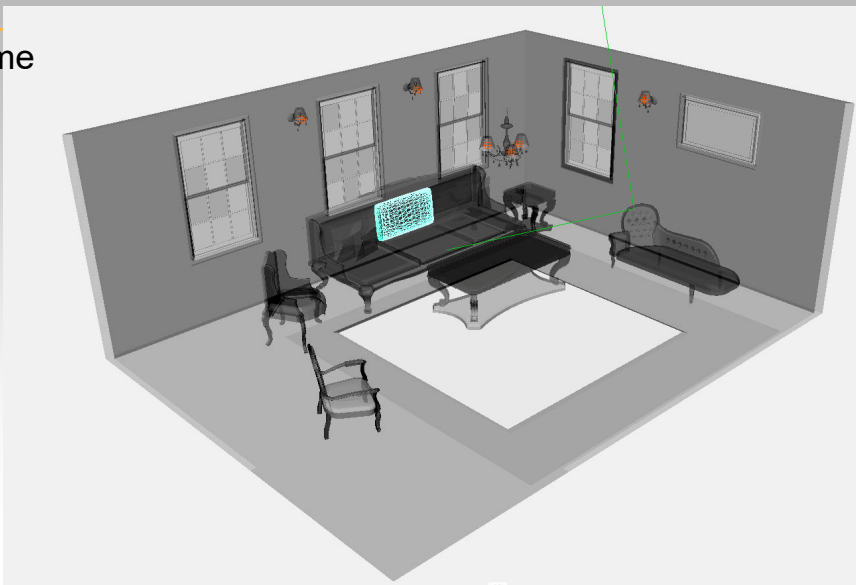
CPSC 436D
Video Game Programming

Rendering

SCENE

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



IMAGE

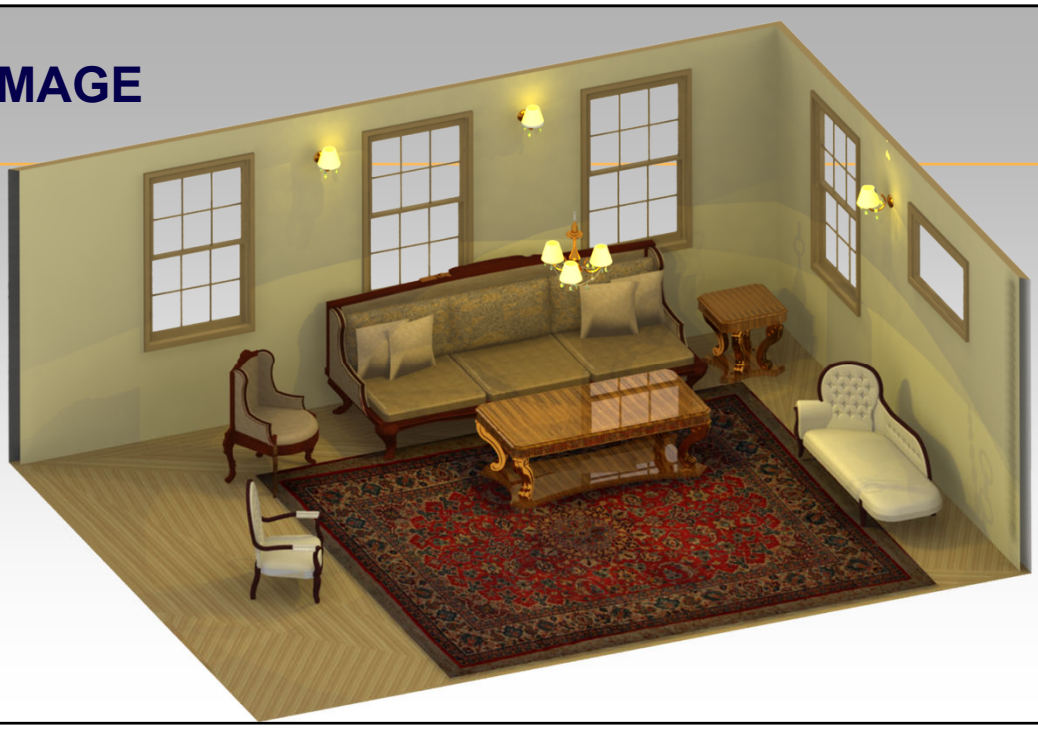


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Image Rendered to Frame Buffer

