Project #7A - Geometry Shaders: Turning a Triangle Model into a Collection of 3D Crosses (Extra Credit)

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1 Description

1.1 Set up

GLSL and glman are used to take the triangles of polygonal object, subdivide each triangle, quantize the subdivided vertices, and place a "3D Cross" at each vertex in the project #7A.

1.2 Program Description

Before explanation about the program in detail, there are requirements that can control and affect the shape of 3-D object.

- uLevel: Number of levels of subdivision
- uQuantize: How much to quantize the 3-D Cross locations
- uSize: Size of the 3-D Crosses

These values in the shaders are indispensable part of the program since they can change the number or shape of the 3-D Crosses, which are the components of the body of the 3-D object.
The vertex shader does not do anything functionally ,but instead geometry shader works identically as the vertex shader does. In the geometry shader, per-fragment lighting (variables gN, gL, gE) is copmuted and passes out through the rasterizer. The variable uLevel is used to subdivide the triangle into smaller triangles with interpolation loops. The geometry shader is used to build 3D crosses with the function named "ProduceCrosses". With the use of the function called Quantize(float f) with the variable uQuantize, Quantization process for vec3 is:

$$vec3\; Quantize(\; vec3\; v\;)\{$$

$$return\; vec3(\; Quantize(v.x),\; Quantize(v.y),\; Quantize(v.z))\}$$

(s,t) interpolation with the variable uSize for v.x, v.y, and v.z also . For the case of v.x, it would be:

$$vec3\; v = V0 + s * V01 + t * V02;$$

$$v = Quantize(v);$$

$$v.x- = uSize;$$

$$gl_Position = gl_ModelViewProjectionMatrix * vec4(v, 1.);$$

$$EmitVertex();$$

$$v.x+=2.0*uSize;$$
$$gl_Position = gl_ModelViewProjectionMatrix * vec4(v, 1.);$$
$$EmitVertex();$$
$$EndPrimitive();$$

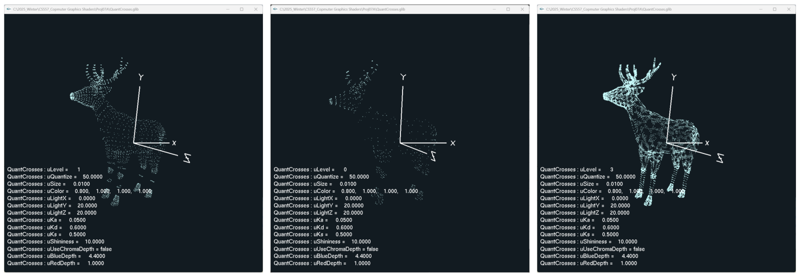
For extra credit, the program includes new variables such as uUseChromaDepth, uRedDepth, and uBlueDepth. The bool variable uUseChromaDepth is a mode changer if it is true, the program will show a chromaDepth feature. The variables uRedDepth and uBlueDepth are used to balance the colors on the 3-D object. In the geometry shader, z-coordinate is added. Then, in the fragment shader, the function "Rainbow" applies into the program to show beautiful rainbow colors. The vec3 variable myColor would be uColor.rgb for base color when the ChromaDepth function is off.
Finally, the program displays a 3-D deer, which is used for this project, consisting of the rainbow color 3-D crosses.

1.3 URL

Video Link(bitly): `https://bit.ly/4kquVD2`

Video Link(original):
`https://media.oregonstate.edu/media/t/1_7vy205nz`

1.4 Test Result

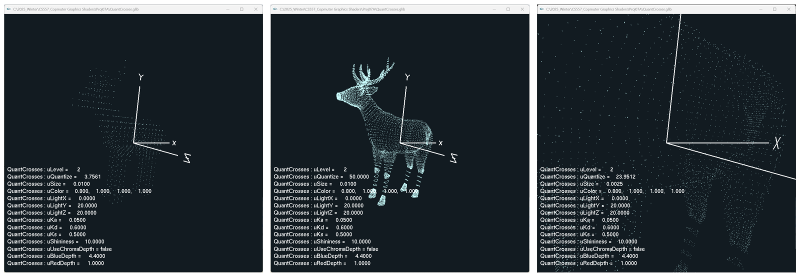


```
QuantCrosses : uLevel =      1
QuantCrosses : uQuantize =    50.0000
QuantCrosses : uSize =     0.0100
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

```
QuantCrosses : uLevel =      0
QuantCrosses : uQuantize =    50.0000
QuantCrosses : uSize =     0.0100
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

```
QuantCrosses : uLevel =      3
QuantCrosses : uQuantize =    50.0000
QuantCrosses : uSize =     0.0100
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

Figure 1: Original(left), low uLevel(middle), and high uLevel(right)

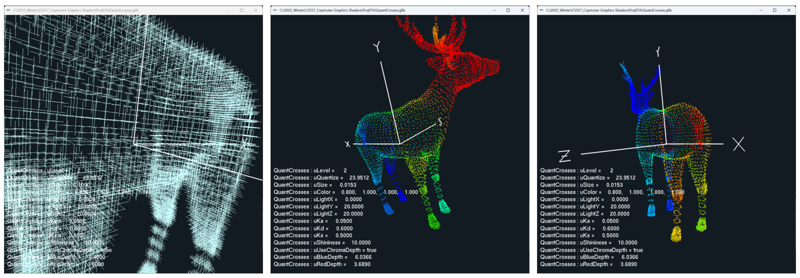


```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =     3.7561
QuantCrosses : uSize =     0.0100
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =    50.0000
QuantCrosses : uSize =     0.0100
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =    23.9512
QuantCrosses : uSize =     0.0025
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

Figure 2: low Quantize(left), high Quantize(middle), and low uSize(right)



```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =    23.9512
QuantCrosses : uSize =     0.1000
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = false
QuantCrosses : uBlueDepth =     4.4000
QuantCrosses : uRedDepth =     1.0000
```

```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =    23.9512
QuantCrosses : uSize =     0.0153
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = true
QuantCrosses : uBlueDepth =     6.0366
QuantCrosses : uRedDepth =     3.6890
```

```
QuantCrosses : uLevel =      2
QuantCrosses : uQuantize =    23.9512
QuantCrosses : uSize =     0.0153
QuantCrosses : uColor =    0.800,    1.000,    1.000,    1.000
QuantCrosses : uLightX =     0.0000
QuantCrosses : uLightY =    20.0000
QuantCrosses : uLightZ =    20.0000
QuantCrosses : uKa =     0.0500
QuantCrosses : uKd =     0.6000
QuantCrosses : uKs =     0.5000
QuantCrosses : uShininess =    10.0000
QuantCrosses : uUseChromaDepth = true
QuantCrosses : uBlueDepth =     6.0366
QuantCrosses : uRedDepth =     3.6890
```

Figure 3: high uSize(left), EC-Front(middle), and EC-Back(right)