CSC 240
Computer Graphics

Fall 2015
Smith College

Outline: 9/28

- Python debugging
- Coordinate frames
- Clipping
- OpenGL intro and demo

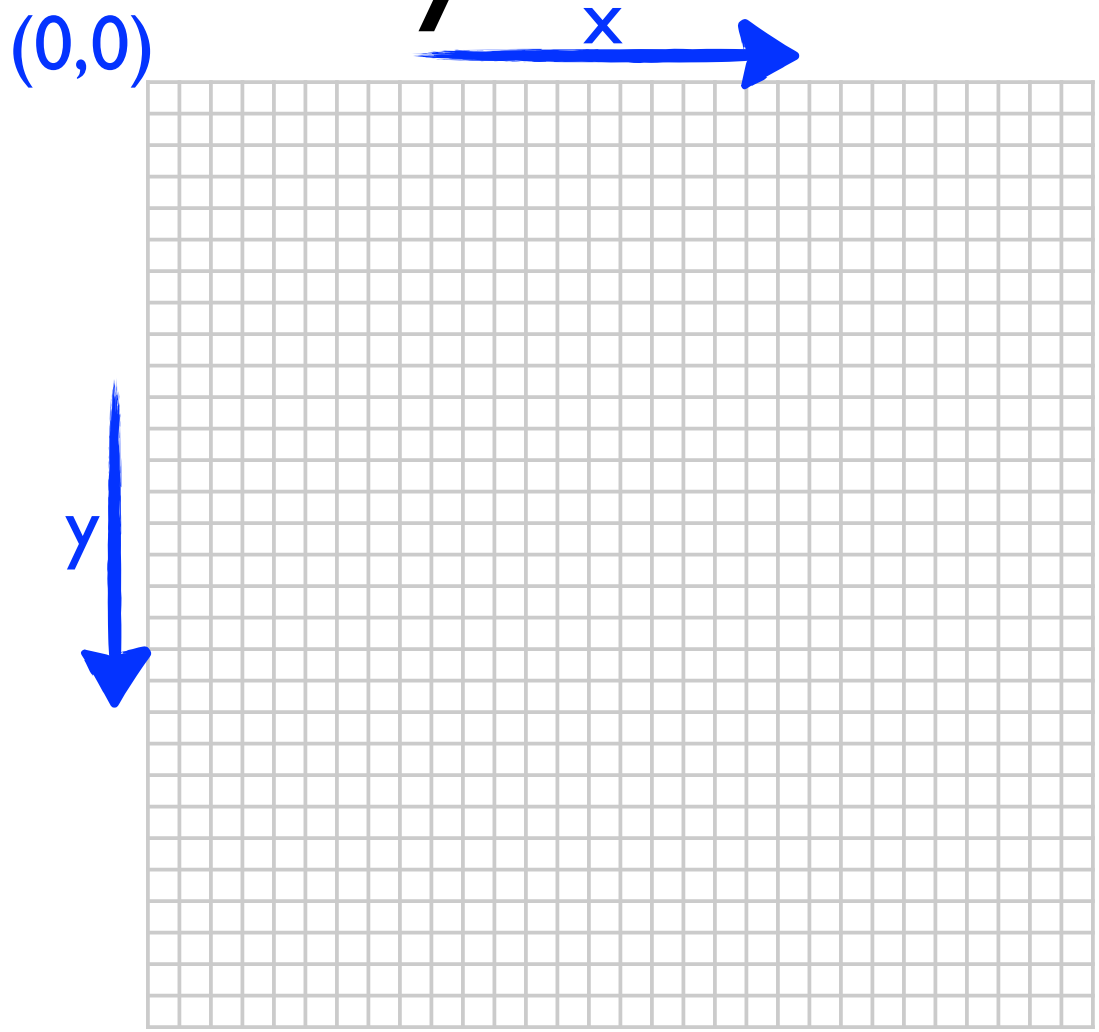
White background slides from Eitan Mendelowitz

Debugging Demo

- Small example
- Print statements
- Google
- Ask the whole class on Piazza
- Email me