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

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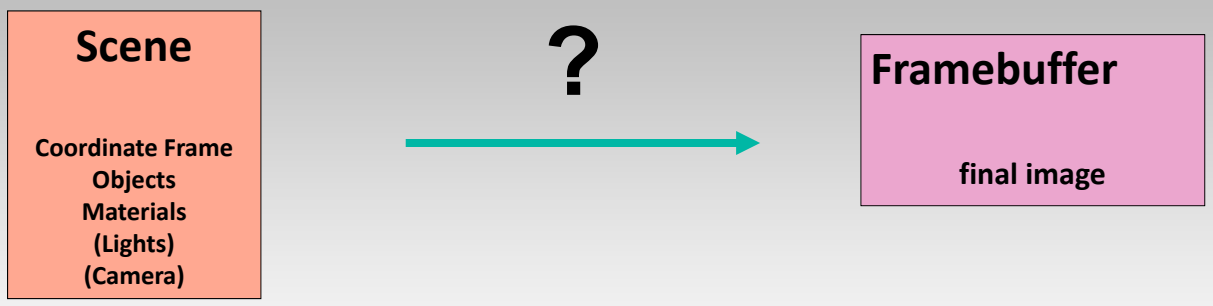
Screen

Displays what's in frame buffer
Terminology:

Pixel: basic element on device
Resolution: number of rows & columns in device

Rendering

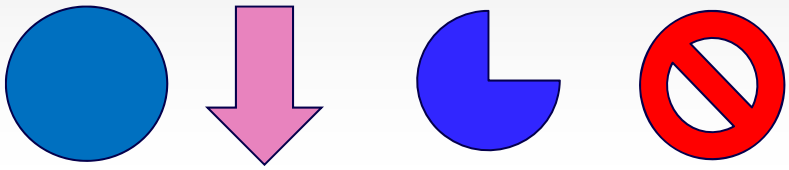


SINGLE OBJECT

How to describe a single piece of geometry?

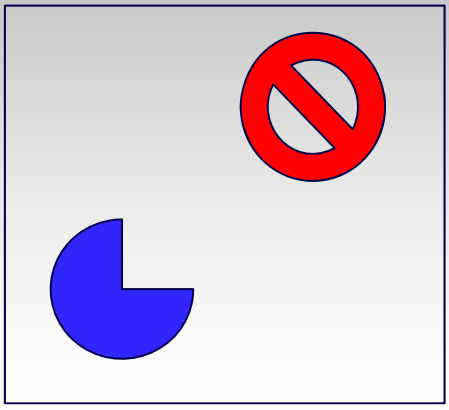
2D

- Triangulated polygon
- Smooth geometry => **discretized/triangulated at render time**
  - *Closed curve (implicit)*
  - *Boolean combination of simple shapes*



SCENE

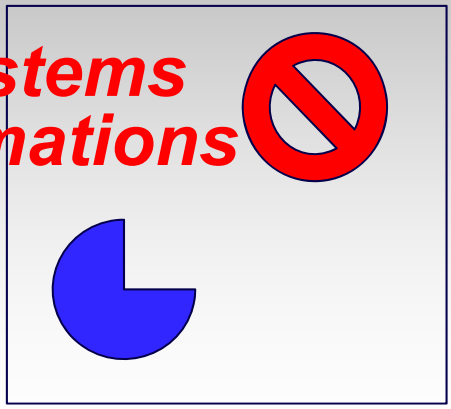
How to describe a scene?



SCENE

How to describe a scene?

Local Coordinate Systems joined via Transformations



Scene

Coordinate Frame
Objects
Materials
(Lights)
(Cameras)

?

Framebuffer

final image

Sketch of a rendering pipeline

Scene

- Coordinate frame
- Models
  - *Coordinates (in local system)*
  - *Local to global transforms*
  - *properties (color, texture, material)*
- Camera
- (Lights)

Sketch of a rendering pipeline

Scene

- Coordinate frame
- Models
  - *Coordinates (in local system)*
  - *Local to global transforms*
  - *properties (color, texture, material)*
- Camera
- (Lights)

