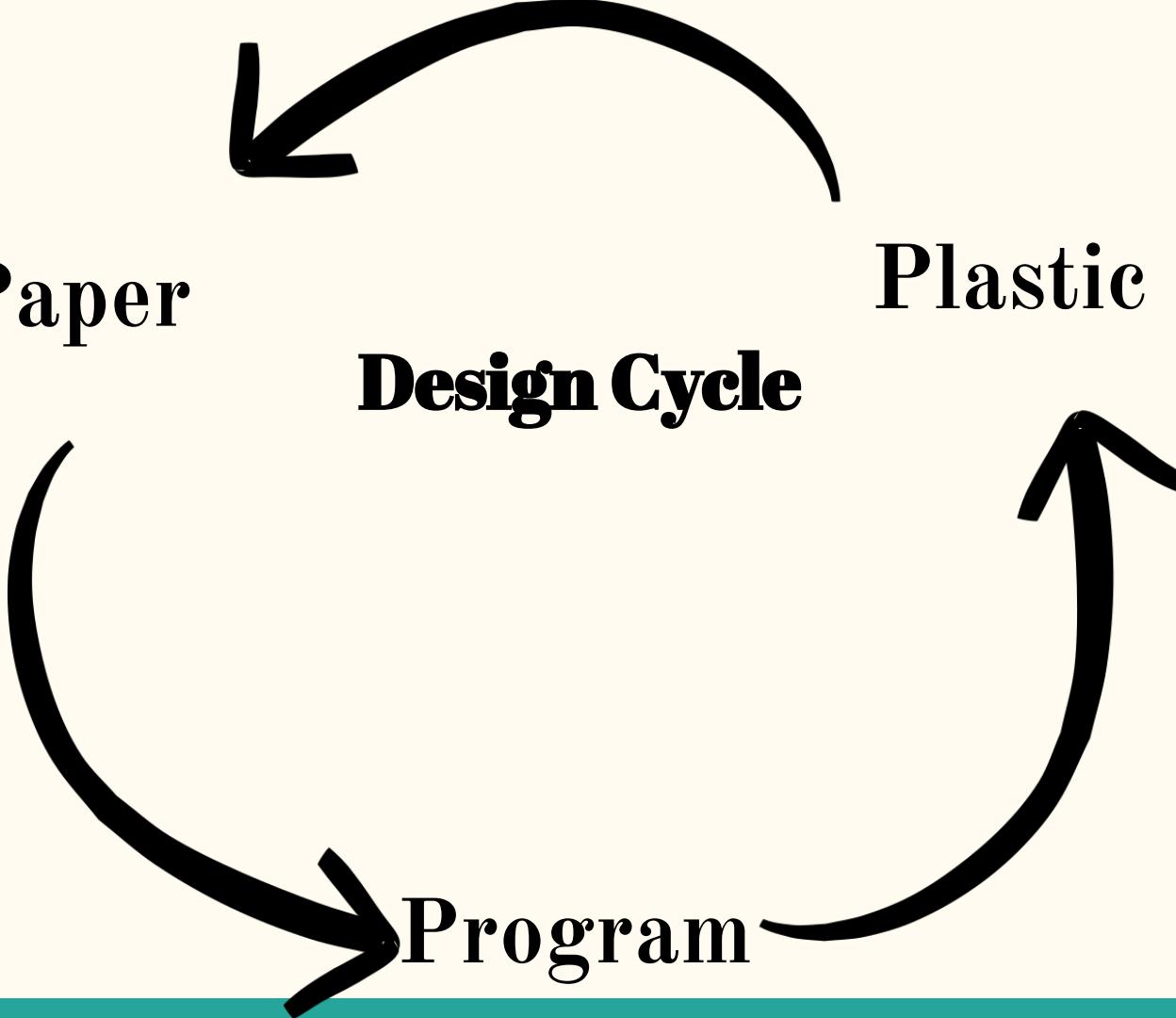


Paper

Plastic

## **Design Cycle**

Program



# Paper

Planning and Preparation

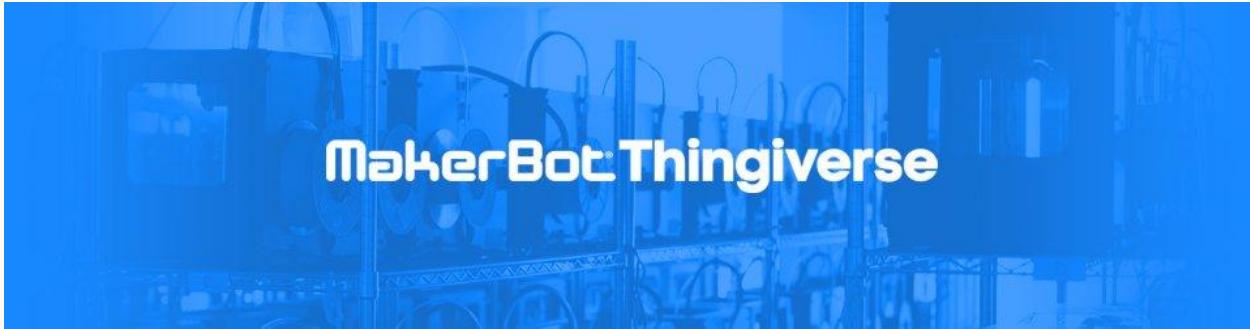
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*All we have to decide is  
what to do with the time  
that is given to us*



Does it exist already?

