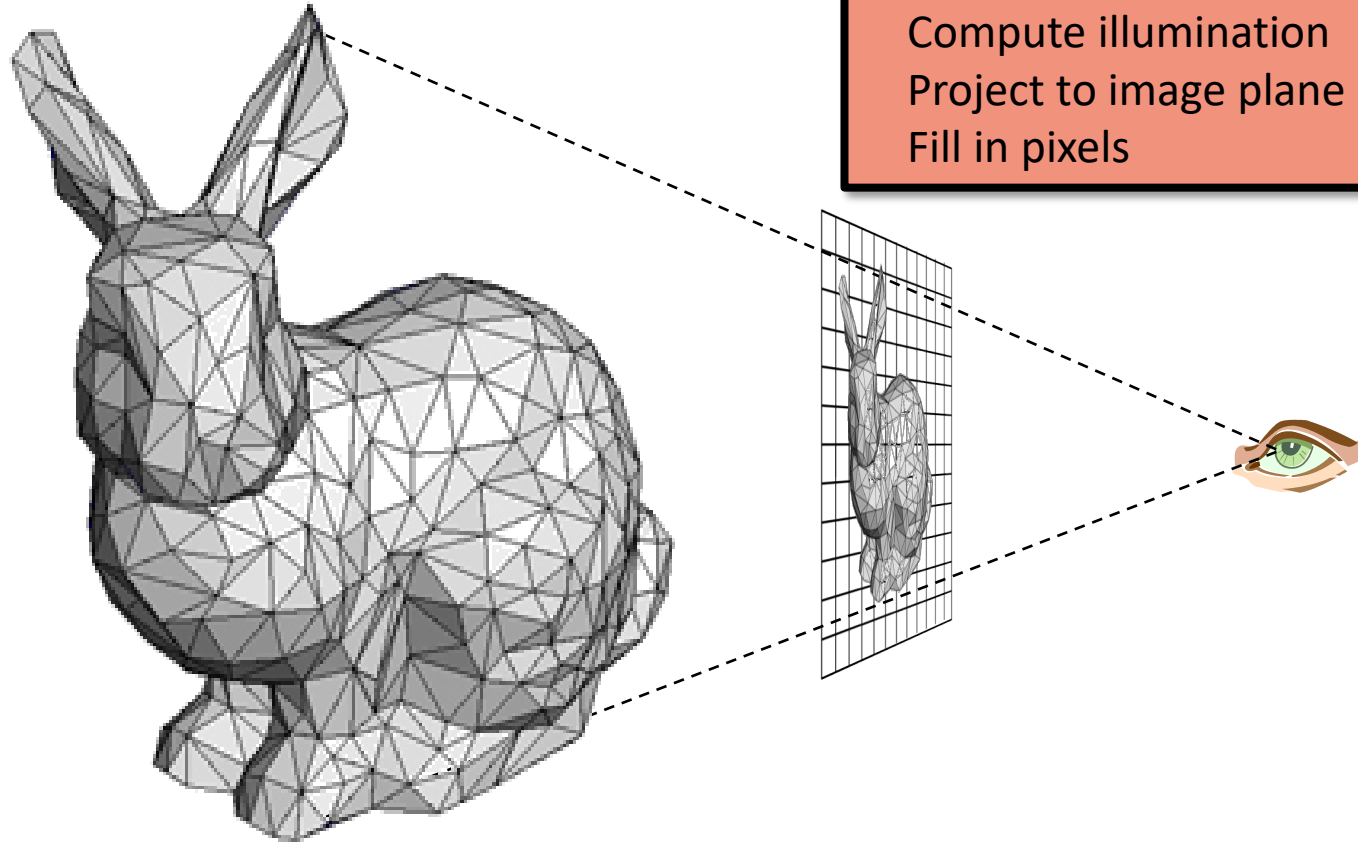


3D Computer Graphics for People in a Hurry

Rasterization Pipeline

Professor Eric Shaffer

Rasterization



Definitions: Pixel and Raster

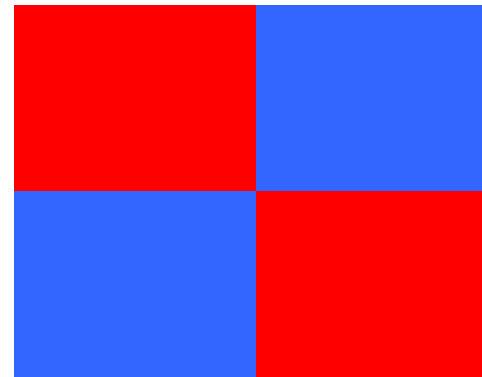
A *pixel* is the smallest controllable picture element in an image

A *raster* is a grid of pixel values

