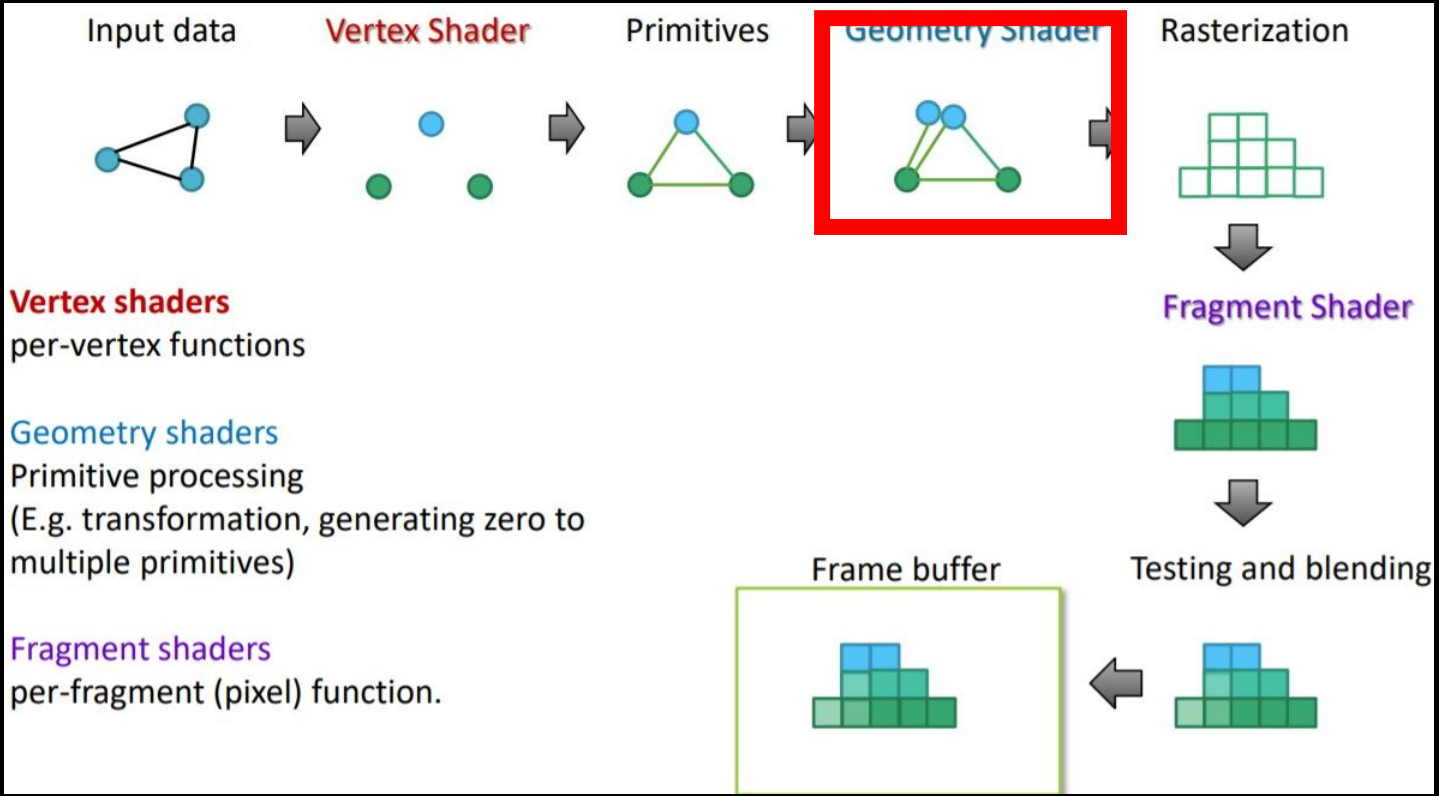
HW4

2021 Introduction to Computer Graphics

Geometry Shader



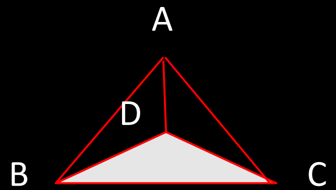
Vertex shaders
per-vertex functions

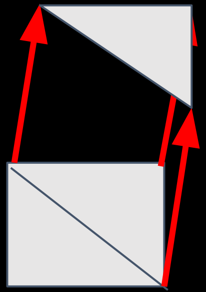
Geometry shaders
Primitive processing
(E.g. transformation, generating zero to multiple primitives)

