

# Creating Virtual Worlds

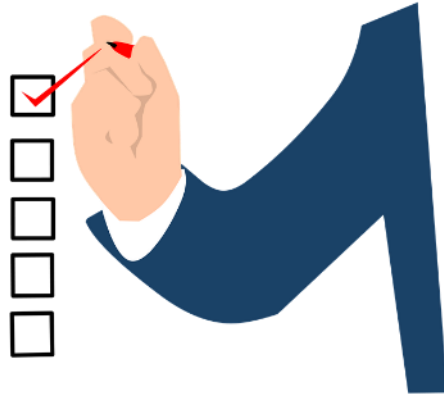
## 3D Modelling

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Lab 01

# A Quick Survey:



- Blender
- Unity 3D knowledge
- Programming (c#)
- VR/AR

(never – low – mid - high)

# Il corso

Sito web del corso (per avvisi e informazioni):

<https://vr.aislab.di.unimi.it/>

Scopo del corso:

- Esplorare differenti modalità di realizzazione e fruizione di esperienze VR.
- Fornirvi strumenti utili per la creazione di esperienze VR

Per approfondimenti:

Testo di riferimento (disponibile gratuitamente online)

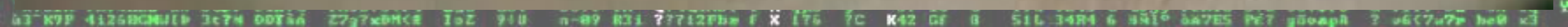
[Virtual Reality \(Steven M. LaValle\)](#)

# Modalità d'esame: ?

## Progetto finale :

- Applicazione realtime di VR/AR
- Video (1-2 minuti) di presentazione del progetto (Modalità a piacere: trailer, screen-capture, rendering, video 360° ). Il video verrà caricato sul canale YouTube del laboratorio.
- Il progetto può essere svolto da soli o in gruppo (max. 2 persone per gruppo)

# MATRIX



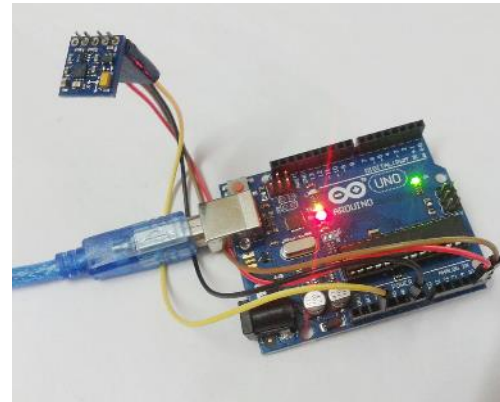
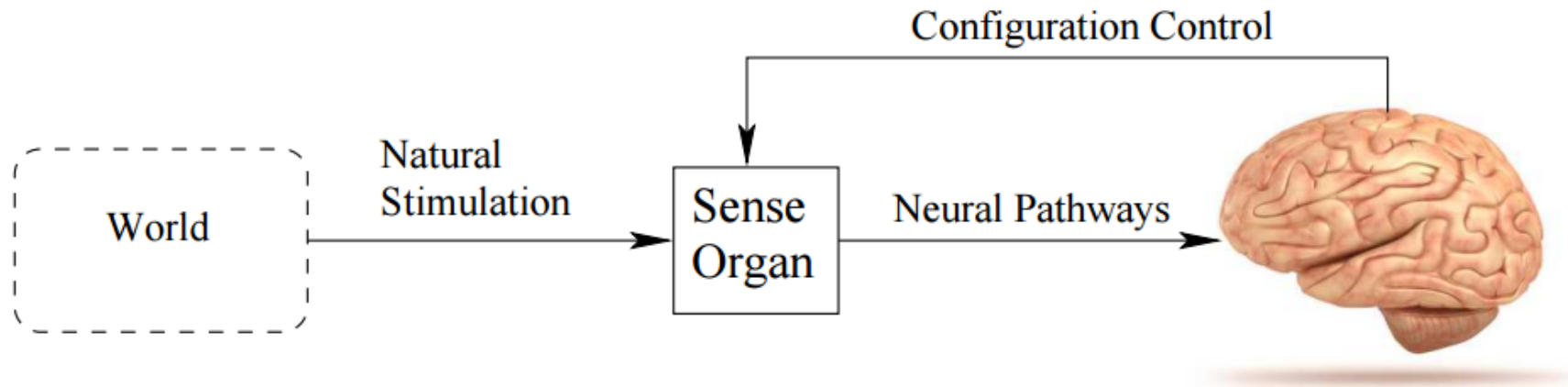
# What is Virtual Reality(VR)?

## **Definition of VR:**

Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference

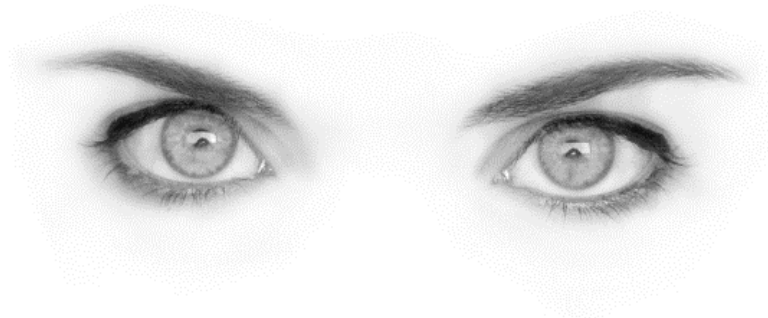
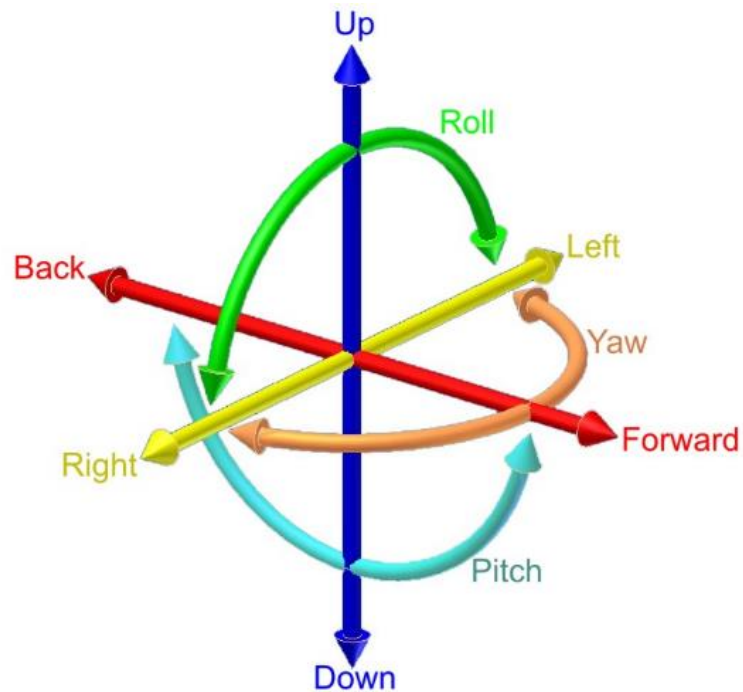
-LaValle

# Similarities between our brain and electronic circuits:



# Sense organ

## Degrees Of Freedom (DOF)





# Some I/O devices we are going to use:



Cardboard



Kinect 2



Oculus Rift DK2 and  
Oculus GO



Bluetooth VR controller



Augmented Reality (AR)  
on mobile devices and  
Microsoft HoloLens



Leap Motion Controller



Joypad

Our first I/O device:



# WHY ?



<https://vr.google.com/cardboard/>

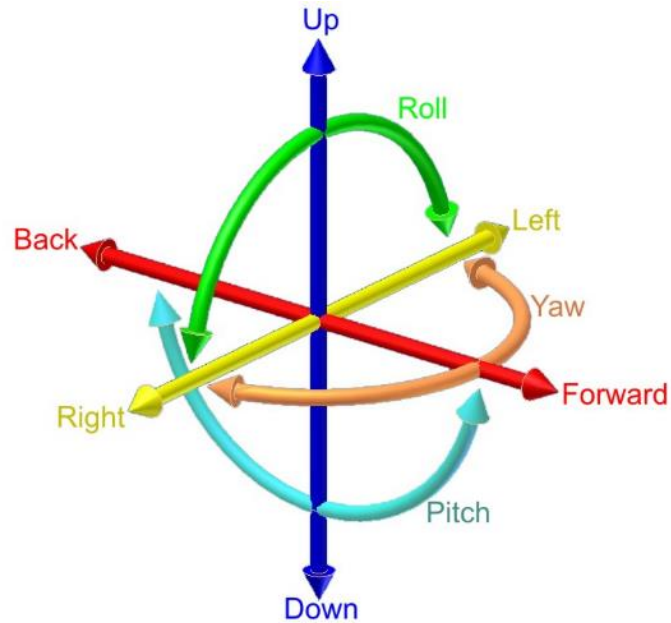


<https://vr.google.com/daydream/>



<http://www.samsung.com/global/galaxy/gear-vr/>

# Smartphone DOF

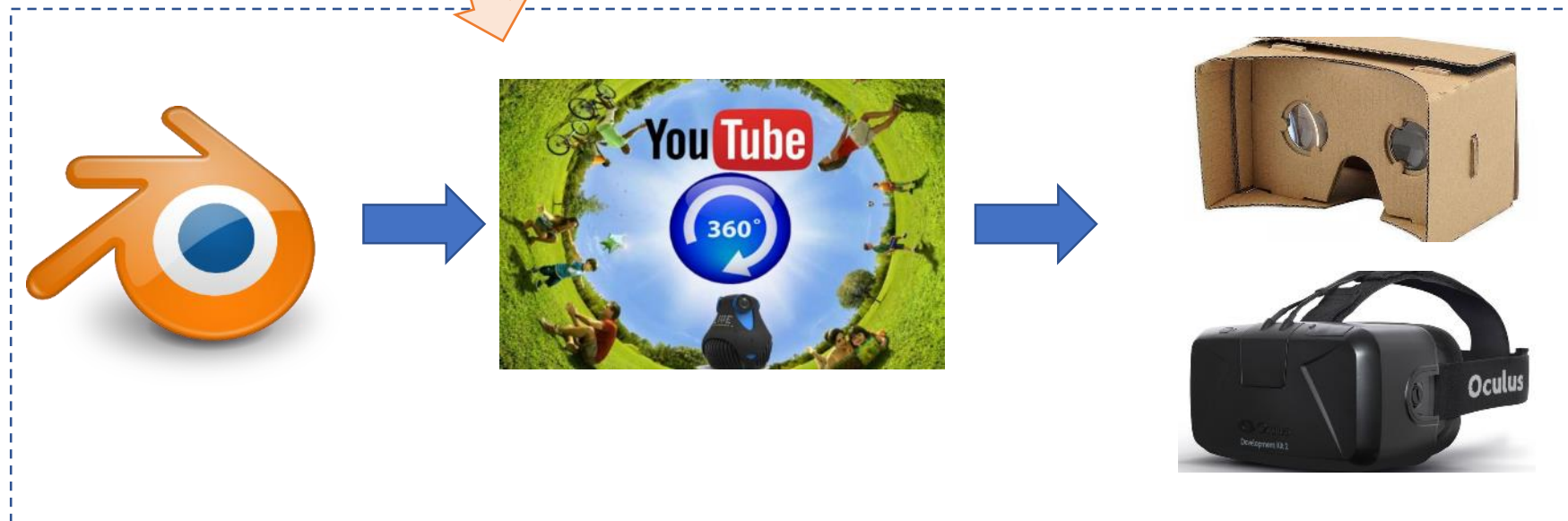
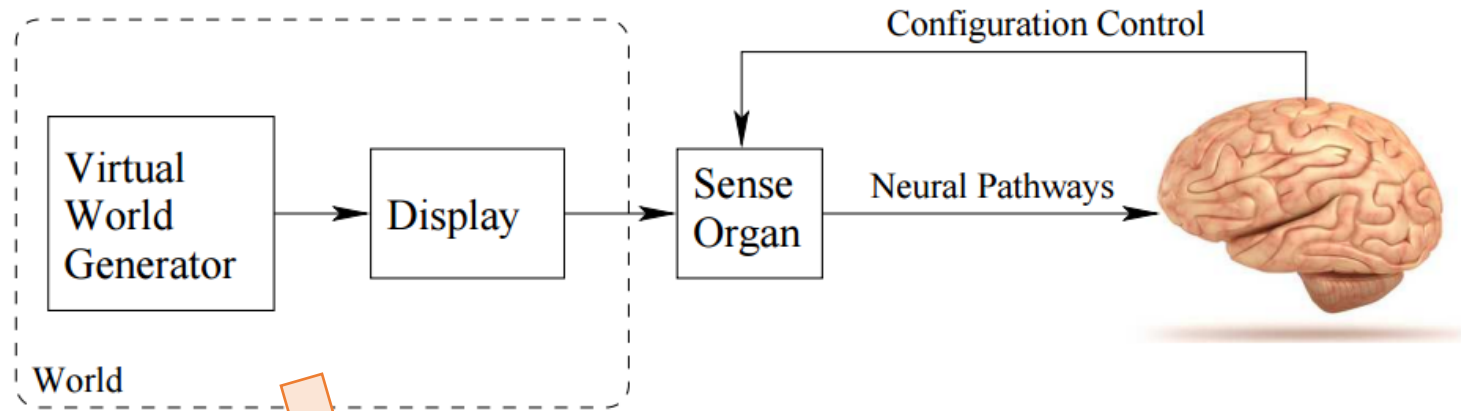


What are we able to measure with the smartphone? (Gyroscope Accelerometer)

We could estimate Rotation pretty well but not the position.  
(False in AR, we will need markers for robust position tracking)

# What we are going to do by the next lesson?

Create virtual world to cheat the human brain:



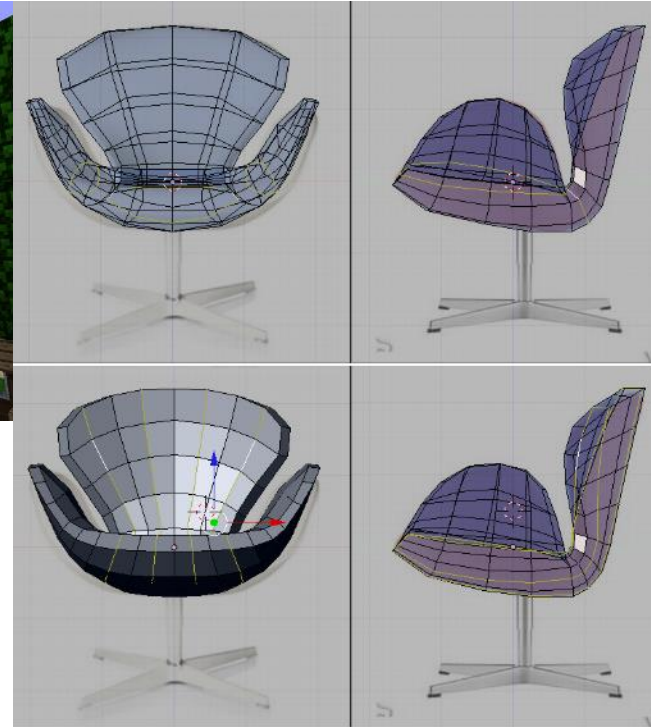
Let's start...



How to create a virtual world ?

# Which are the possible approaches to this problem?

- 3d Scanner (Photogrammetry-DepthCam)
- Procedural content generation
- Modelling



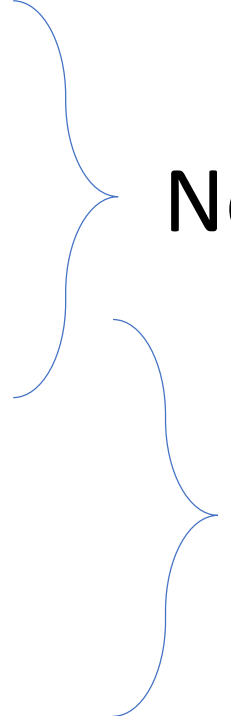
# WHAT are we going to use and WHY?



- Free and Open Source
- Modelling
- Texturing
- Rendering
- Video Editing
- VFX (video-tracking, greenscreen, etc.)
- GameEngine
- ...

