

A decorative graphic on the left side of the slide, consisting of a network of white lines and small circles on a dark blue background, resembling a circuit board or a neural network.

SHADERS

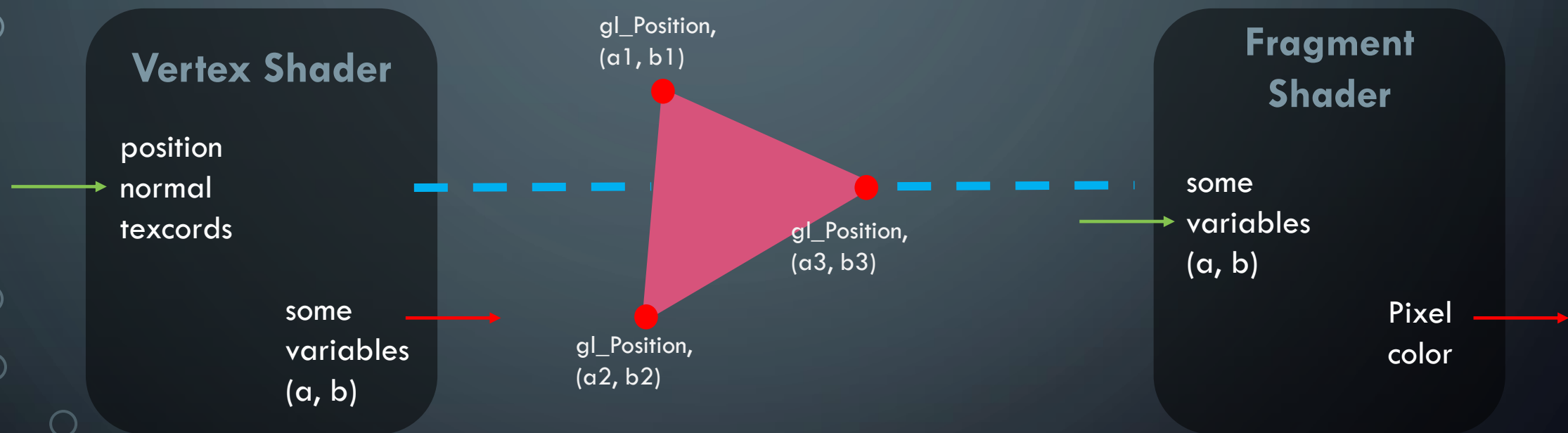
TUTORIAL

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Types of Shaders:

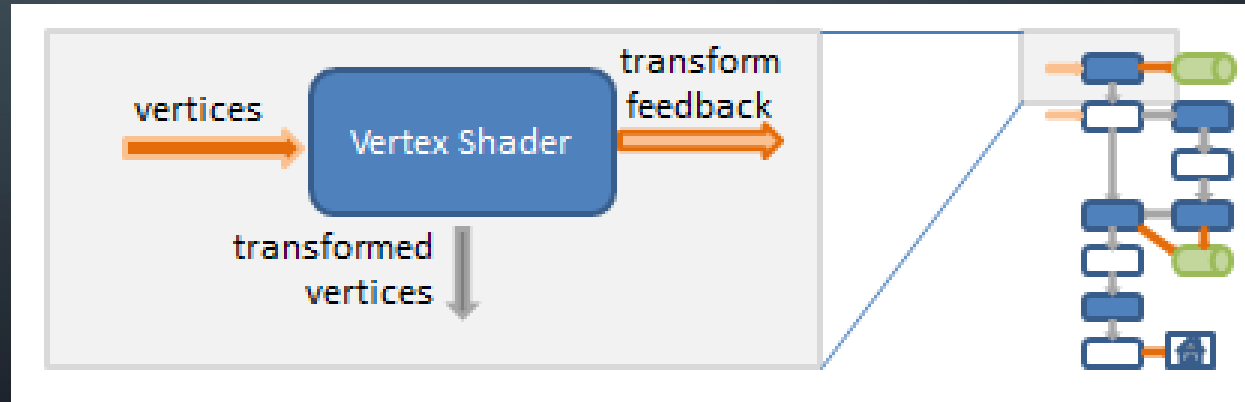
- Vertex Shader (only mandatory shader in pipeline)
- Fragment Shader (widely used)
- Geometry Shader (optional)
- Tessellation Shader (optional)

