

ISP Step 2

Mentor Artist Study

Reference artwork by
Paul J. Stankard





Characteristics I observed from photographs of Paul J. Stankard's work:

- Realism, nearly biologically accurate with simplification
- Combination of different plants, insects, and objects
- A variety of forms and colors
- Contents at the center of the glass with major and minor islands
- Unity and harmony: no strong focus, each part works together
- Shape of glass is either a sphere or a cuboid with rounded edges and curved faces
- Photographed on dark glossy surface with blurred environmental lighting

Image sources:

https://www.thisiscolossal.com/2014/06/artisti_c-glass-paperweights-paul-stankard/

<https://www.google.com/search?q=Paul+J.+Stankard&tbo=isch>

File Edit Selection View Go Run Terminal Help

dragonfly_1_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 × dragonfly_1_sdf.gsl A GROUP 2 isp-life > dragonfly_1_sdf.gsl 103 max(0.16+0.3/(pow(q.x-0.3,2.)+1.5)+0.2*q.y+0.05*q.x,0.1), 104 0.8*max(0.05+0.03*q.y,0.01)); 105 return d; 106 } 107 float mapWing2(vec3 p) { 108 p.x = abs(p.x); 109 vec3 q; 110 q = rotx(0.2)*rotz(-0.35)*(p-vec3(1.13,-0.28,-0.05)); 111 q.z += 0.5*q.y*q.y; 112 float d = sdEllipsoid(q, vec3(113 1.05, 114 max(0.1+0.3/(pow(q.x+0.2,2.)+1.5)+0.2*q.y-0.05*q.x+0.02*exp(2.0*q.x),0.1), 115 0.8*max(0.05+0.03*q.y,0.01)); 116 return d; 117 } 118 119 float map(vec3 p) { 120 p = rotx(0.2)*p; 121 p.z -= 0.2*length(vec2(p.x, 0.5))-0.2; 122 float body = mapBody(1.2*p)/1.2; 123 float wing1 = mapWing1(p); 124 float wing2 = mapWing2(p); 125 float d = smin(body, min(wing1, wing2), 0.02); 126 return d; 127 } 128 129 130 float sdf(vec3 p) {

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

dragonfly_1_sdf.gsl A

17 MS (3-1721324)

GLSL Preview

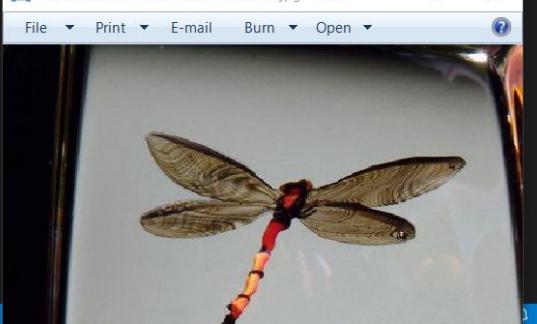
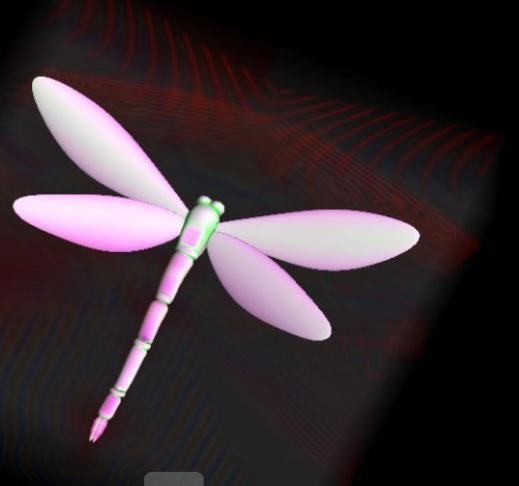
17 MS (3-1721324)

11ca5e4acf20be9b783c91d71013e1f7.jpg - Win...

File Print E-mail Burn Open

2021/11/06 Modeling a dragonfly. I took Paul's work as reference, although I realized it isn't biologically accurate after checking some real dragonfly photos.

Inspired by the work of [Inigo Quilez](#), I use an (approximate) signed distance field to represent the subject, programmed in an original SDF visualizer.



File Edit Selection View Go Run Terminal Help

dragonfly_1_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 SHADERTOY PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Get Started Static GLSL Preview 17 MS (1-110B)

