CPSC 436D
Video Game Programming

Rendering

TODOs

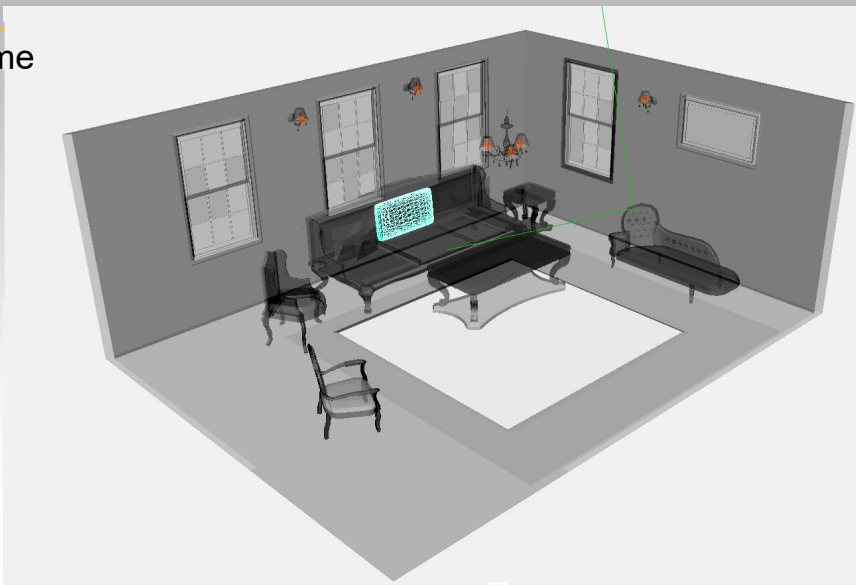
- Individual:
  - *"Hello game" assignment (individual)*
  - *Read through course pages*
  - *Register to Piazza*
- **!!!Team organizing!!!**