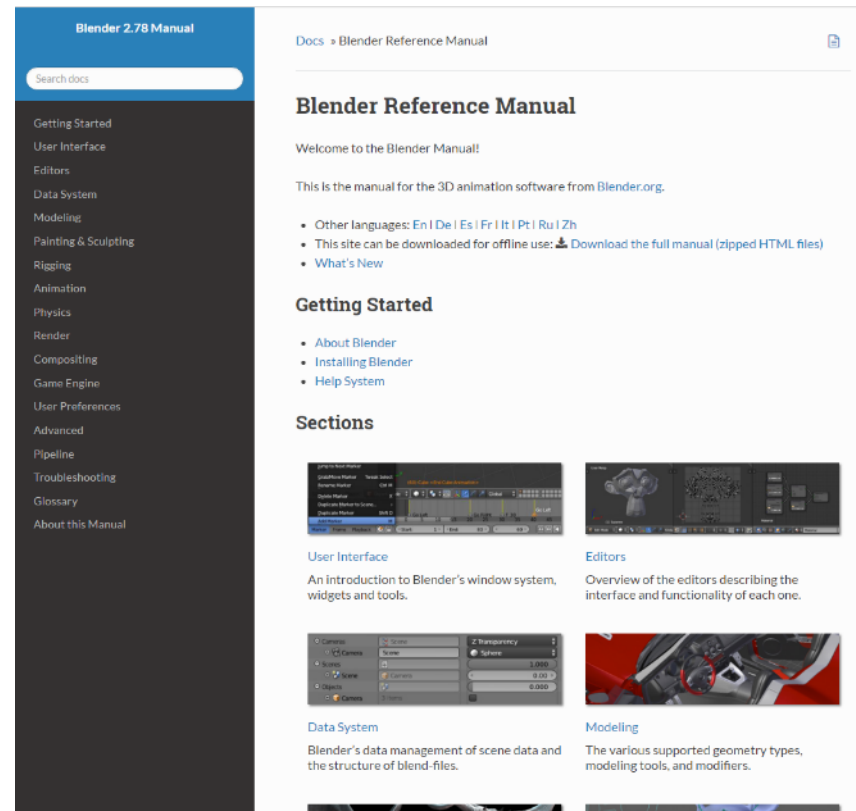


# Which modelling techniques are available in Blender ?

- Polygonal
  - Curve
  - *Simulation*
  - Procedural
  - Metaballs
  - Sculpting
- Non Organic
- Organic
- 
- A diagram showing a list of modelling techniques on the left, grouped into two categories on the right. The top three items (Polygonal, Curve, and Simulation) are grouped under the label 'Non Organic' by a blue curly bracket. The bottom three items (Procedural, Metaballs, and Sculpting) are grouped under the label 'Organic' by another blue curly bracket.

# Blender Documentation:

<https://docs.blender.org/manual/en/dev/>



The screenshot displays the Blender 2.78 Manual website. On the left is a dark navigation sidebar with a search bar and a list of categories including Getting Started, User Interface, Editors, Data System, Modeling, Painting & Sculpting, Rigging, Animation, Physics, Render, Compositing, Game Engine, User Preferences, Advanced, Pipeline, Troubleshooting, Glossary, and About this Manual. The main content area is titled 'Blender Reference Manual' and includes a welcome message, a link to the manual for Blender.org, and a list of other languages (En | De | Es | Fr | It | Pt | Ru | Zh). It also features sections for 'Getting Started' (About Blender, Installing Blender, Help System) and 'Sections' with four featured articles: 'User Interface' (introduction to window system), 'Editors' (overview of editors), 'Data System' (scene data management), and 'Modeling' (supported geometry types and tools). Each article is accompanied by a small thumbnail image from the Blender interface.

# Blender introduction



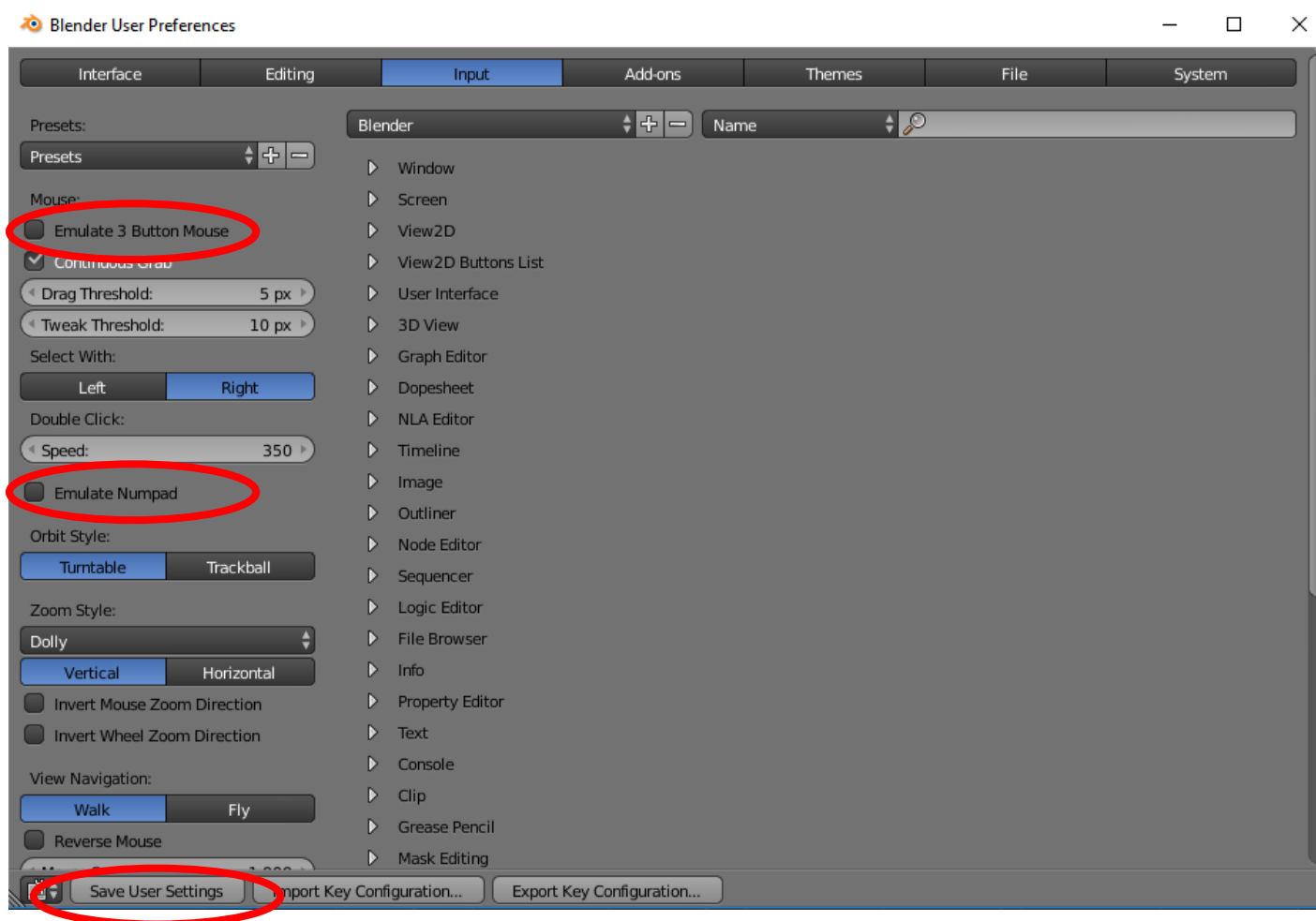
Basic concepts will be introduced during the course when needed.

Take a look here for good tutorials: Cg cookies

<https://www.youtube.com/user/blendercookie/playlists>

# Blender shortcuts and laptop useful tips:

<https://www.giudansky.com/design/51-blender-map>



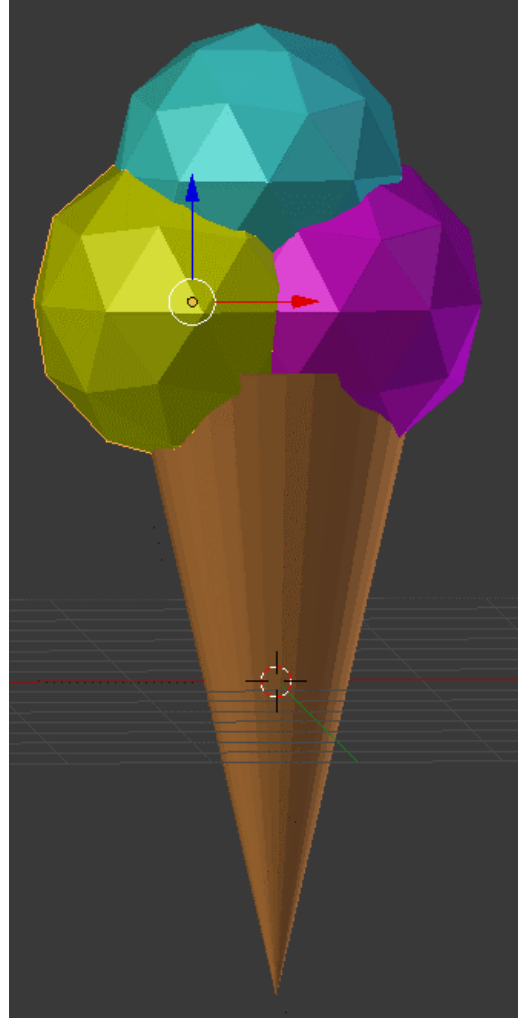
# Moving things around :

