Intro to Computer Graphics: Parts of OpenGL

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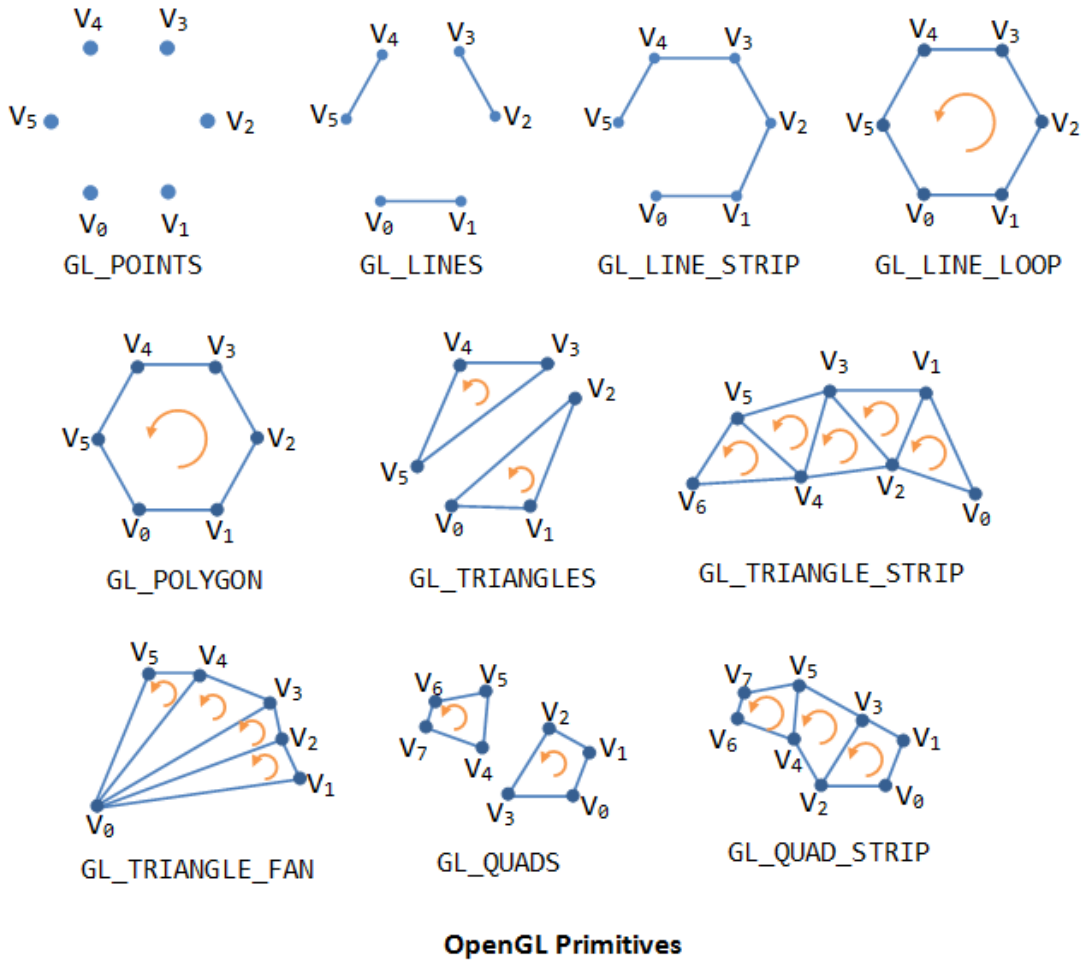
Primitives



