CPSC 436D
Video Game Programming

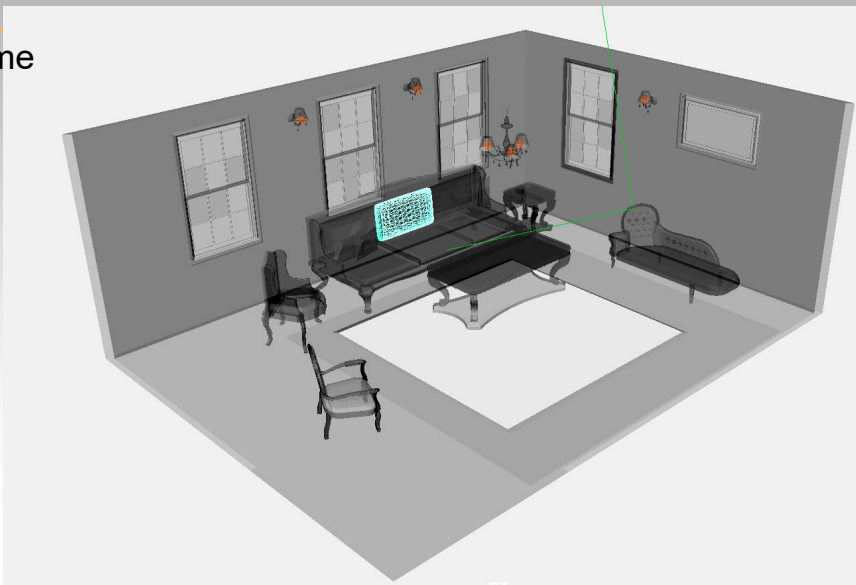
Rendering

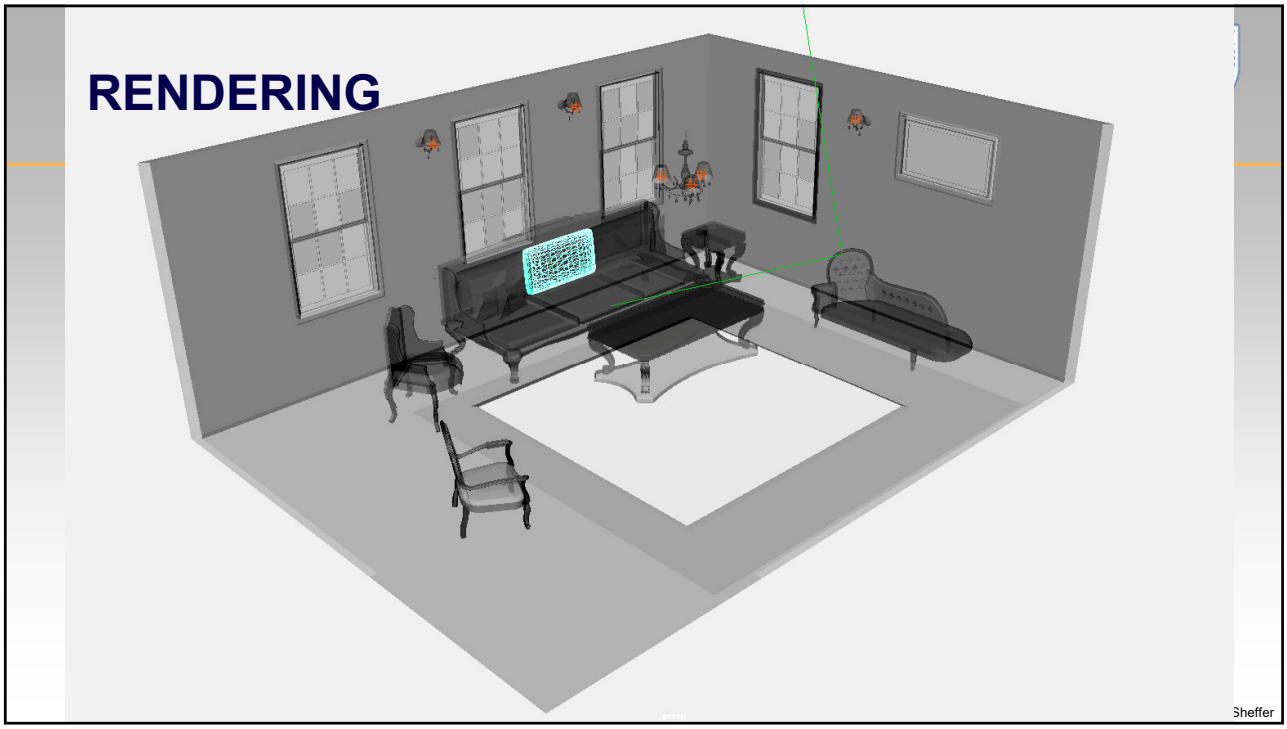
What is rendering?