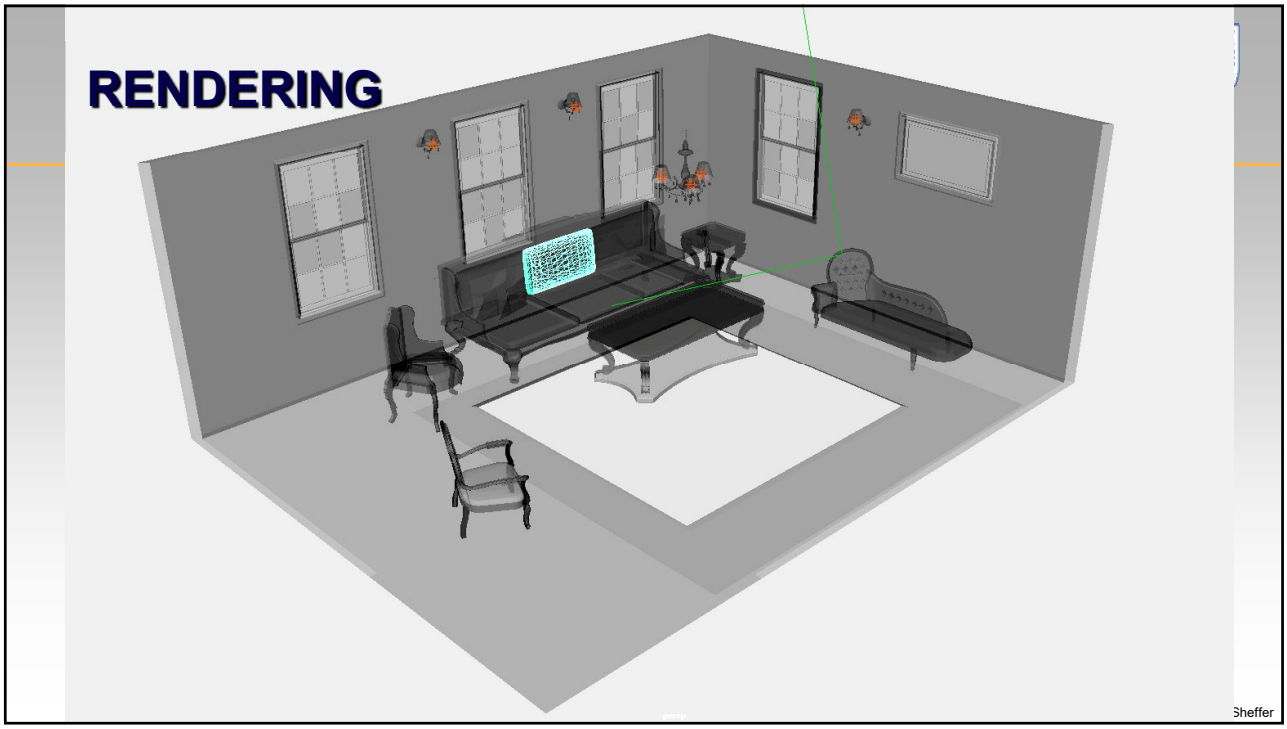
TODO: TEAM ORGANIZING

- Team organizing (use piazza to connect), seek common game ideas, diversity of experience
  - *Initial teams: Jan 14*
  - *Finalize by **Jan 18***
  - **We can help…**
- Game Pitch (storyline + basic technical elements) – individual/mini-team
  - *Informal piazza pitches: ASAP – helps with team building*
  - *Oral pitches: **Monday Jan 14***
    - Plan on ~1-2 minutes: game idea+team
    - Register via poll on Piazza
  - *Written draft: due **Jan 14***

SCENE

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




RENDERING
Sheffer


RENDERING
UBC
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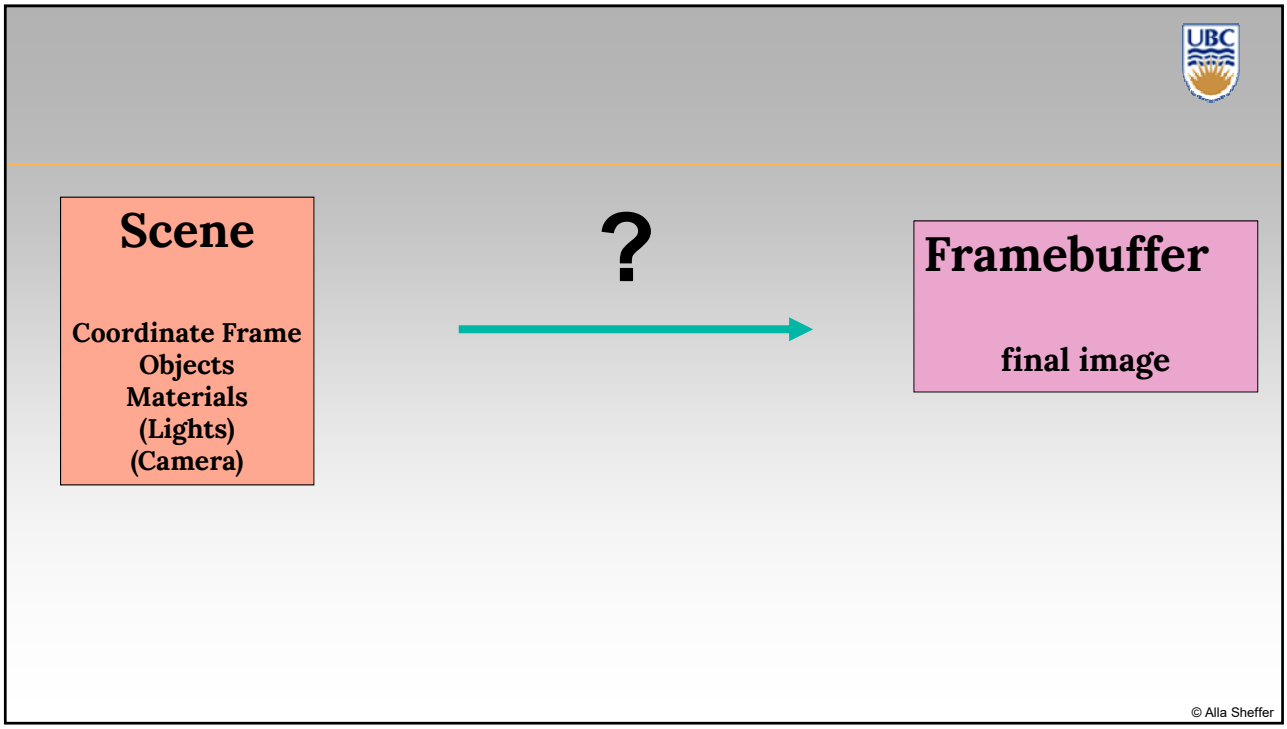
Frame Buffer