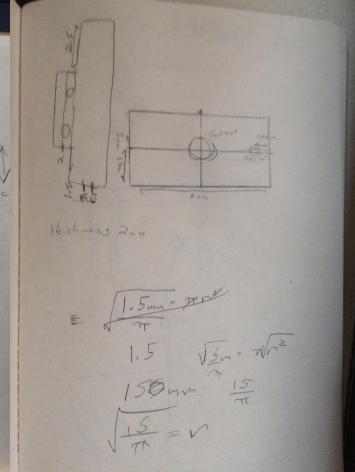
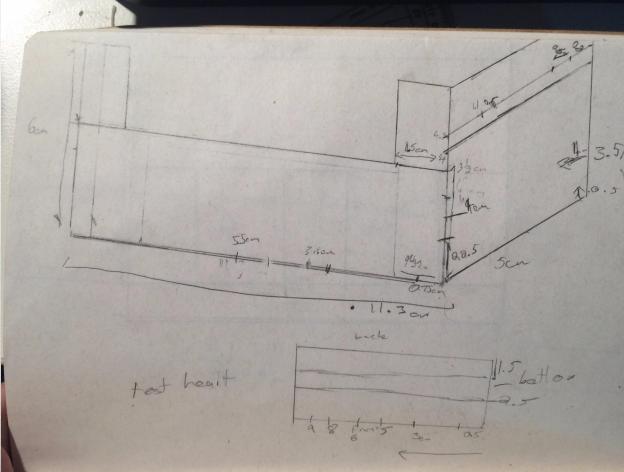
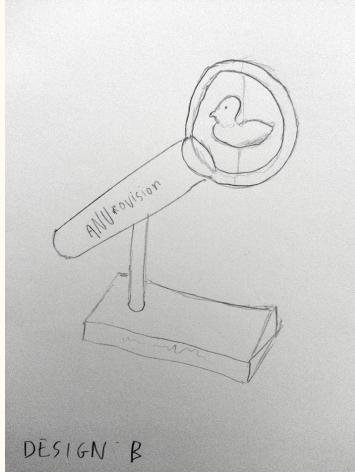
# Places of Printable Stuff



- Thingiverse
- GrabCAD
- Sketchfab
- Autodesk 123D
- CGTrader
- Yobi3D
- STL
- My Mini Factory
- Yeggi
- YouMagine

# Draw a sketch

- Solidifies your idea
- Identifies problems and flaws early
- Gets the creative juices flowing



# Needs

Is there a lot of detail?



How strong does it  
need to be?



How is the object used?



# FDM (Layers)

vs

# SLA/DLP

## Good

- Wide variety of materials
- Common
- Cheap
- Consumables

## Not So Good

- Limited Detail

## Good

- **Extremely High Detail**
- Smooth Seamless

## Not So Good

- Expensive
- Limited Materials and Colours
- Consumables

# Materials

## **PLA - polylactide**

*Good all round plastic most commonly used*

- Plant based, biodegradable
- Wider range of colours-opacity
- Higher Print speed
- Low warping



## **ABS**

*Good for things that need strength and solidness*

- Petroleum based
- Higher strength
- More flexible
- Easily sanded, machined



# Wood

- Smells like wood when printing
- Different shades from light to dark wood
- Sandable and paintable



# Metal

- Feels like metal
- Can be drilled and polished



Stainless Steel



# Flexible

- Bending and Flexible



# Other Filaments

- Coffee



- Beer  
waste byproducts, spent grain

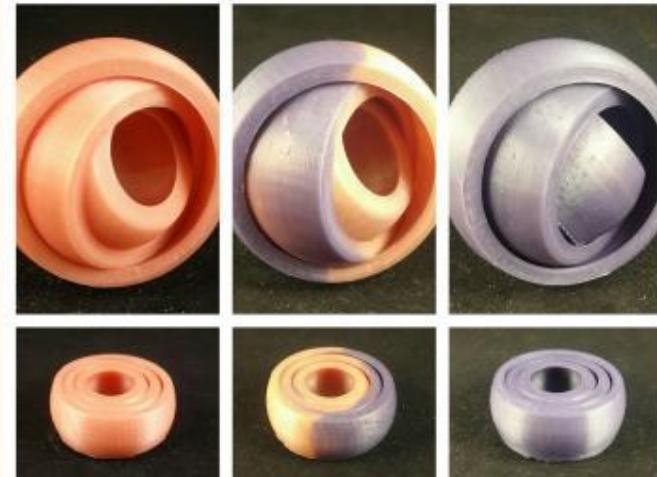


- Hemp  
Marijuana



# Many Many More

- PVC, released a few weeks ago
- Engineering specific materials
- Nylon
- Glow in the dark
- Colour Changing

