

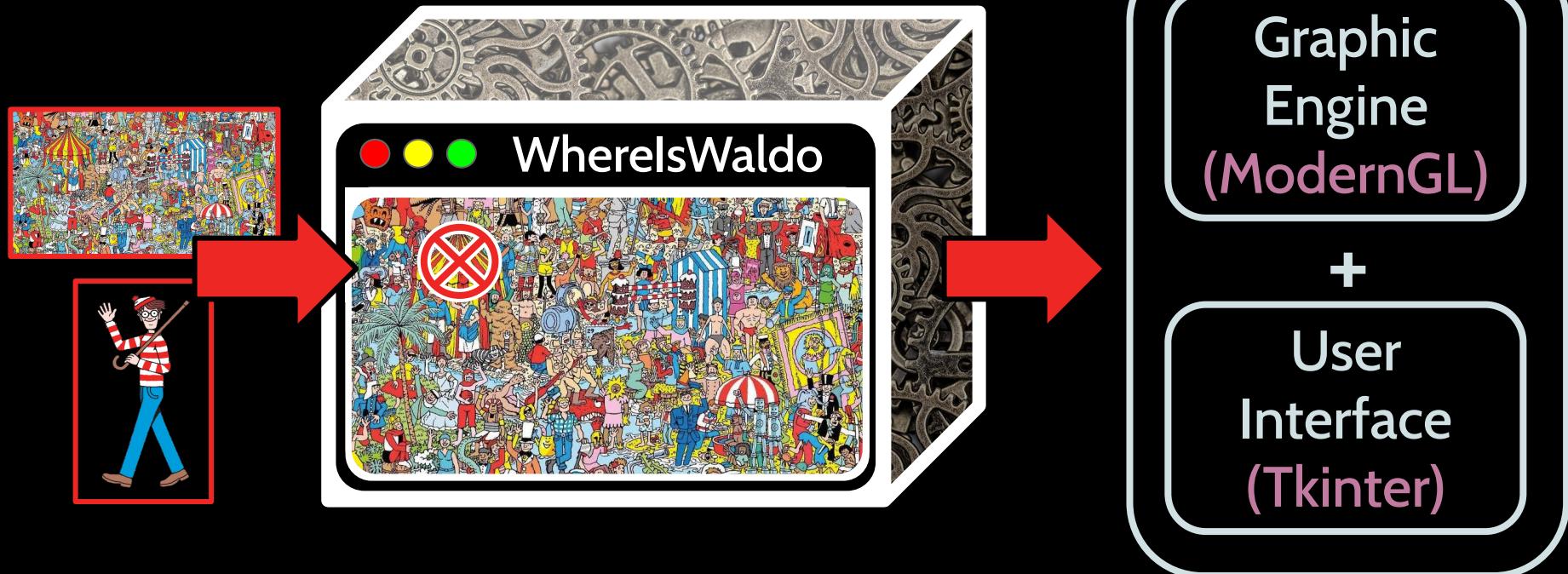
# PyGraphicsGui

for Human-in-the-Loop Machine Learning

Dalya Gartzman

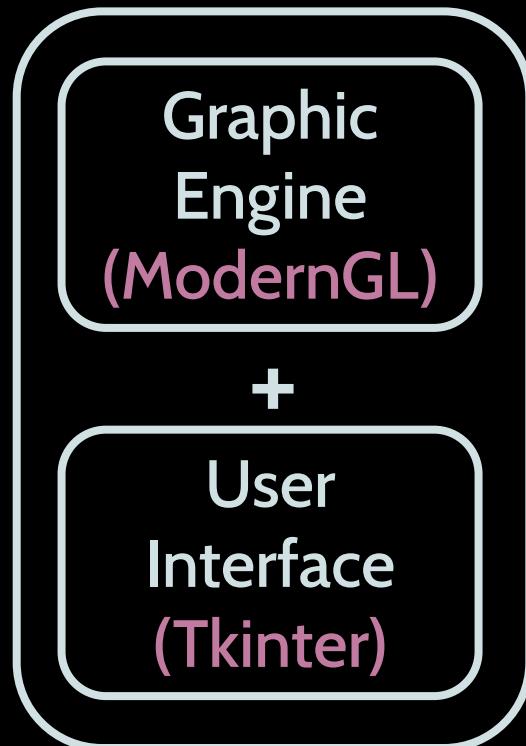
[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

# What is PyGraphicsGui?



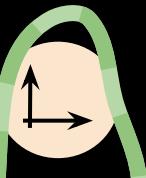
[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

# Our Goal Today:



# Intro to Computer Graphics

xy



Coordinate Systems



Model-View-Projection Matrix



Vertex Array



Shaders Program

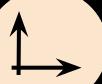


Framebuffer



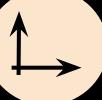
Render



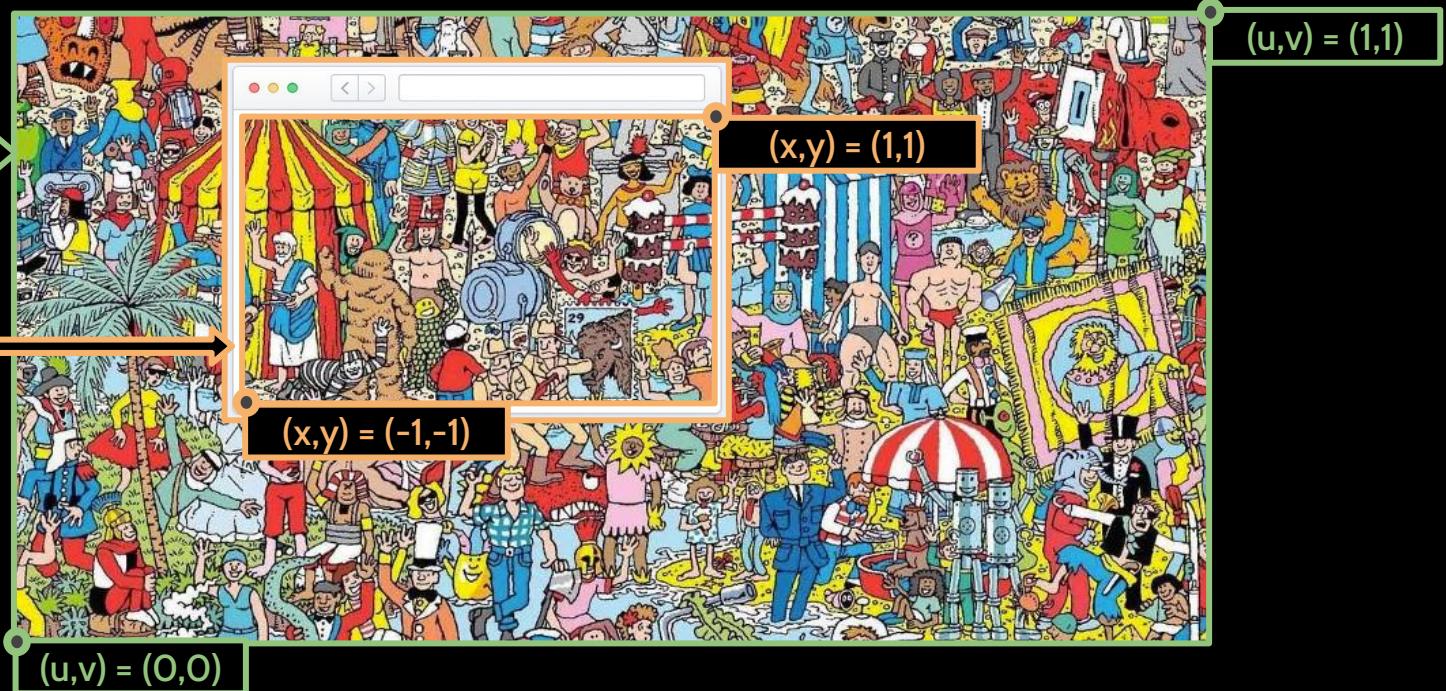


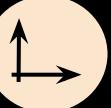
# Coordinate Systems

pixels	Window	Image
"what we see on screen"	(0,0)  (w,h)	(0,0)  (W,H)
fraction	Viewport	Texture
"abstract entities"	(-1,-1)  (1,1)	(0,0)  (1,1)