Generating image from a (3D) scene

SCENE

- A coordinate frame
- Objects
- Their materials
- (Lights)
- (Camera)




RENDERING
Sheffer


RENDERING
UBC
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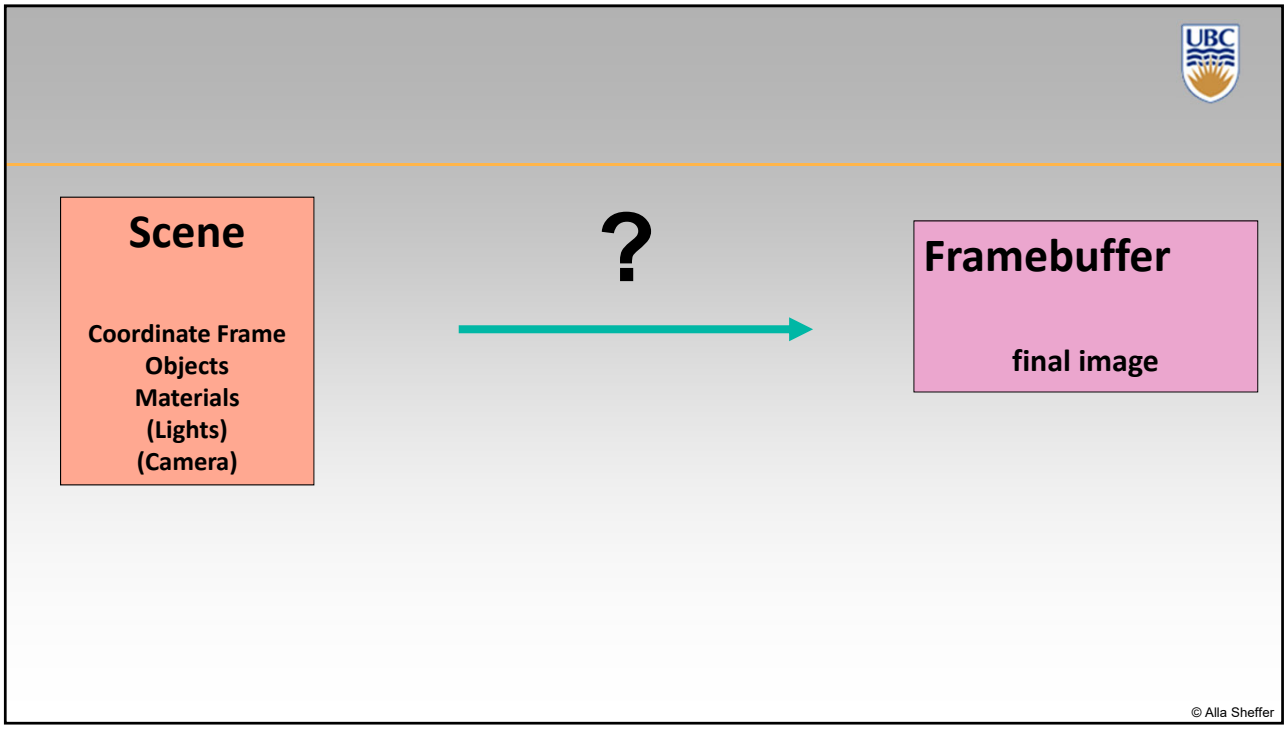
Frame Buffer

- Portion of RAM on videocard (GPU)
- What we see on the screen
- Rendering destination

Screen

Displays what's in frame buffer
Terminology:

Pixel: basic element on device
Resolution: number of rows & columns in device
Measured in
- Display: Absolute values (1K x 1K)
- Printer: Density values (300 dots per inch)