Typically rectangular grid of color values

$(1.0, 0.0, 0.0), (0.0, 0.0, 1.0)$

$(0.0, 0.0, 1.0), (1.0, 0.0, 0.0)$



RGB Color Representation

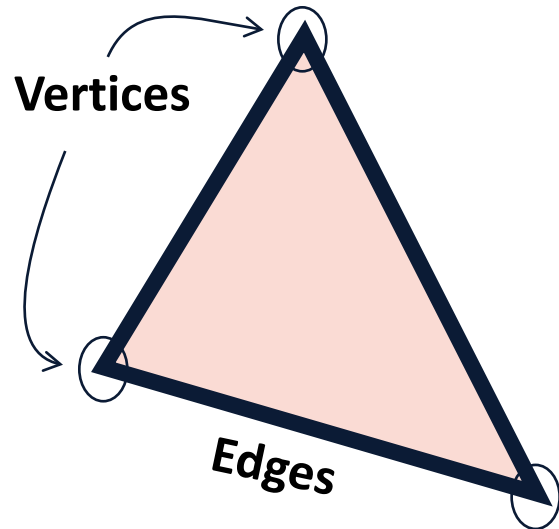
A color is a triple (R,G,B) representing a mix of red, green, and blue light.

Each color channel has a value in $[0, 1]$ indicating how much light is emitted.