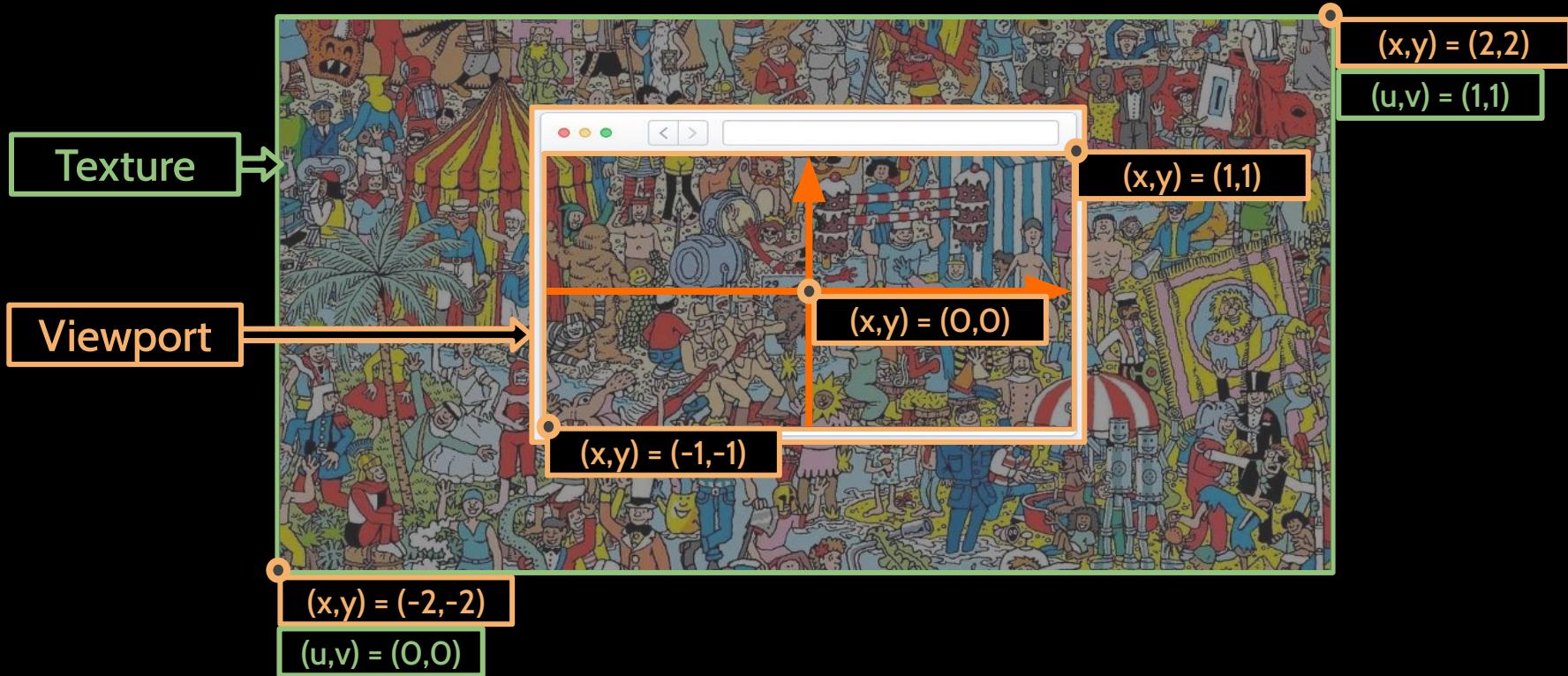


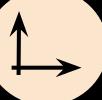
# Coordinate Systems



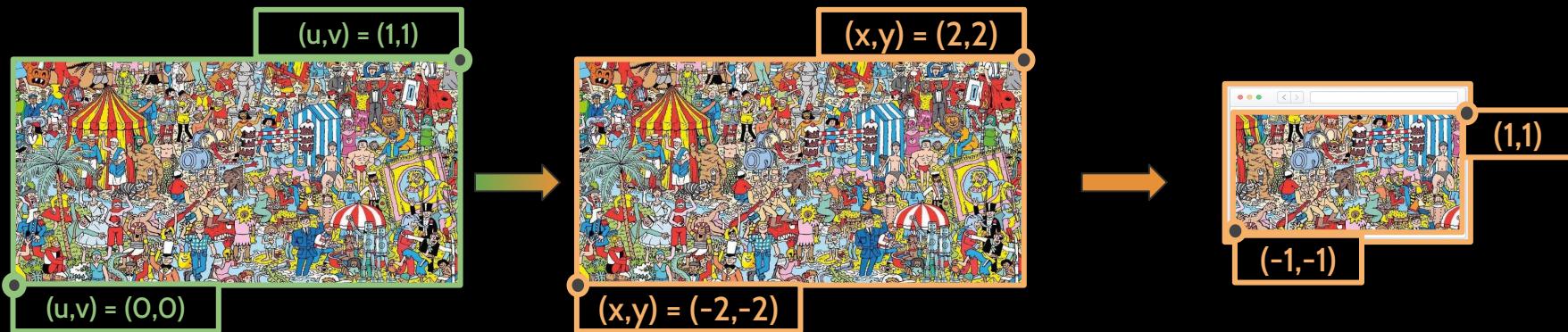


# Coordinate Systems





# Coordinate Systems





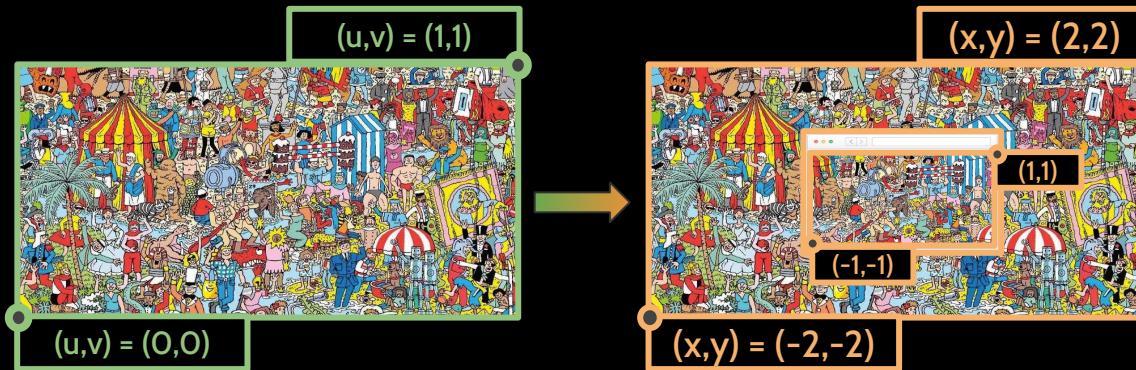
**WOOHOO!**  
**HARDEST PART IS DONE!**





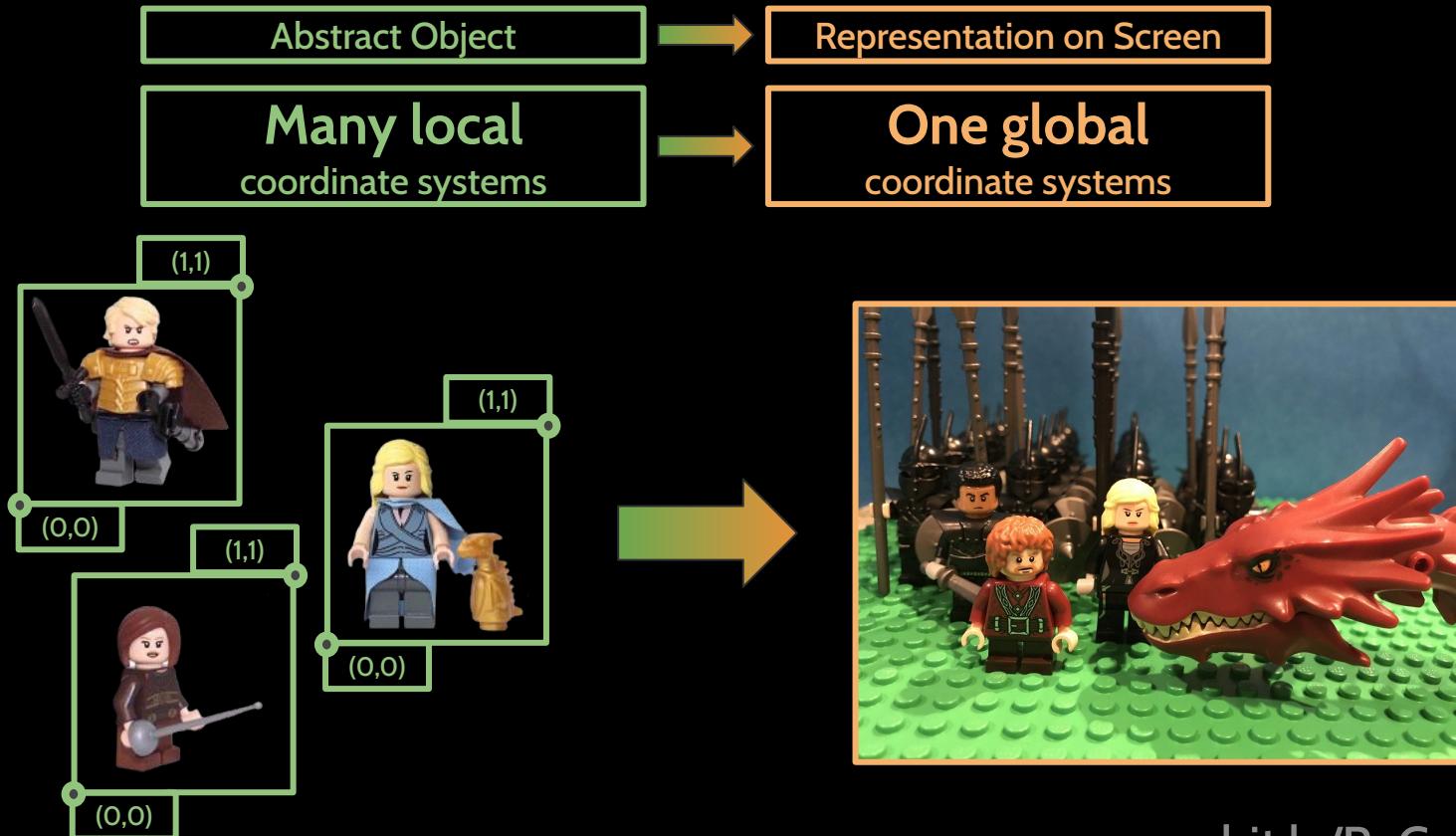
# Model-View-Projection Matrix

Abstract Object → Representation on Screen



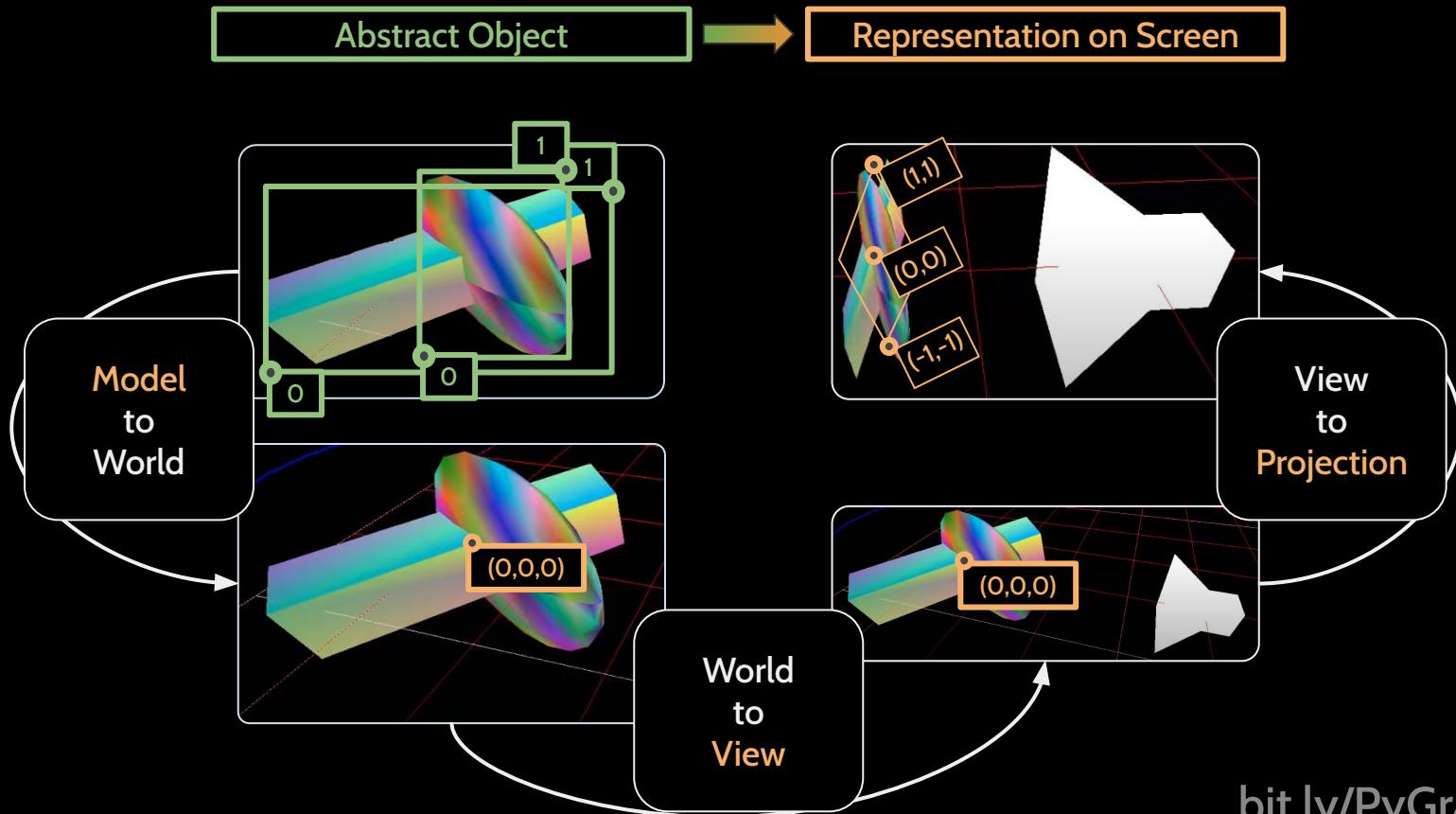


# Model-View-Projection Matrix



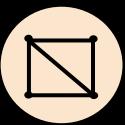