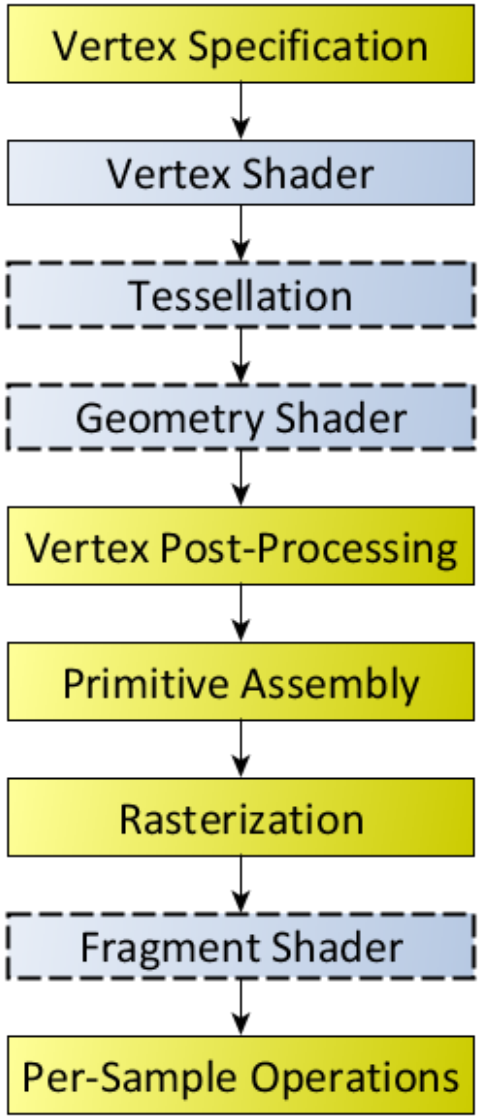
OpenGL Primitives

Note: Vertices are not primitives! Vertices are used to build primitives.

Image Source: https://www.ntu.edu.sg/home/ehchua/programming/opengl/CG_Introduction.html

Rendering Pipeline

- Sequence of steps that OpenGL takes when rendering objects



Set up an ordered list of vertices to send to pipeline

Perform basic processing to each individual vertex

(Optional) Patches of vertex data are subdivided into smaller primitives

(Optional) Governs the processing of primitives

1. Records data from vertex processing steps into buffer object
2. Primitives are clipped to the view volume

Collects a run of vertex data output and composes them into a sequence of primitives

Primitives are converted into a sequence of fragments

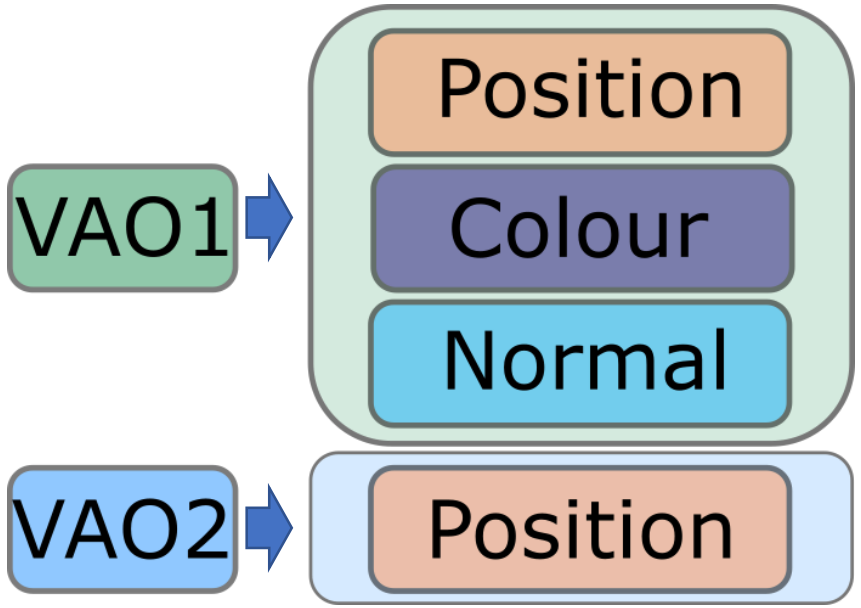
(Optional) Fragments are output with color, depth, and stencil value

Fragments are processed, and their data are written to various buffers

Source: https://www.khronos.org/opengl/wiki/Rendering_Pipeline_Overview

Vertex Array Objects (VAO)