- Exploring the 3D view:
  - Mouse buttons
    - Left -> move 3d cursor (origin)
    - Shift + Middle -> Pan
    - Middle -> Rotate around world(0,0,0)
    - Wheel -> Zoom
    - Right -> Select / move
  - If 3rd mouse button emulated:
    - Alt + Left -> Rotate around world(0,0,0)
    - Ctrl + Alt + Left-> Zoom
    - Shift + Alt + Left -> Pan
- Create things:
  - Shift + A (Add to the Scene)
- Moving stuff around:
  - Select the object
  - Translate - Rotate – Scale (Handles)

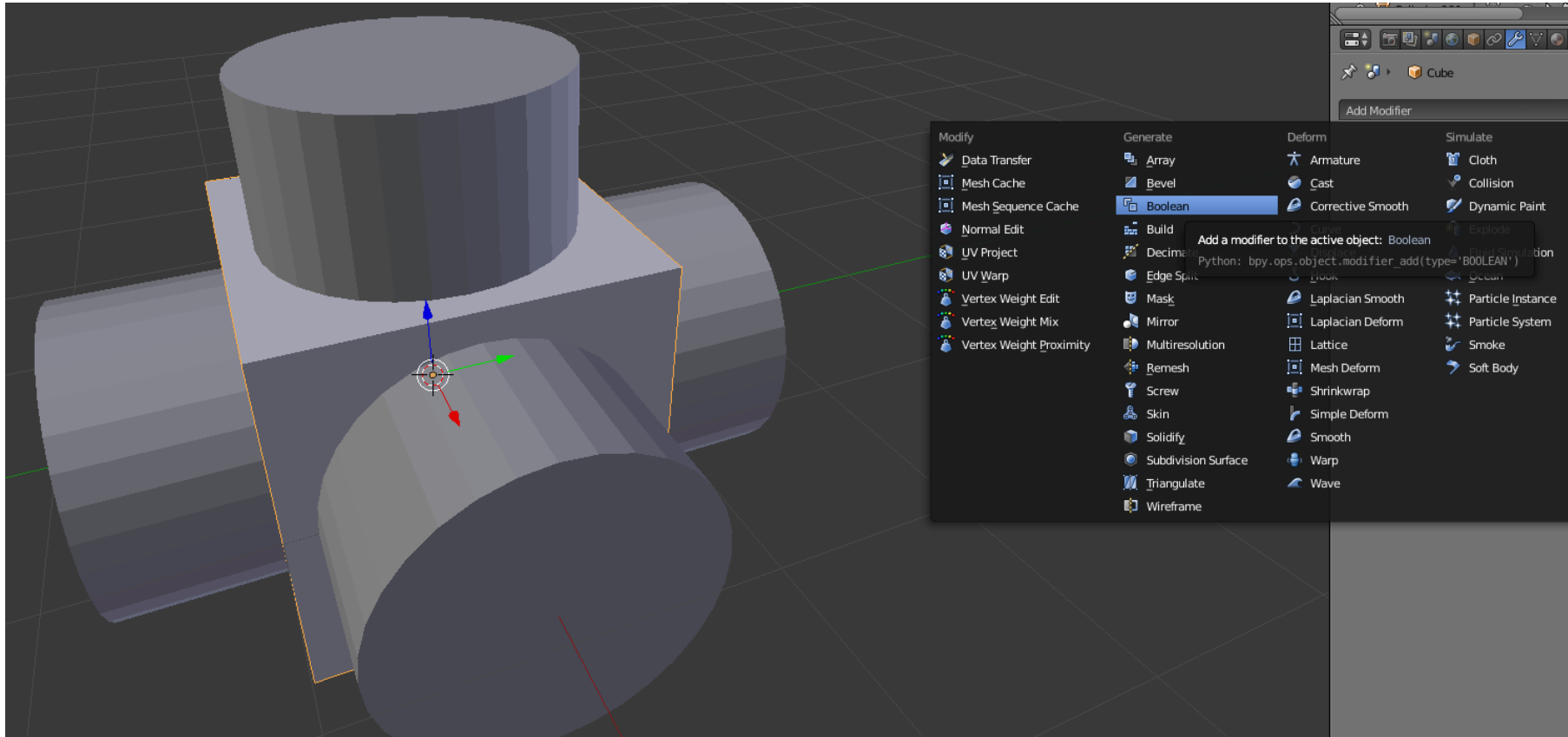
# Let's start using some primitives:

The fantabulous ice-cream ingredients :