# Model-View-Projection Matrix





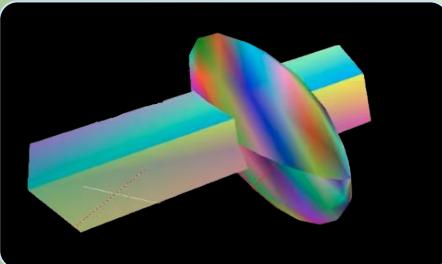
MODEL-VIEW-PROJECTION MATRIX  
YOU DA REAL MVP



# Vertex Array

Vertex Buffer:

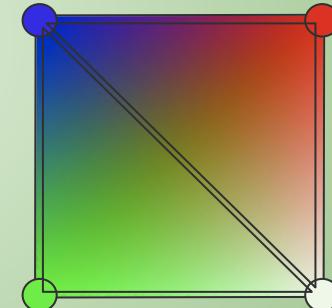
[△ △ △ ▷ ▷ ▷ ...]



Abstract Object

Vertex Buffer:

[△ △ △ ▷ ▷ ▷]

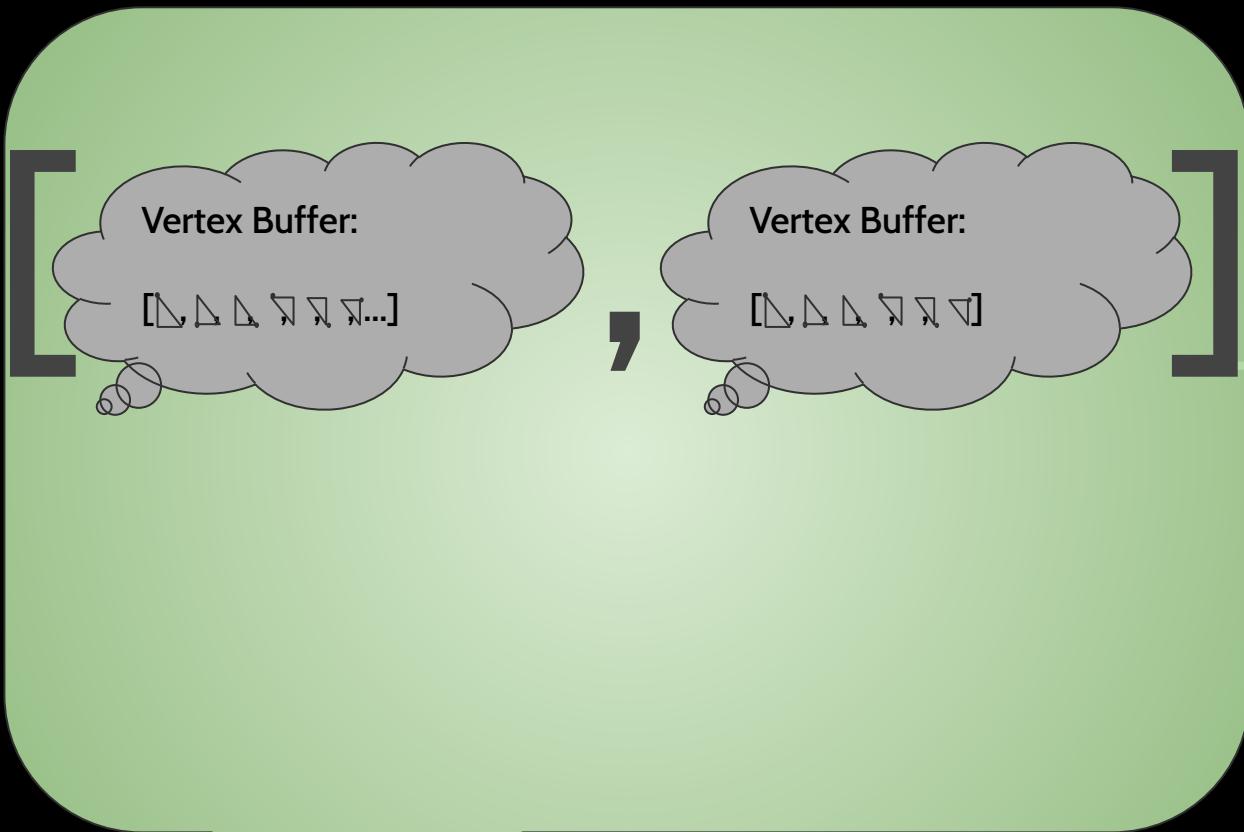


Representation on Screen





# Vertex Array



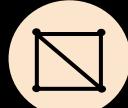
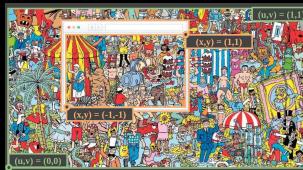


**WHAT IS THIS???**  
**A WAR FOR ANTS!?**

{ }

# Shaders Program

Means:



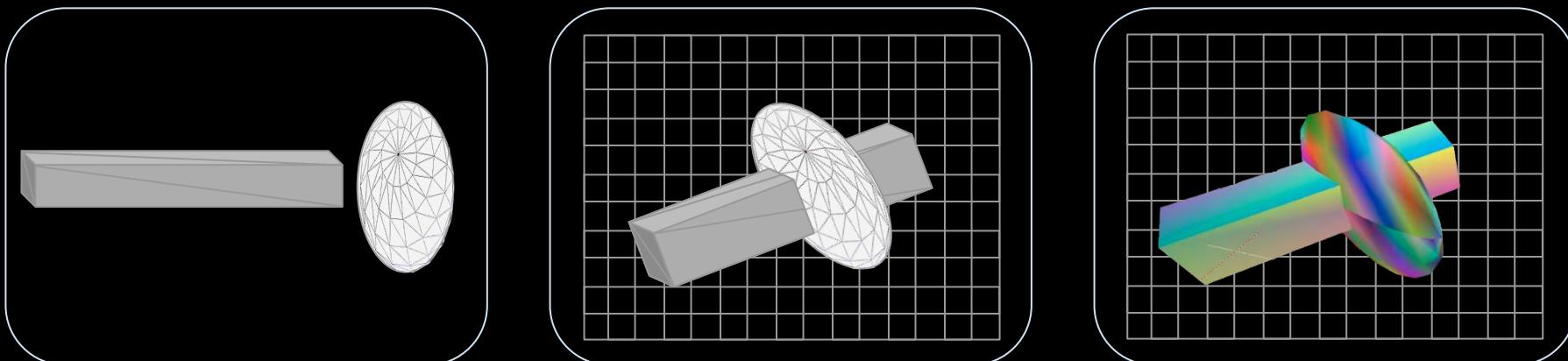
Goal:



[bit.ly/PyGraphicsGu](http://bit.ly/PyGraphicsGu)

{ }

# Shaders Program



Model Data

Pixel per Vertex

Color per Pixel



Vertex  
Shader

Fragment  
Shader

[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)



RECAP

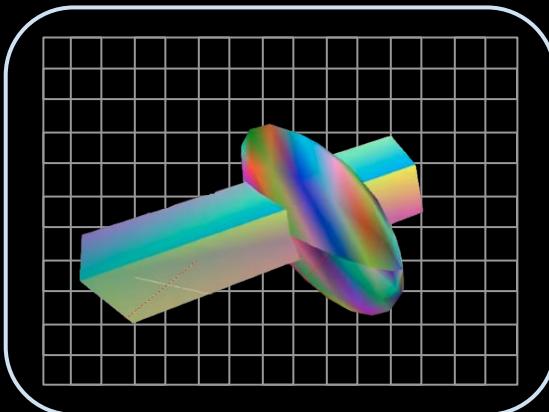


IT REALLY  
TIES THE ROOM TOGETHER

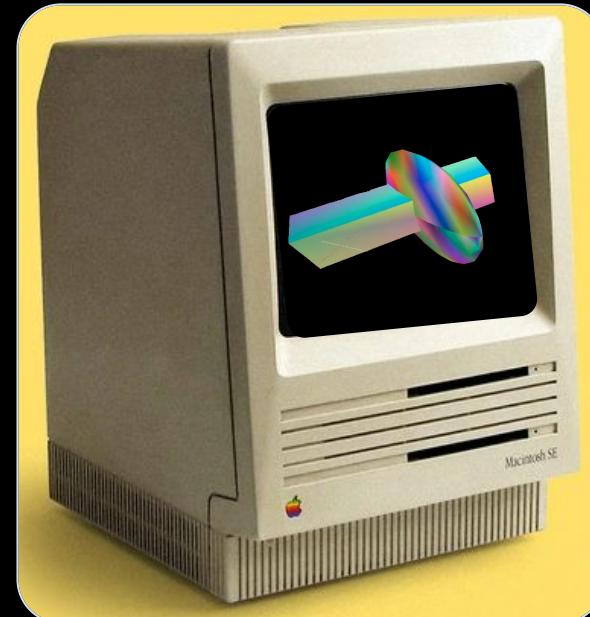


# Framebuffer

Thus far:



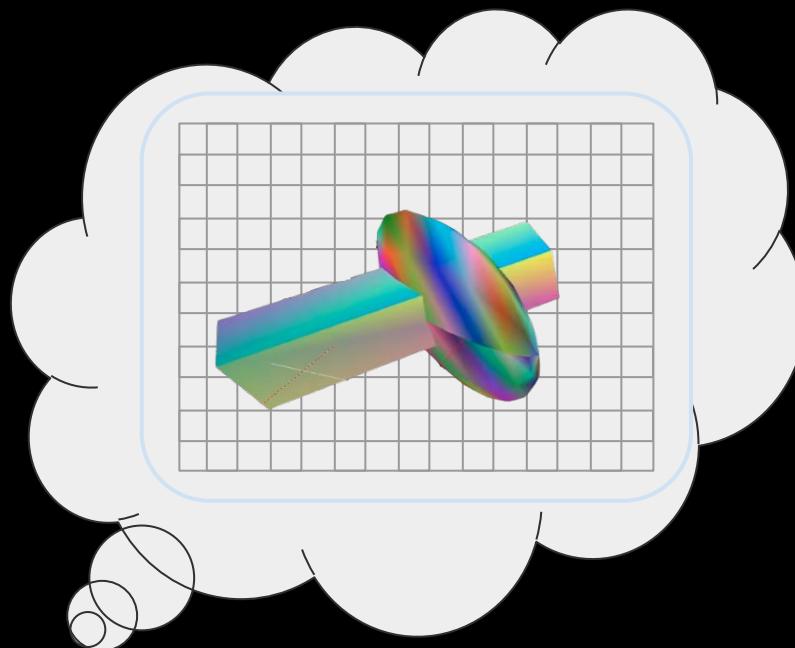
Goal:





# Framebuffer

Now:

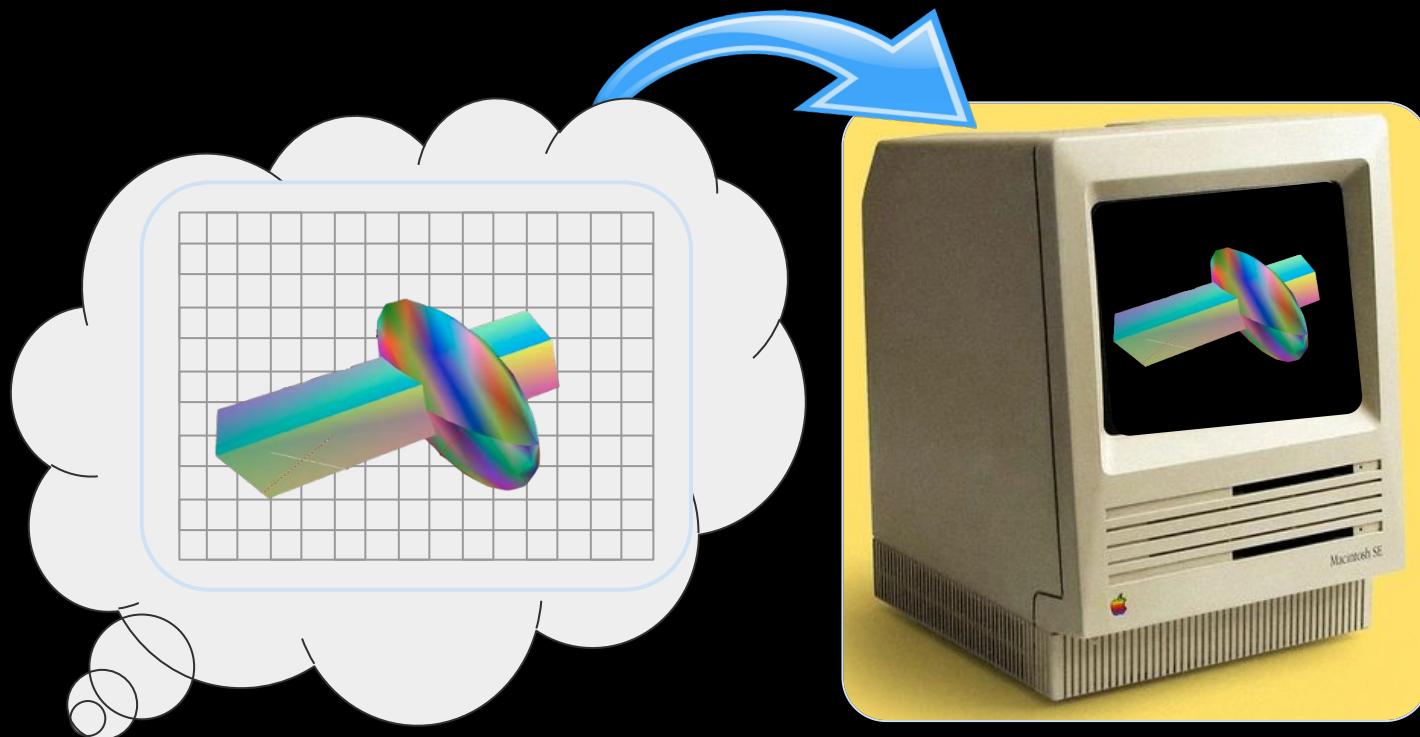


Goal:





# Render



[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)



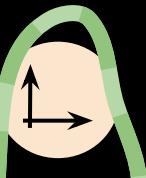
RECAP

## BREAKING NEWS

With the new Face ID feature, Arya Stark can now unlock every iPhone in the Westeros

