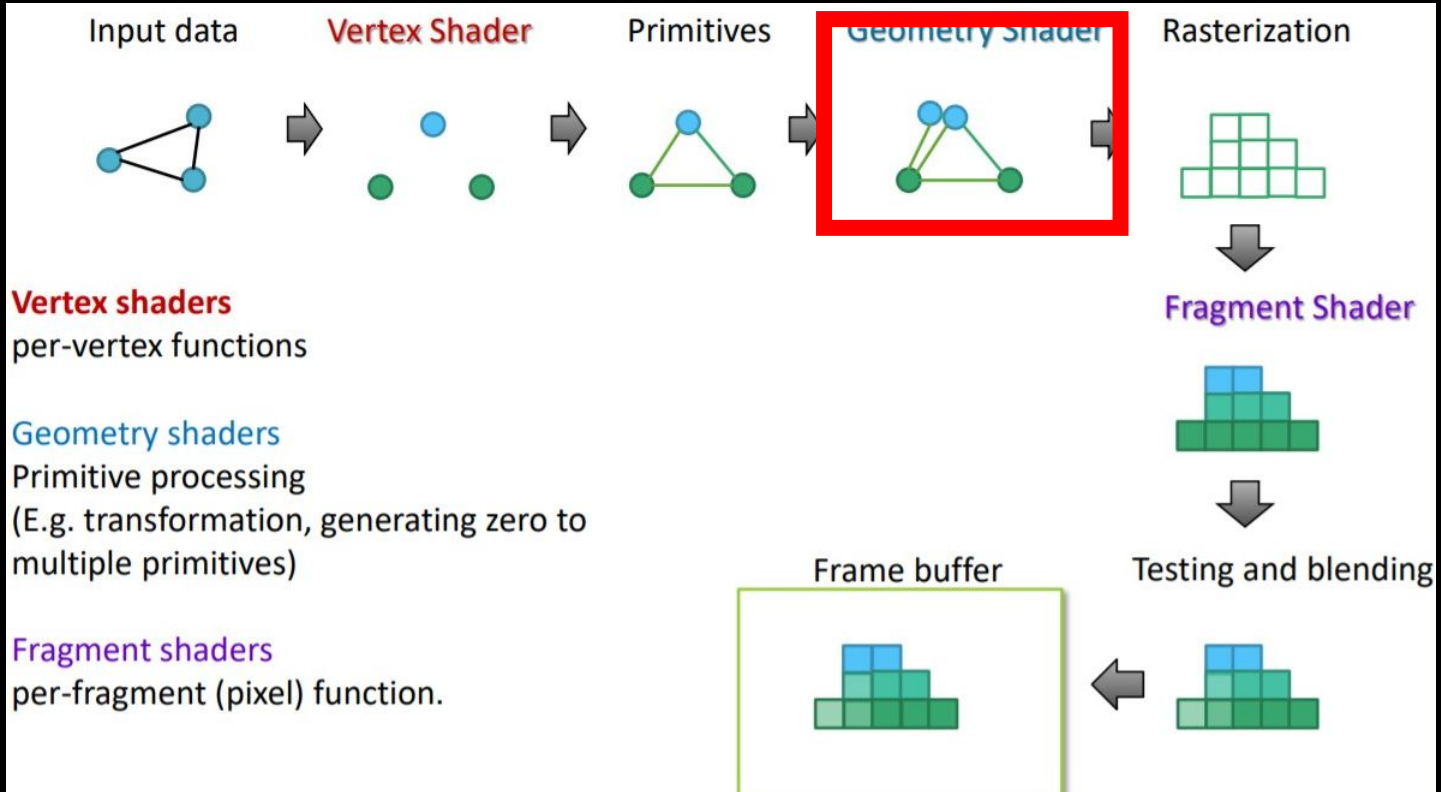


HW4

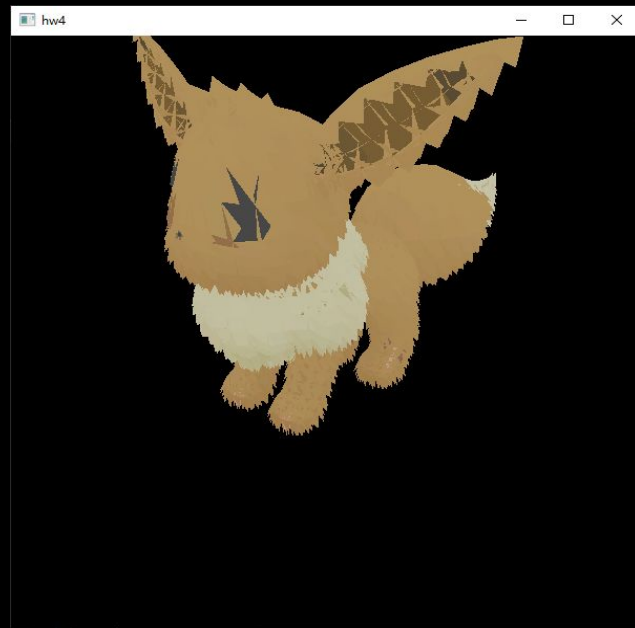
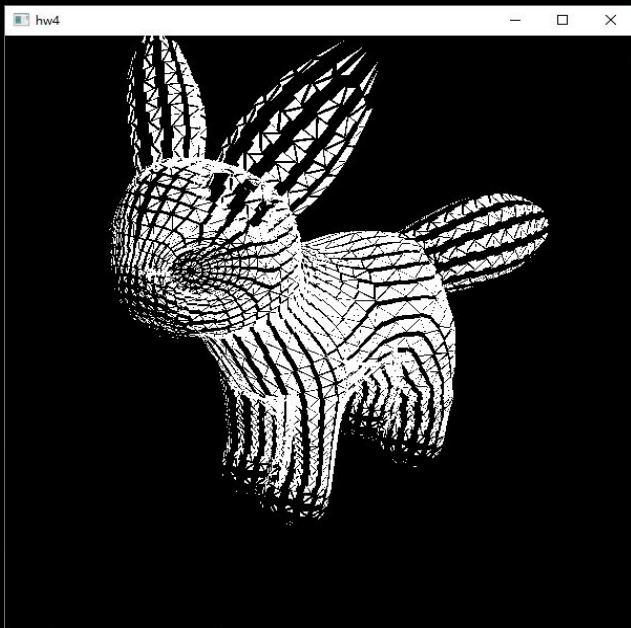
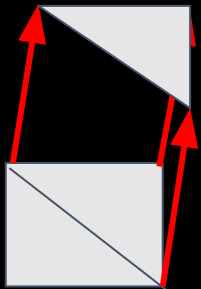
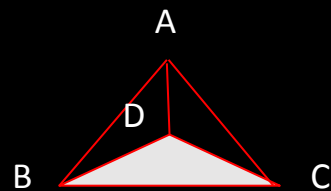
2021 Introduction to Computer Graphics

Geometry Shader



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.


```
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);  
}
```

Code in "main.cpp"

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; Code in "normal.geom"  
layout(line_strip, max_vertices = 6) out;
```



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
<pre>out VS_OUT { vec3 normal; //other attributes } vs_out;</pre>	<pre>in VS_OUT { vec3 normal; //other attributes } gs_in[];</pre>
<pre>vs_out.normal</pre>	<pre>gs_in[index].normal (index: index for input vertices)</pre>

Geometry Shader- `gl_in` variable

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

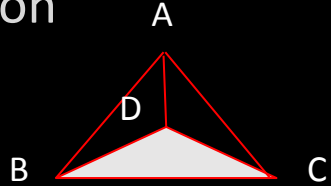
```
in gl_Vertex
{
    vec4 gl_Position;
    float gl_PointSize;
    float gl_ClipDistance[];
} gl_in[];
```

```
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>