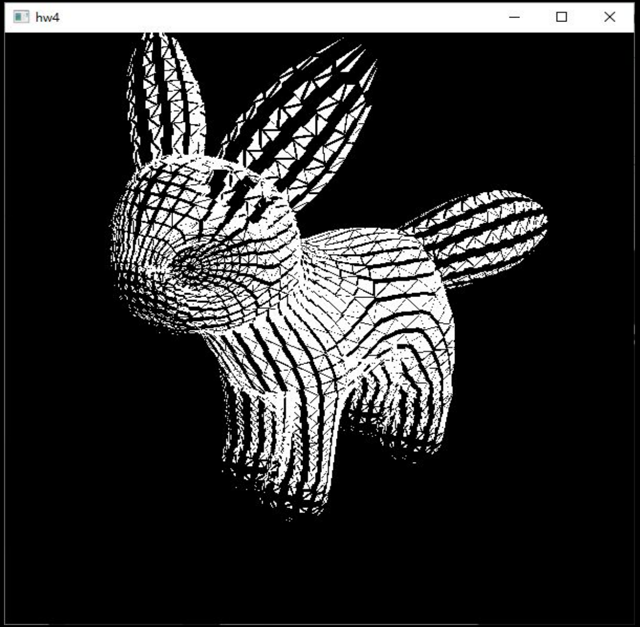
Fragment shaders
per-fragment (pixel) function.