# Intro to Computer Graphics

xy



Coordinate Systems



Model-View-Projection Matrix



Vertex Array



Shaders Program



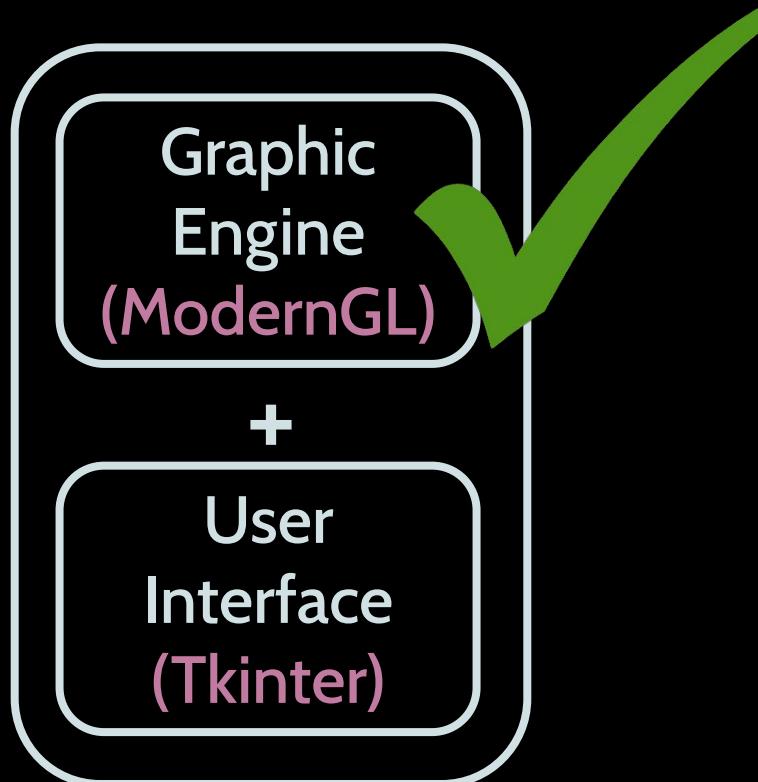
Framebuffer

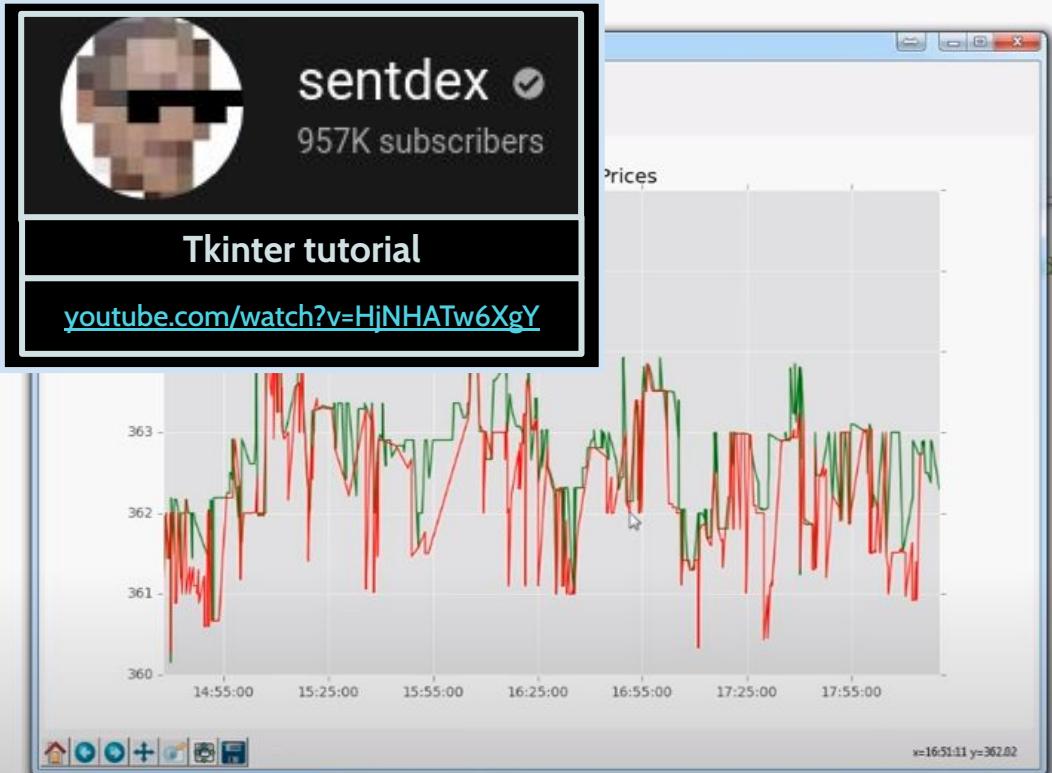


Render



# Our Goal Today:





```
class SeaofBTCapp(tk.Tk):  
    def __init__(self, *args, **kwargs):
```



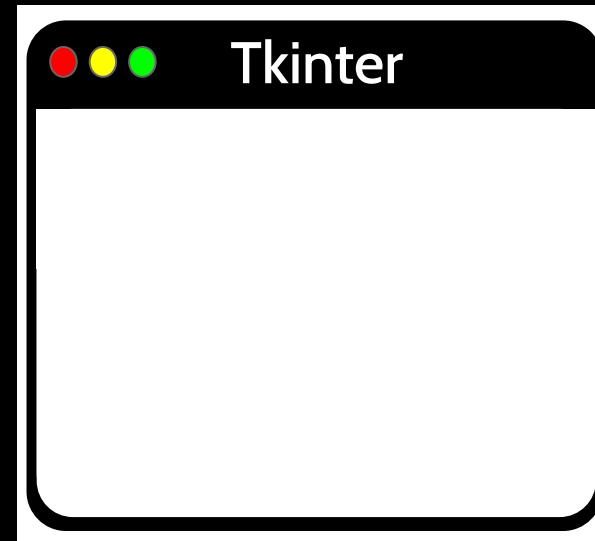
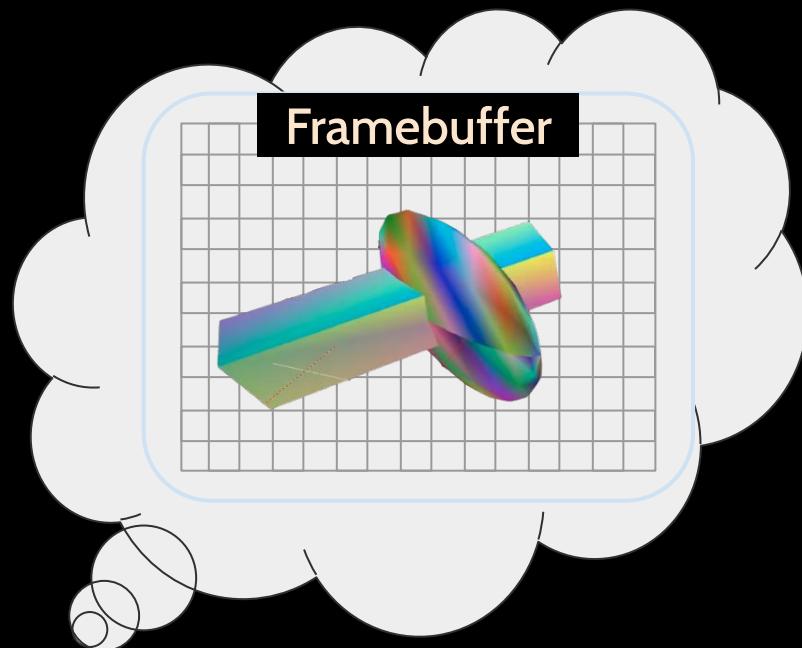
Ln: 50 Col: 21  
4:30 / 11:14 10:14  
11/11/2014

# Graphic Engine + GUI



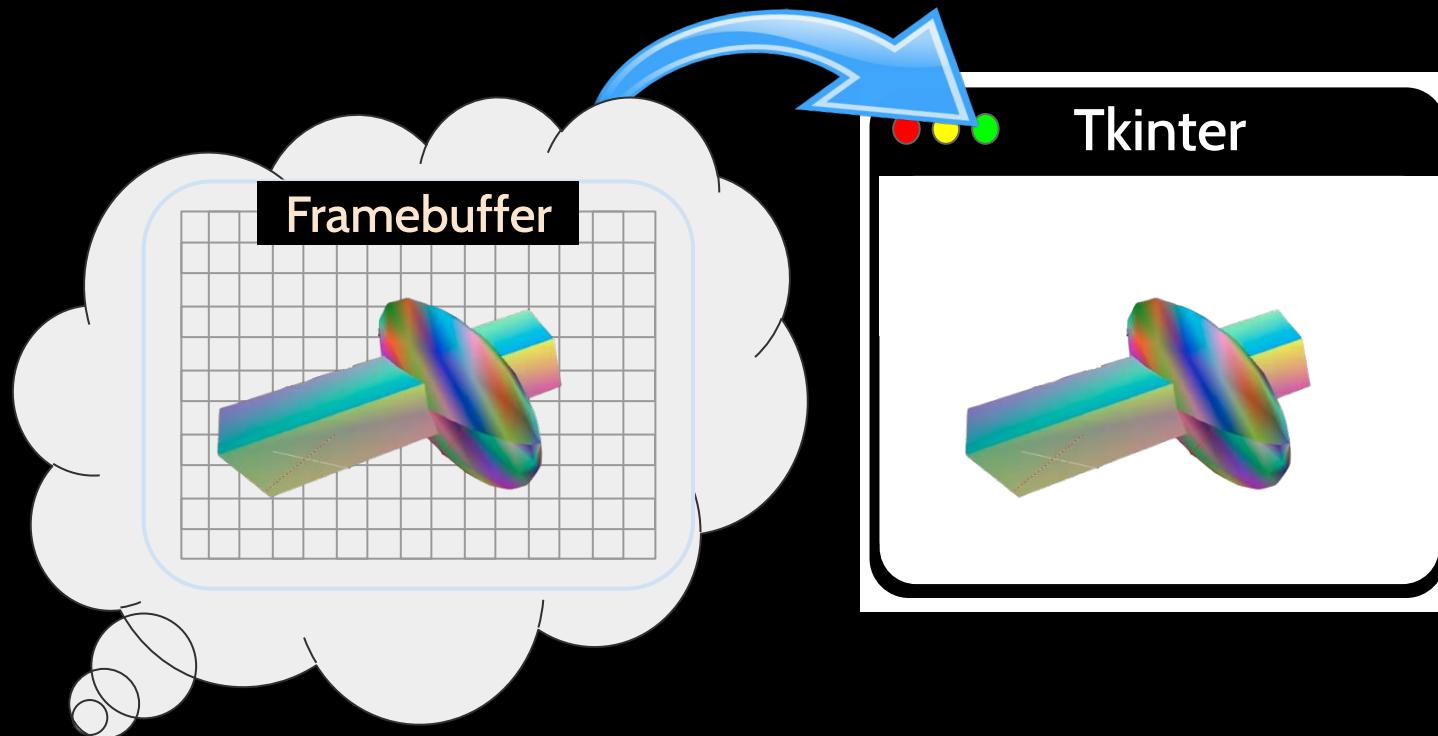
[bit.ly/PyGraphicsGui](https://bit.ly/PyGraphicsGui)