Basic shader pipeline

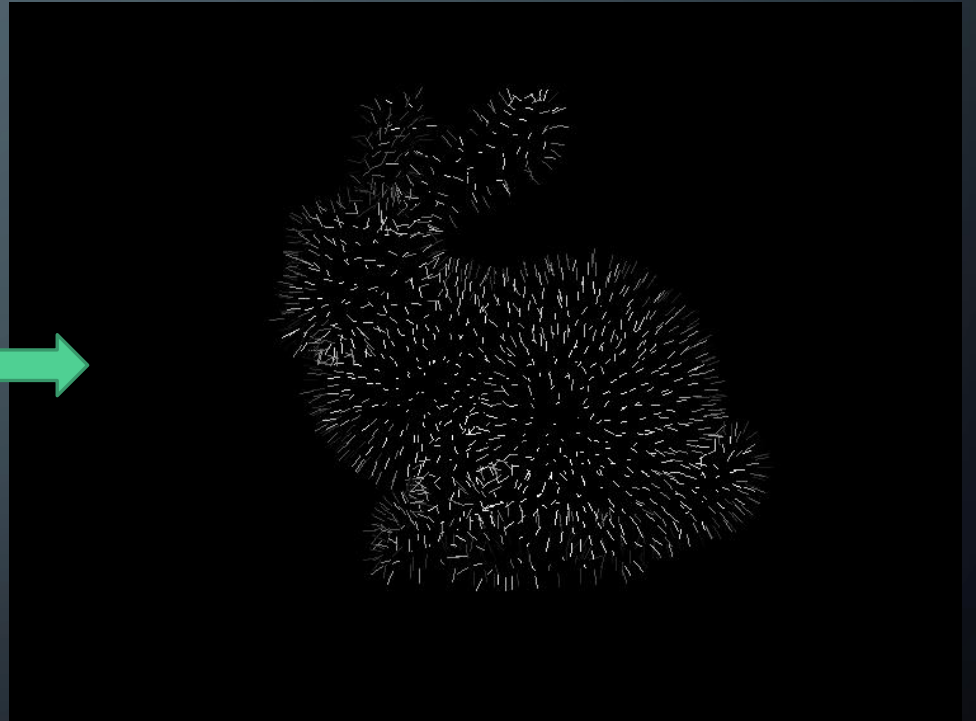
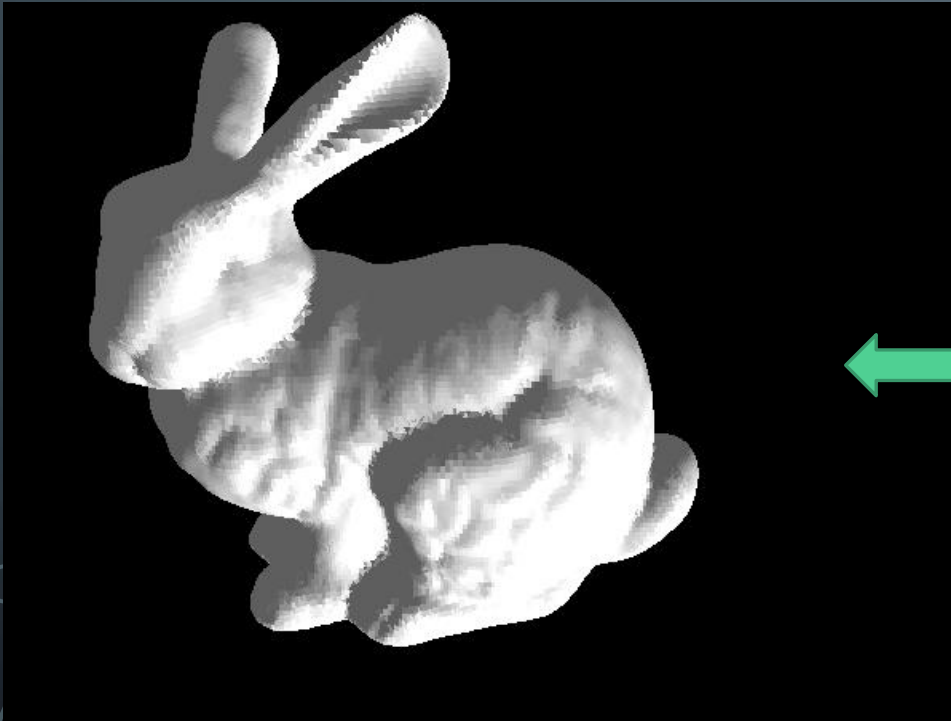


Need for other shaders:

- VS cannot create additional geometry
- VS cannot access data of other vertices
- Additional capabilities for real-time interface



Geometry Shader



Geometry Shader

Vertex Shader

**Geometry
Shader**

**Fragment
Shader**

Executes once for
every triangle
(primitives)



Geometry Shader

`a[], b[]`
(variable
for each
primitive)

Executes once for every triangle
(primitives)

in (points,
lines,
triangles etc.)

out (points,
lines,
triangles etc.)

