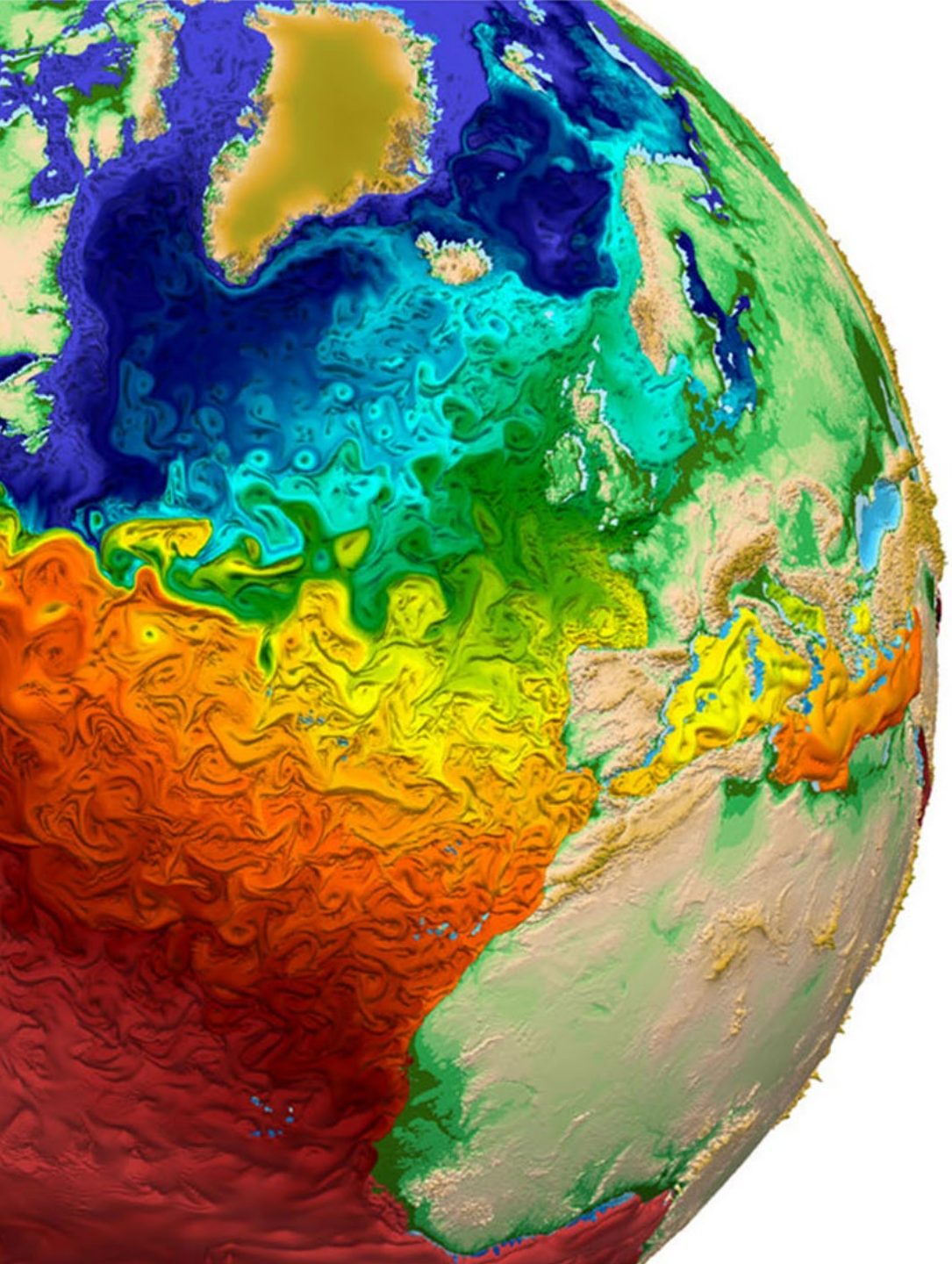


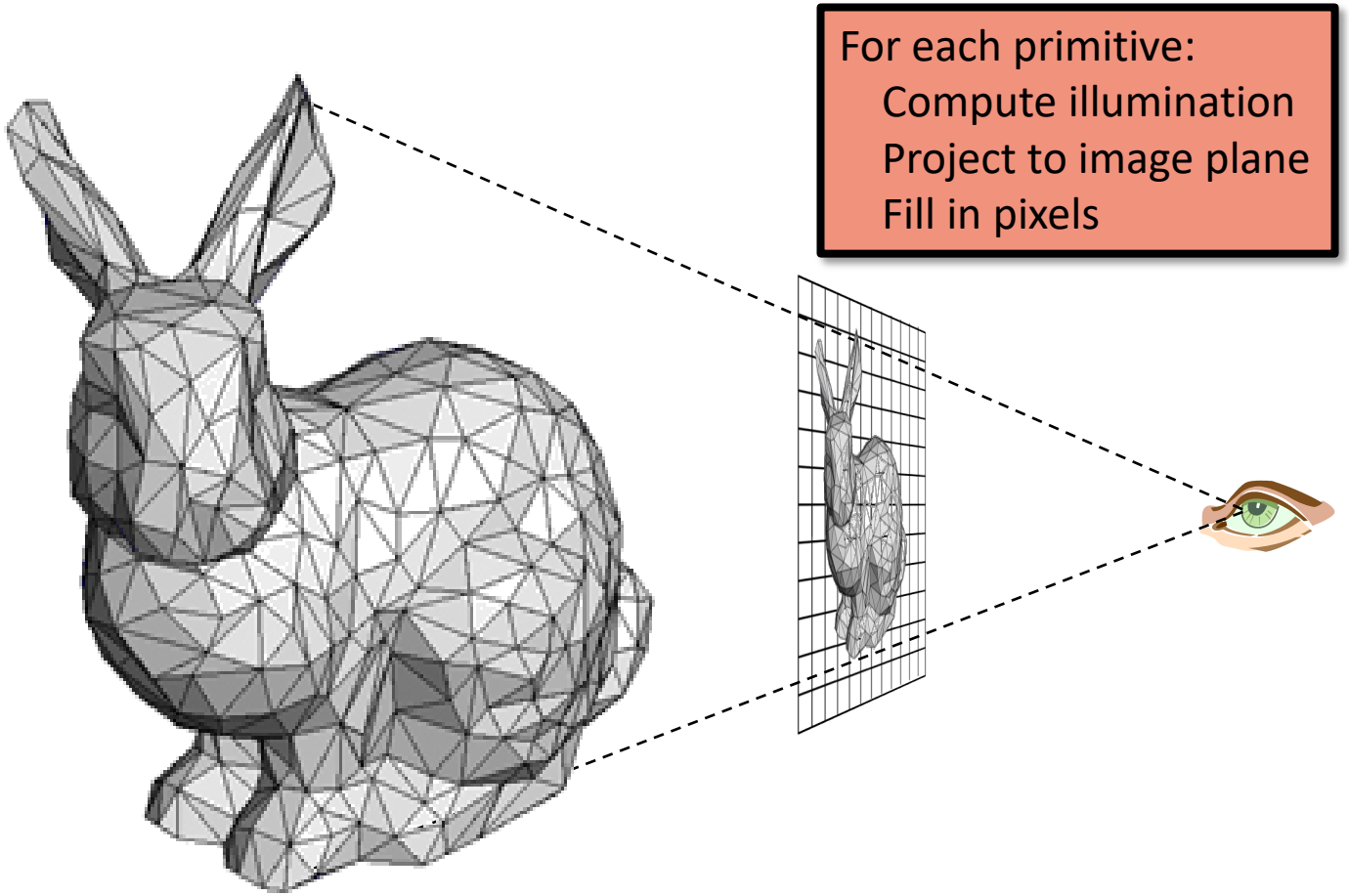
3D Computer Graphics for People in a Hurry