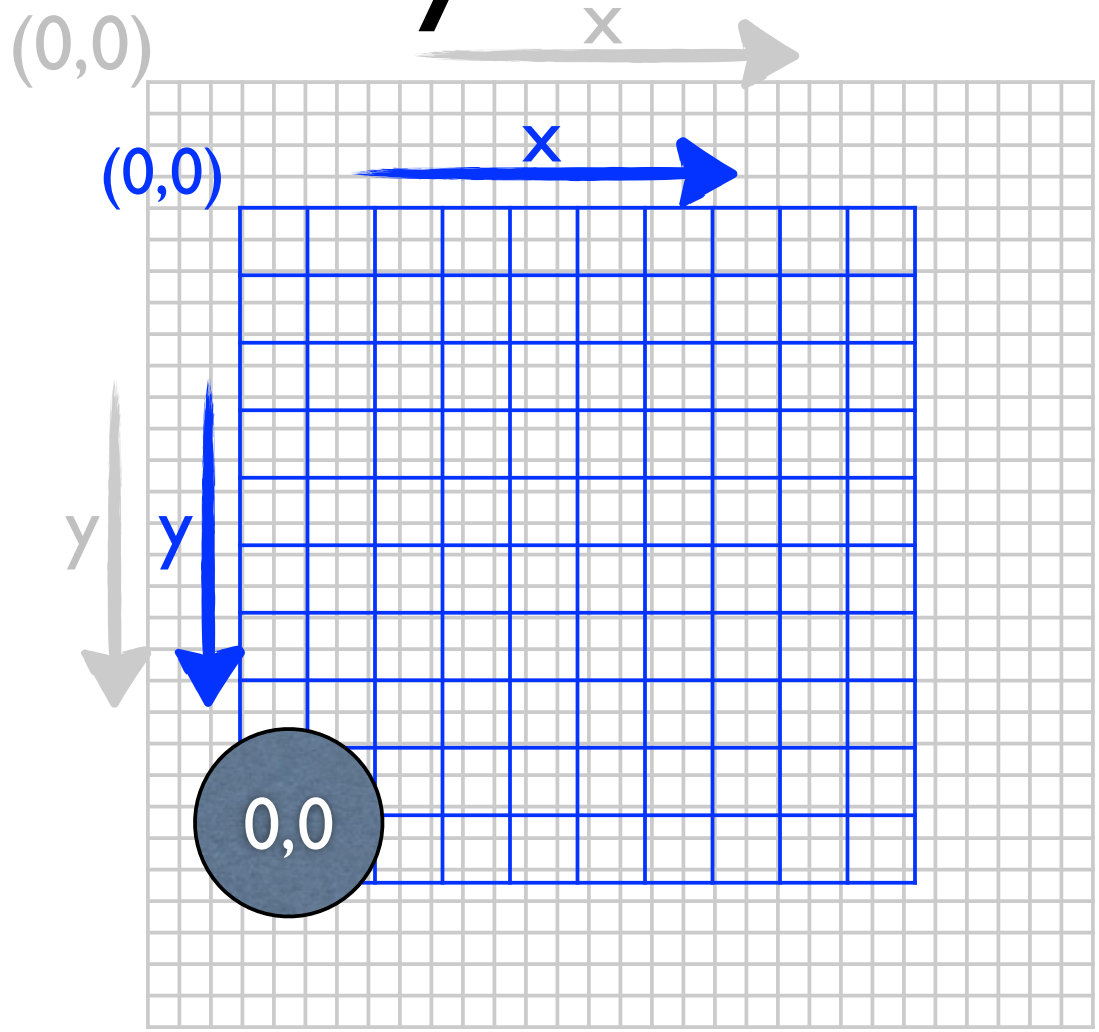
Coordinate Systems

- Screen Coords



Coordinate Systems

- Screen Coords
- Viewport
- World Coords



Coordinate Systems

- Use transformation matrices to change coordinate systems

3D Graphics

- 2 major approaches
  - “Graphics Pipeline”/OpenGL (now)
  - Ray Casting/Tracing (~4 weeks)