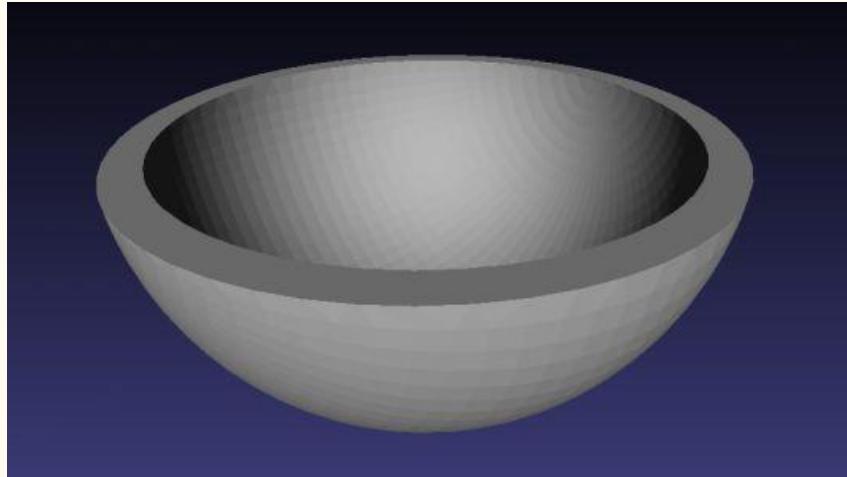
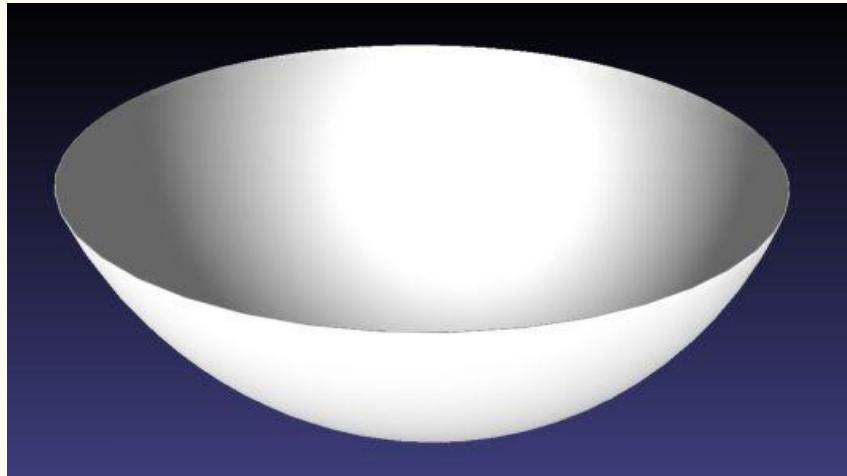