- 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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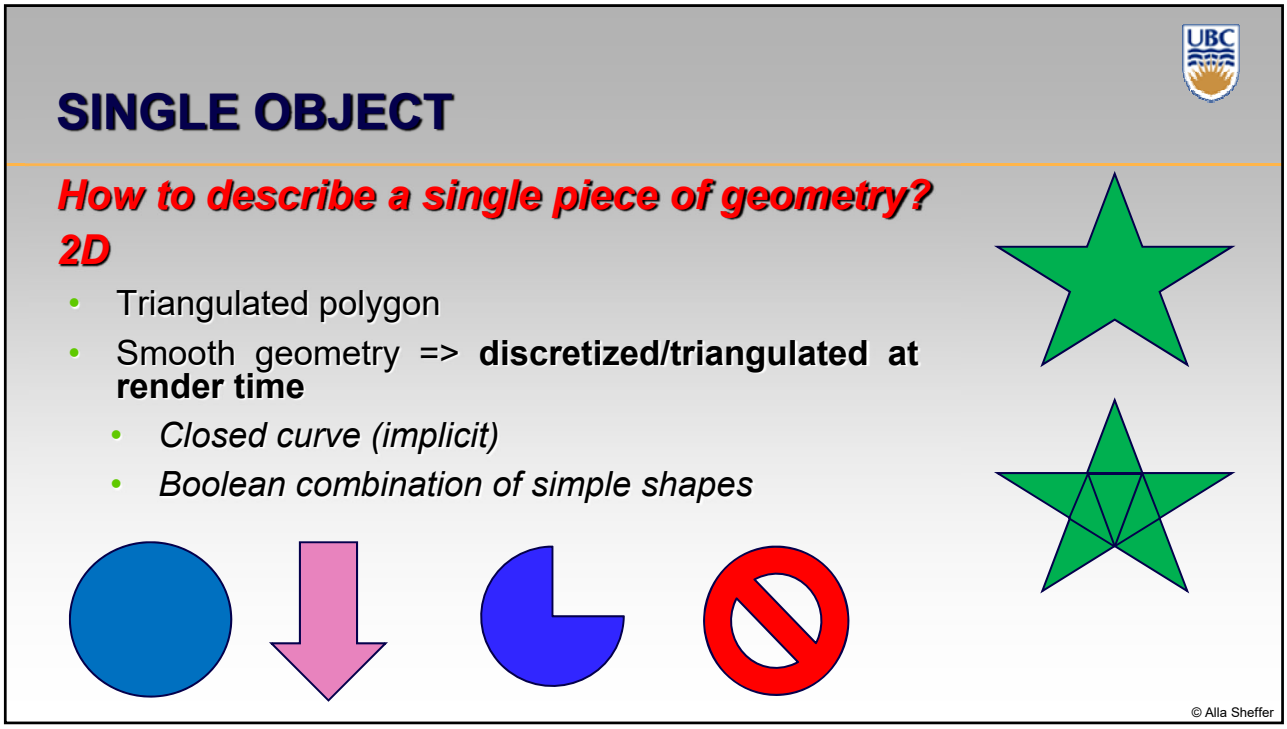
SINGLE OBJECT
How to describe a single piece of geometry?
2D
• Triangulated polygon
• Smooth geometry => discretized/triangulated at render time
• Closed curve (implicit)
• Boolean combination of simple shapes
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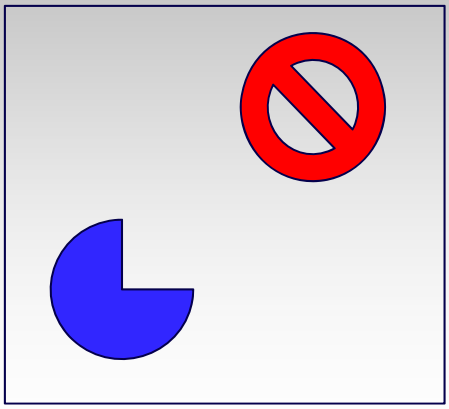
SCENE

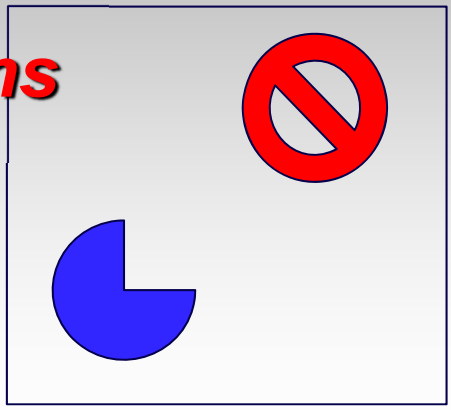
How to describe a scene?