3D Approaches

- **Graphics Pipeline**
- Project 3D → 2D
  - Transformations
- Polygon Rasterization
- Limited Effects/Tricks
- Fast (Real Time)
  - Hardware Accelerated

- **Ray Casting/Tracing**
- Simulation of Eye/Camera
- Rendering of Solids
- Lots of effects (simulation)
- Slow
  - But getting faster

Approach

- map 3d vertices → screen
- process objects one at a time as they are being generated by the application

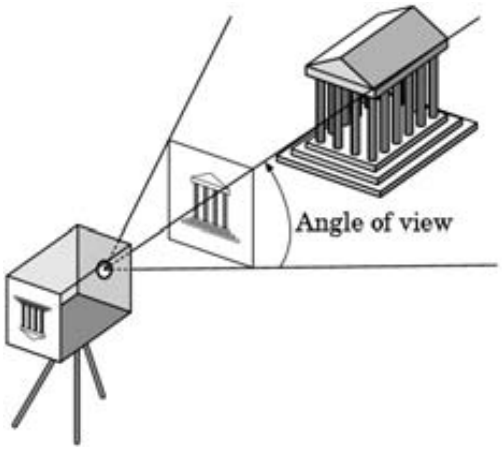
All step can be implemented in hardware on the graphics card

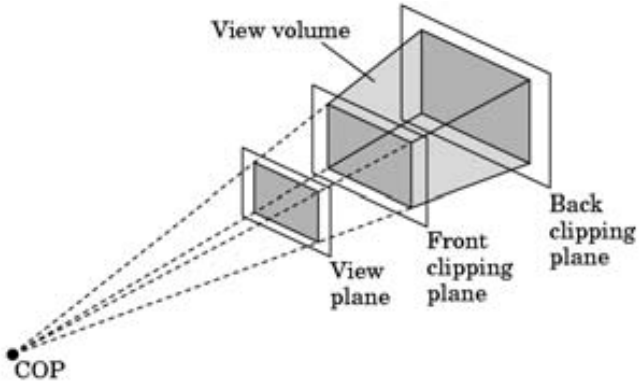
The Pipeline: Transformations

- Changes from one coordinate system to another
  - Object coordinates
  - world coordinates
  - Camera coordinates