- Cone
- Cream sphere

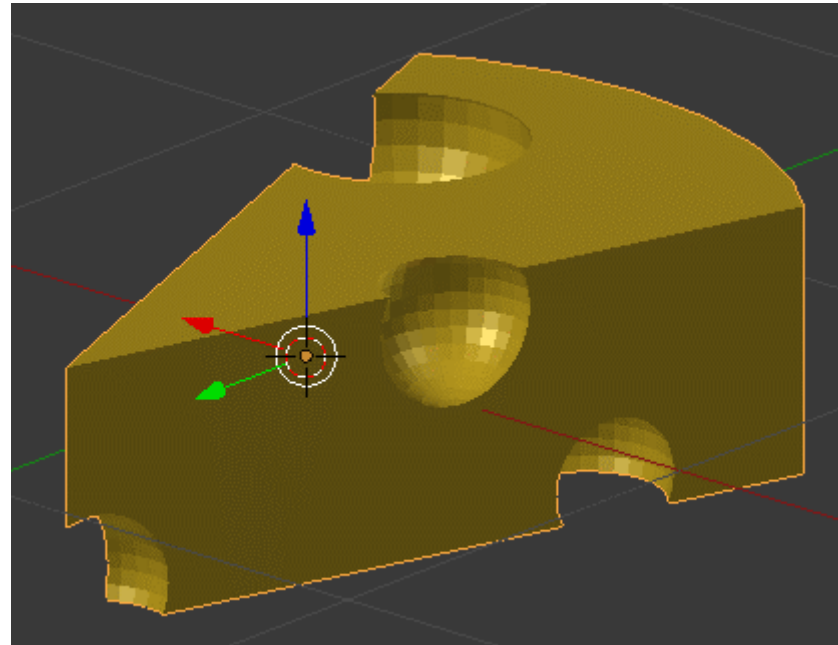


# Modifiers: Boolean



# Let's make cheese:

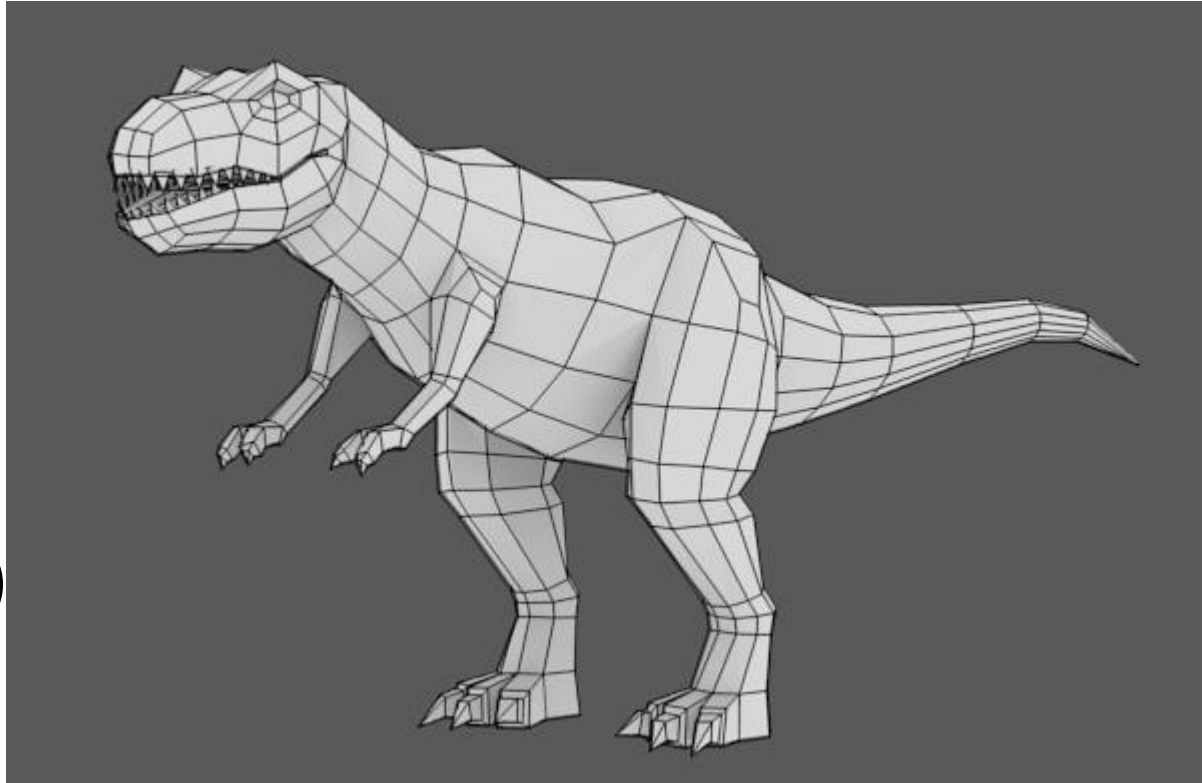
- Swiss Cheese





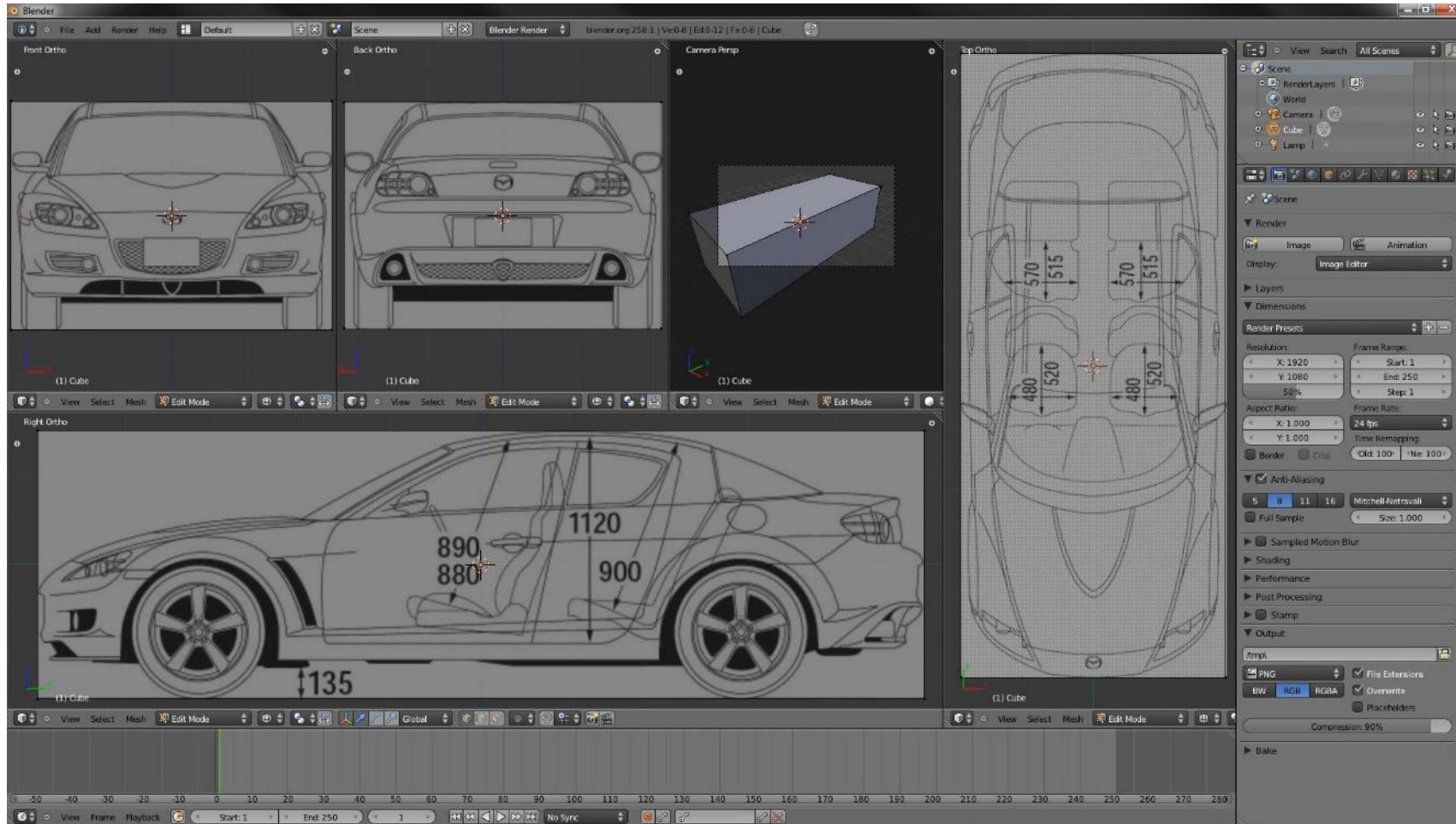
# Polygonal - Edit mode (tab)

- Vertex
  - Edge
  - Faces
- 
- Extrude(e)
  - Cut (Ctrl + r + wheel)
  - Select connected vertices(L)
  - Split Mesh(p)
  - Join Mesh(Ctrl+j)
  - Merge Vertices(alt+m)



# Reference Images

(search in google images: blueprints 3d modeling)

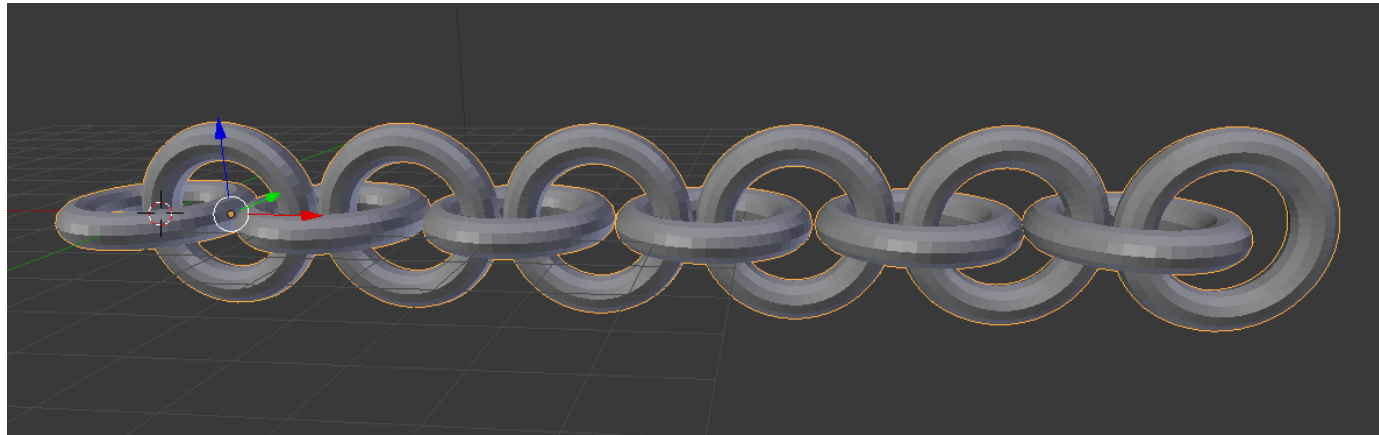


# Blender Modifiers

- Mirror
- Decimate
- Array
- Displace (linked to a noise texture)



Let's chain:

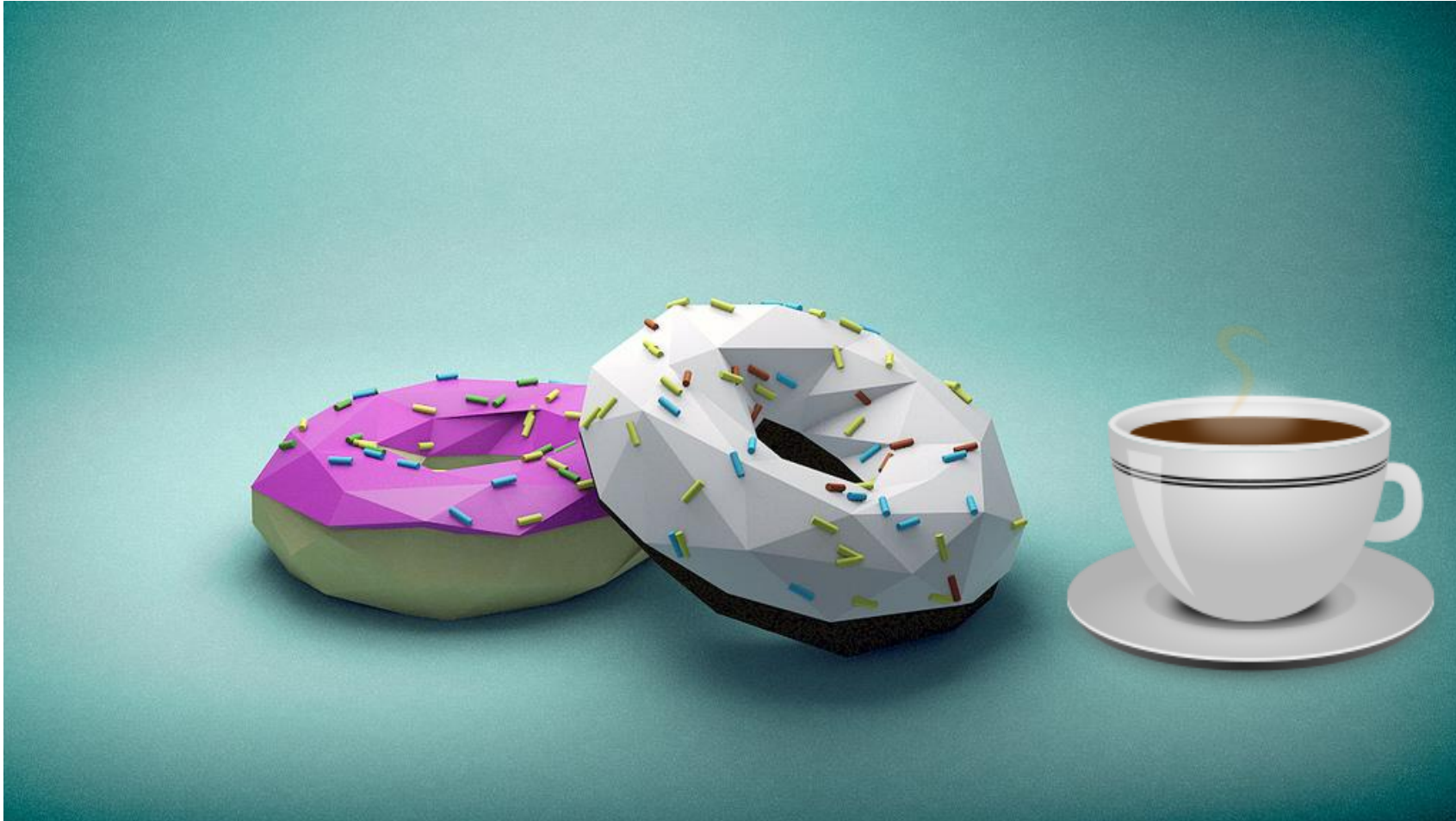


# Let's create something... (low poly)

- Start extruding/cutting the cube (e / ctrl + r)
- Apply some modifier  
(for example the Mirror modifier to simplify the process)

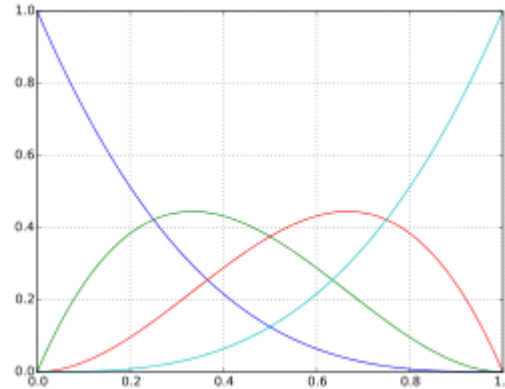
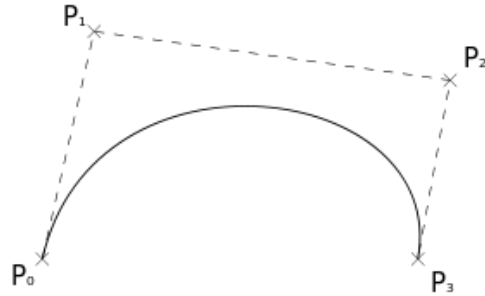
You have 10 mins

Coffee BREAK!!! (15 min)



# Curve

- Bezier
- B-Spline
- Nurbs
- ...



The [basis functions](#) on the range  $t$  in  $[0,1]$  for cubic Bézier curves:

blue:  $y_0 = (1 - t)^3$

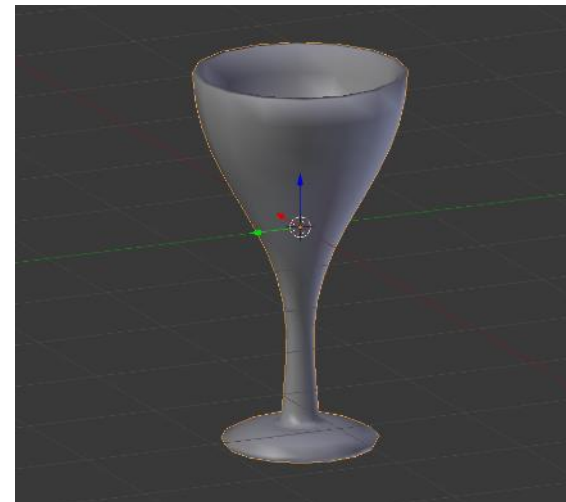
green:  $y_1 = 3(1 - t)^2 t$

red:  $y_2 = 3(1 - t) t^2$

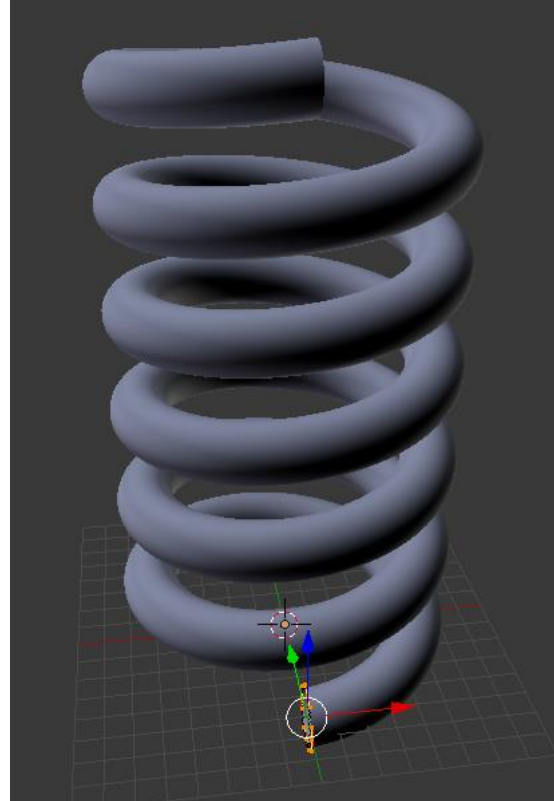
cyan:  $y_3 = t^3$ .

## Let's create a Glass:

- Add Bezier curve
- Rotate y  $90^\circ$  & apply rotation
- Add/Adjust control vertex (edit mode)
- Add Screw modifier
- If needed convert from curve to mesh



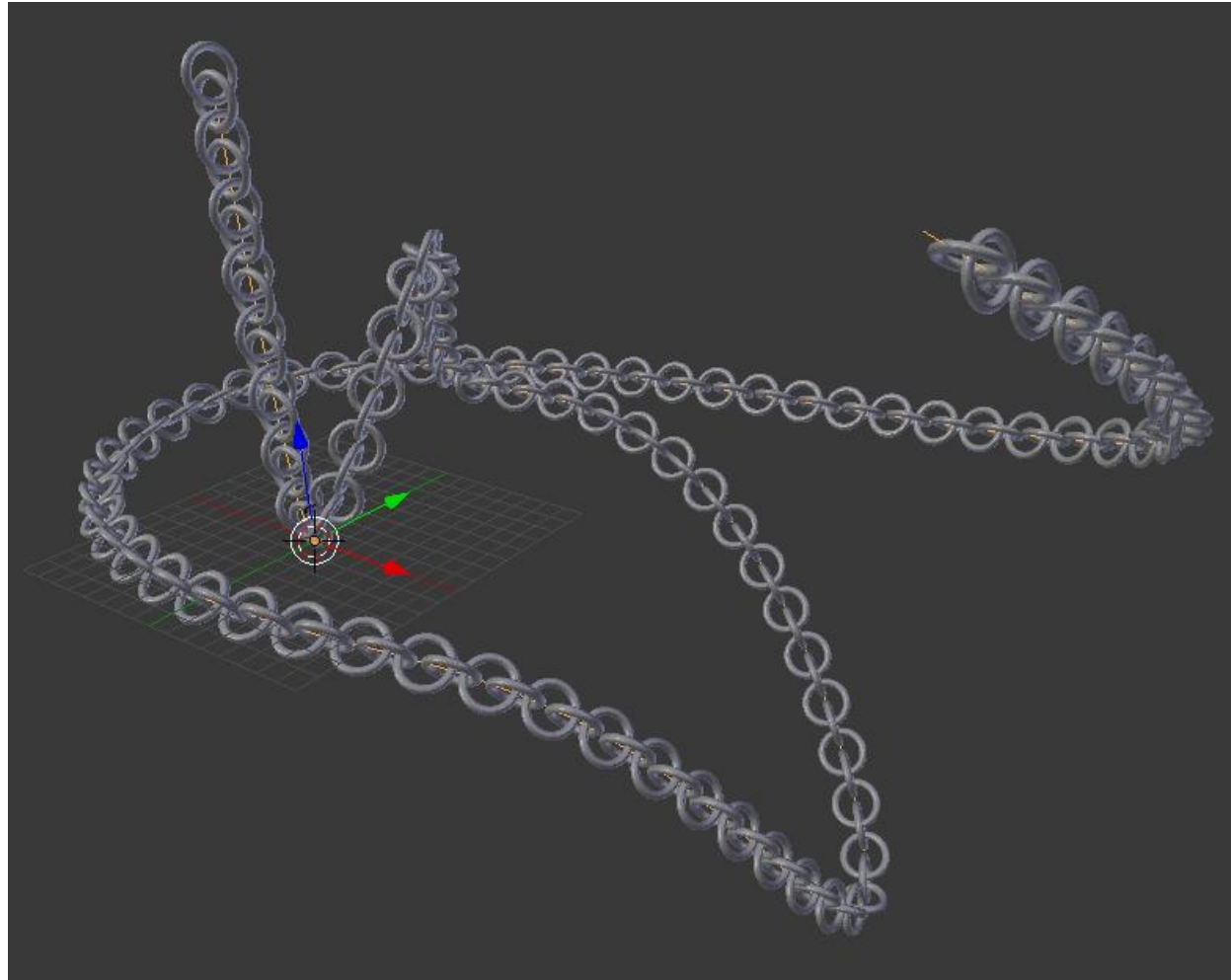
# Let's create a spring:



HINT: Pay attention to the pivot! If it's wrong you are going to create a sphere instead...



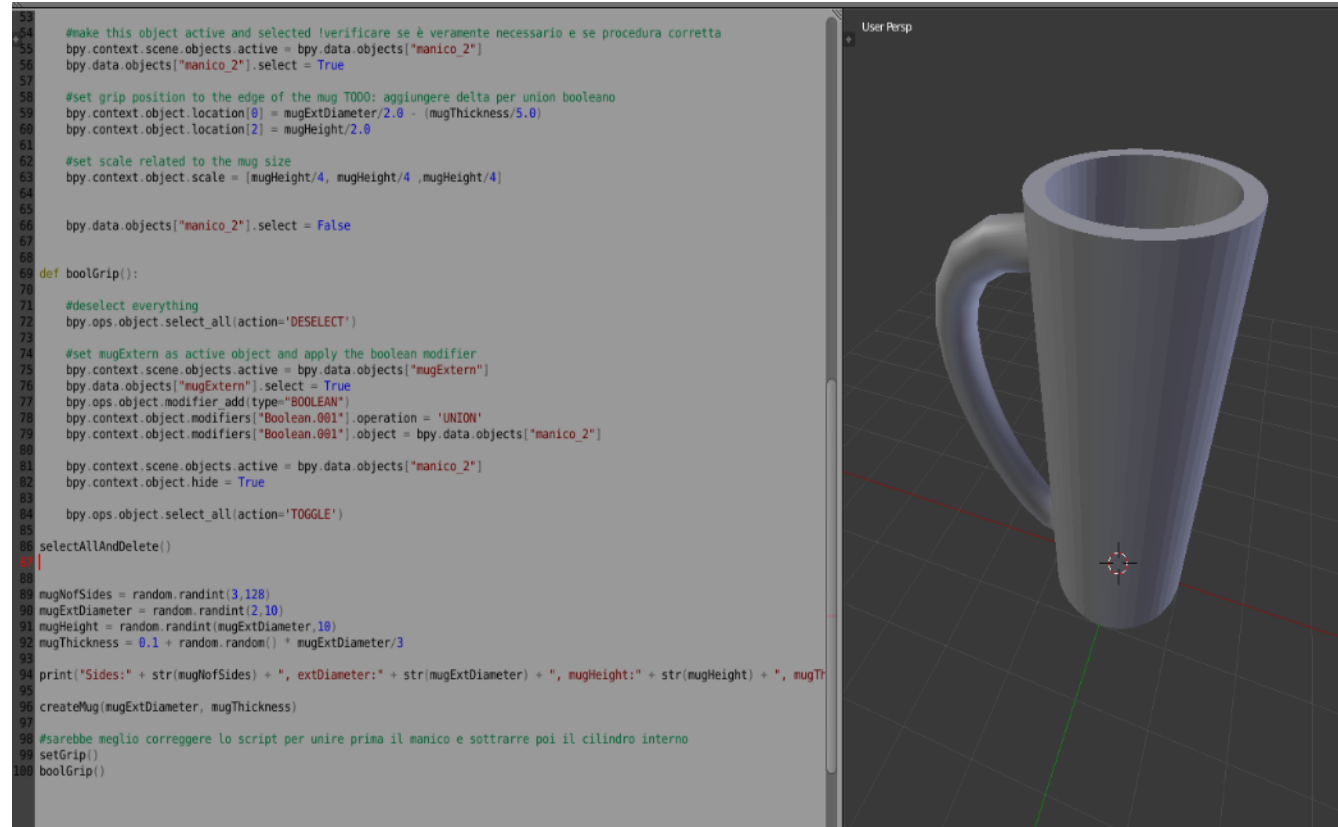
Let's chain again with curves:



# Procedural Content Generation

( [PCG is the programmatic generation of game content using a random or pseudo-random process that results in an unpredictable range of possible game play space](#))