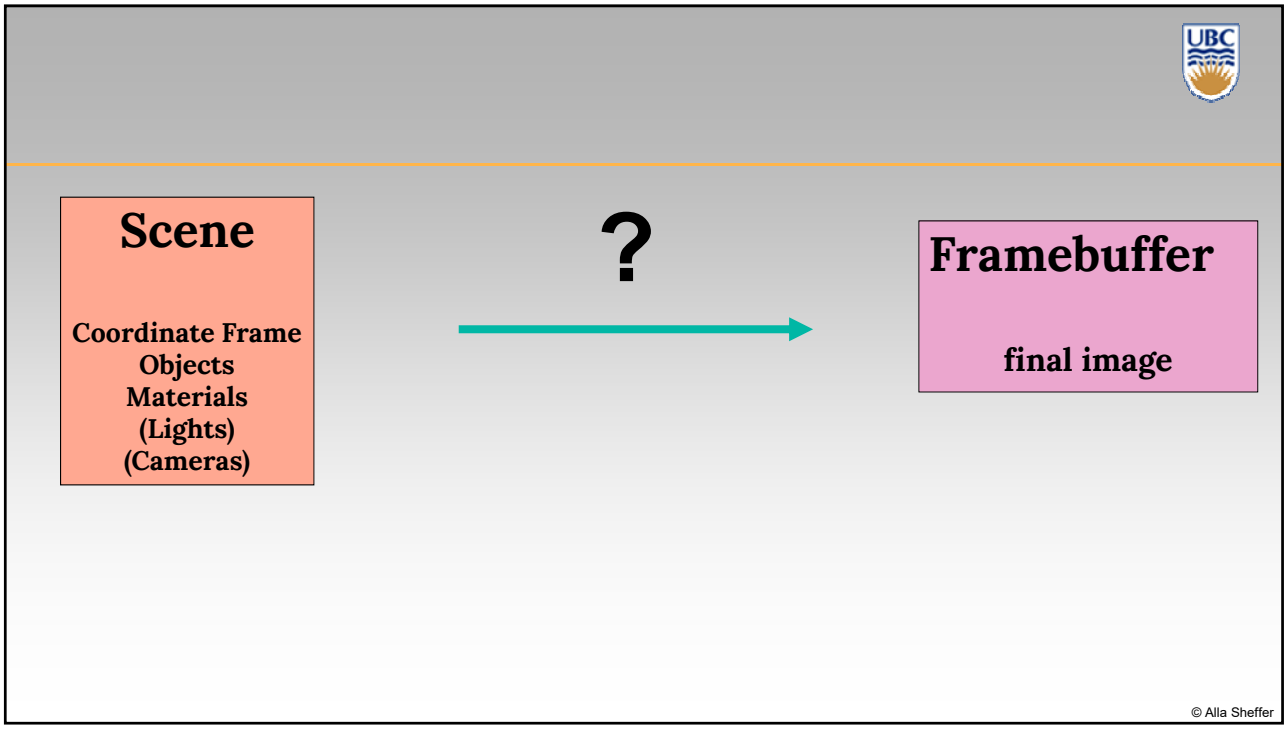


SCENE

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)

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Sketch of a rendering pipeline

Scene

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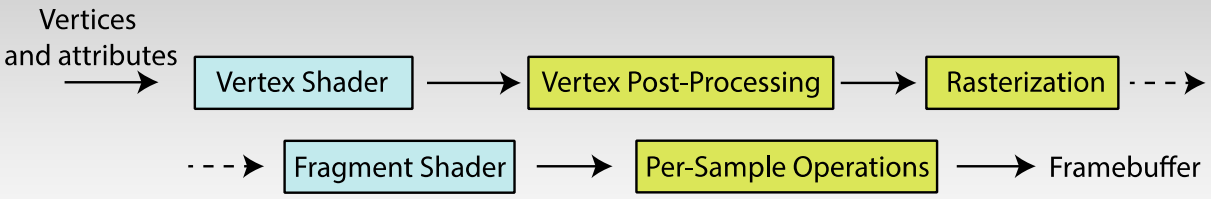
- **Camera View**
  - **2D positions of shapes**
  - **(Depth of shapes)**
  - **(Normals)**