Rasterization Pipeline

Professor Eric Shaffer

ILLINOIS

Rasterization



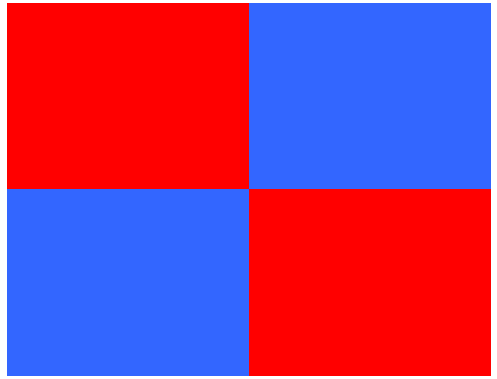
Definitions: Pixel and Raster

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

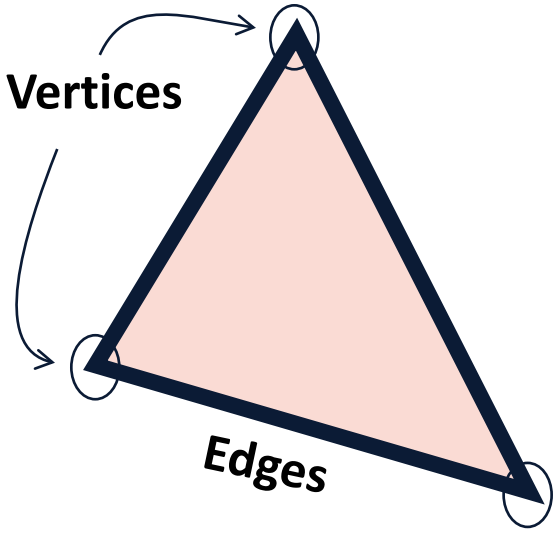
(1.0, 0.0, 0.0), (0.0, 0.0, 1.0)
(0.0, 0.0, 1.0), (1.0, 0.0, 0.0)



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.