Scene
Coordinate Frame
Objects
Materials
(Lights)
(Camera)
?
Framebuffer
final image
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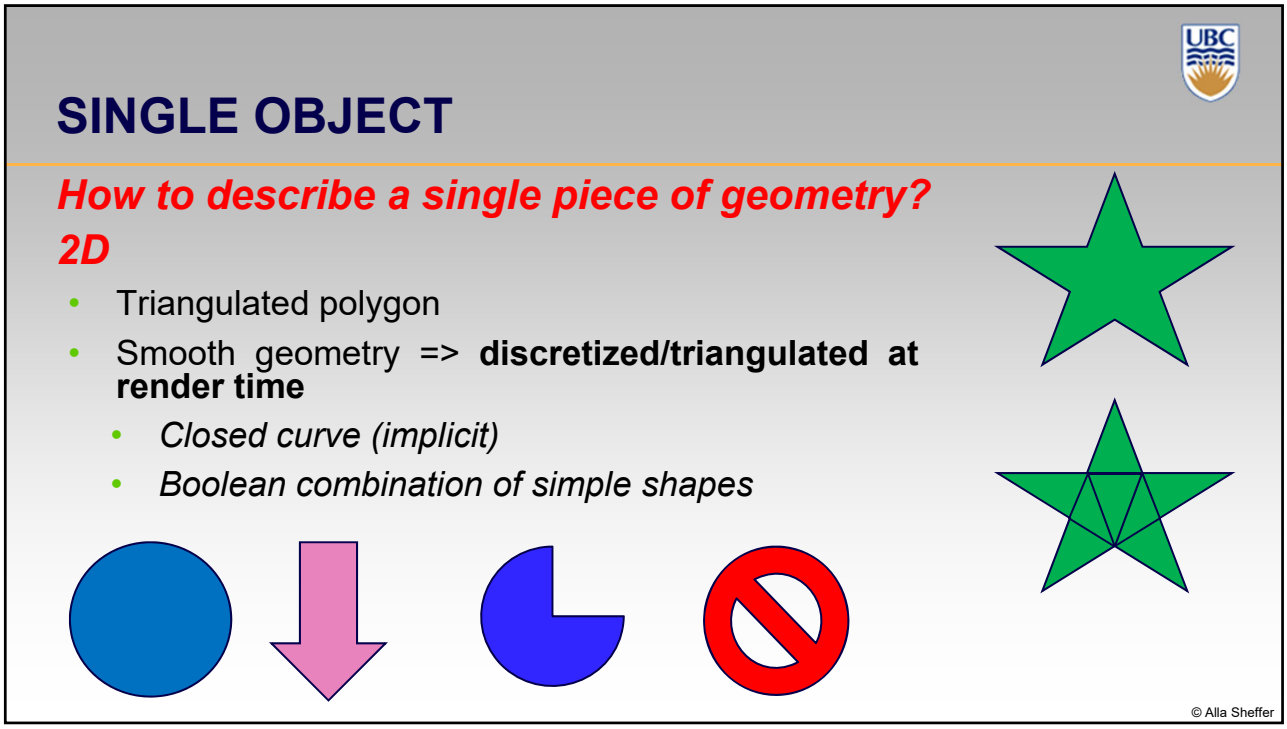
SINGLE OBJECT
How to describe a single piece of geometry?
2D
Triangulated polygon
Smooth geometry => discretized/triangulated at render time
Closed curve (implicit)
Boolean combination of simple shapes
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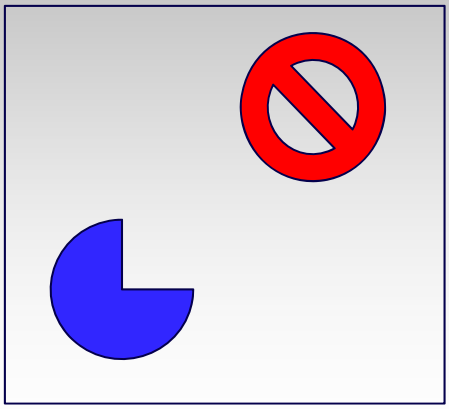
SCENE

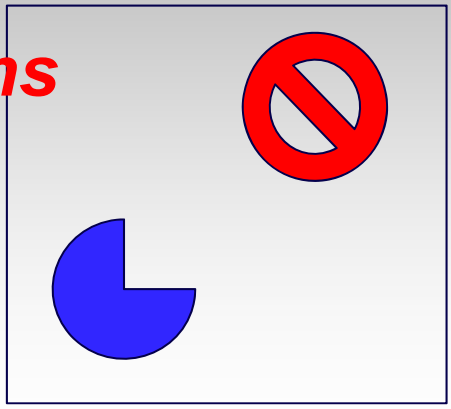
How to describe a scene?