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

openGL

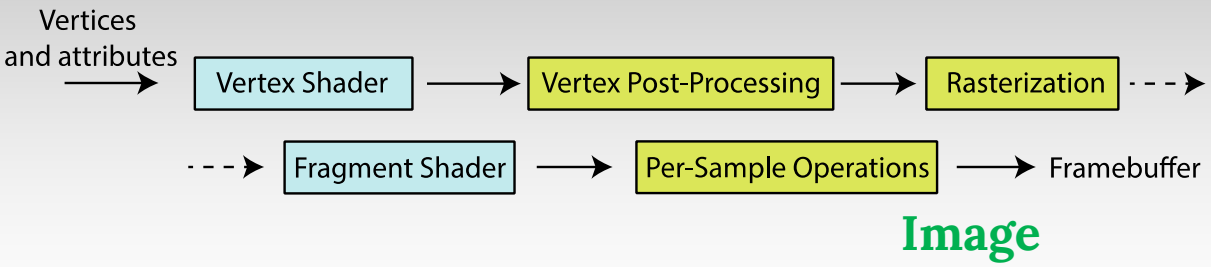
- Open Graphics Library
- One of the most popular libraries for 2D/3D rendering
- A software interface to communicate with graphics hardware
- Cross-language API

OpenGL RENDERING PIPELINE



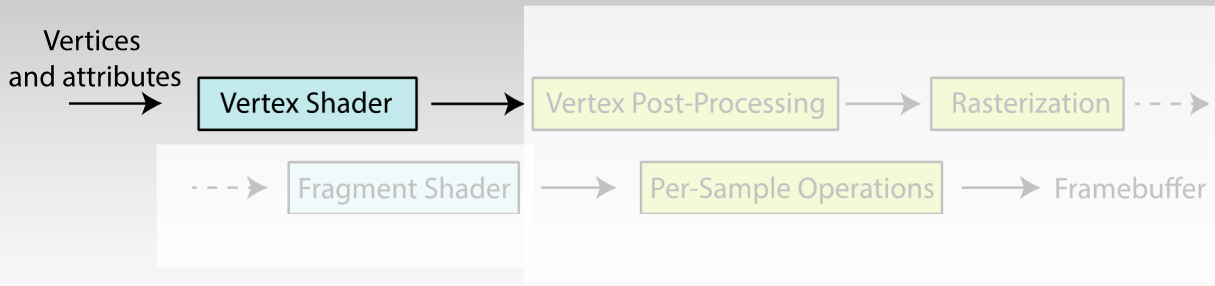
OpenGL RENDERING PIPELINE

Scene Camera Coords Device Coords

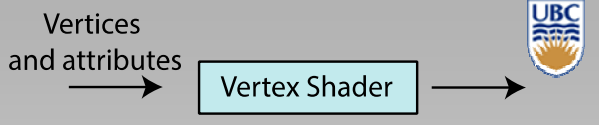


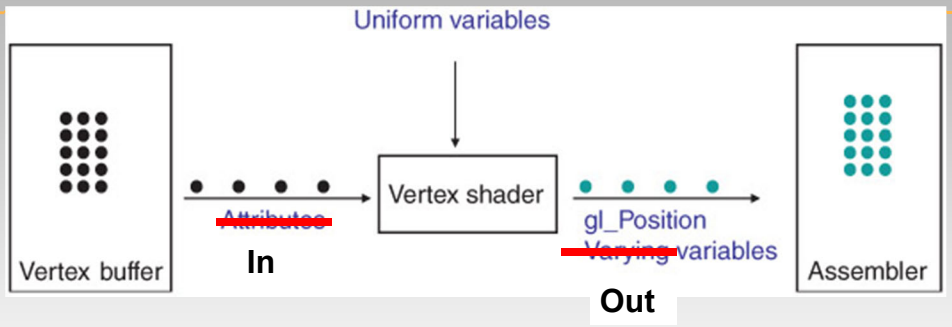