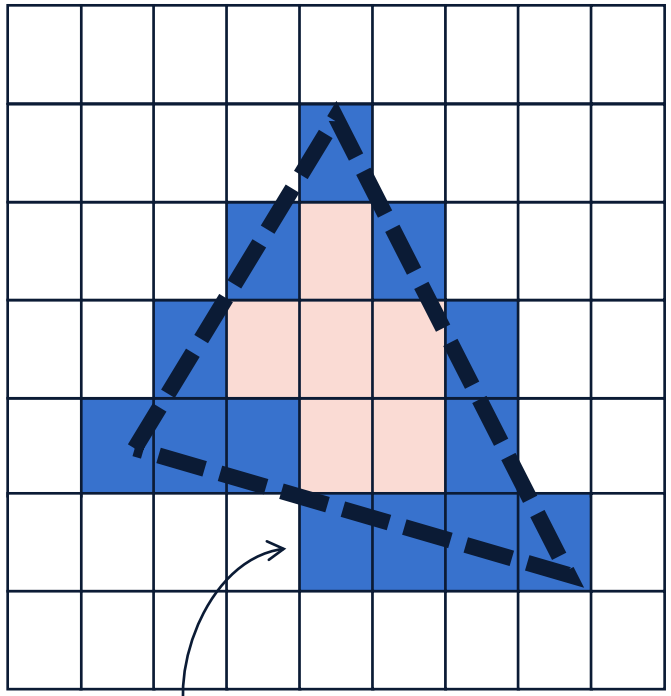
Rasterization

Primitives



Generate a raster image
from a vector description

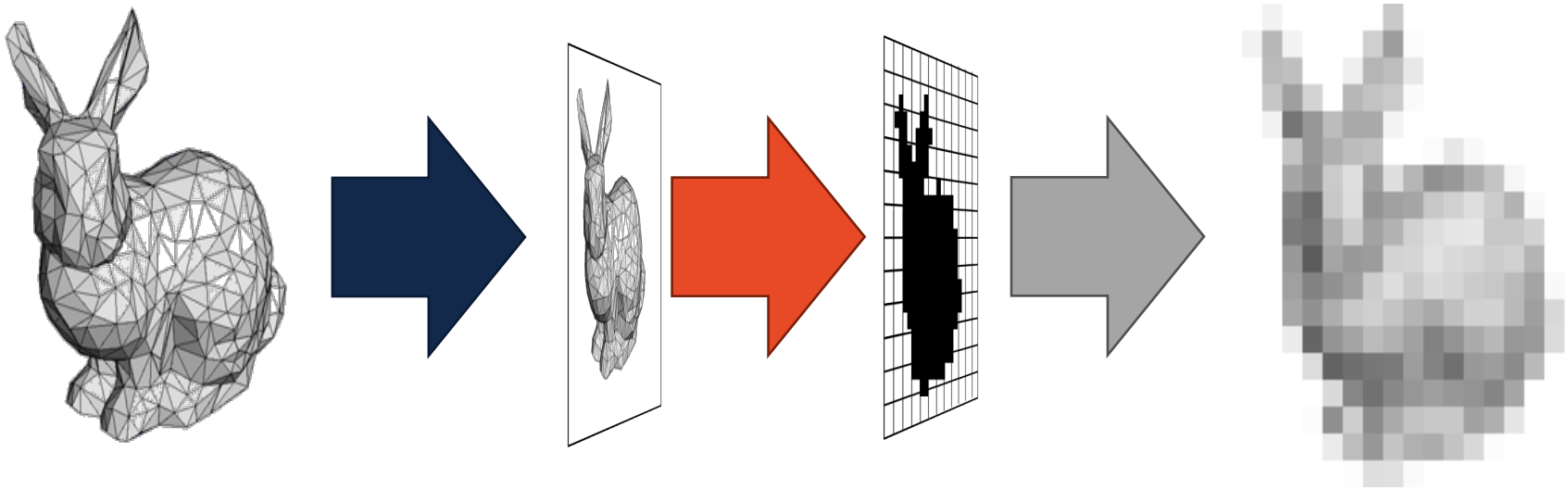
Pixels



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.