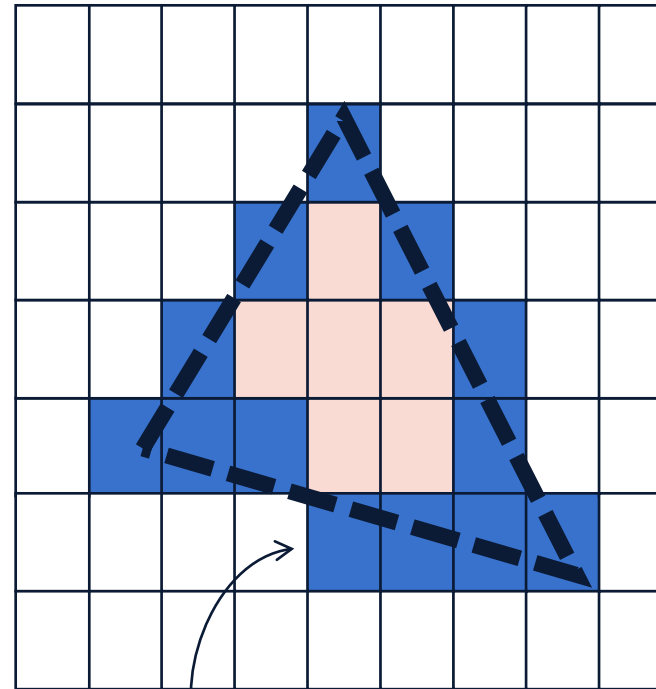
Rasterization

Primitives



Generate a raster image
from a vector description

Pixels



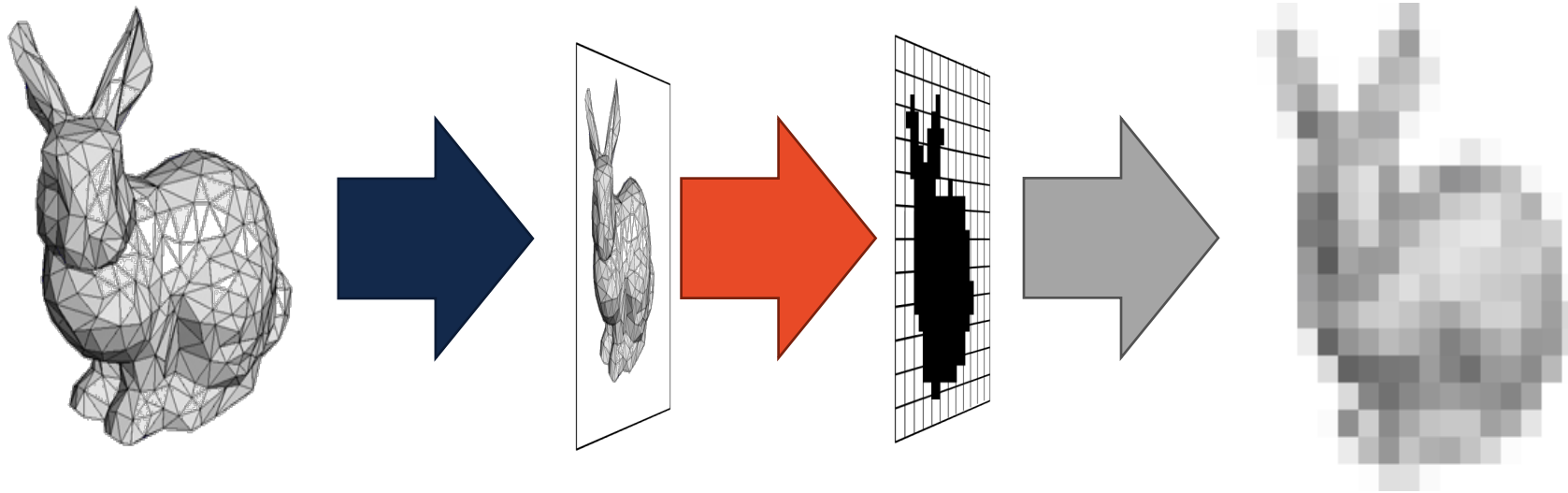
Vector Graphics Representation

Is a purely mathematical representation of shape. For example, a line is $y=mx+b$. Typically, **vector graphics** refers to 2D shapes, but the idea applies to 3D as well.