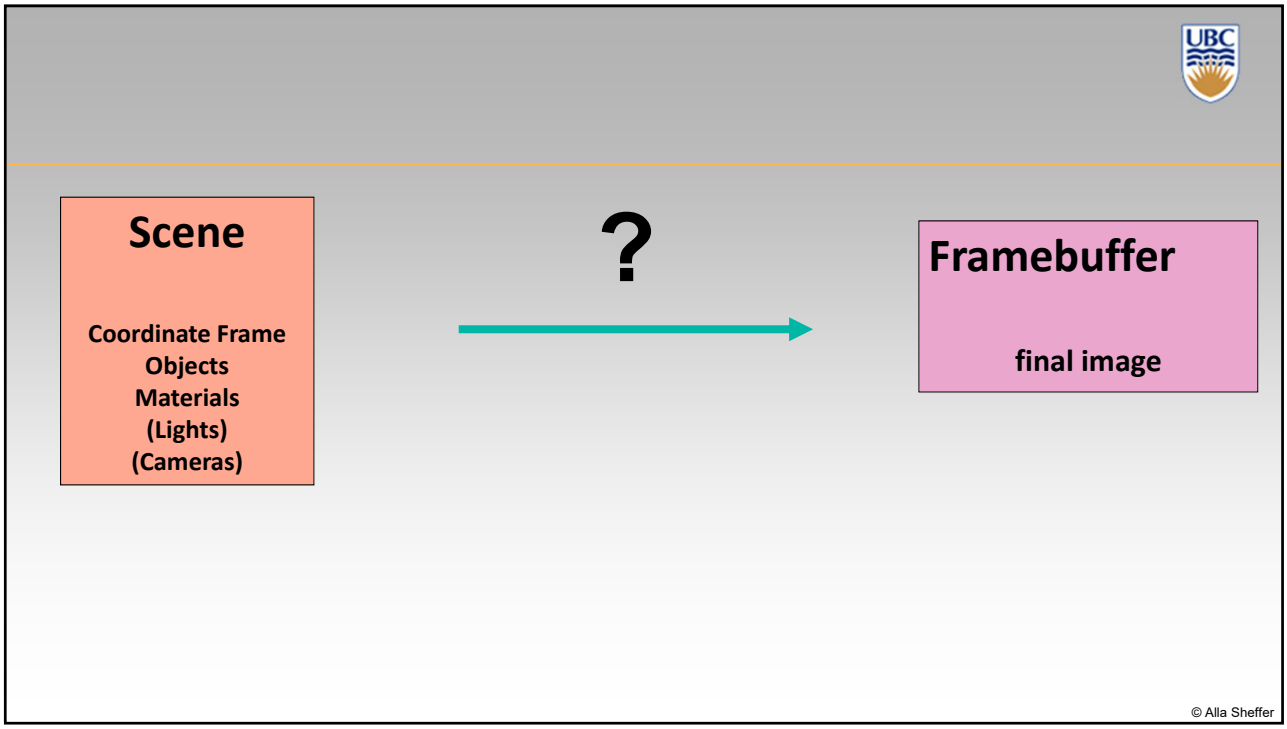


SCENE

How to describe a scene?

Local Transformations





Sketch of a rendering pipeline

Scene

- Coordinate frame
- Models
  - *Coordinates*
  - *Local transforms*
  - *properties (color, texture, material)*
- (Lights)
- (Camera)

Sketch of a rendering pipeline

Scene

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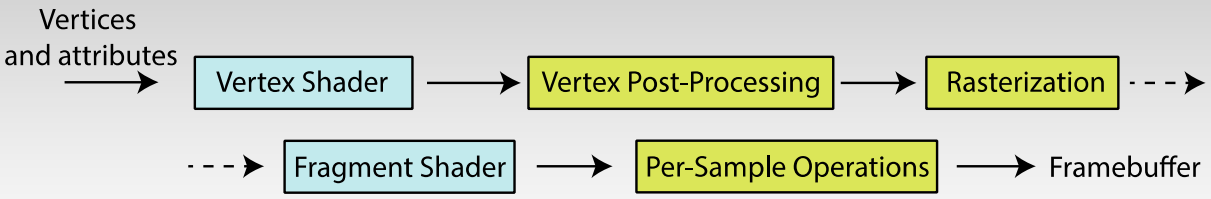
- **Camera View**
  - **2D positions of shapes**
  - **(Depth of shapes)**
  - **(Normals)**

- **Image**
  - **Shape pixels**
  - **Their color**
  - **Which pixel is visible**