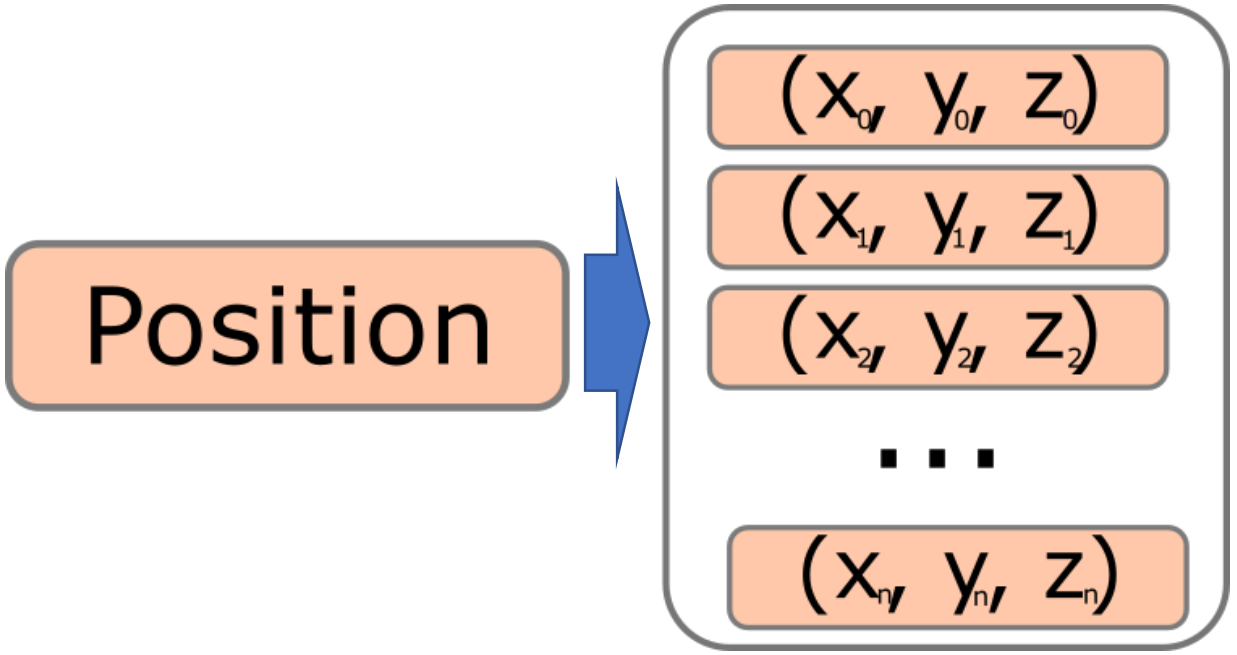
- OpenGL Object that stores all of the state needed to supply vertex data
  - E.g. format of vertex data (e.g. float, short, vec3), reference to buffer objects



Source: https://www.khronos.org/opengl/wiki/Vertex_Specification

Vertex Buffer Object (VBO)

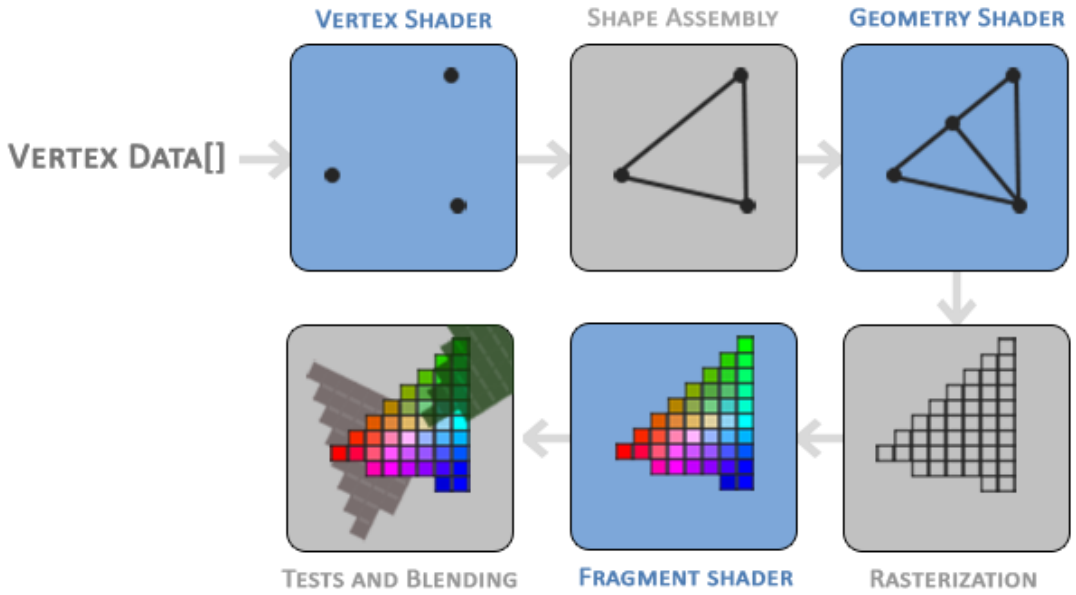
- **Buffer Objects**: OpenGL objects that store an array of unformatted memory allocated by the OpenGL context (AKA the GPU)
  - *Vertex Buffer Object*: buffer object used as a source for vertex array data



Source: https://www.khronos.org/opengl/wiki/Vertex_Specification
Source: https://www.khronos.org/opengl/wiki/Buffer_Object