# Graphic Engine + GUI



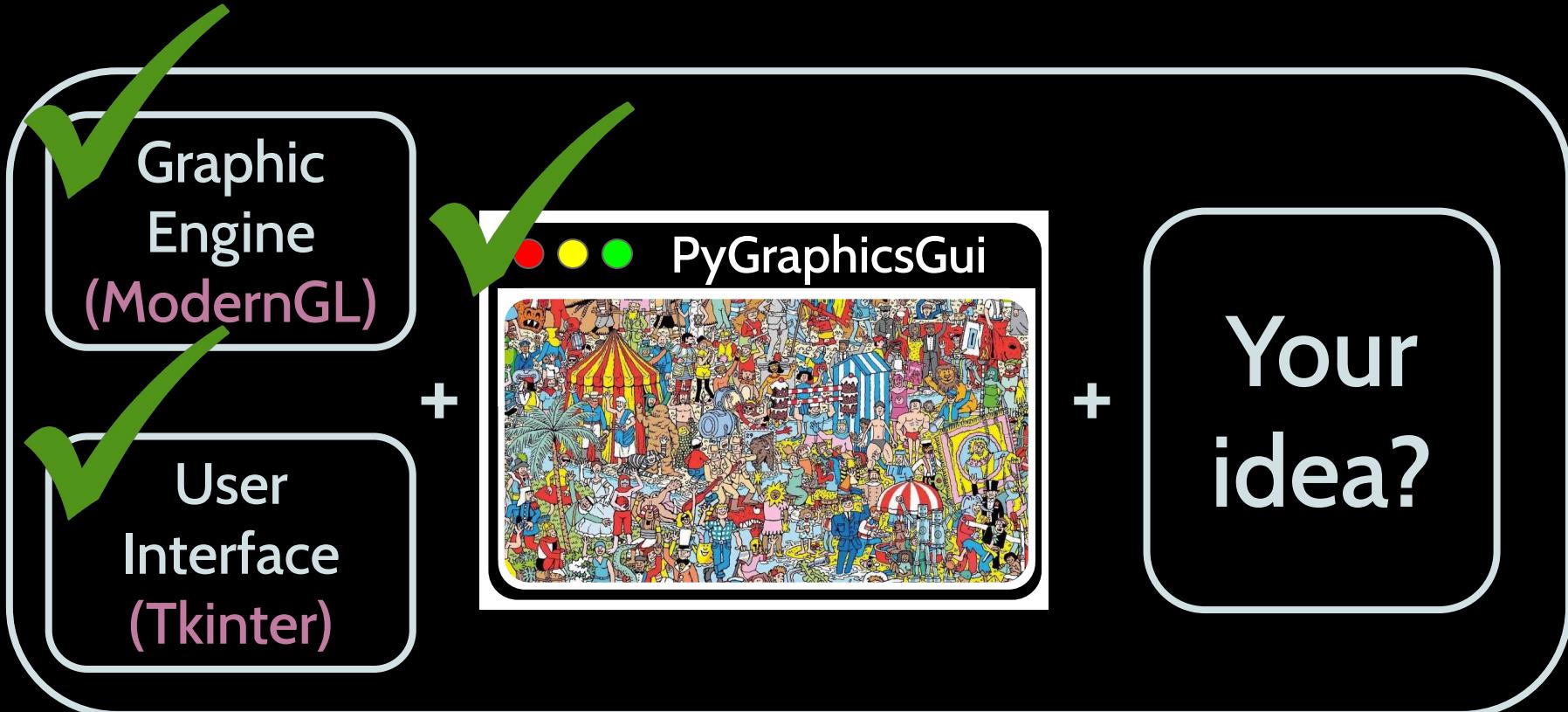
[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