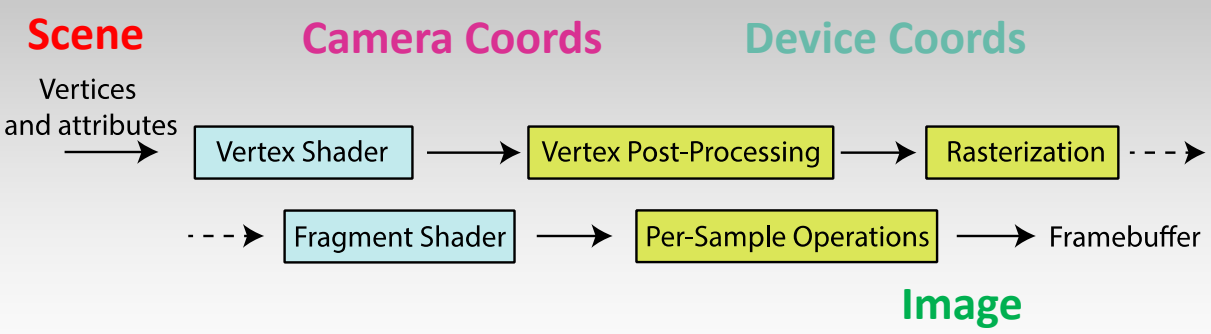
openGL

- Open Graphics Library
- One of the most popular libraries for 2D/3D rendering
- A software interface to communicate with graphics hardware
- Cross-language API

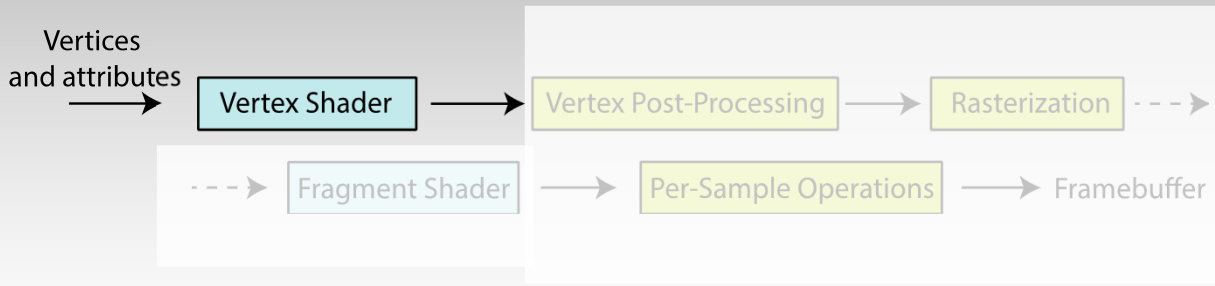
OpenGL RENDERING PIPELINE



OpenGL RENDERING PIPELINE



VERTEX SHADER



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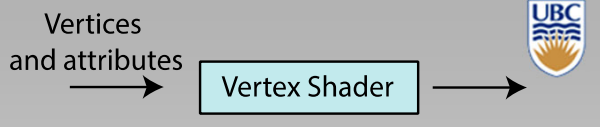
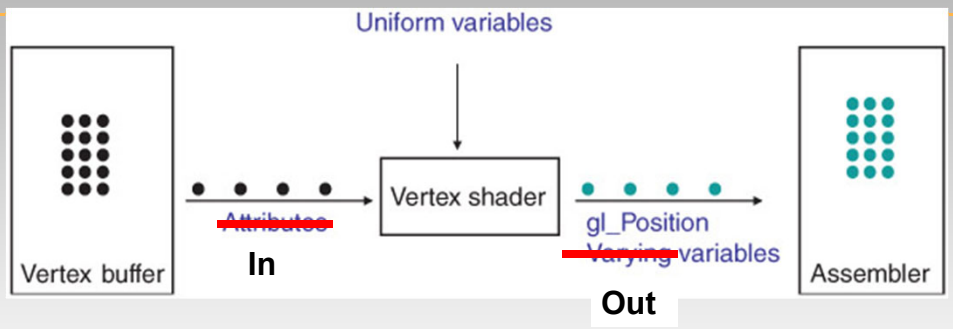
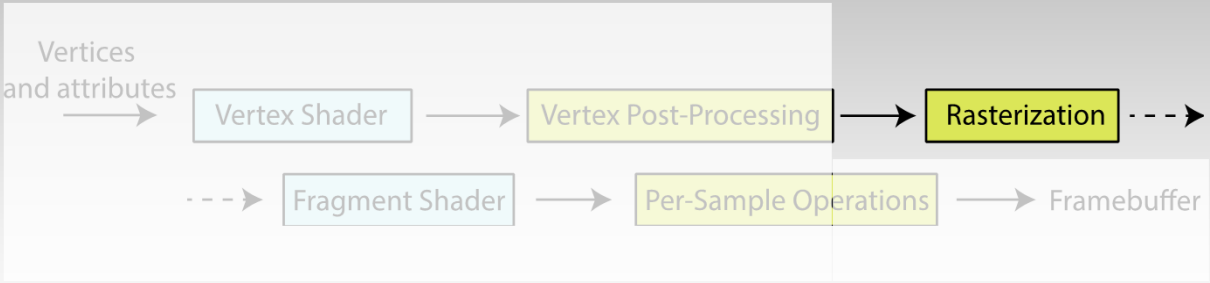