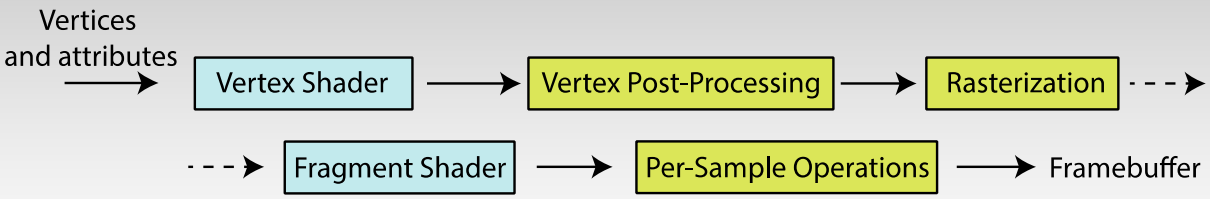
- **Camera View**
  - **2D positions in camera coordinate frame**
  - **Depth/depth order of shapes**
  - **(Normals)**

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

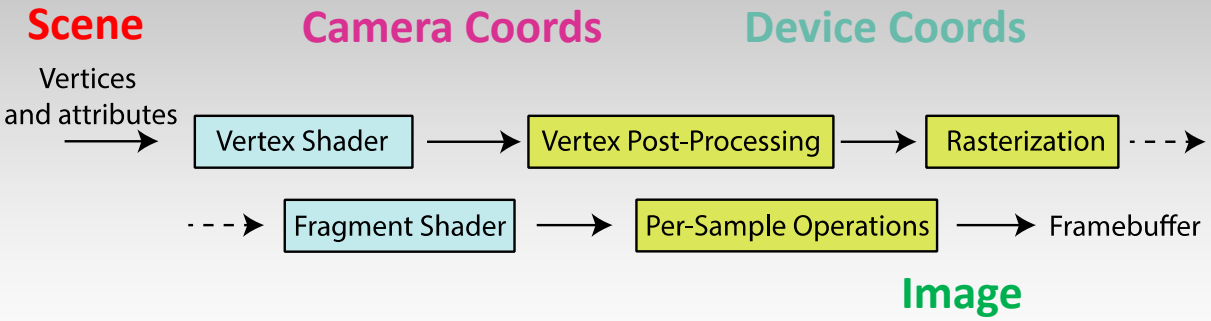
openGL

- 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



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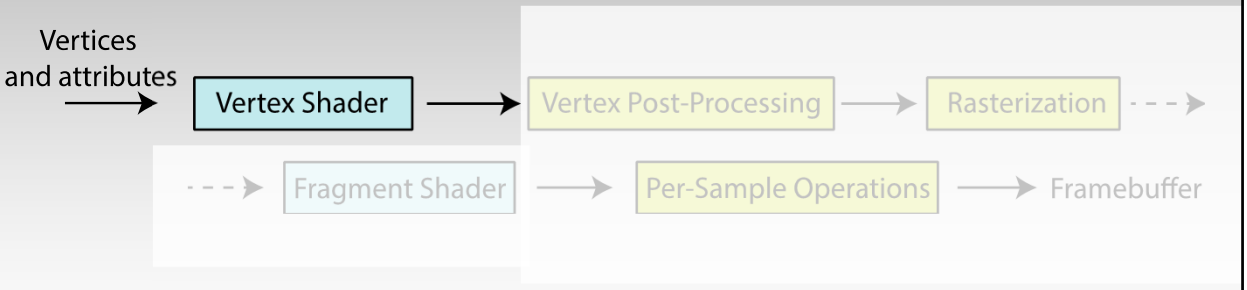
VERTEX SHADER