# Design Considerations

Simple, but the most important

# Wall Thickness

- Bigger Model thicker walls
- Too thin = Weak model



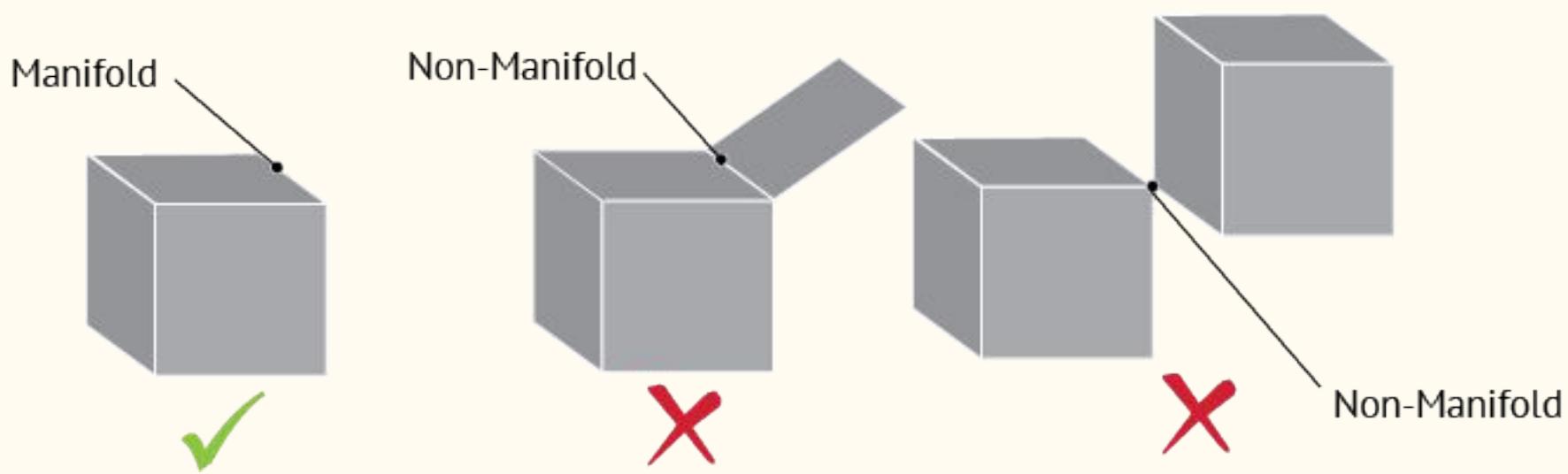
# “Water Tight” Model

- Missing “Faces”
- Unconnected Edges/Vertices



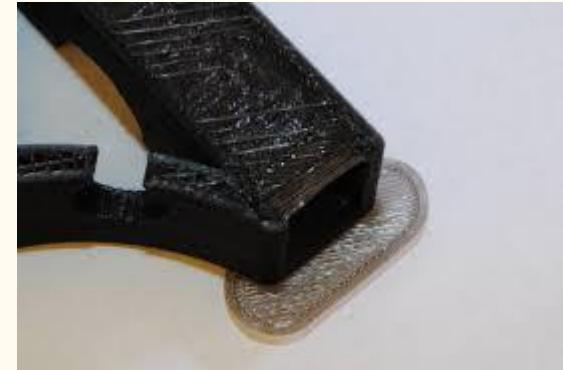
# Non-Manifold Objects

- Shapes/Geometry that can't exist in the real world
- No width



# Corners

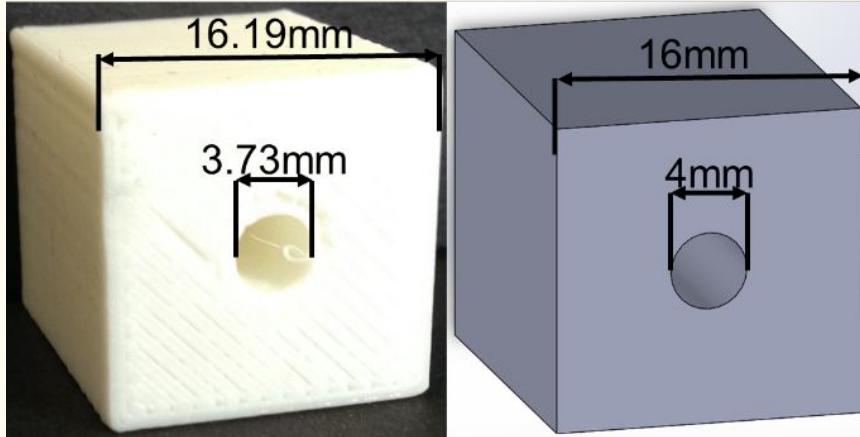
- Corners can “Curl”
- Round Corners are stronger than sharp
- Mouse Ears prevents curling and improves printing



# Spacing

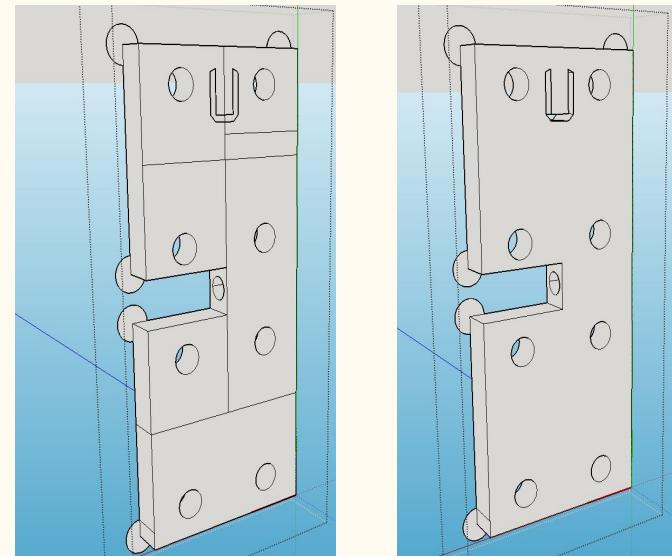
Default (Rule of Thumb)