- Python 3.X
- Boolean
- Random or Tailored



# Metaballs



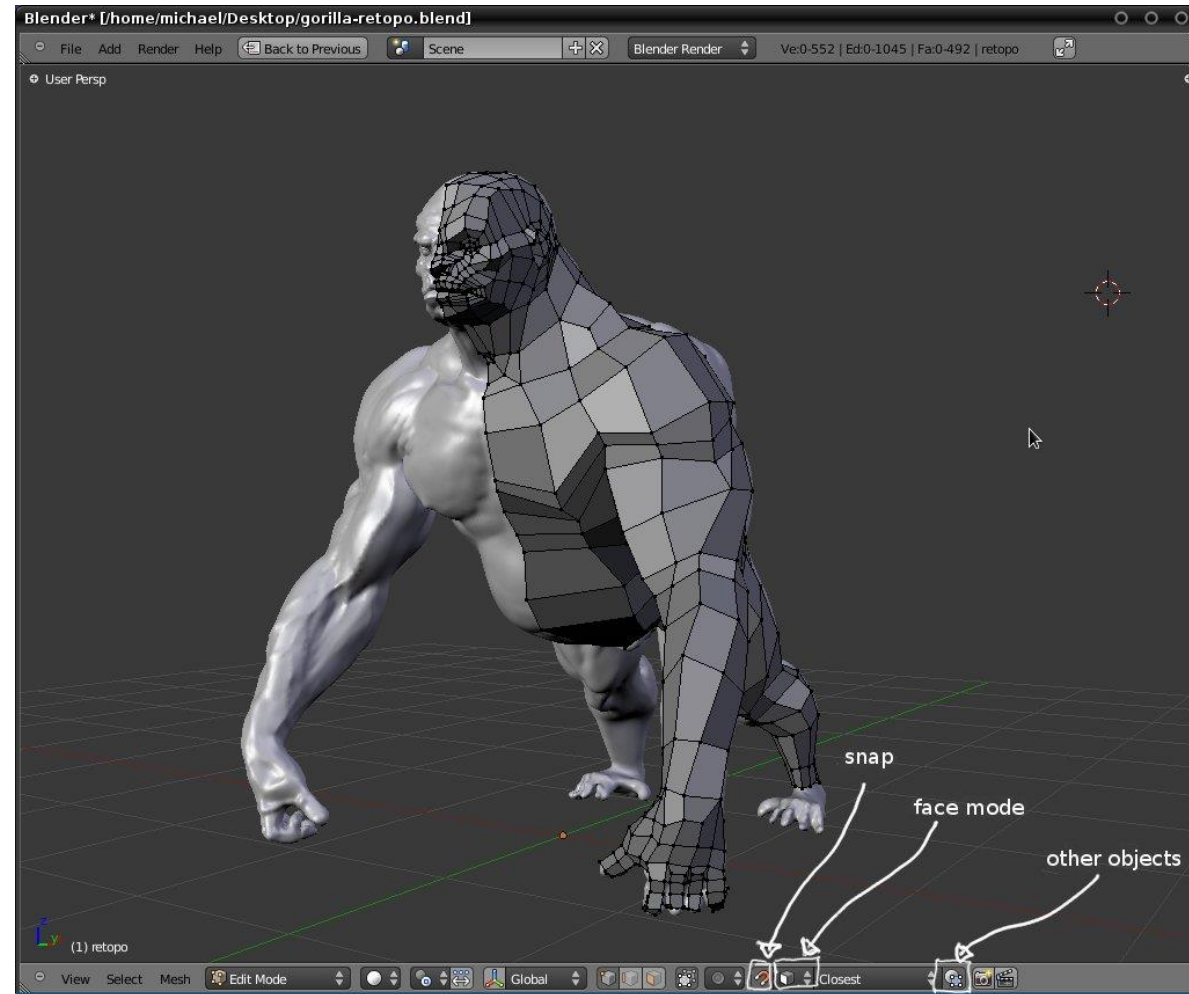
# Sculpting

- Easier with tablet pen
- Dynamic topology
- High Definition = Many Polygons



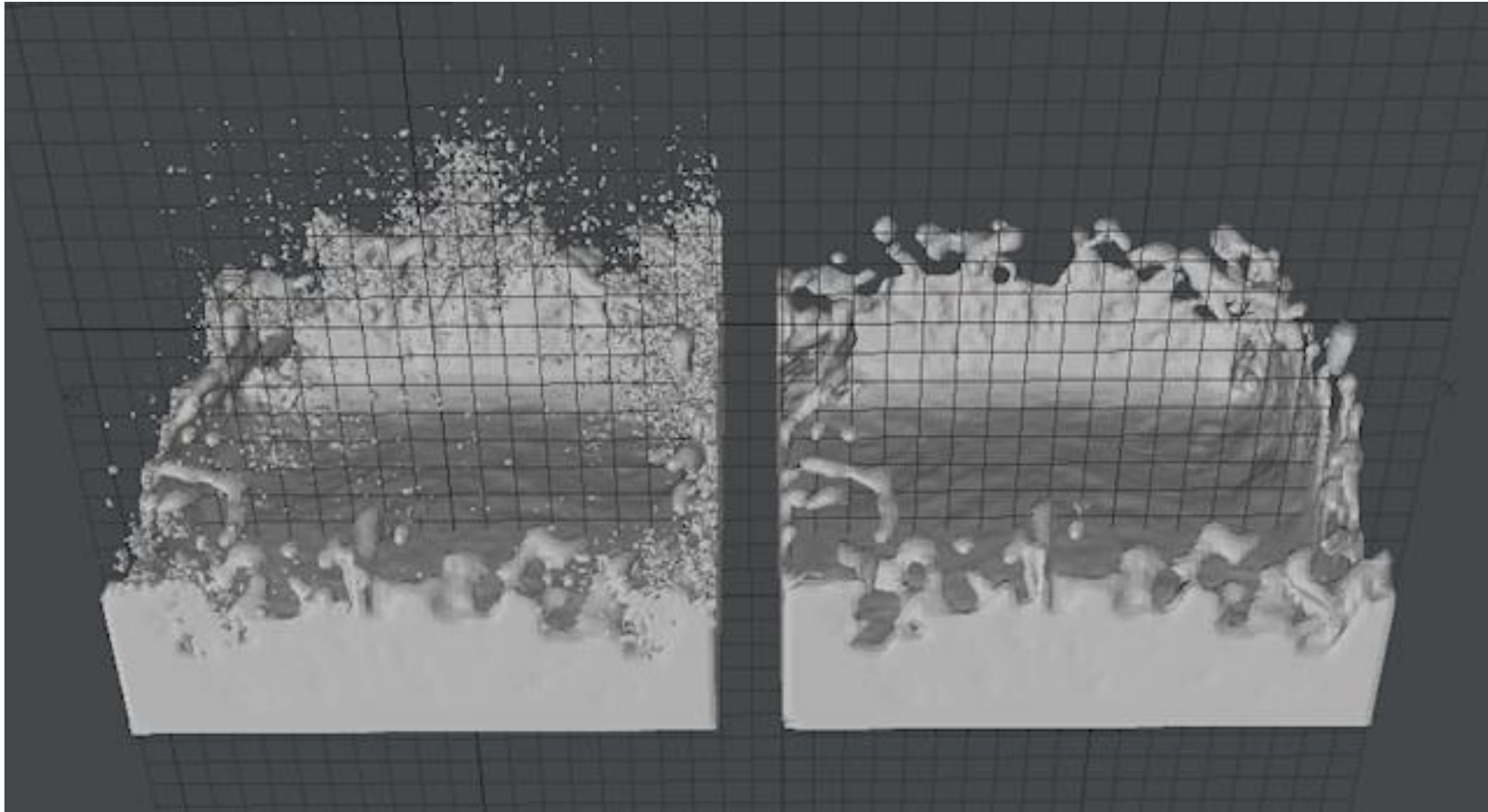
# Metaballs / Primitives -> Sculpting -> Low Poly through Retopolgy or Decimate(modifier)

HINT: Near Plane camera too high?  
(press n in the 3D view) and change it



# Simulations

- Mesh -> Fluid
- Mesh ->
- High Definition = Many Polygons

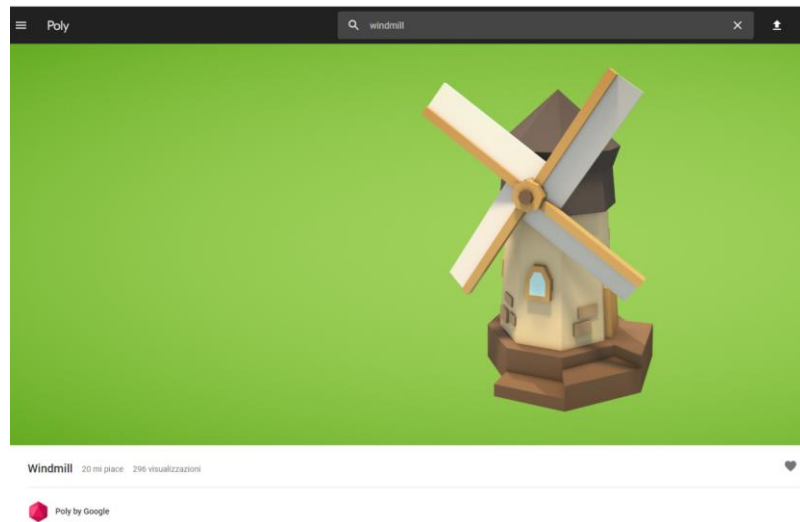


# Low poly vs High poly

- When to use what? Realtime and not
- Organic vs non organic
- Cartoon vs Photorealistic

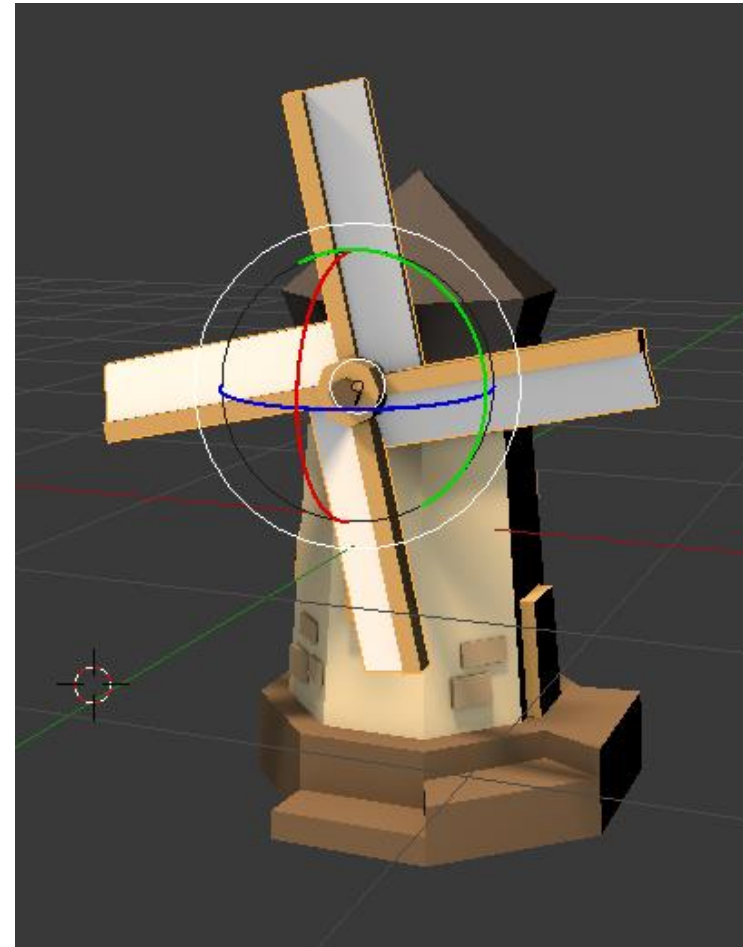
# How to edit Google Poly meshes in Blender:

## Google Poly:



### Steps:

- Import OBJ
- Select connected pieces with «L»
- Separate «P»
- Move origin to baricenter





# Next lab lesson prerequisites:

- Blender on your personal laptop.
- Mouse with 3 buttons.