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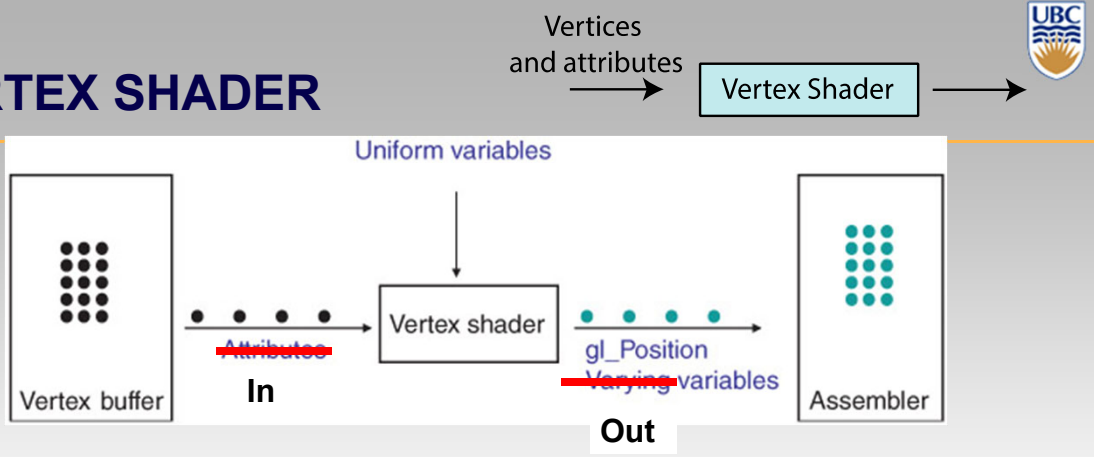
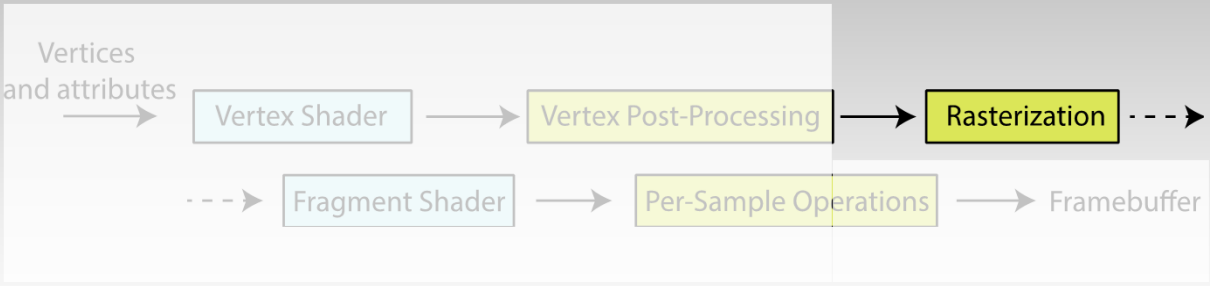
VERTEX SHADER

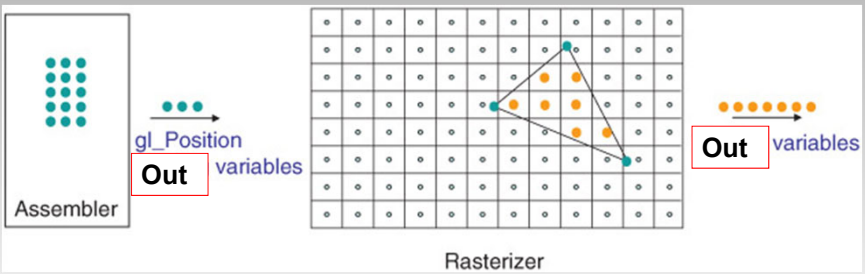


- Vertices are stored in vertex buffer
- Each one is processed by vertex shader
- Converts vertex into camera coordinates (View Coordinates)
- May compute per-vertex variables (color, texture, etc.)