- Tight Fit = 0.2mm
- Loose Fit = 0.4mm



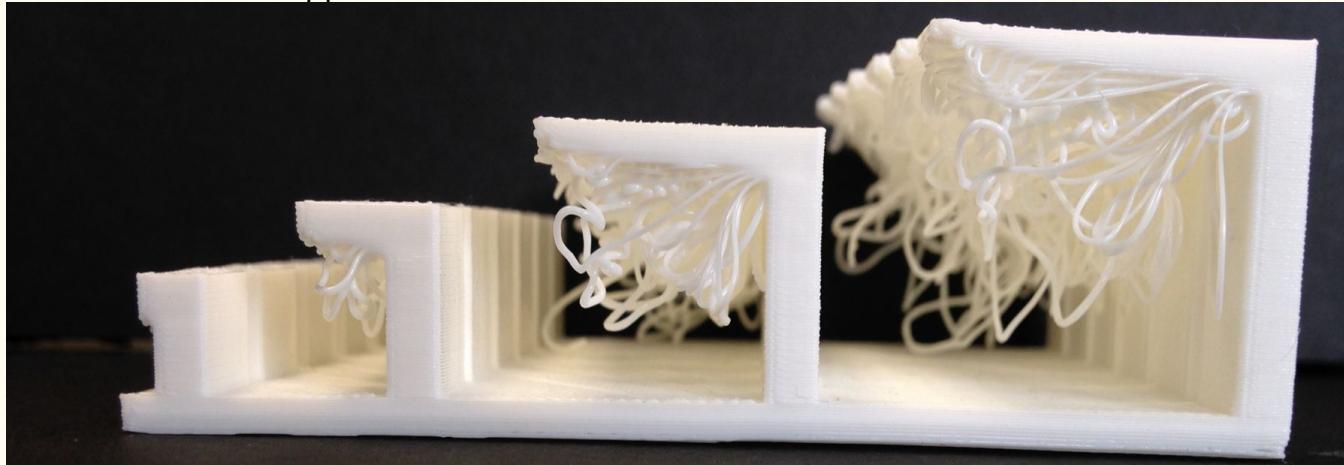
## Clean up your model

- Stray lines and faces



# Supports

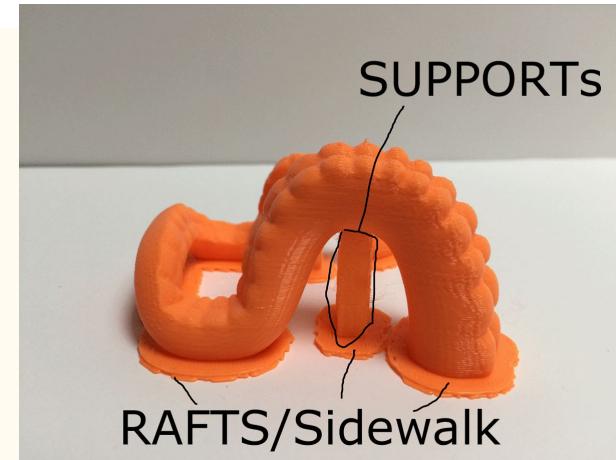
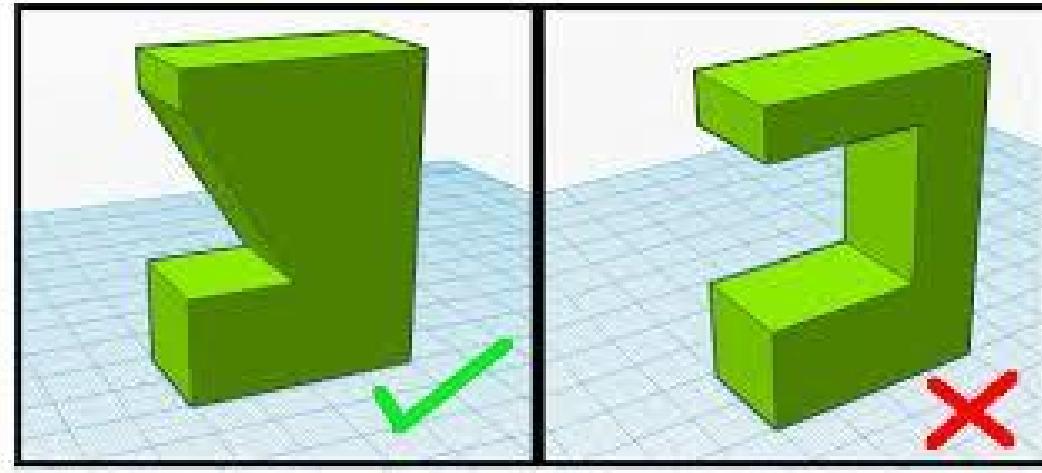
- Try to design to not use supports
- 45 degree rule
  - If a overhang is 45 degrees of more than it will need support.



Failed Horizontal Overhangs

# DIY Supports

- Most software has automatic support generators
- Build supports into your model



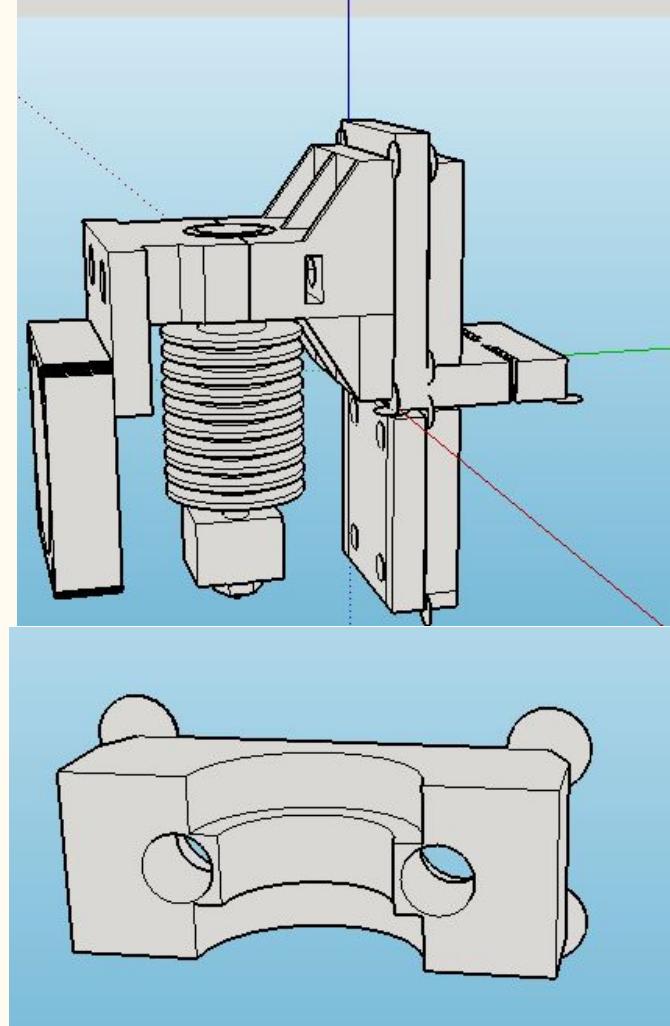
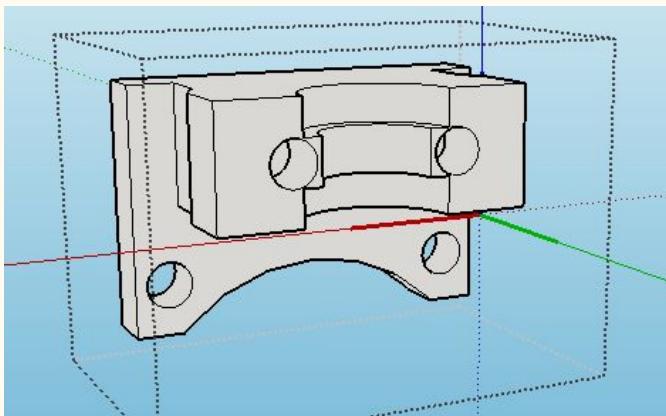
# Multipart Pieces