- Vertices are stored in vertex buffer
- Each one is processed by vertex shader
- Converts vertex into camera coordinates (View Coordinates)
- May compute per-vertex variables (color, texture, etc.)

RASTERIZATION



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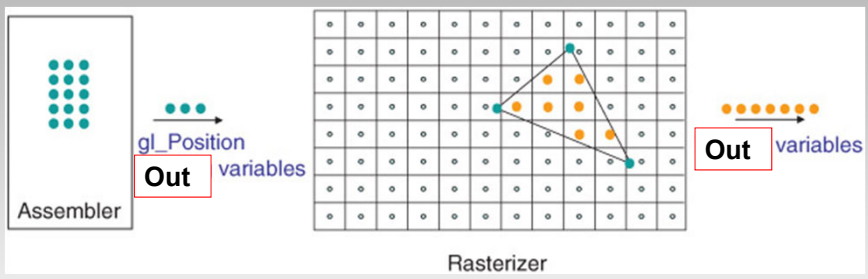
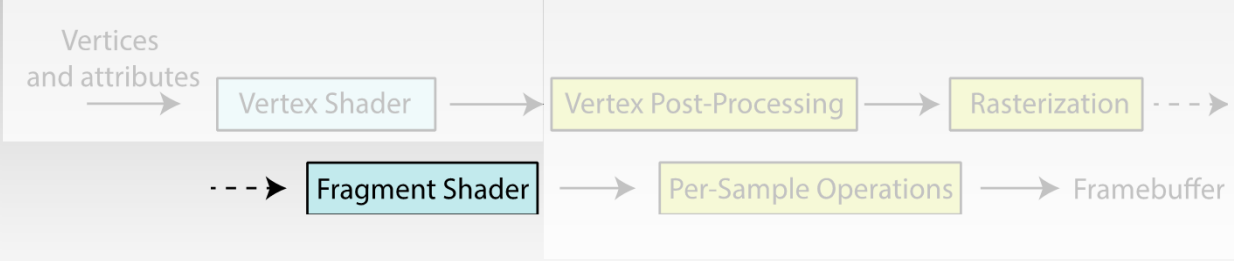
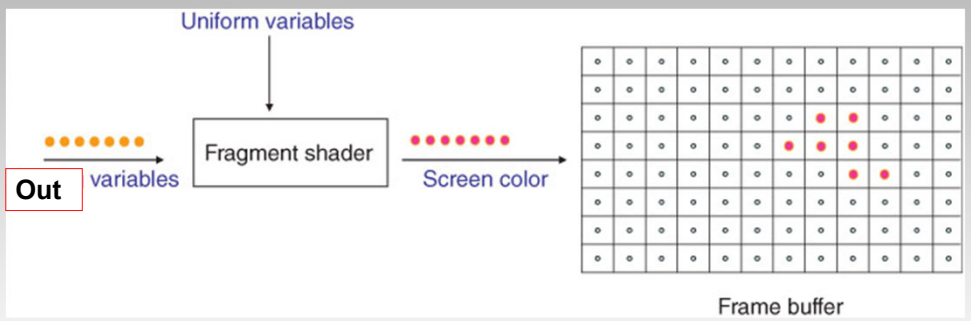


- Places three 2D vertices on a virtual screen
- Fills up the space between them
- Interpolates per-vertex variables to get per-fragment variables