RASTERIZATION

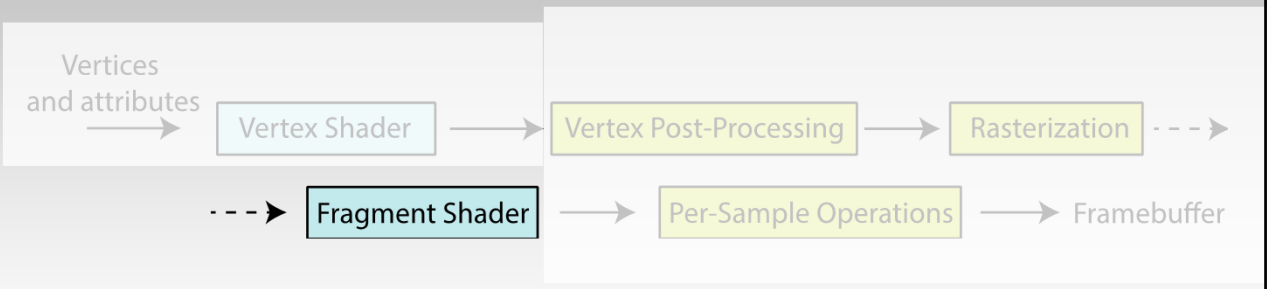


RASTERIZATION

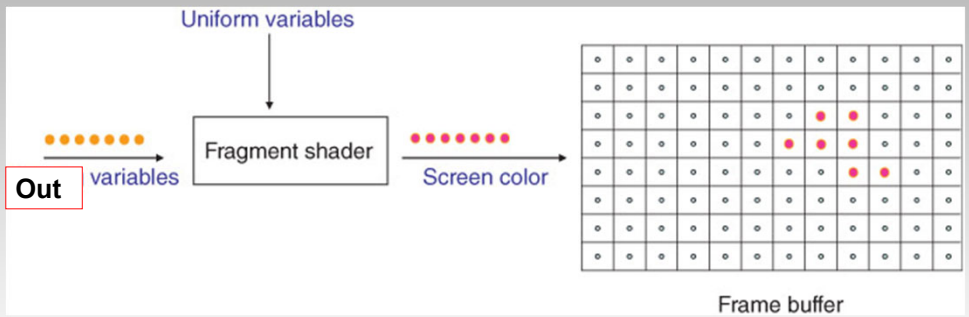


- Places three 2D vertices on a virtual screen
- Fills up the space between them
- Interpolates per-vertex variables to get per-fragment variables

FRAGMENT Shader



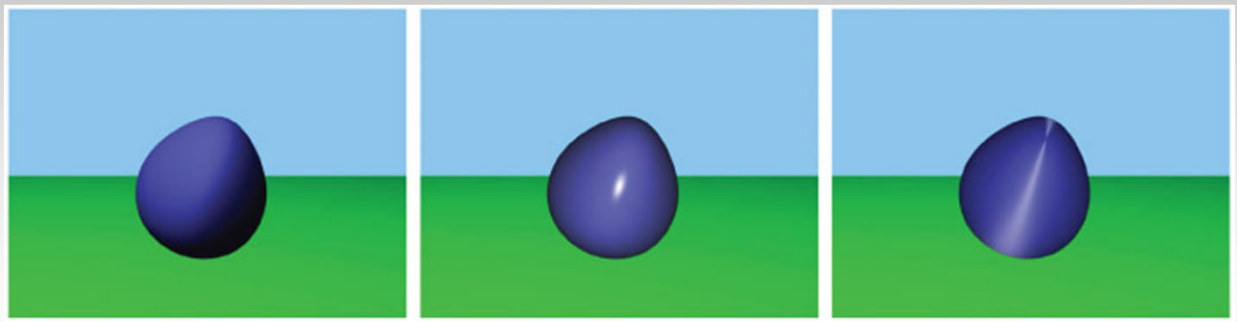
FRAGMENT Shader



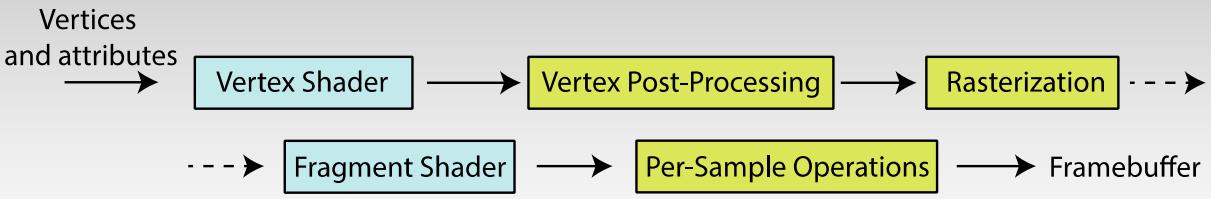
- Each fragment is passed through Fragment Shader
- Here it computes fragment (per pixel) color