- Breaking up a object can avoid supports
- Improve print quality and speed



# Testing Parts

- Triple Check sizes, gaps and tolerances.
- Segmentation for real world testing



# Help?

Getting help

# Documentation

- Google!! Google!! Google!!
- Forums
  - [3dprintboard.com](#)
  - <https://www.3dhubs.com/talk>
  - <https://www.3dprintingforum.org/>
  - [ms.whirlpool.net.au](http://ms.whirlpool.net.au) › Gadgets

# Drop in Sessions

- Semester 2 - *to be announced*  
3D Printing/Modelling help drop ins

Club Email: [anu.maker.club@gmail.com](mailto:anu.maker.club@gmail.com)

Subject: 3D Printing Help

# Break Time



# Program

---

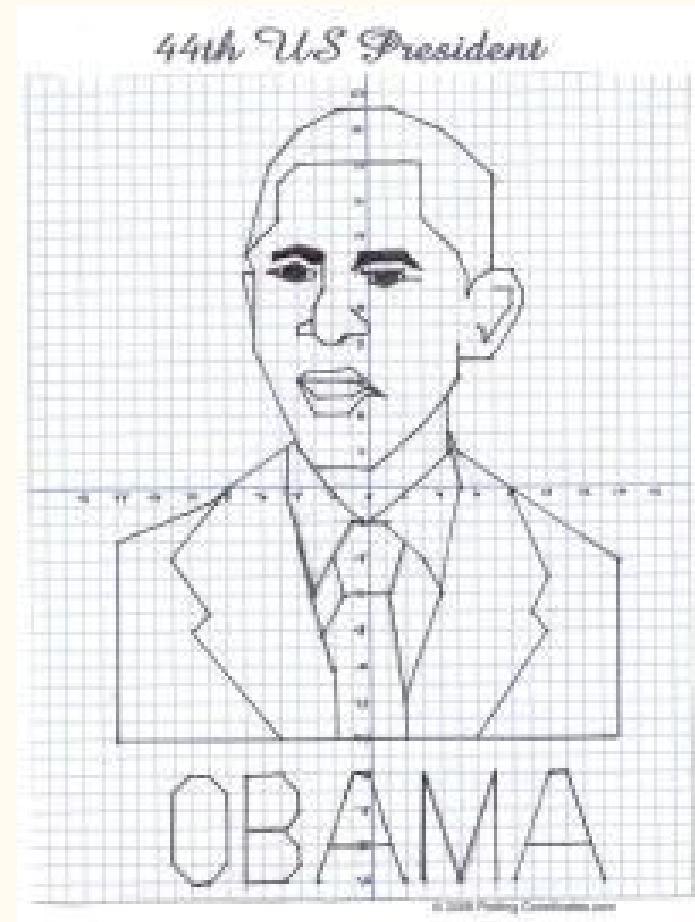
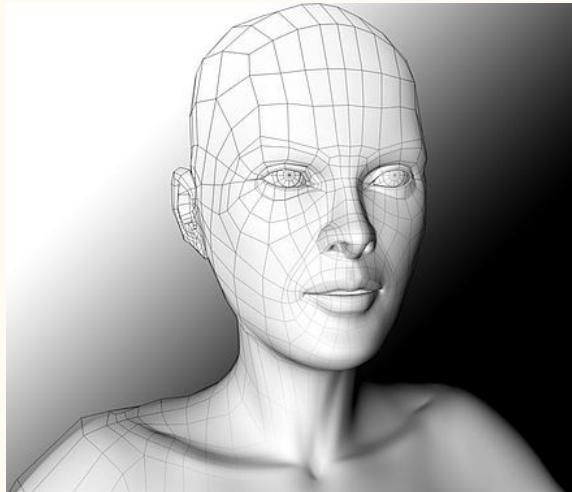
# What will we be (trying)to make?