3D Graphics Pipeline

Vertex Processing **Rasterization** Fragment Processing



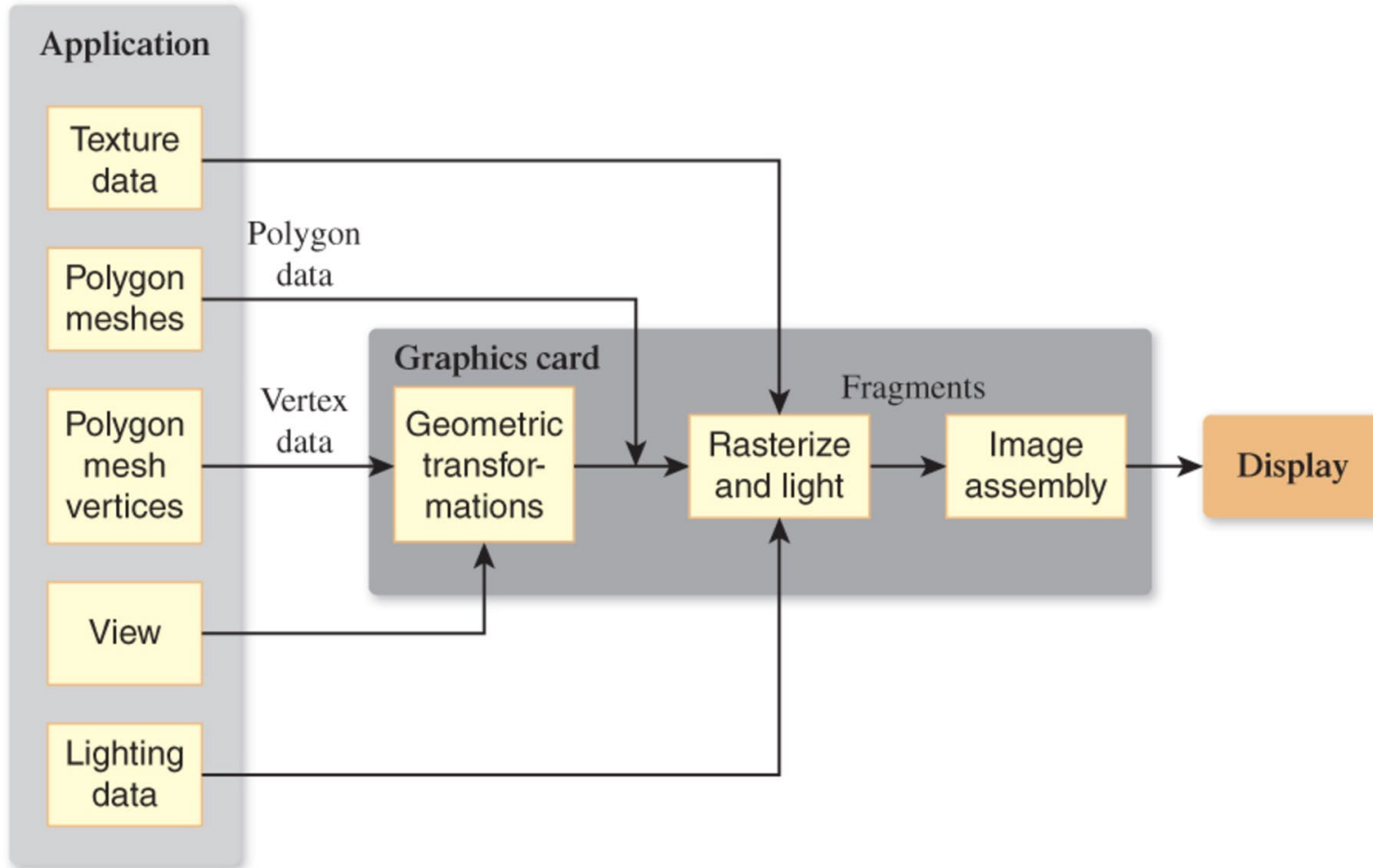
Fragments

Are like pixels...but they aren't necessarily the finalized pixels you see in an image. Each fragment has a 2D location in a raster and a color.

Final pixel value is typically found by applying *hidden surface removal* and possibly *compositing* to a set of fragments.