Image

VERTEX SHADER



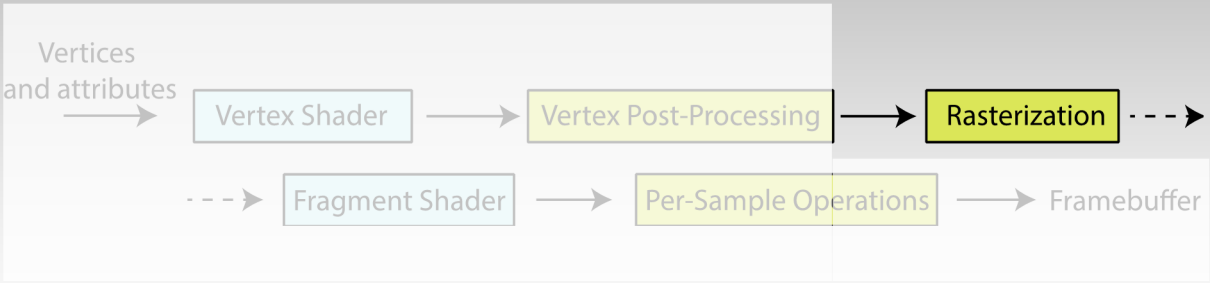
VERTEX SHADER





- 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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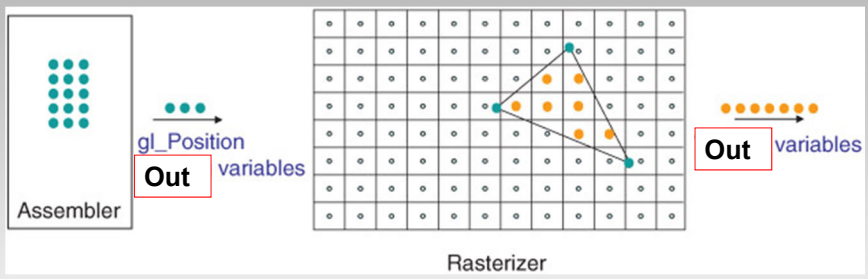
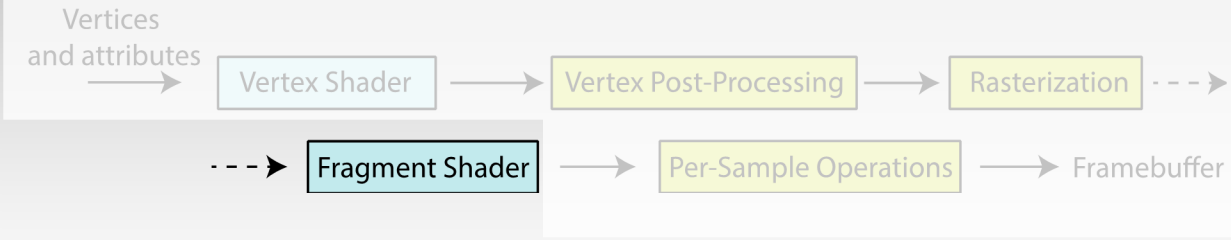
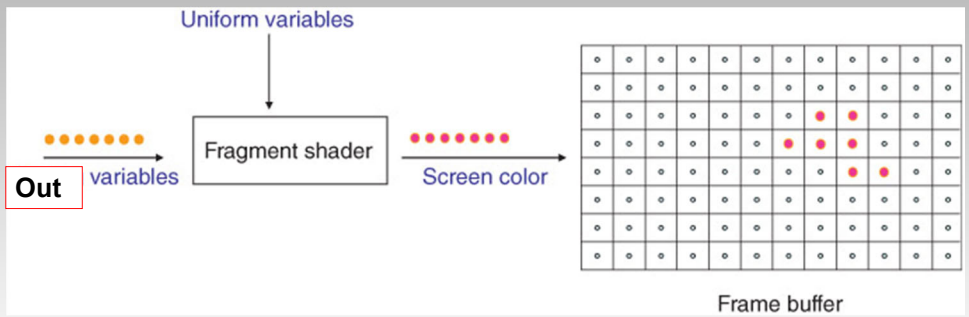


- Places three 2D vertices on a virtual screen
- Fills up the space between them
- Interpolates per-vertex variables to get per-fragment vars