The Pipeline: Clipping

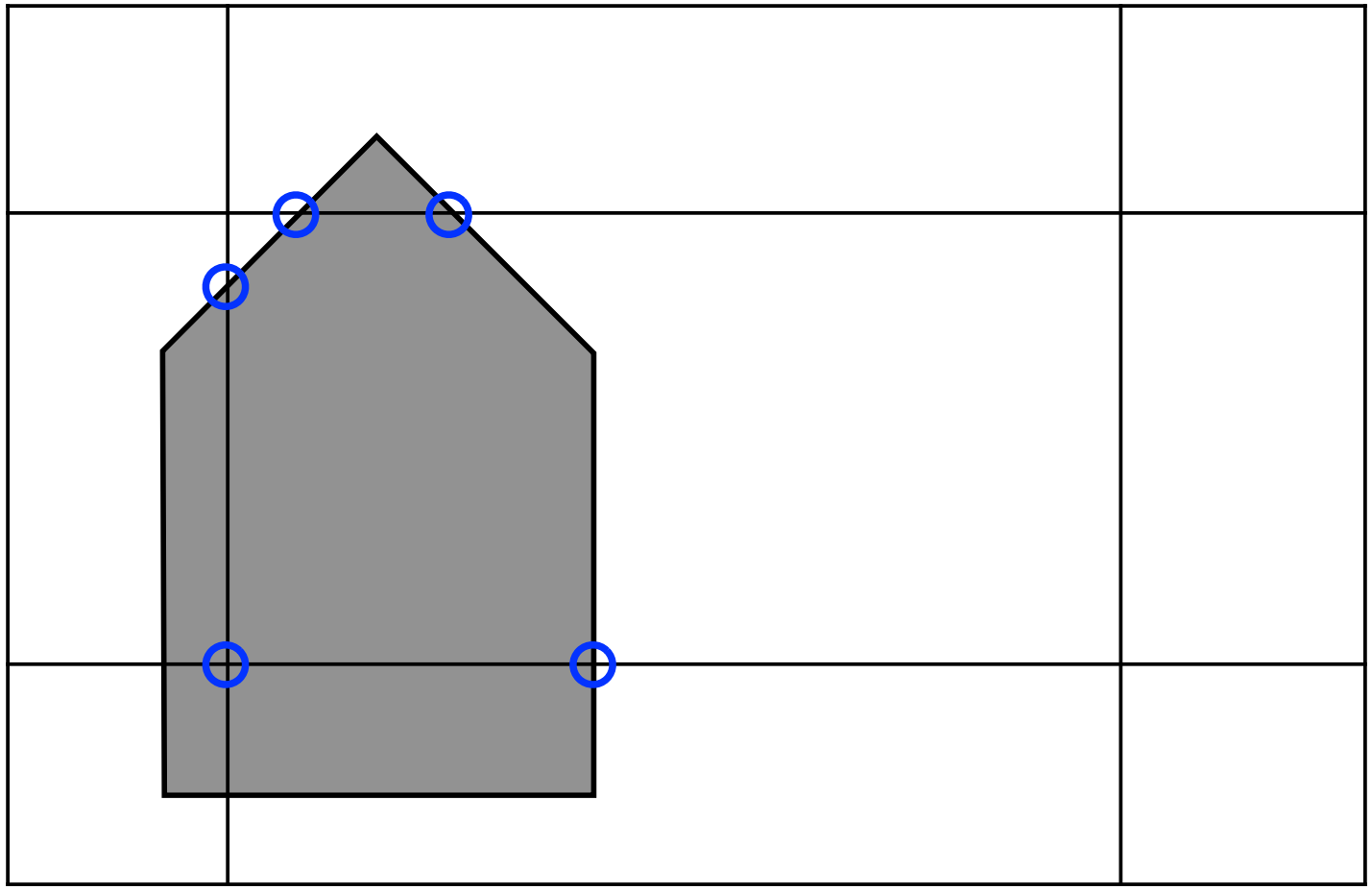
- Eliminate objects the camera can't see.