FRAGMENT Shader



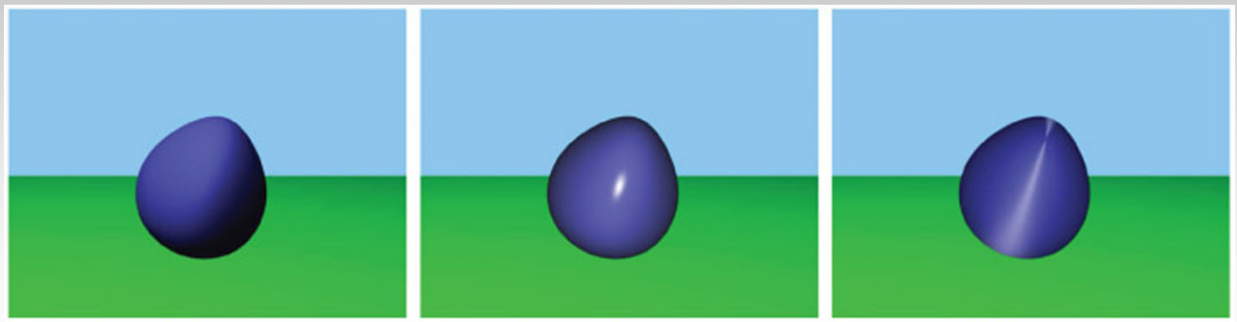
FRAGMENT Shader



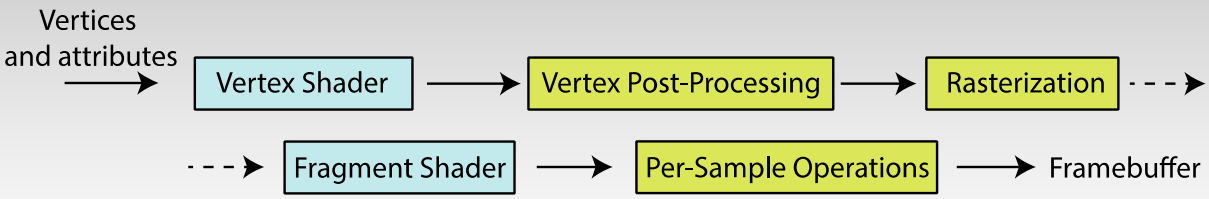
- Each fragment is passed through Fragment Shader
- Here it computes fragment (per pixel) color