# Graphic Engine + GUI



[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

# Our Goal Today:

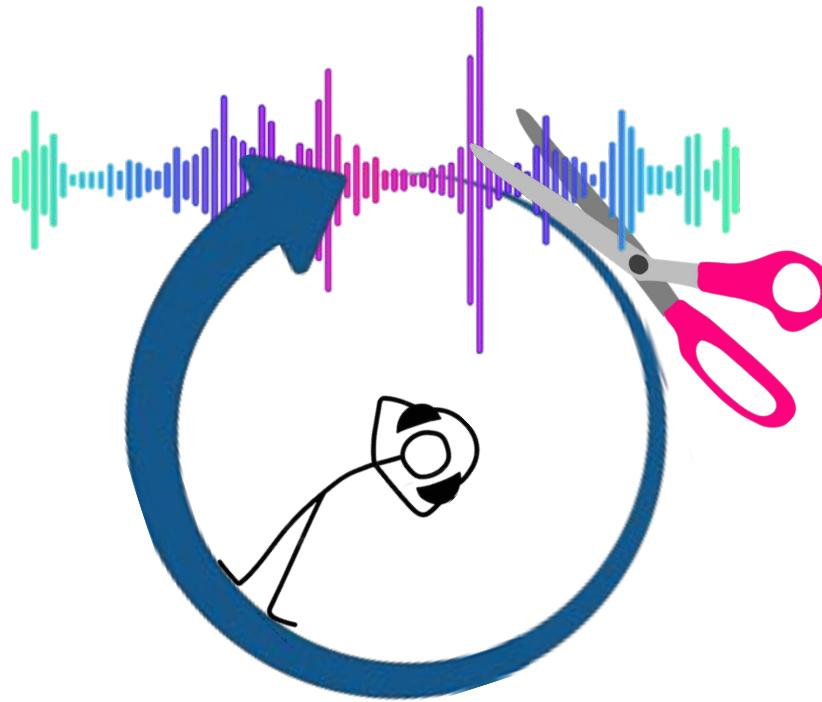


# Imagine



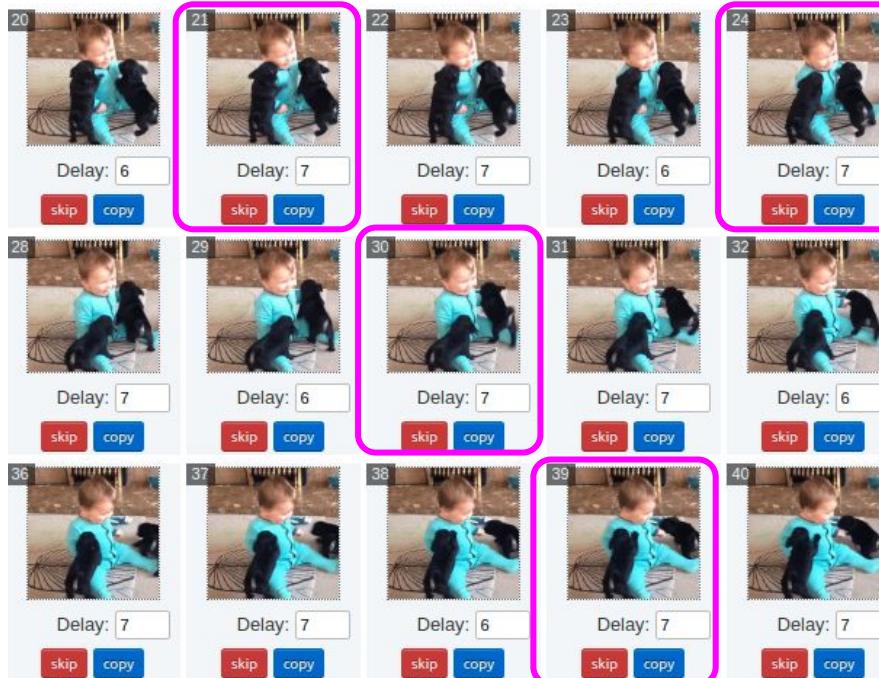


# Signal Processing



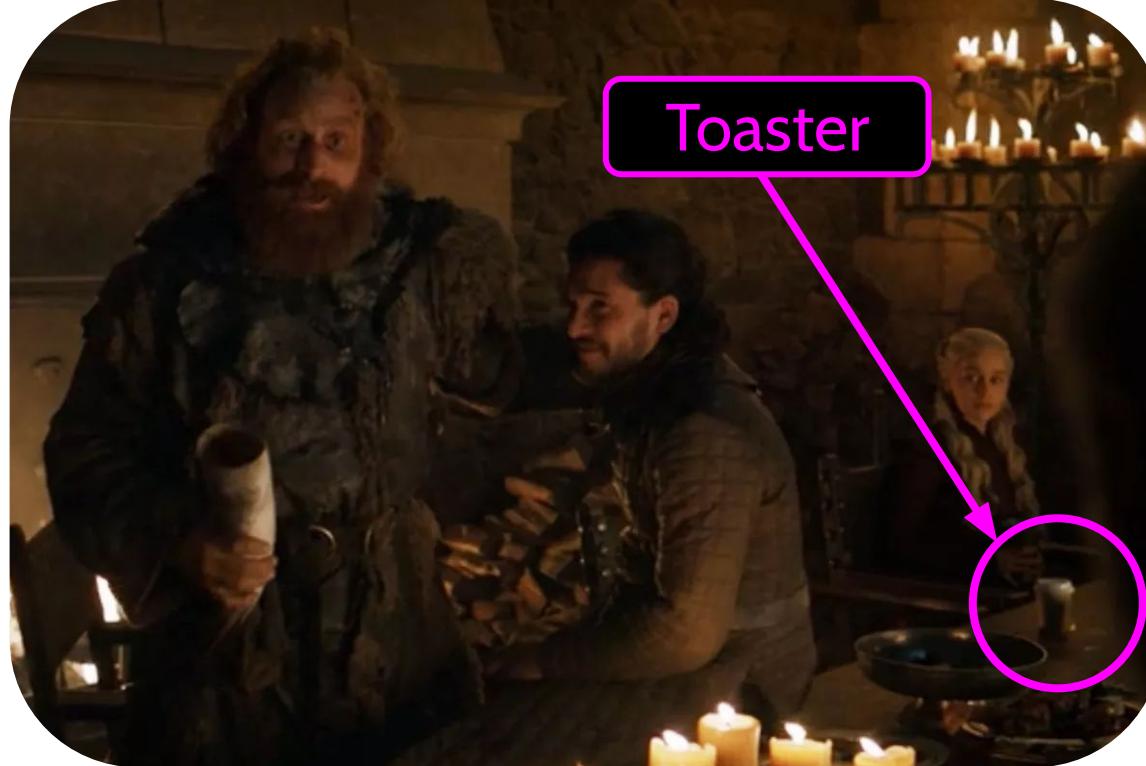


# Computer Vision



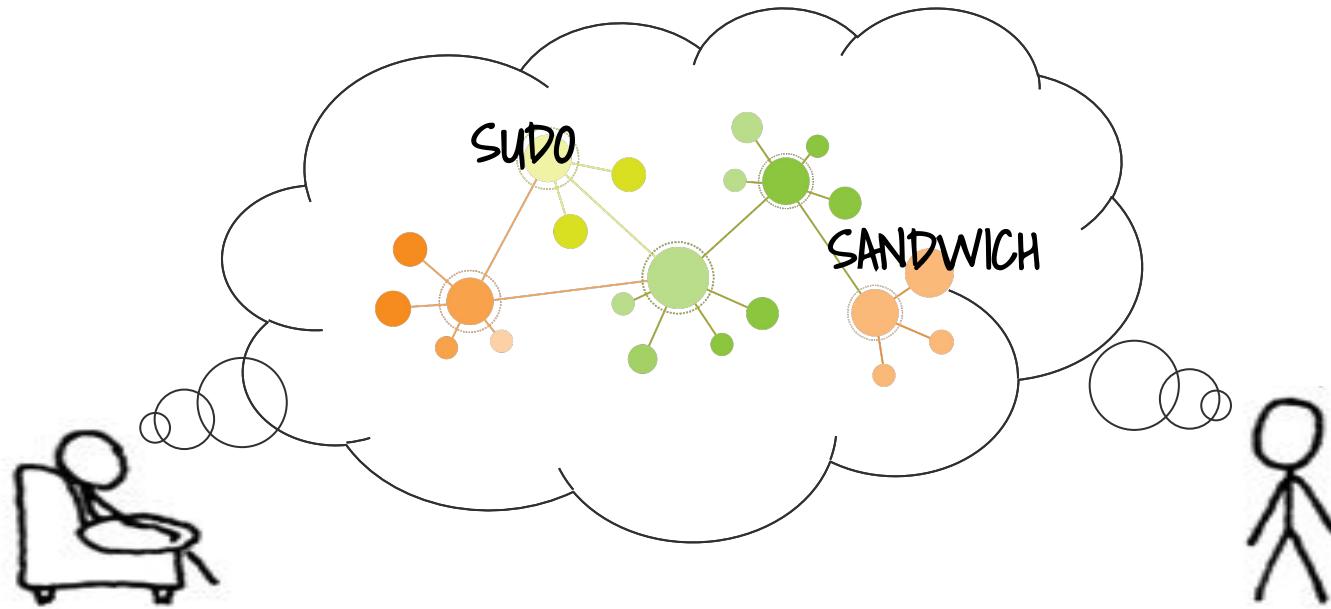


# Double Meme Break



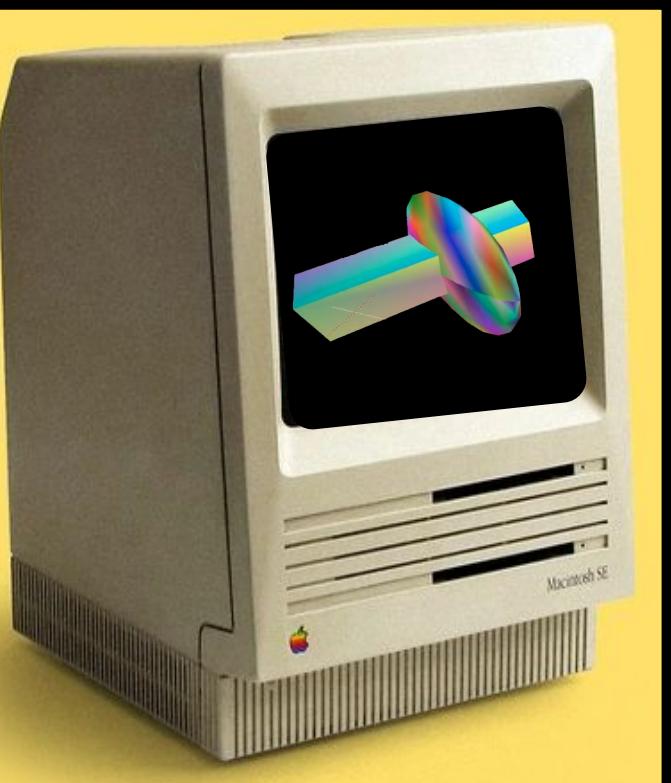


# Network Analysis





# Why?



# How?



# What?

[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

# Take Home Message



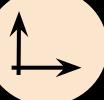
**WHEN YOU ARE  
DONE WITH WINTER**

# Thank You :)

## Questions?

Dalya Gartzman  
[bit.ly/PyGraphicsGui](https://bit.ly/PyGraphicsGui)

# Content Recommendations

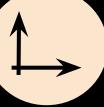


# Coordinates Systems

The video frame shows a lecture on 2D Clipping. The whiteboard displays two diagrams under the heading "2D Clipping:-". The first diagram, labeled "i) Different Viewport Same Window", shows a house-shaped object in a window defined by dashed lines. Two different viewports are indicated by solid lines: one large one covering most of the window and a smaller one inside it. The second diagram shows the resulting clipped shapes after applying viewing transformation. The teacher, Mrs. M. Jyothi, is visible on the left, pointing towards the board. The video player interface at the bottom includes controls for play/pause, volume, and progress (9:20 / 16:08).  
Computer Graphics: 2D Viewing  
19,936 views • Aug 3, 2018  
Jyothi Mandala 5.43K subscribers

[youtube.com/watch?v=DnEldu8MpjY](https://youtube.com/watch?v=DnEldu8MpjY)

[bit.ly/PyGraphicsGu](http://bit.ly/PyGraphicsGu)



# Coordinates Systems

Why we use  
homogeneous coordinates  
in computer graphics

The video player displays a slide with the following content:

- A 2D coordinate system with a green  $+y$  axis.
- Three black triangles representing geometric transformations:
  - The left triangle is labeled "scaling".
  - The middle triangle is labeled "translation".
  - The right triangle is unlabeled.
- A binary code background.
- Video controls at the bottom: play/pause, volume, progress bar (2:20 / 14:45), and a <C> button.
- Video details: "The True Power of the Matrix (Transformations in Graphics) - Computerphile" (476,239 views, Dec 7, 2013).
- Channel information: Computerphile (1.77M subscribers).
- Subscription status: SUBSCRIBED.

[youtube.com/watch?v=vQ60rFwh2ig](https://youtube.com/watch?v=vQ60rFwh2ig)

[bit.ly/PyGraphicsGu](http://bit.ly/PyGraphicsGu)



# Model-View-Projection Matrix

The screenshot shows a 3D rendering application with a black background and red grid lines. A 3D model consisting of a green rectangular prism and a multi-colored torus is positioned in the center-left. To its right is a white, pyramid-like object. At the bottom right of the screen is a small video player window showing a man's face.

**Box:**  Show  
Scale: < 1.4 0.3 0.3 >  
Rotate: < 279 0 45 >  
Translate: < -3.75 0 0 >  
Matrix: 0.989 -0.21 0 -3.75  
0.154 0.033 0.296 0  
-0.97 -0.20 0.046 0  
0 0 0 1

**Sphere:**  Show  
Scale: < 0.2 1 1 >  
Rotate: < 0 72 0 >  
Translate: < -3.25 0 0 >  
Matrix: 0.061 0 0.951 -3.25  
0 1 0 0  
-0.19 0 0.309 0  
0 0 0 1

**Eye:** < 0 0 0 >  
Look at: < -1.5 0 0 >  
Up: < 0 1 0 >  
Matrix: 0 0 -1 0  
0 1 0 0  
1 0 0 0  
0 0 0 1

Show World  Show Camera  Fix eye to camera position 0

Model View Projection Matrices  
62,864 views • Oct 21, 2013  
Jamie King 48.6K subscribers  
SUBSCRIBED   
1.2K likes 18 dislikes SHARE SAVE ...