- Experiment with different programs
- Think about design
- Cross Program Experience



# 3D Modelling

- Mathematical Virtual representation of an Object
- Made from triangles/lines/curves



# Computer Aided Design (CAD)

## Advantages

- High Level of accuracy

## Common Use

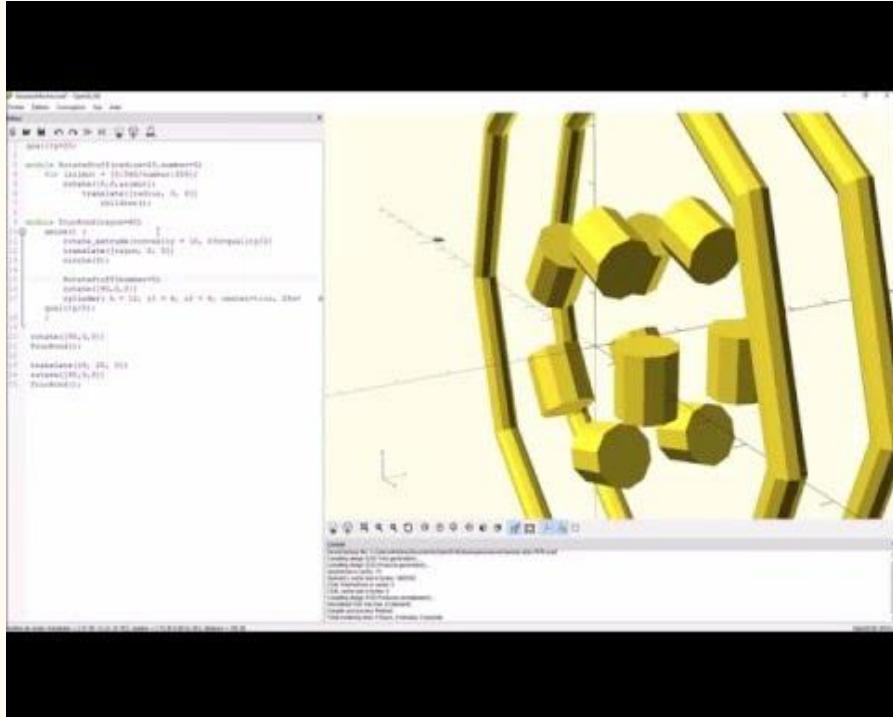
- Engineering



# Textual Modelling

## Advantages

- High Level of Accuracy
- Easily Customisable



# Interactive 3D Modelling

## Advantages

- Artistic Freedom
- Additional features
  - Water/Physics simulation
  - Poseable Models

## Common Use

- Industry non-engineering modelling



# Sculpting

## Advantages

- Extreme level of detail
- Ideal results for organic modelling

## Common Use

- Creating organic models especially humans and animals



# Software for creating 3D models

Interactive 3D Modellers	Computer Aided Design (CAD)
Blender 3DS Max Sketchup	FreeCAD AutoCAD Autodesk 360
Textual Modeller	Sculpters
OpenSCAD OpenJSCAD	Sculptris Z-Brush

# Which Programs to use?

- Lot of customisation little detail?  
OpenSCAD
- High level of detail?  
Sculpting/Interactive Modelers
- Functional/Highly Accurate  
Parts?  
CAD Software

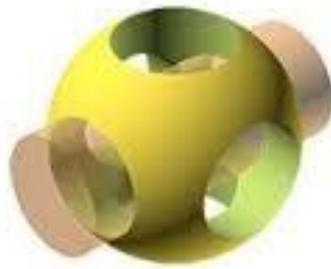
Overall what program works best for you!

Some programs have a steep learning curve



Difficulty: Beginner and Intermediate

- Easy to learn
- Fast and efficient workflow
- Accuracy
- Free version can't be used commercially



OpenSCAD

Difficulty: beginners - Intermediate

- Code Orientated

<http://openscad.net/>



AUTODESK®  
TINKERCAD®

Difficulty: Beginner

- Browser Based
- Simple to use

<https://www.tinkercad.com/>



Difficulty: Advanced - Intermediate

- Feature Rich
  - Sculpting
  - Game Engine
  - Physics
  - Animation
- Free!!!!
- High Learning Curve

# SculptGL

Difficulty: Beginner to Advanced

- Open Source
- Browser Based

<http://stephaneginier.com/sculptgl/>

Time to  
make  
Something



AUTODESK®  
TINKERCAD®



SculptGL

## Questions to consider

- What orientation will the device be? (Upright, On the side)
- Where will it be used? (Bedside, desk)
- How will it be used? (Will the screen be pressed often, is it used more for display or many uses)

## Tolerances

0.2mm - Close Fit  
0.4mm - Loose Fit

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<https://creativecommons.org/licenses/>



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- Commercial, Tweaks, Remixes, Improvements
- Credit Original Maker
- Least restrictive license



## Attribution-ShareAlike CC BY-SA

- Commercial, Tweaks, Remixes, Improvements
- Credit Original Maker
- Often used for Open Source
- Used by Wikipedia



## Attribution No Derivs CC BY-ND

- Re-distribute for commercial/noncommercial
- No changes
- Credit to original Maker



## Attribution Noncommercial CC BY-NC

- Remix, Tweak build upon
- Must be non-commercial
- Credit original
- License does not pass to remixes/derivatives



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- Remix, Tweak, build upon
- Only non-commercial
- Credit original Maker
- License new creations under identical terms