FRAGMENT Shader



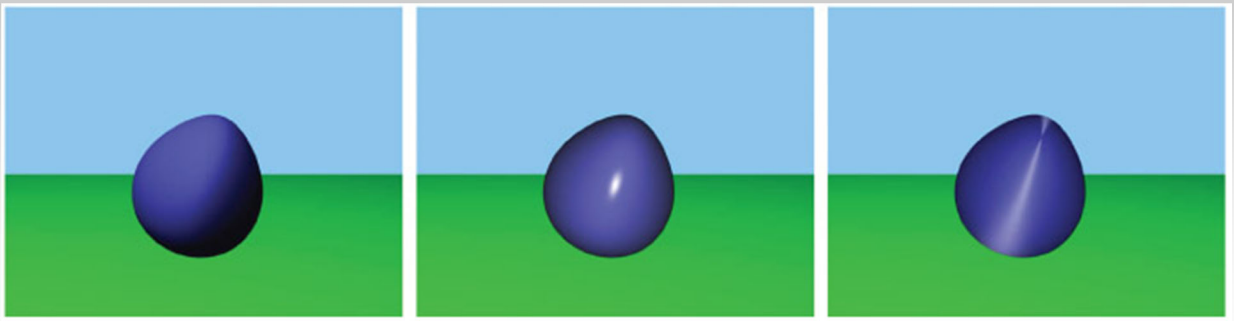
FRAGMENT Shader



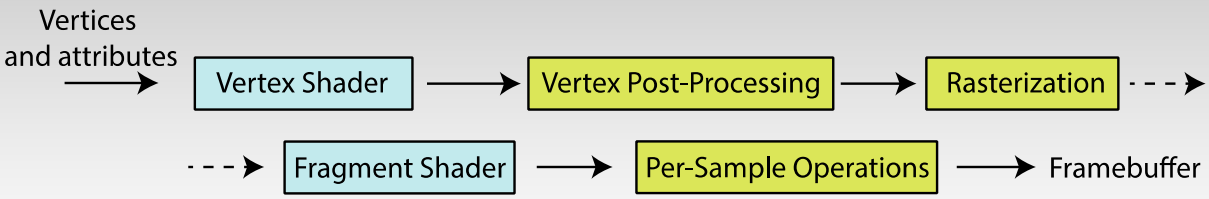
- Each fragment is passed through Fragment Shader
- Here it computes fragment (per pixel) color