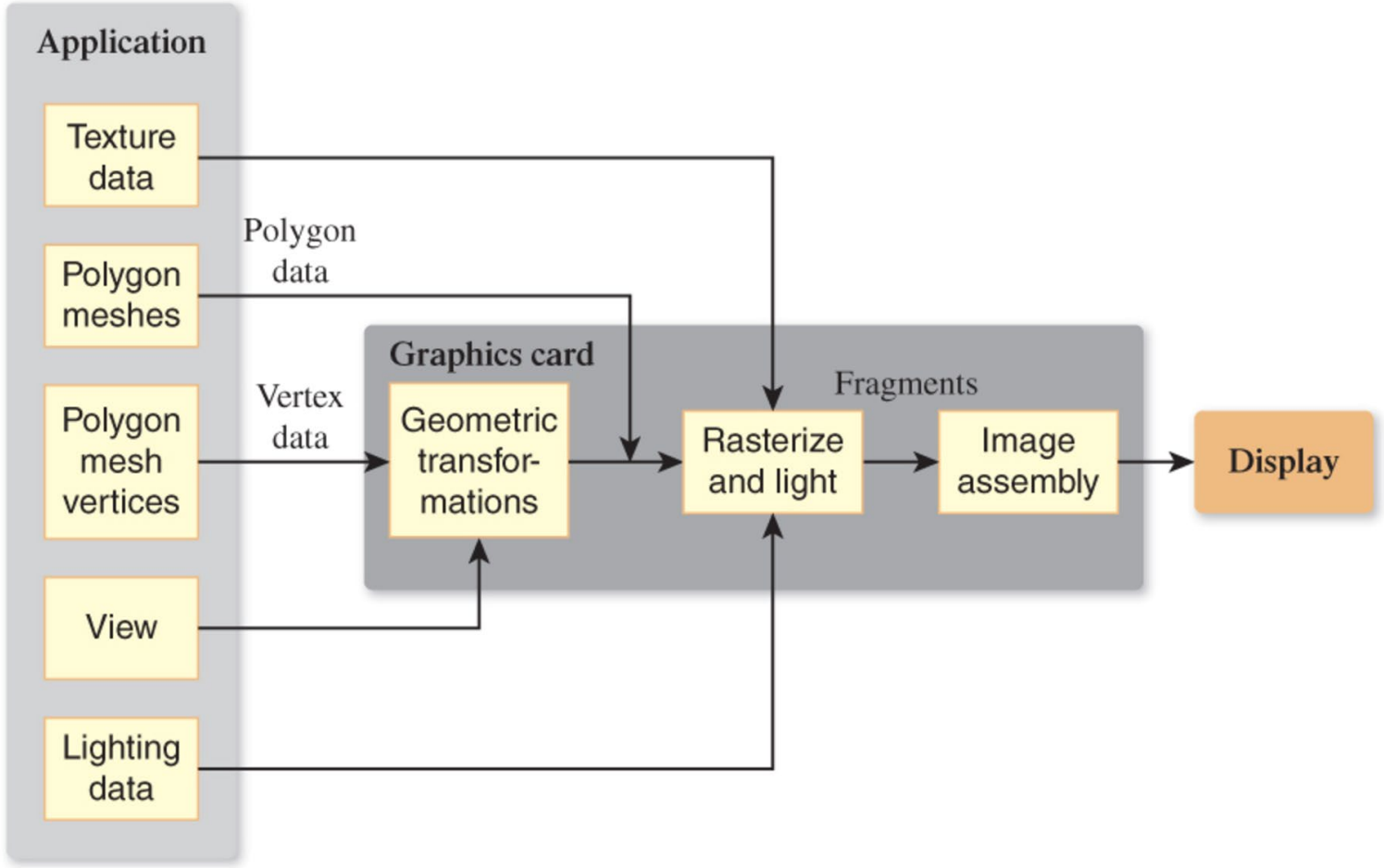
3D Graphics Pipeline

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**

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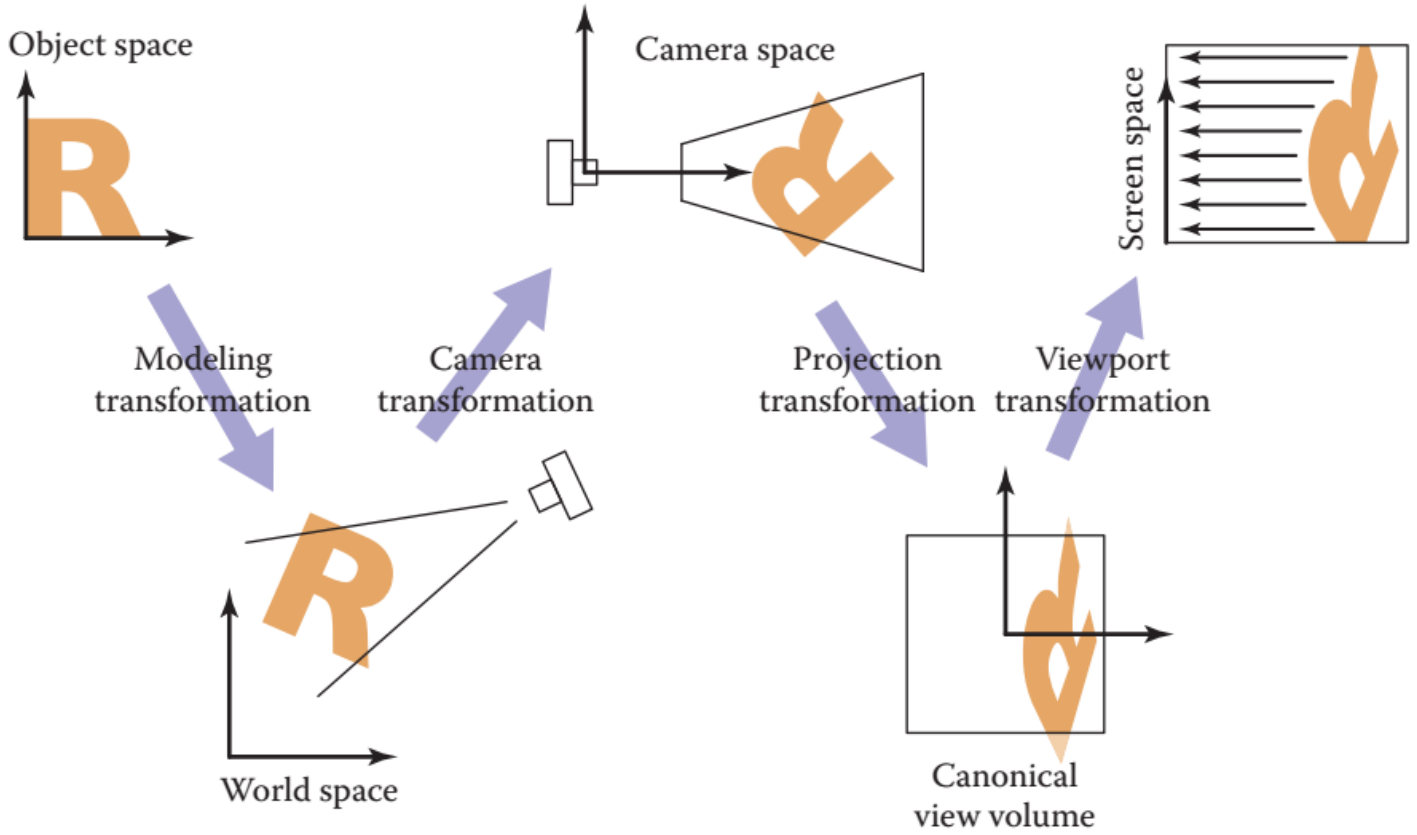
Vertex Shader