[youtube.com/watch?v=-tonZsbHty8](https://youtube.com/watch?v=-tonZsbHty8)

[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

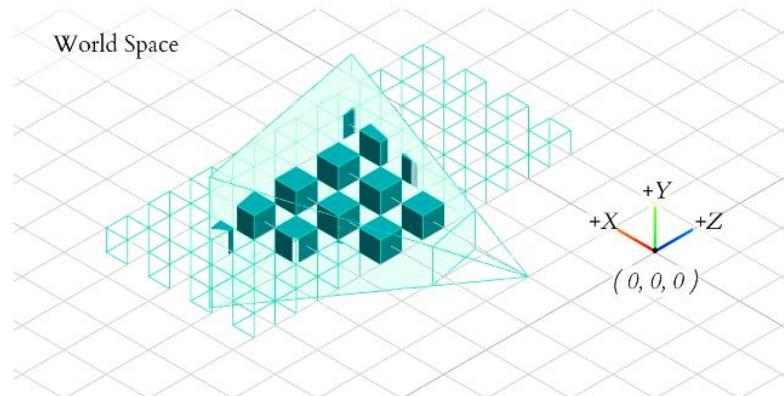


# Model-View-Projection Matrix

## Model View Projection

April 14, 2019

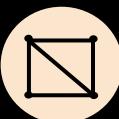
In 3D engines, scenes are typically described as objects in three-dimensional space, with each object comprised of many three-dimensional vertices. Ultimately, these objects are rendered and displayed on a flat screen. Rendering a scene is always relative to the camera, and as such, the scene's vertices must also be defined relative to the camera's view.



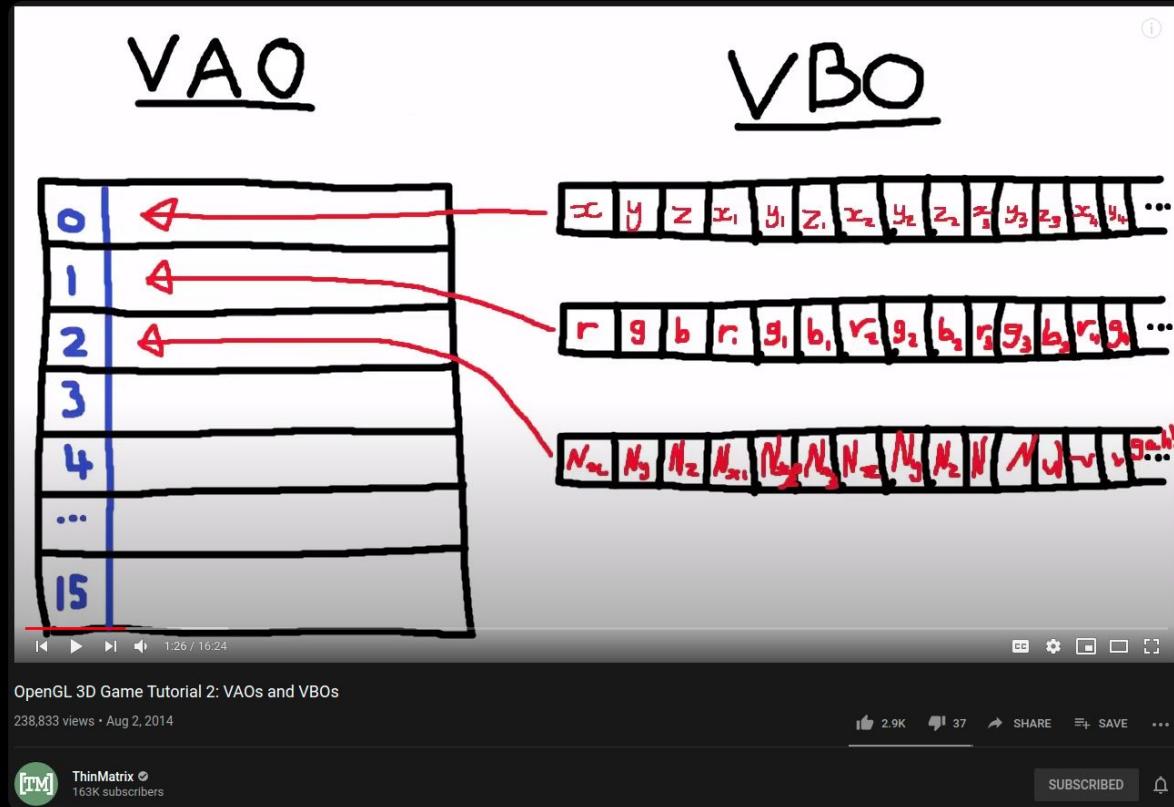
A scene being visualized in world space, camera space, and then normalized device coordinates, representing the stages of transformation in the *Model View Projection* pipeline.

[jsantell.com/model-view-projection/](https://jsantell.com/model-view-projection/)

[bit.ly/PyGraphicsGui](https://bit.ly/PyGraphicsGui)



# Vertex Array

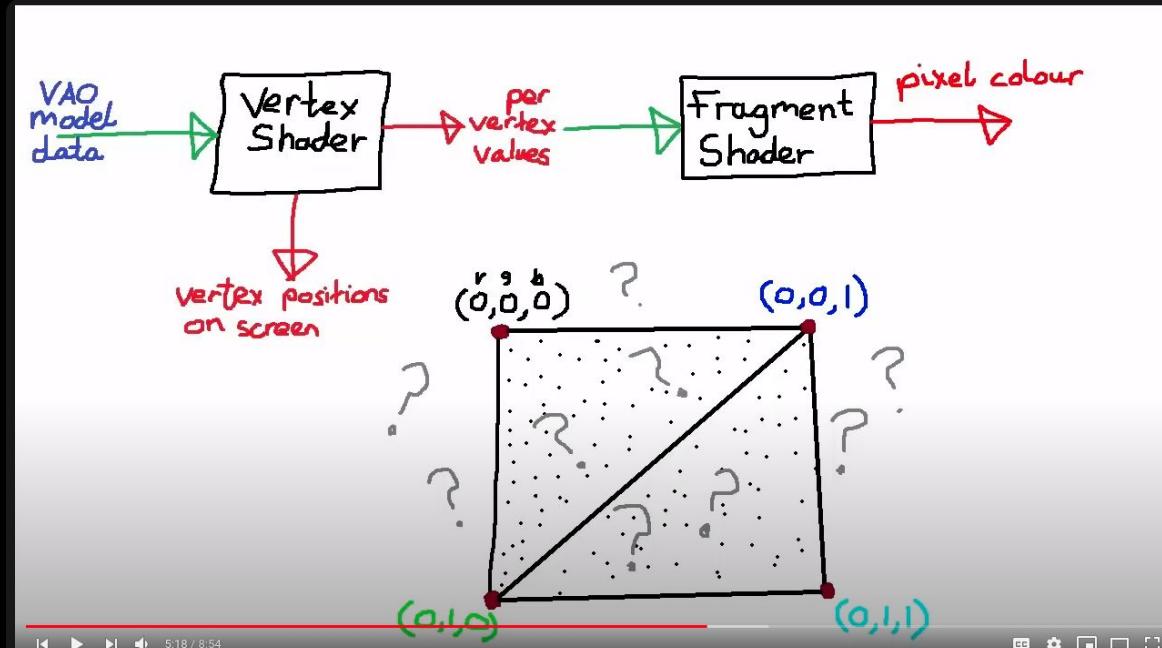


[youtube.com/watch?v=WMiggUPst-Q](https://youtube.com/watch?v=WMiggUPst-Q)

[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

{ }

# Shaders Program



OpenGL 3D Game Tutorial 4: Introduction to Shaders

103,992 views • Aug 13, 2014



1.7K



2



SHARE



SAVE

ThinMatrix  
163K subscribers

SUBSCRIBED

[youtube.com/watch?v=AyNZG\\_mqGVE](https://youtube.com/watch?v=AyNZG_mqGVE)[bit.ly/PyGraphicsGui](http://bit.ly/PyGraphicsGui)

{ }

# Shaders Program

 Categories  Search for anything

Development > Web Development > OpenGL

## Learn GLSL Shaders from Scratch

Bring your WebGL alive with custom shaders

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 Created by **Nicholas Lever**

Last updated 5/2020   English   English [Auto]

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[udemy.com/course/learn-glsl-shaders-from-scratch/](https://udemy.com/course/learn-glsl-shaders-from-scratch/)

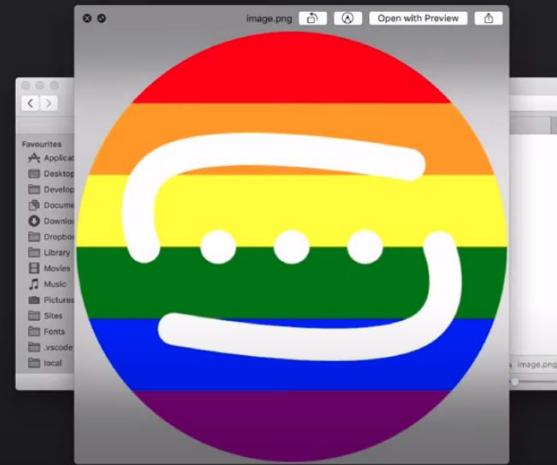
[youtube.com/watch?v=uwzEqE7uQ](https://youtube.com/watch?v=uwzEqE7uQ)

[bit.ly/PyGraphicsGu](http://bit.ly/PyGraphicsGu)



# Framebuffer

A recommended series for learning OpenFrameworks - an “easy” framework for computer graphics in C++



The image shows a YouTube video player interface. At the top, there are play controls (rewind, forward, volume, progress bar at 1.00 / 6:13). Below the video frame, the title reads "#openFrameworks #framebuffer #drawing openFrameworks tutorial series - episode 024 - ofFbo". The video has 950 views and was posted on Sep 19, 2019. The channel information shows "Lewis Lepton" with 6.42K subscribers. At the bottom, there are like (27), dislike (1), share, save, and more options buttons. A "SUBSCRIBED" button with a bell icon is also visible.

[youtube.com/watch?v=je7NVnaVHCg](https://youtube.com/watch?v=je7NVnaVHCg)

[bit.ly/PyGraphicsGu](http://bit.ly/PyGraphicsGu)