Shader Objects

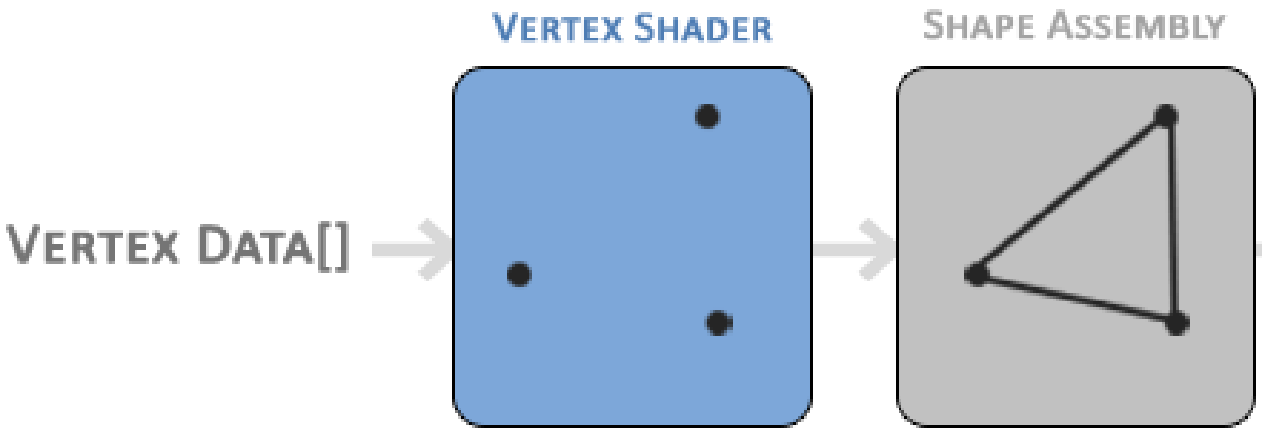
- Object in the OpenGL API that encapsulates the linked shader
  - *Shader*: user-defined program designed to execute one of the programmable stages of the rendering pipeline.



Source: https://www.khronos.org/opengl/wiki/Shader
Source: https://www.khronos.org/opengl/wiki/GLSL_Object
Image Source: https://learnopengl.com/Getting-started/Hello-Triangle

Vertex Shader

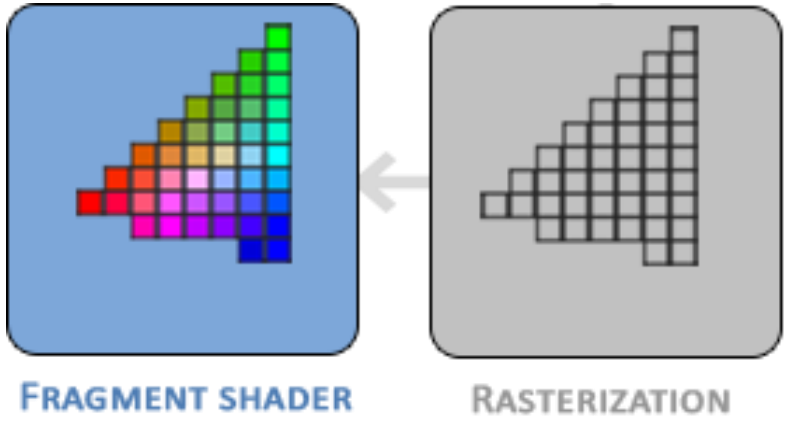
- Handles processing of individual vertices
  - *Input*: vertex attribute data (e.g. position, colour, normal)
    Output: vertex



Source: https://www.khronos.org/opengl/wiki/Vertex_Shader
Source: Image Source: https://learnopengl.com/Getting-started/Hello-Triangle

Fragment Shader

- Process a fragment into a set of colours and depth value
  - *Fragment*: data needed to draw a single pixel
    - E.g. window-space position (X-Y-Z), interpolated value across surface (e.g. colour, texture coordinates), colour values, depth value, stencil value
  - Input: Fragment
    Output: colour values, depth value



Source: https://www.khronos.org/opengl/wiki/Fragment_Shader
Source: https://www.khronos.org/opengl/wiki/Fragment
Source: https://gamedev.stackexchange.com/questions/8977/what-is-a-fragment-in-3d-graphics-programming
Image Source: Image Source: https://learnopengl.com/Getting-started/Hello-Triangle

Recommended Resources

(These are quite good!)

- Wiki: https://www.khronos.org/opengl/wiki/Main_Page
- Easy-to-read explanation: https://learnopengl.com/
- Tutorial for simple implementation: http://www.opengl-tutorial.org/
- Textbook: https://learning.oreilly.com/library/view/fundamentals-of-computer/9781482229417/

Exercise

- Import the code for Sierpinski triangle to core-profile OpenGL
- Draw a green circle with core-profile OpenGL