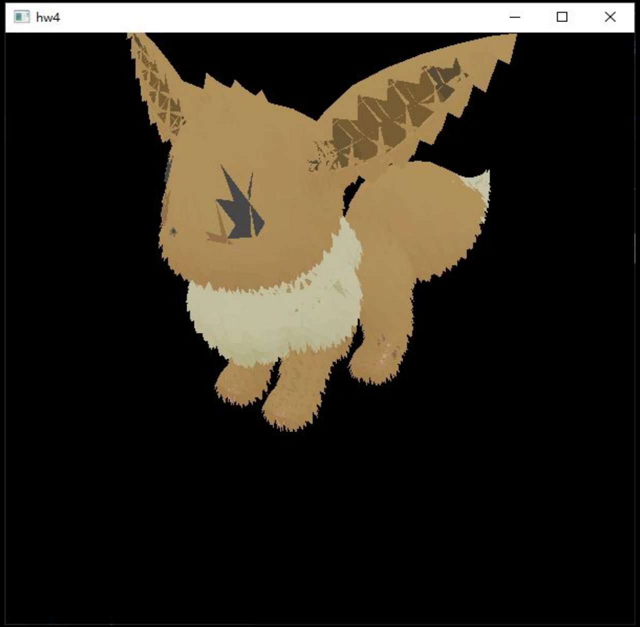
Geometry Shader

- Sample code demo

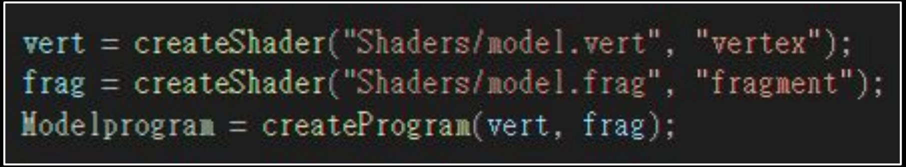








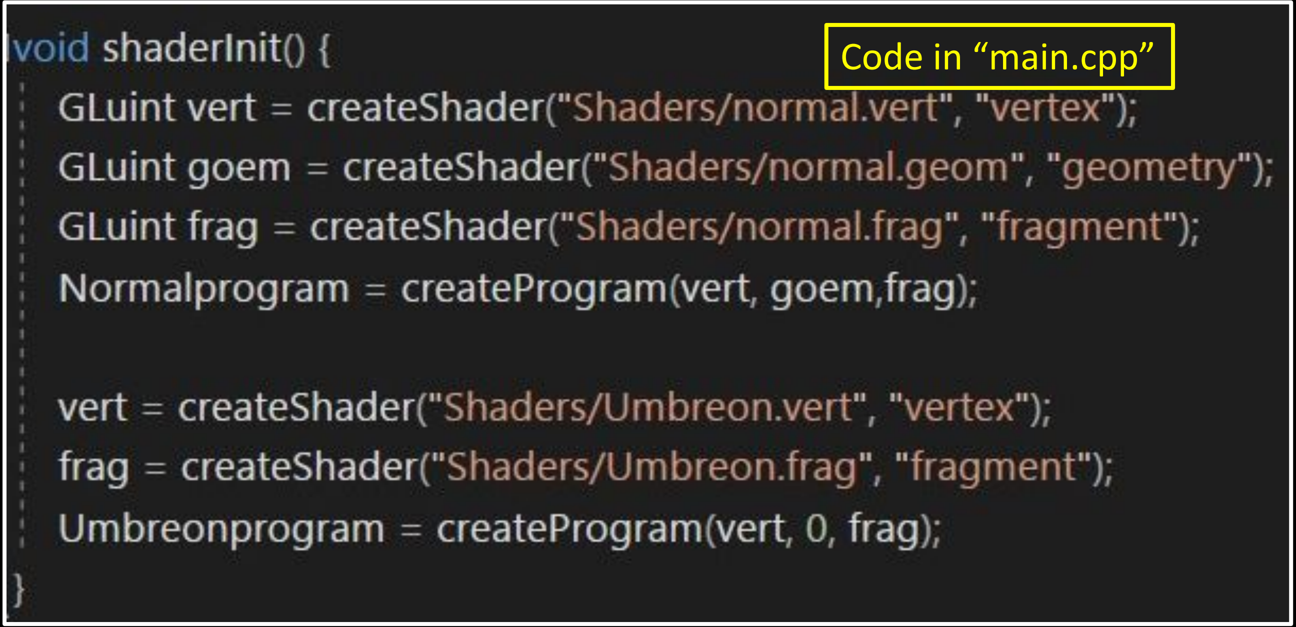
Geometry Shader



```
vert = createShader("Shaders/model.vert", "vertex");
frag = createShader("Shaders/model.frag", "fragment");
Modelprogram = createProgram(vert, frag);
```

- GLuint createProgram(GLuint vert, GLuint geom, GLuint frag);

  If you don’t need the geometry shader, you can put “0” at geom or use it as same as HW2 & HW3.



Code in “main.cpp”

```
void shaderInit() {
    GLuint vert = createShader("Shaders/normal.vert", "vertex");
    GLuint goem = createShader("Shaders/normal.geom", "geometry");
    GLuint frag = createShader("Shaders/normal.frag", "fragment");
    Normalprogram = createProgram(vert, goem,frag);

    vert = createShader("Shaders/Umbreon.vert", "vertex");
    frag = createShader("Shaders/Umbreon.frag", "fragment");
    Umbreonprogram = createProgram(vert, 0, frag);
}
```

Geometry Shader- declare the type of primitive input

- Declare the type of primitive input we're receiving from the vertex shader.
- Method : Declaring a layout specifier in front of the ”in” keyword.

 layout(primitive values) in;

primitive values	Rendering primitives(glDrawArrays)	Points per primitive
points	GL_POINTS	1
lines	GL_LINES or GL_LINE_STRIP	2
lines_adjacency	GL_LINES_ADJACENCY or GL_LINE_STRIP_ADJACENCY	4
Triangles	GL_TRIANGLES, GL_TRIANGLE_STRIP or GL_TRIANGLE_FAN	3
triangles_adjacency	GL_TRIANGLES_ADJACENCY or GL_TRIANGLE_STRIP_ADJACENCY	6

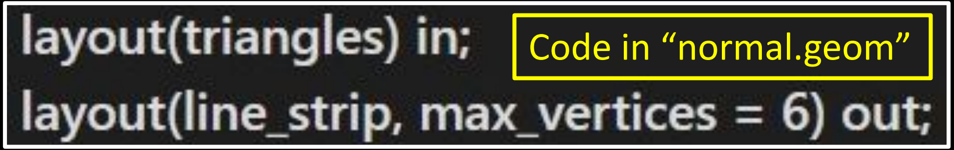
Geometry Shader- declare the type of primitive output