Cant output
mixture

`gl_Position,`
`(a1, b1)`



BASIC GEOMETRY SHADER

```
#version 330 core
layout (points) in;
layout (line_strip, max_vertices = 2) out;

void main() {
    gl_Position = gl_in[0].gl_Position + vec4(-0.1, 0.0, 0.0, 0.0);
    EmitVertex();

    gl_Position = gl_in[0].gl_Position + vec4( 0.1, 0.0, 0.0, 0.0);
    EmitVertex();

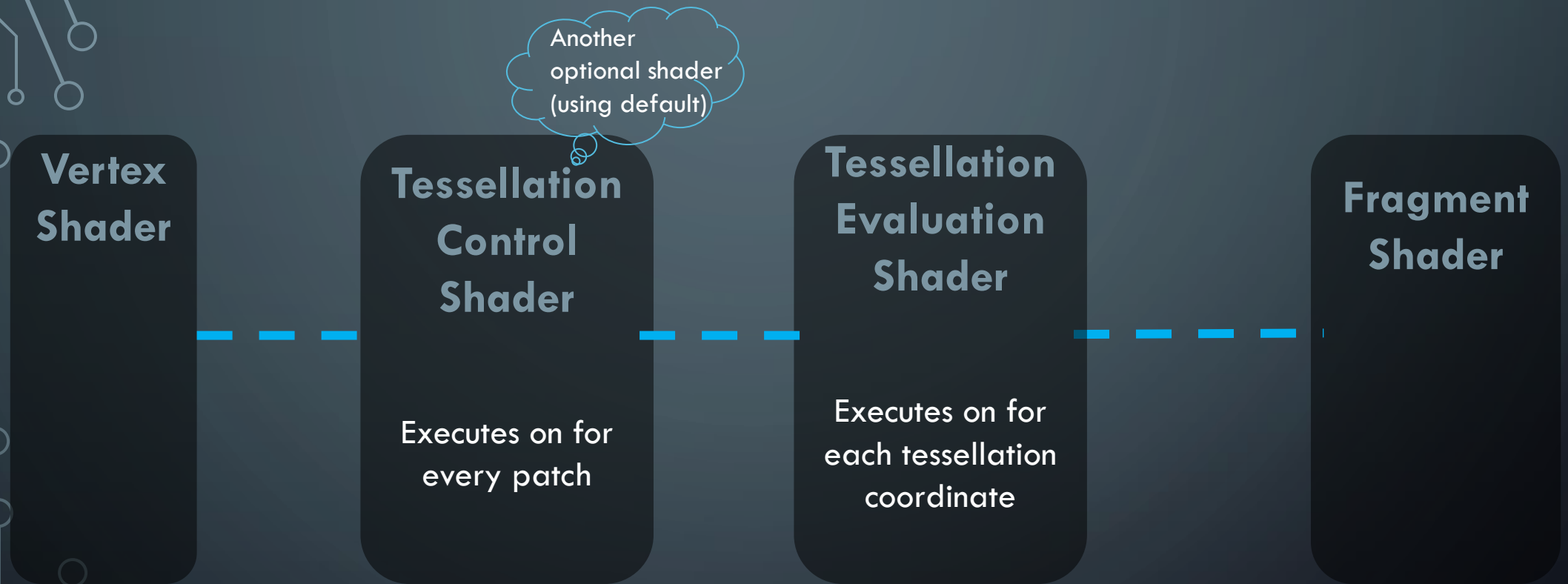
    EndPrimitive();
}
```

- 'in' identifier depends on primitive declared in program
- 'out' can be set as any primitive
- EmitVertex() add the gl_Position vector to output primitive.
- EndPrimitive() combine all the vertices to render output.

Tessellation Shader



Tessellation Shader



Patches: List of vertices (specified in draw call) passed preserving their order during processing

Tessellation Control Shader

only
patches as
primitives
are allowed

Primitive
Generator

Executes on for every patch

Output patch vertices
with updated values,

Specify tessellation
level factors

Tessellation Evaluation Shader

Tessellation
coordinates

VS for new
primitives

Executes on for each
tessellation coordinate

Position the
vertices

A decorative graphic on the left side of the slide, consisting of a network of thin, light-blue lines and small circles, resembling a circuit board or a stylized tree structure.

THANK YOU!