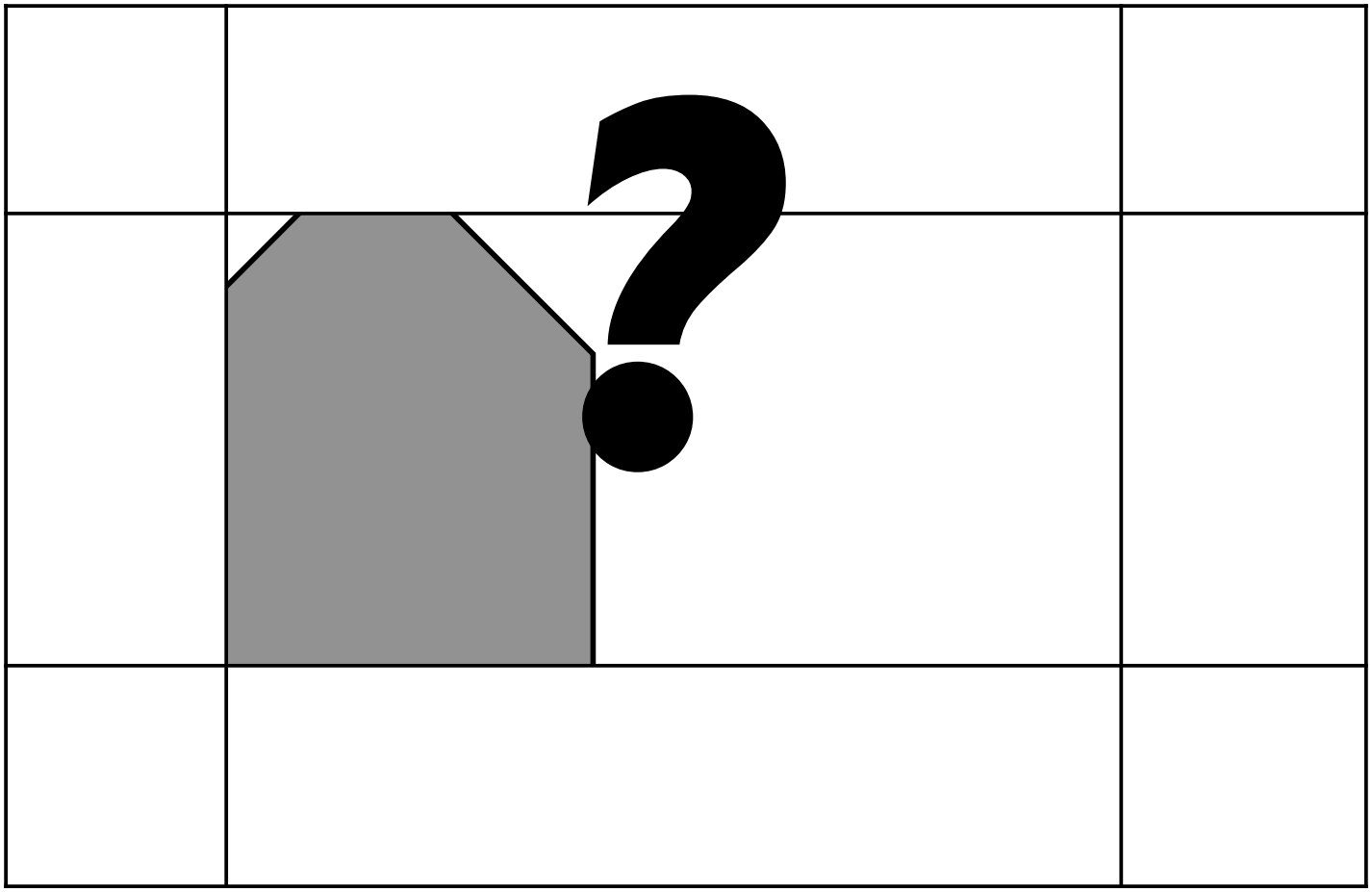


vertices → transformer → clipper

Clipping

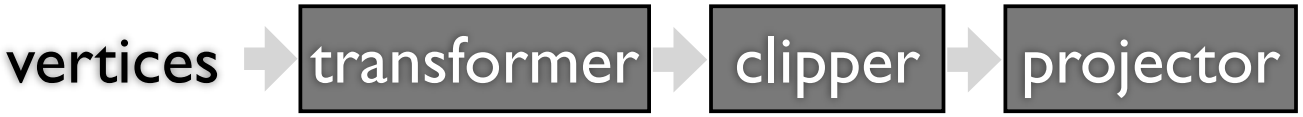


Clipping



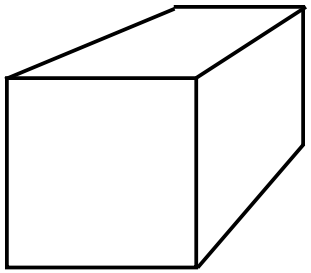
The Pipeline: Projection

- Transformation of 3D objects to 2D
  - Camera Coordinates to Screen Coordinates
  - two ways: perspective and orthographic

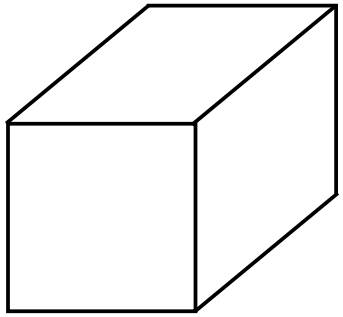


Orthographic vs Perspective Projection

- Perspective
  - Vanishing Point
  - Foreshortening



- Orthographic
  - Parallel Projection
  - Distances Preserved



OpenGL is not OOP

OpenGL is not object oriented and its python libraries are auto generated so you get functions like this...

```
glVertex3f
glVertex2i
glVertex3d
```