FRAGMENT SHADER

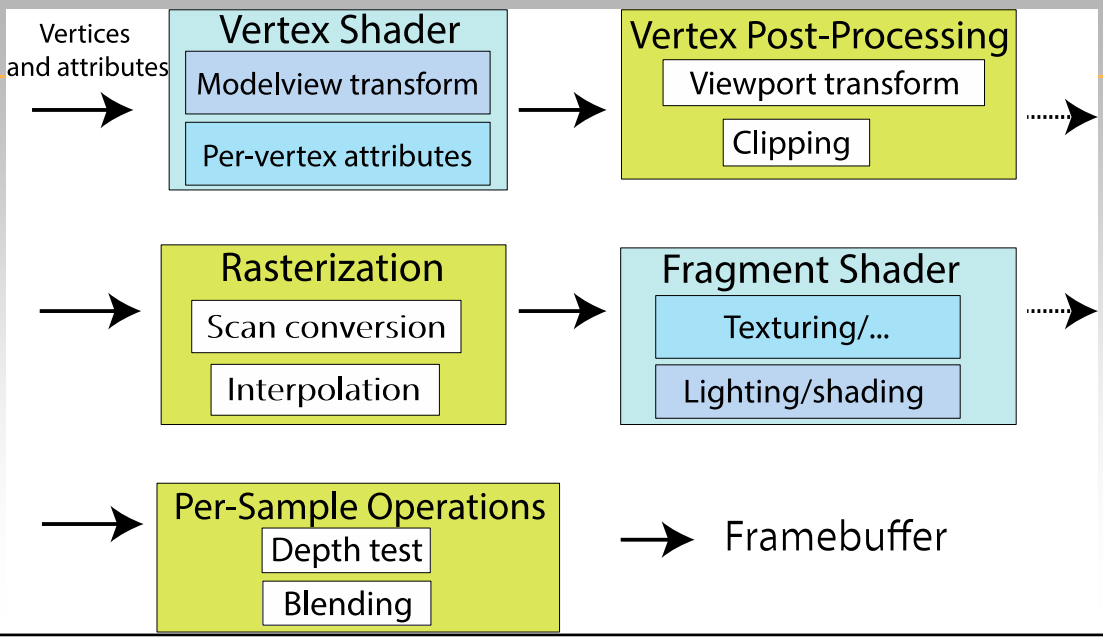
Can simulate different materials and lights

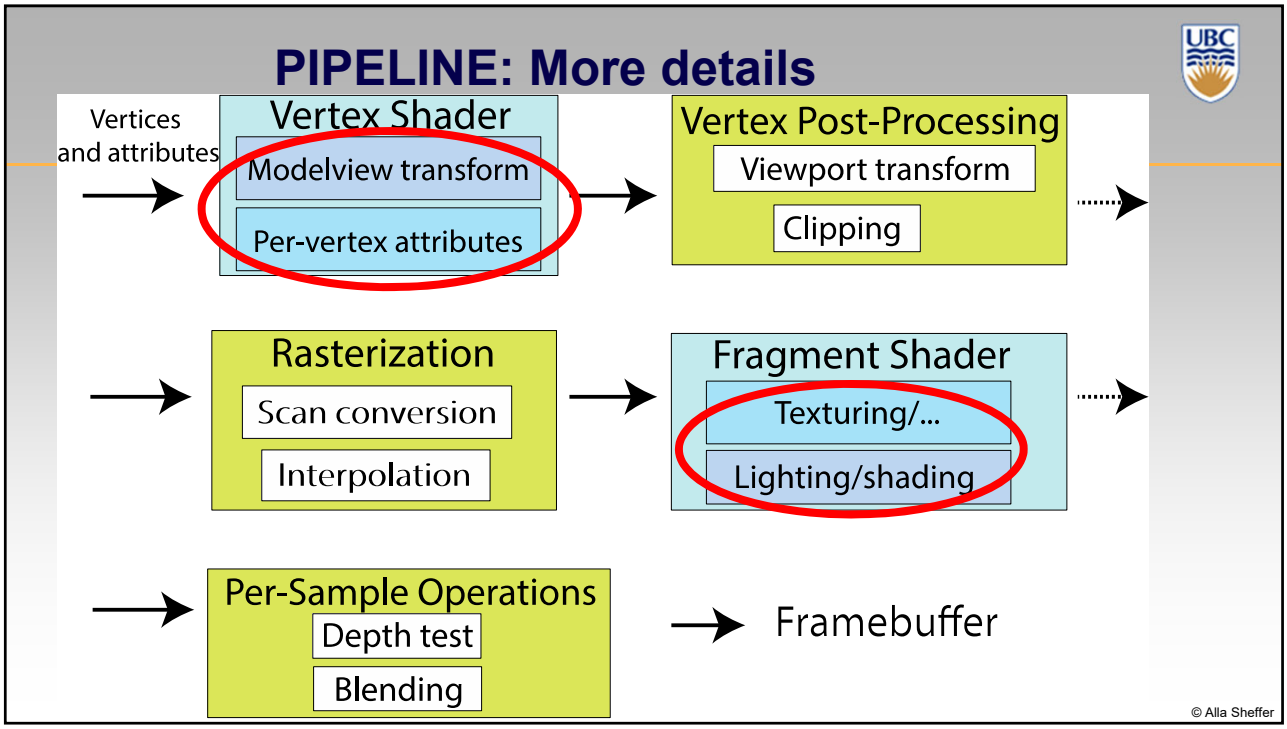


Opengl RENDERING PIPELINE



PIPELINE: More details




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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