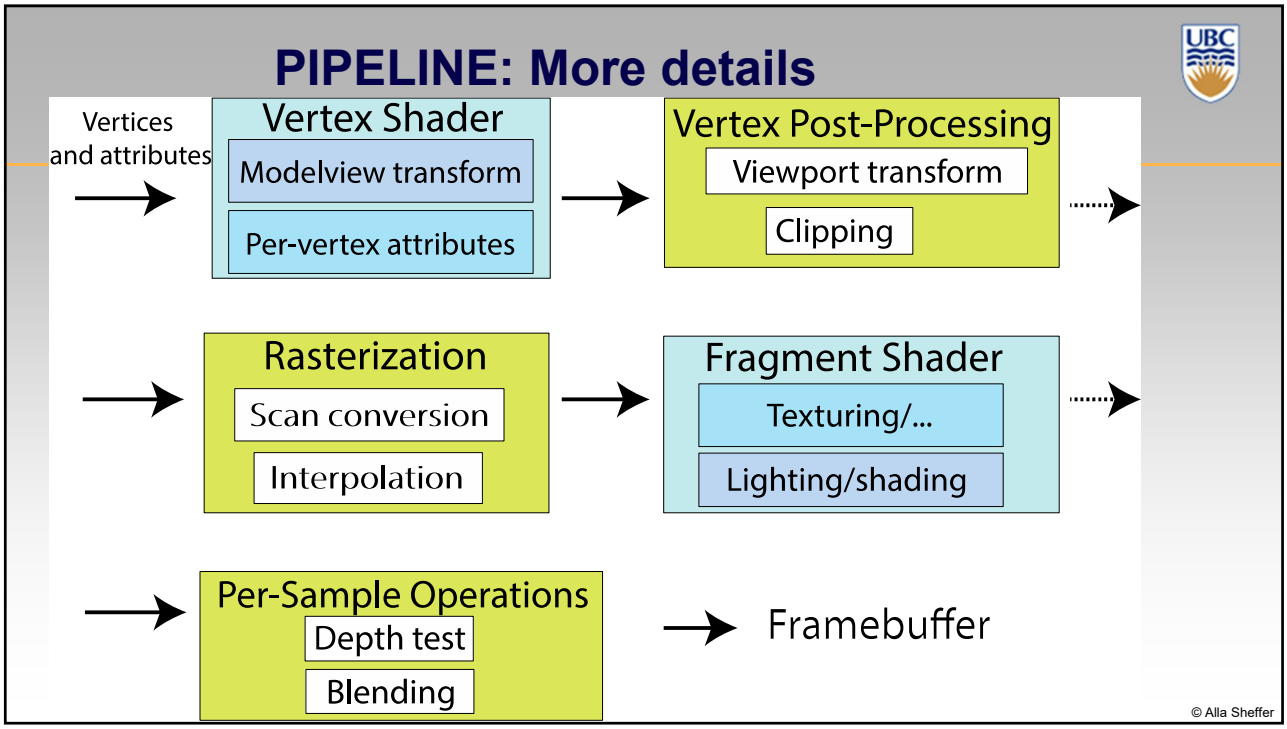
FRAGMENT SHADER

Can simulate different materials and lights



Opengl RENDERING PIPELINE




PIPELINE: More details
Vertices and attributes
Vertex Shader
Modelview transform
Per-vertex attributes
Vertex Post-Processing
Viewport transform
Clipping
Rasterization
Scan conversion
Interpolation
Fragment Shader
Texturing/...
Lighting/shading
Per-Sample Operations
Depth test
Blending
Framebuffer
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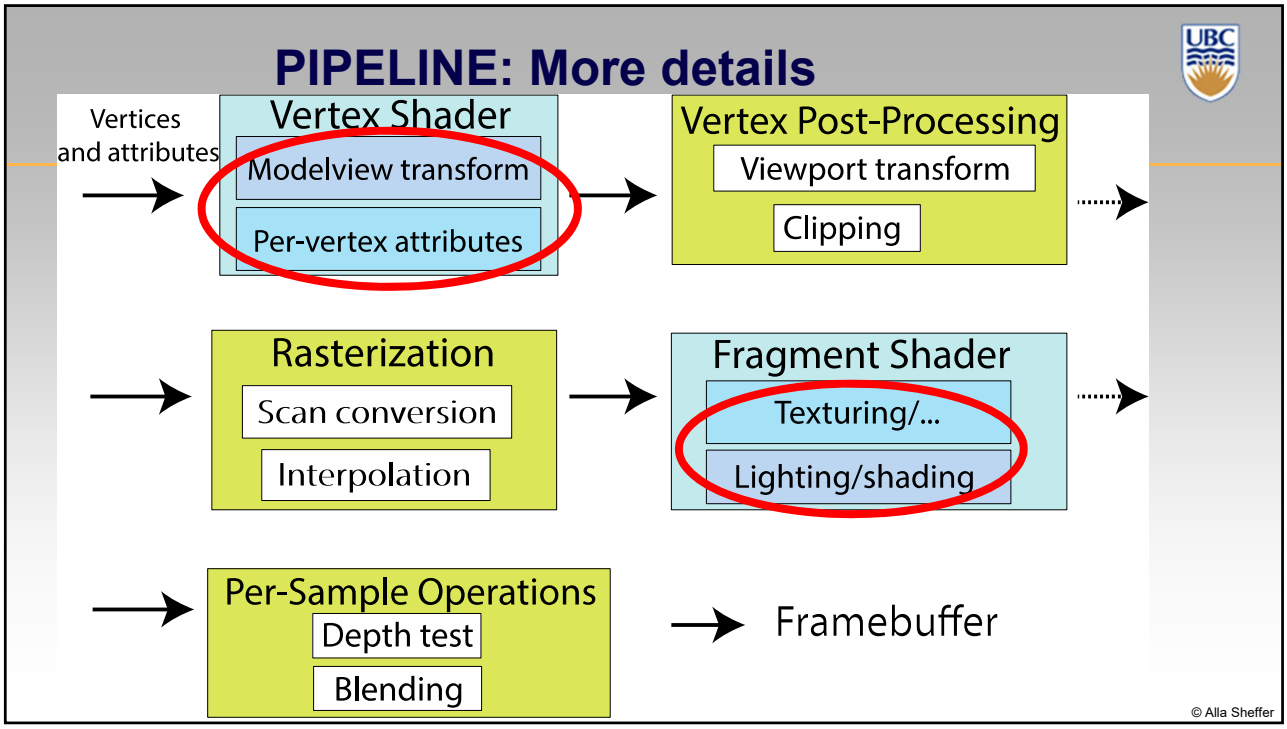
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