- We also need to specify a primitive type that the geometry shader will output.
- Method : Declaring a layout specifier in front of the ”out” keyword.

 layout(primitive values, max_vertices) out;

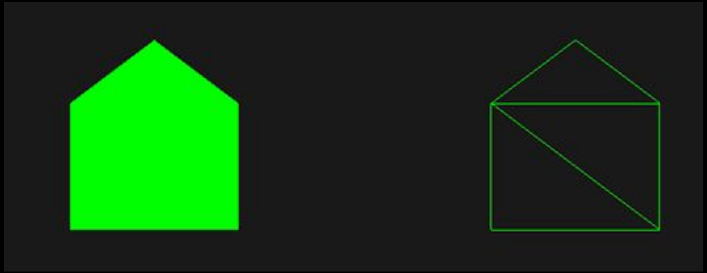
primitive values ： points, line_strip, triangle_strip

max_vertices ： If you exceed this number, OpenGL won't draw the extra vertices.



```
layout(triangles) in;
layout(line_strip, max_vertices = 6) out;
```

Code in “normal.geom”



Geometry Shader- update attributes to geometry shader

- We can update some attributes(color, normal) from vertex shader to the geometry shader.
- Method： Using an interface block.
- Array length : Ex. layout(Triangles) in ; array length is 3.

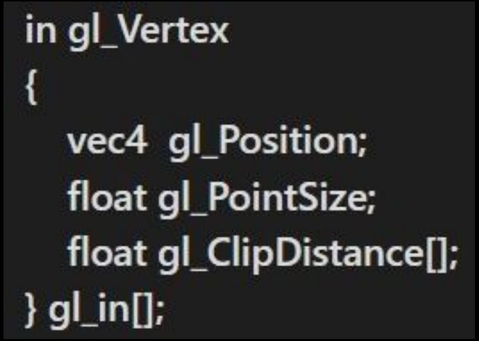
Code in vertex shader	Code in geometry shader

out VS_OUT {
    vec3 normal;
    //other attributes
} vs_out;
	in VS_OUT {
	    vec3 normal;
	    //other attributes
	} gs_in[];

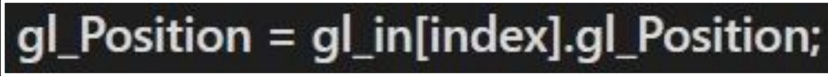
vs_out.normal	gs_in[index].normal (index：index for input vertices)

Geometry Shader- gl_in variable

- GLSL gives us a built-in variable called gl_in that internally (probably) looks something like this:



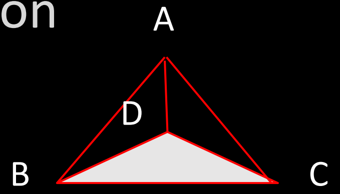
```
in gl_Vertex
{
    vec4  gl_Position;
    float gl_PointSize;
    float gl_ClipDistance[];
} gl_in[];
```



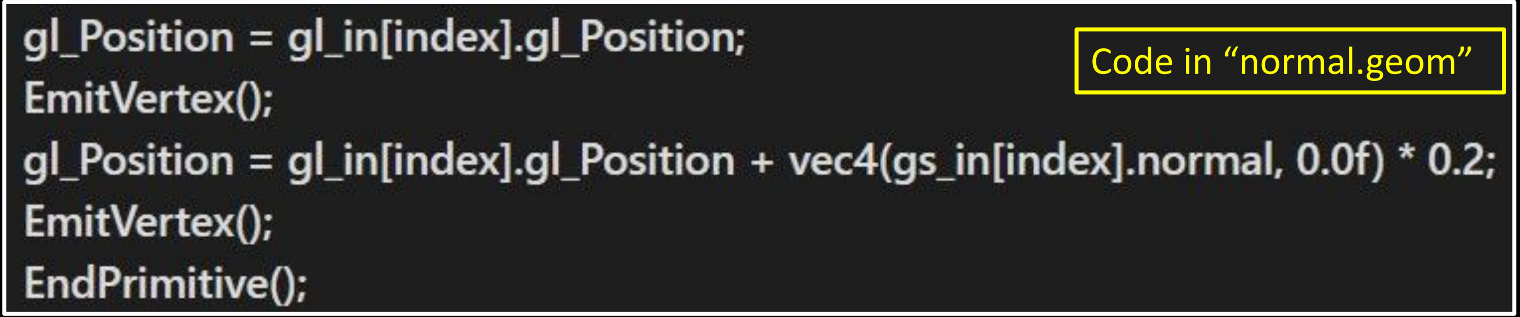
```
gl_Position = gl_in[index].gl_Position;
```

