

畫背景的小星點

- 在geometry shader中利用頂點的位置去random產生星點要出現的位置(利用很短的線段來讓它看起來像星點)

```
float rand(vec3 co){ return fract(sin(dot(co.xyz ,vec3(12.9898,78.233, 52.3256))) * 43758.5453); }
```

```
color=vec4(r,g,b,1.0);  
gl_Position = P * V * M *gl_in[2].gl_Position+vec4(gs_in[2].normal, 0.0f)*rand(gl_in[2].gl_Position.xyz)*30;  
EmitVertex();  
gl_Position = P * V * M *gl_in[2].gl_Position+vec4(gs_in[2].normal, 0.0f)*rand(gl_in[2].gl_Position.xyz)*30.3;  
EmitVertex();  
EndPrimitive();
```

背景的小星點會隨時間改變顏色

- 透過由main傳uniform的rgb值(在main中會隨時間改變)給shader

main:

```
if (b < 1) {  
    b += 0.05;  
}  
else if (g < 1) {  
    g += 0.05;  
}  
else if (r < 1) {  
    r += 0.05;  
}
```

```
GLuint ParameterID = glGetUniformLocation(program, "r");  
glUniform1f(ParameterID, r);  
  
ParameterID = glGetUniformLocation(program, "g");  
glUniform1f(ParameterID, g);  
  
ParameterID = glGetUniformLocation(program, "b");  
glUniform1f(ParameterID, b);
```

shader:

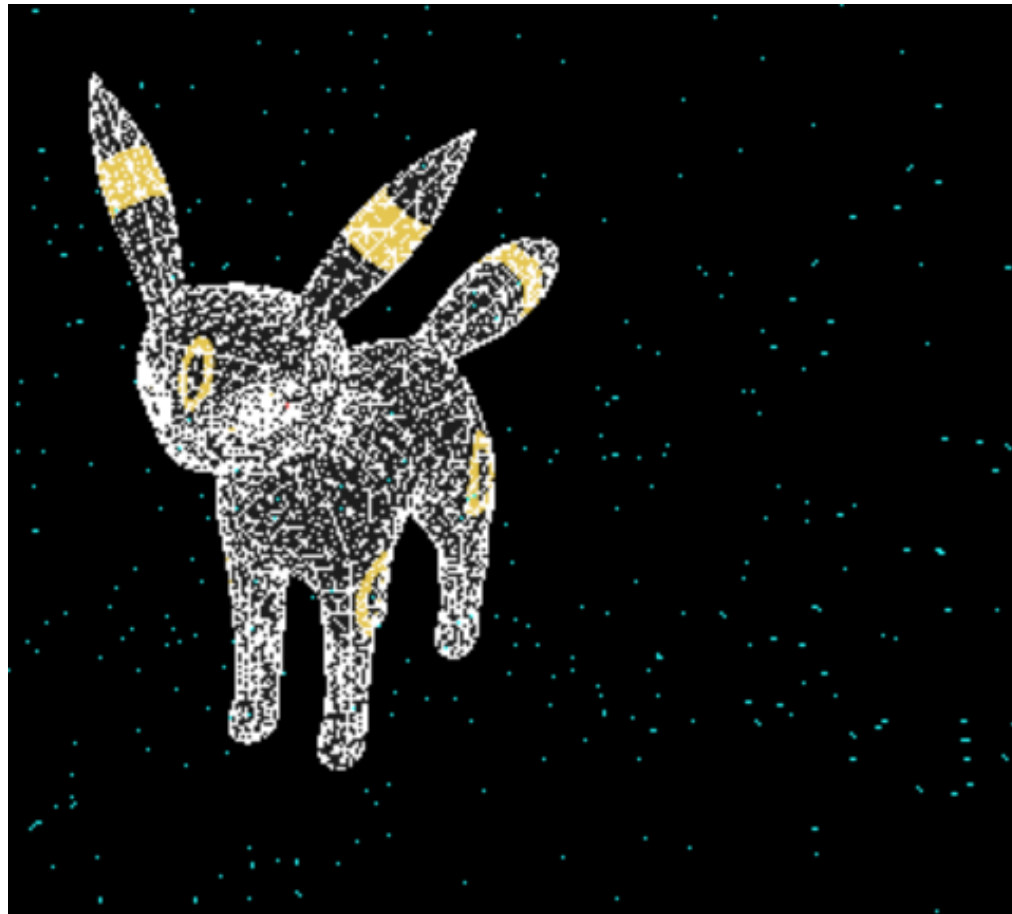
```
uniform float r;  
uniform float g;  
uniform float b;
```

```
color=vec4(r,g,b,1.0);
```