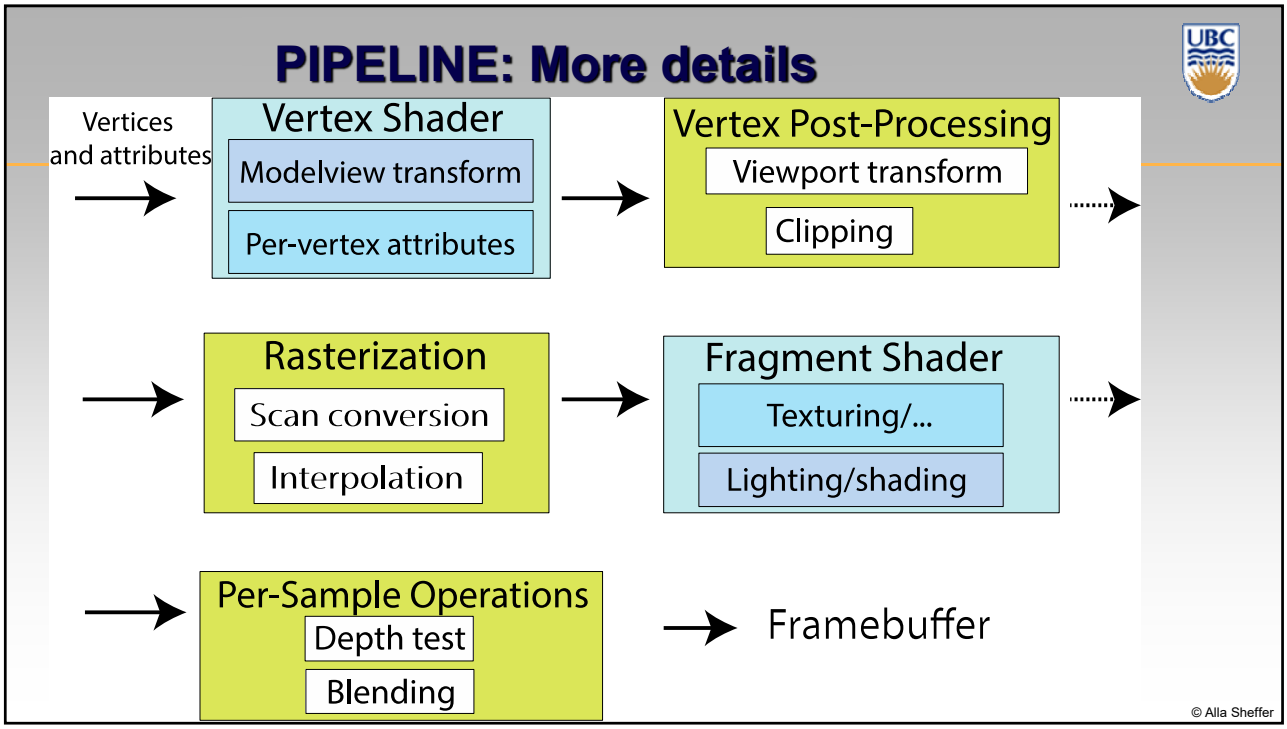
FRAGMENT SHADER

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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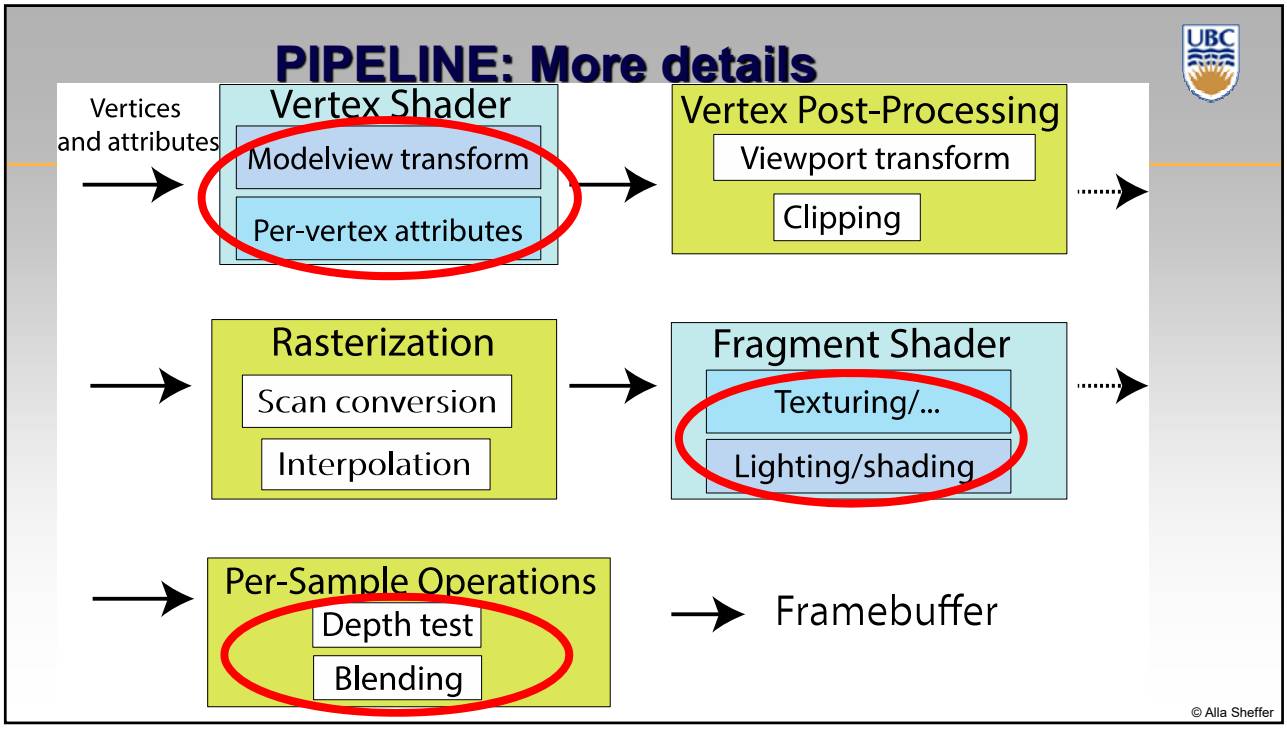
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