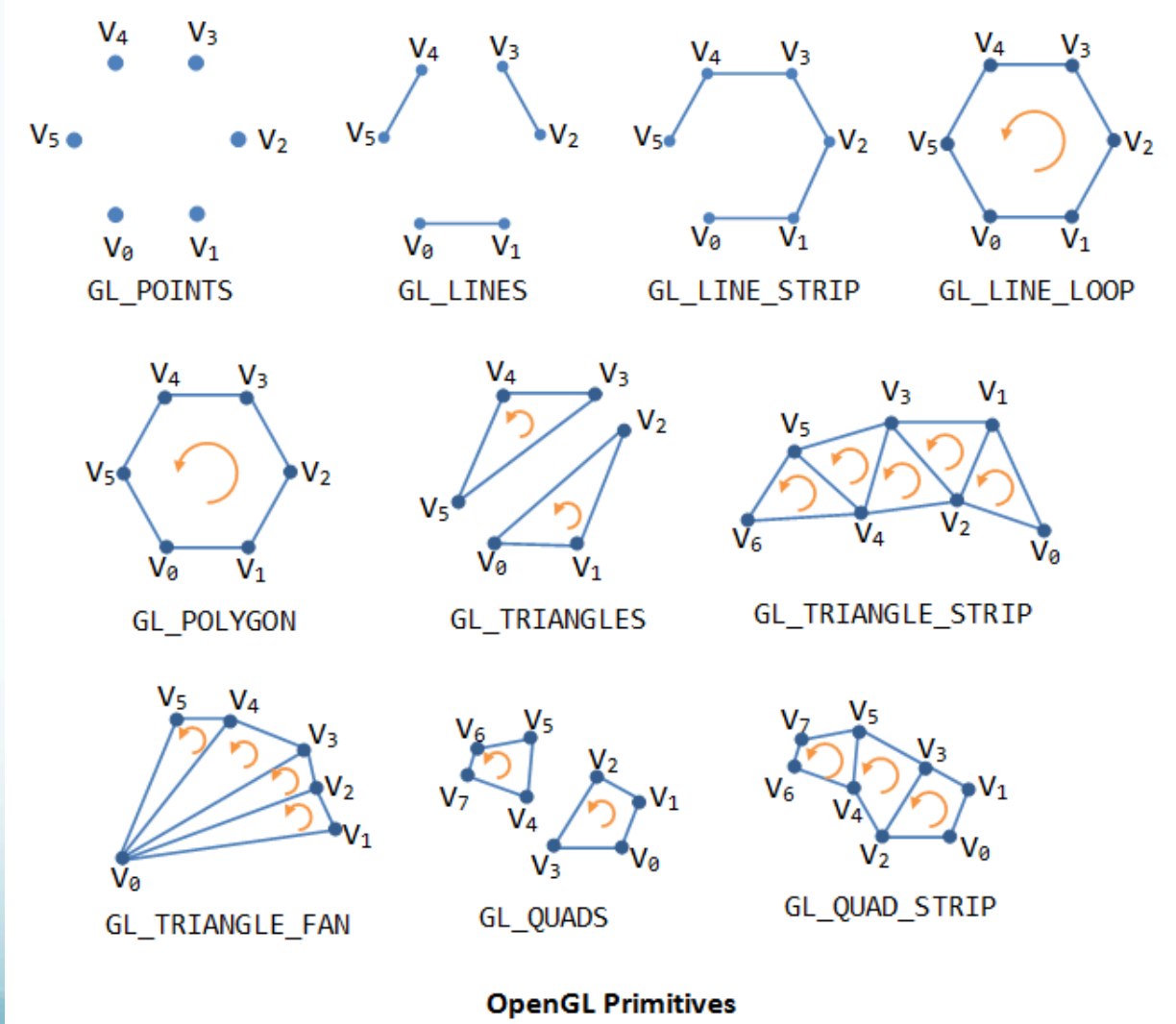
```
glVertex3f(x,y,z)
```

GL library

function name

3 floats

OpenGL Primitives



OpenGL Primitives