- 藍色的小星點



- 藍綠色的小星點



月亮伊布身上的白色網格

- 把primitive的頂點兩兩連線起來畫出三角形
- 透過由main傳隨時間改變的uniform值給shader，再在shader利用mod來決定三角形的邊要不要畫，做出漸層出現的白色網格

main:

```
show += 0.0015;  
  
if (show > 200)  
    show = 200;  
}
```

shader:

```
uniform int triangle;
```

```
if(mod(dot(gl_in[0].gl_Position, gl_in[1].gl_Position), 200)<show){  
    color=vec4(1.0,1.0,1.0,1.0);  
    gl_Position = P * V * M *gl_in[0].gl_Position;  
    EmitVertex();  
    gl_Position = P * V * M *gl_in[1].gl_Position;  
    EmitVertex();  
    EndPrimitive();  
}
```

爆炸效果

- 透過傳進來的primitive頂點位置計算primitive平面的normal

```
vec3 GetNormal()  
{  
    vec3 a = vec3(gl_in[0].gl_Position) - vec3(gl_in[1].gl_Position);  
    vec3 b = vec3(gl_in[2].gl_Position) - vec3(gl_in[1].gl_Position);  
    return normalize(cross(a, b));  
}
```

- 讓頂點位置朝normal方向平移一段距離，決定距離的magnitude也是由main傳uniform進來
(magnitude的改變大小一開始增加較快，後面增加較慢，模擬真實的爆炸)

main:

```
if (magnitude < 20)  
    magnitude += 0.01;  
else if (magnitude < 40)  
    magnitude += 0.008;  
else  
    magnitude += 0.005;  
  
if (magnitude > 60) {  
    magnitude = 0;  
    explode = false;  
    triangle = true;  
}
```

shader:

```
uniform float magnitude;
```

```
vec4 explode(vec4 position, vec3 normal)
{
    vec3 direction = normal * magnitude;
    return position + vec4(direction, 0.0f);
}
```

```
void main()
{
    vec3 normal = GetNormal();

    gl_Position = explode( P * V * M * gl_in[0].gl_Position, normal);
    color=vec4(1.0,1.0,1.0,1.0);
    EmitVertex();
    gl_Position = explode( P * V * M * gl_in[1].gl_Position, normal);
    color=vec4(1.0,1.0,1.0,1.0);
    EmitVertex();
    gl_Position = explode( P * V * M * gl_in[2].gl_Position, normal);
    color=vec4(1.0,1.0,1.0,1.0);
    EmitVertex();
    EndPrimitive();
}
```

keyboard

- 透過keyboard可以決定要不要轉、要不要爆炸、身上要不要有網格等，可以做出如影片中展現的各種組合

```
void keyboard(unsigned char key, int x, int y) {  
    switch (key) {  
        case 's':  
        {  
            stop = !stop;  
            explode = false;  
            break;  
        }  
        case 'e':  
        {  
            explode = true;  
            triangle = false;  
            show = 0;  
            break;  
        }  
        case 'w':  
        {  
            explode = true;  
            triangle = true;  
            break;  
        }  
    }  
}
```