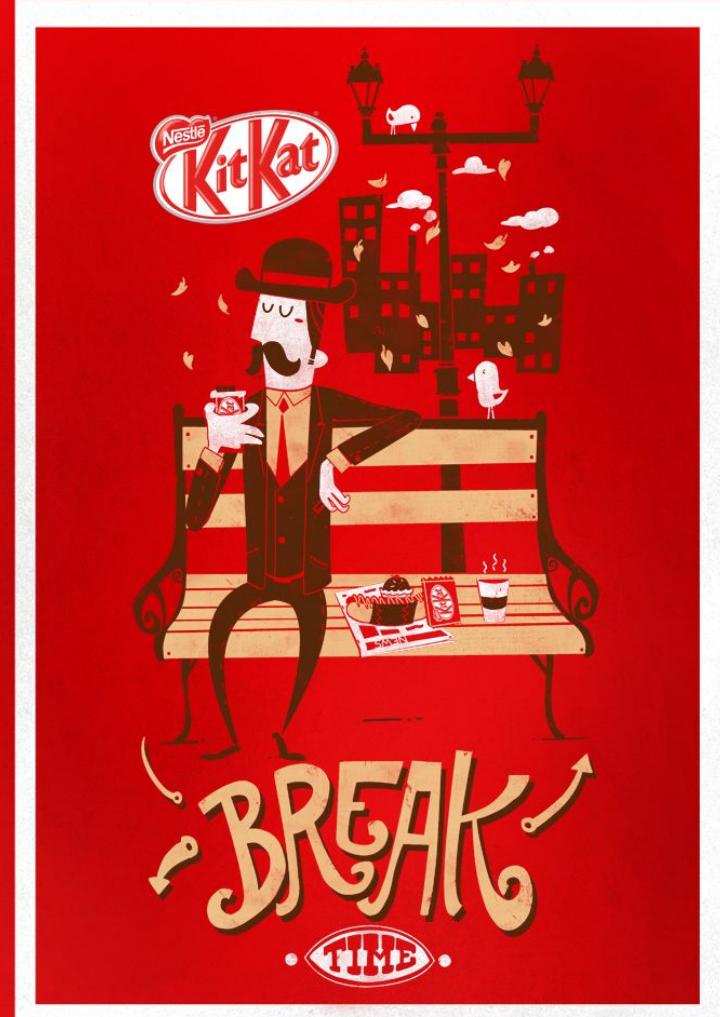
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- Sharing and Downloading
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- Most restrictive

# Public Domain License CC0



- Waive as many rights to the work as legally possible
- Free to be used by anyone for any purpose
- Work is not controlled or owned by anyone
- Free in the purest sense



# Plastic

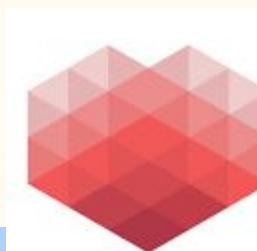
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## Places to Print

- The Club
  - Shapeways
  - 3D Hubs
-

# 3D Hubs

- Connects people with local printers
- Hire Designers



3D HUBS



# Shapeways

- 3D Printing Online Stores
- High Quality Printing Services
- Hire Designers

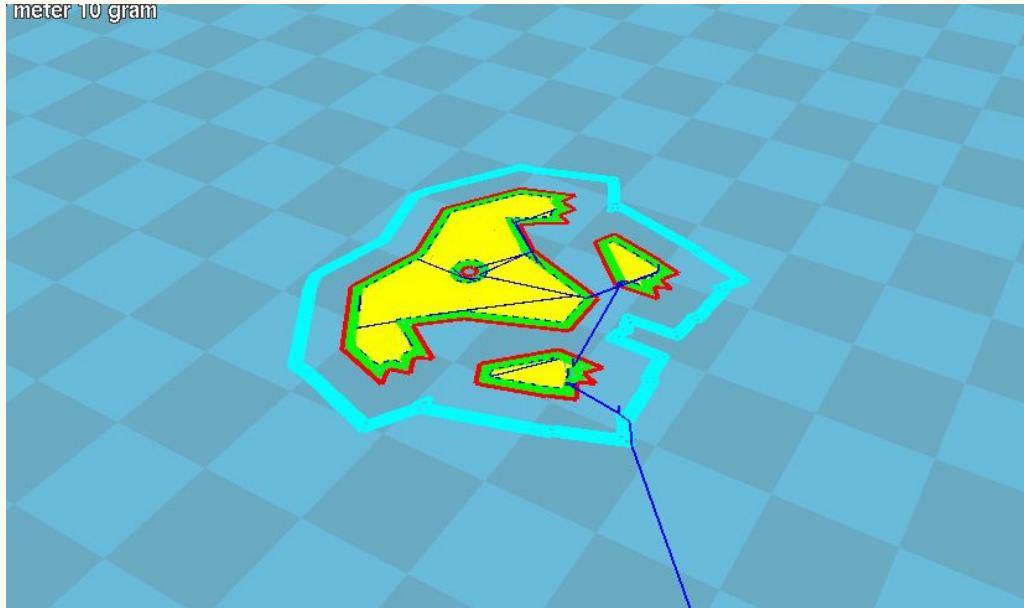


# The Club



# Slicers

- Slicers break down a 3D Model into individual layers or “slices” that consist of lines that are each printed or “extruded” by the printer.



# Break

# Last Notes

---

# Future Events

- Advanced Design for 3D Printing
- 3D Modelling
  - OpenSCAD
  - Blender
  - FreeCAD
- Wikipedia, editing and contributing

# Market Day Stall

- Starts Semester 2
- Items
  - 3D Printed Objects
  - Member made stuff
    - Members get a portion of profits

# Feedback!