- 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

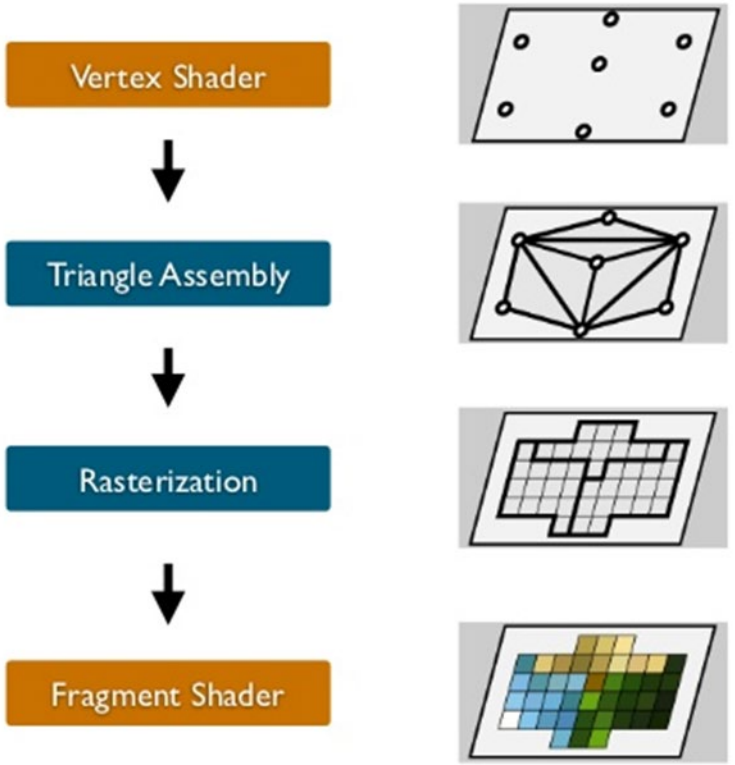
Rasterization

Rasterizer produces a set of fragments for each triangle

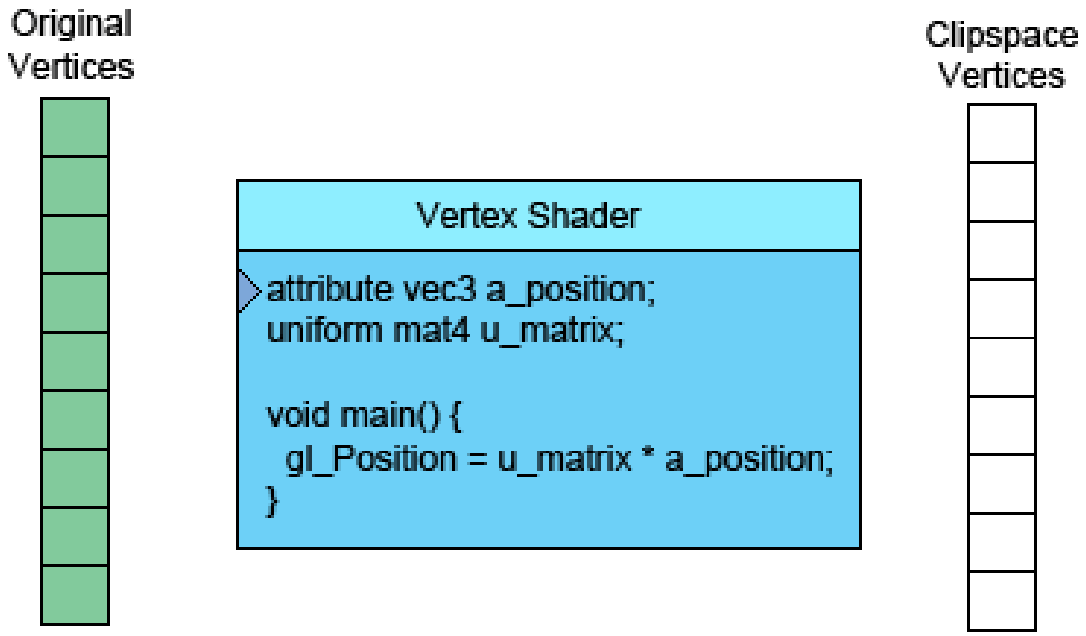
Fragments are “potential pixels”

- 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?

W hat a Fragment Shader Does…