Code in “normal.geom”

Geometry Shader- EmitVertex /EndPrimitive function



- Each time we call EmitVertex(), the vector currently set to gl_Position is added to the output primitive.
- Whenever EndPrimitive() is called, all emitted vertices for this primitive are combined into the specified output render primitive.



```
gl_Position = gl_in[index].gl_Position;
EmitVertex();
gl_Position = gl_in[index].gl_Position + vec4(gs_in[index].normal, 0.0f) * 0.2;
EmitVertex();
EndPrimitive();
```

Code in “normal.geom”

Reference: https://learnopengl.com/Advanced-OpenGL/Geometry-Shader

Load Model

- In obj file : (about face information)
  f vertex position/texture coordinate/normal
  f 1/1/1 473/2/2 1370/3/3 (3 vertice/primitive)
  f 1/1/1 473/2/2 1370/3/3 479/4/4 (4 vertice/primitive)
  f 1//1 473//2 1370//3 (no texture coordinate)
- In Object.cpp file, the format of the face information must be f 1/2/3 or f 1//3. (f 1/3 cannot be read.)
  You can modify Object.cpp or write another code for read obj file.
- In geometry shader, you cannot render the object with glDrawArrays(GL_QUADS).
  You can use the "GL_LINES_ADJACENCY" mode of "glDrawArray"

HW4 - Animation with Geometry Shaders

Homework 4- Goal

1. Make a 20 ~45 seconds video.
   First 10 ~30 seconds for playing the video.
   Last 10 ~15 seconds for introducing the features of the video and technique you have used.
2. Theme : Animation with Geometry Shaders
3. Must include :
   (1) At least an object
   (2) Geometry shader to create new point, line or polygon
   (You can change the position or shape of polygon and create additional polygon and so on)

* You can refer to the examples on the Internet, but you must mention it in the introduction part of the video and cite the original source.

Video sample

Homework 4- Recording tools

1. Screen recording :
   OBS : https://obsproject.com/

2. Introduce your video :
   (1) PowerPoint
   (2) Other video editing tools

Homework 4- Something you can do with Geometry shader

1. Explosion
2. Shrinking triangles
3. Silhouettes
4. Other creative ideas…

Homework 4- Score

1. Creativity/ Richness/technical difficulty (40%)
2. Your code is executable (30%)
3. Votes from classmates (30%)
   (We will provide a Google sheet and let you choose 5 best videos)

*Requirements for geometry shader :
(1)You should do a different effect from the example code we provided, or your score will be zero.
(2) Developing a simple function with Geometry shader can meet the basic requirement.

Homework 4- Upload Format and Rules

1. Upload your video to Youtube (must be anonymous).
2. Please hand in your video link and the whole project file as HW4_<yourstudentID>.zip to e3 platform.
   *If your uploading format doesn't match our requirement, there will be penalty to your score. (-5%)
3. DeadLine: 2022/ 1 / 17 23: 59:59

   After deadline : 0 score
4. Use geometry shader to do this homework, otherwise you'll get zero points.

Reference

- Learn OpenGL : https://learnopengl.com/Advanced-OpenGL/Geometry-Shader
- OpenGL wiki : https://www.khronos.org/opengl/wiki/Geometry_Shader
- E3 Forum : https://e3.nycu.edu.tw/mod/forum/view.php?id=251401

#tool

- GLSL language integration :

  https://marketplace.visualstudio.com/items?itemName=DanielScherzer.GLSL