Rasterization is a Pipeline

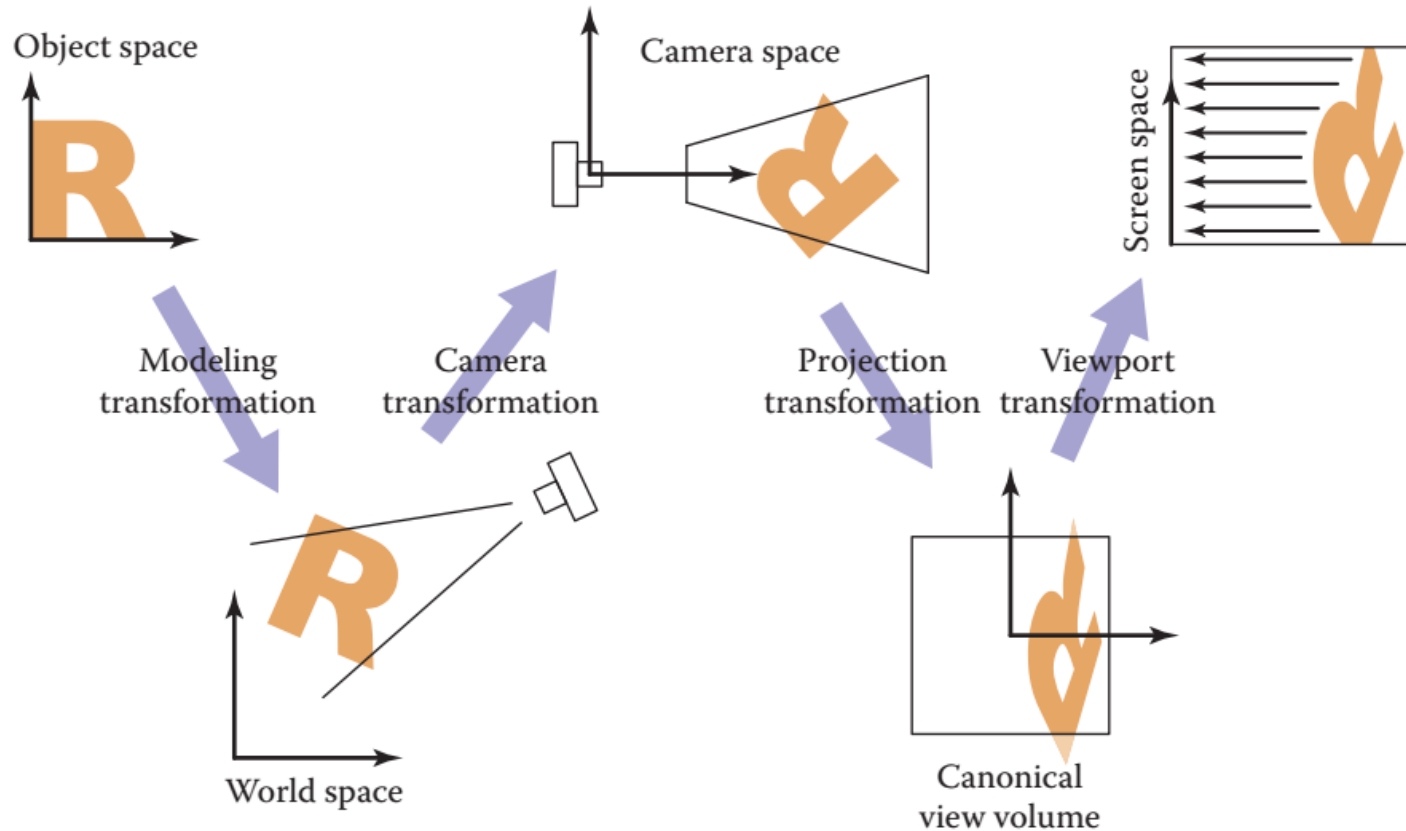


- Data for objects in the scene usually in the form of polygonal meshes
- Most of the work to render an image is done on the Graphics Processing Unit (GPU)
- GPU code will have at least two parts
 - Vertex Shader
 - Fragment Shader

Vertex Shader

- Program that runs on the GPU
- Typically transforms vertex locations from one coordinate system to another
 - Transformations can be useful for placing objects in your scene
 - Also, some operations on the geometry are easier when done in specific coordinate system
- Change of coordinates usually equivalent to a matrix transformation
- Vertex shader can also compute vertex colors

Changing Coordinate Systems



Model Transformation:

Move a model from a local coordinate system to a position in the “world”

Camera Transformation:

Places camera at the origin and moves the objects in the world using the same transformation

Projection Transformation:

Change coordinates so that a 3D to 2D projection of the geometry is done correctly

Viewport Transformation:

Change from 2D coordinates in $[-1,1]$ to pixel coordinates

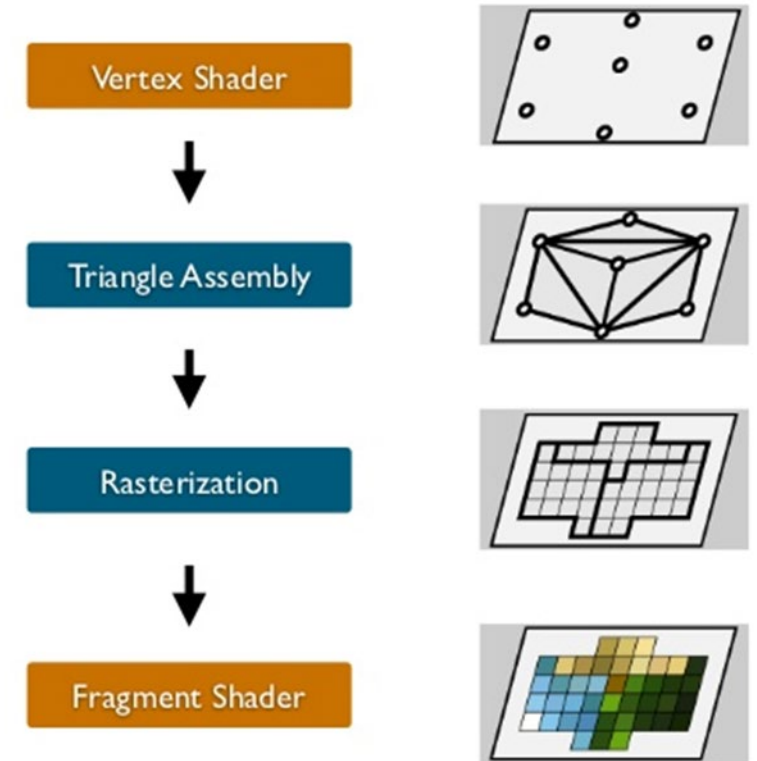
Rasterization

Rasterizer produces a set of fragments for each triangle

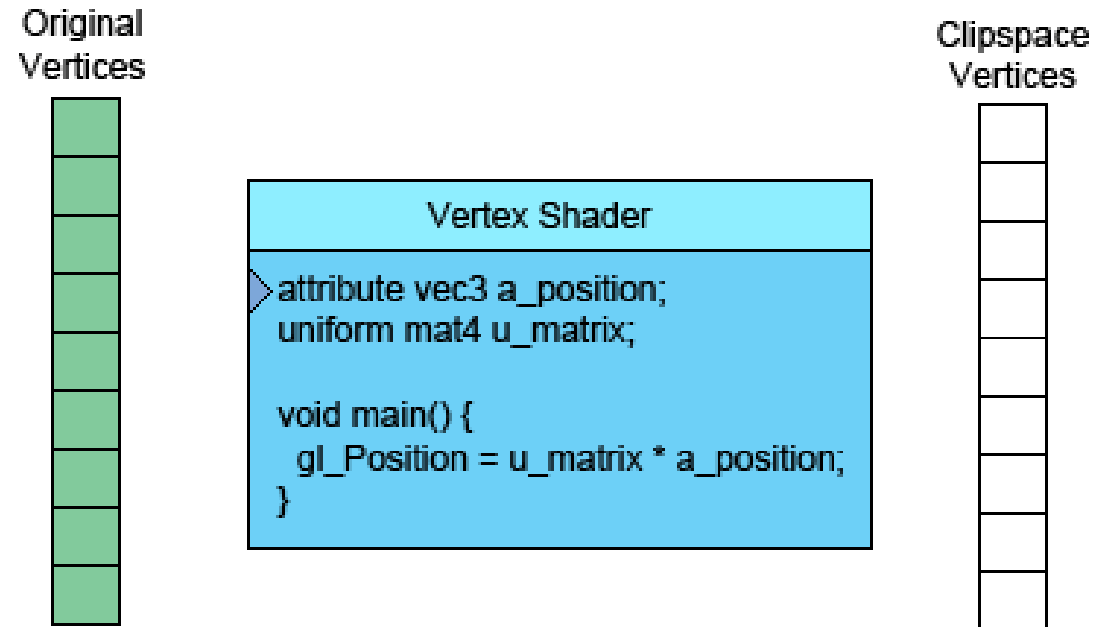
Fragments are “potential pixels”

- Have a location in frame buffer
- Color and depth attributes

Vertex attributes are interpolated across fragments



What a Vertex Shader Does...



Taken from webglfundamentals.org

Can you guess what is slightly incorrect about this animation?



What a Fragment Shader Does...