A screenshot of the colored dragonfly added on a later day.

```
131 float tu = 0.1*sin(47.0*u)+0.1*sin(31.0*v);
132 float tv = -0.1*sin(16.0*v)+0.1*sin(137.0*v)+0.05*sin(73.0*v);
133 float t = (0.5+tv+tu) * 1.0/(1.0+exp(-8.0*(u-v+1.4)));
134 vec3 col = mix(vec3(0.06,0.03,0.01), vec3(0.6,0.5,0.4), t);
135 return vec4(col, d);
136 }
137 vec4 mapWing2(vec3 p, bool col_required) {
138     p.x = abs(p.x);
139     vec3 q;
140     q = rotx(0.2)*rotz(-0.35)*(p-vec3(1.13,-0.28,-0.05));
141     q.z += min(0.5*q.y*q.y, 1.0);
142     vec3 r = vec3([
143         1.05,
144         max(0.1+0.3/(pow(q.x+0.2,2.0)+1.5)+0.2*q.y-0.05*q.x+0.02*exp(2.0*q.x), 0.1),
145         0.4*max(0.05+0.03*q.y, 0.01)]);
146     float d = sdEllipsoid(q, r);
147     if (!col_required) return vec4(vec3(1.0), d);
148     q = q / r + vec3(1, 0, 0);
149     float u = 2.0*atan(q.y,q.x);
150     float v = dot(q.xy,q.xy)/(2.0*q.x);
151     float tu = 0.1*sin(47.0*u)+0.1*sin(31.0*v);
152     float tv = -0.1*sin(16.0*v)+0.1*sin(137.0*v)+0.05*sin(73.0*v);
153     float t = (0.5+tv+tu) * 1.0/(1.0+exp(-4.0*(u+0.9)));
154     vec3 col = mix(vec3(0.06,0.03,0.01), vec3(0.6,0.5,0.4), t);
155     return vec4(col, d);
156 }
157 
```

Filter (e.g. text, **.ts, !**/node_modules/**)

Ln 142, Col 19 Spaces: 4 UTF-8 CRLF GLSL

File Edit Selection View Go Run Terminal Help

dragonfly_1_glass.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 SHADERTOY

dragonfly_1_glass.gsl

```
316    for (int iter = 0; iter < 64; iter++) {
317        ro += EPSILON*rd;
318        vec3 n, min_n;
319        float t, min_t = 1e12;
320        int material = background;
321
322        // plane
323        t = -ro.z / rd.z;
324        if (t > 0.0) {
325            min_t = t, min_n = vec3(0, 0, 1);
326            col = vec3(0.9, 0.95, 0.98);
327            material = lambertian;
328        }
329
330        // object
331        t = 0.0;
332        if (intersectGlass(ro, rd, t, min_t)) {
333            min_t = t;
334            min_n = gradGlass(ro+rd*t, 0.005);
335            col = is_inside ? exp(-vec3[0.0, 0.2, 0.4])*t : vec3(1.0);
336            material = refractive;
337        }
338
339        // update ray
340        if (material == background) {
341            //if (iter == 0) return vec3(0.f);
342        }
343    }
344}
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview Static GLSL Preview

17 MS (4-540)

Filter (e.g. text, **~.ts, !**/node_modules/**)

2021/11/07 Modeling the glass, setting up surface and lighting.

Rendering technique: Monte-Carlo path tracing

master* 0 0 ▲ 0

Ln 335, Col 53 Spaces: 4 UTF-8 CRLF GLSL

File Edit Selection View Go Run Terminal Help

dragonfly_1_glass.gsl - Shadertoy - Visual Studio Code

EXPLORER ...

OPEN EDITORS

GROUP 1

- dragonfly_1_sdf.gsl
- dragonfly_1_glass.gsl A
- In_norm-ellipsoid.gsl A
- glassball-01-basic.gsl

GROUP 2

- Static GLSL Preview
- Static GLSL Preview

SHADERTOY

- bsdf-tests
- references
- cook-torrance-ggx-i...
- cook-torrance-ggxg...
- bunny
- cubemaps
- isp-glass
- imgs
- references
- buffer_test.gsl
- glassball-01-basic.gsl
- glassball-02-scatter...
- glassball-03-scatter...
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter...
- glassball-09-scatter...
- glassball-10-emissio...
- glassball-11-mix.gsl
- glassball-12-mix.gsl
- isp-life
- dragonfly_1_g... A
- dragonfly_1_sdf.gsl
- fungi_1_sdf.gsl
- primitives
- In_norm-ellipso... A
- spiral

OUTLINE

TIMELINE

master+ 0 0 △ 0

dragonfly_1_glass.gsl

```
120d * h = clamp(0.5 + 0.5 * (b.w - d.w) / k, 0., 1.);  
float d = mix(b.w, a.w, h) - k * h * (1.0 - h);  
return vec4(mix(b.xyz, a.xyz, h), d);  
  
// Modeling  
  
> vec4 mapBody(vec3 p, bool col_required) { ...  
126 }  
  
127  
128 > vec4 mapWing1(vec3 p, bool col_required) { ...  
147 }  
148 > vec4 mapWing2(vec3 p, bool col_required) { ...  
167 }  
  
168  
169 vec4 mapDragonfly(vec3 p, bool col_required) {  
170     p -= vec3(0, 0, 1);  
171     p = rotx(0.2)*p;  
172     p.z -= 0.2*length(vec2(p.x, 0.5))-0.2;  
173     vec4 body = mapBody(1.2*p, col_required)/1.2;  
174     vec4 wing1 = mapWing1(p, col_required);  
175     vec4 wing2 = mapWing2(p, col_required);  
176     vec4 d = smin(body, cmin(wing1, wing2), 0.02);  
177     //d.xyz = 0.05+0.95*pow(d.xyz, vec3(0.8));  
178     d.xyz = saturate(d.xyz);  
179     return d;  
180 }  
181  
> float mapContent(vec3 p) { ...  
182 }
```

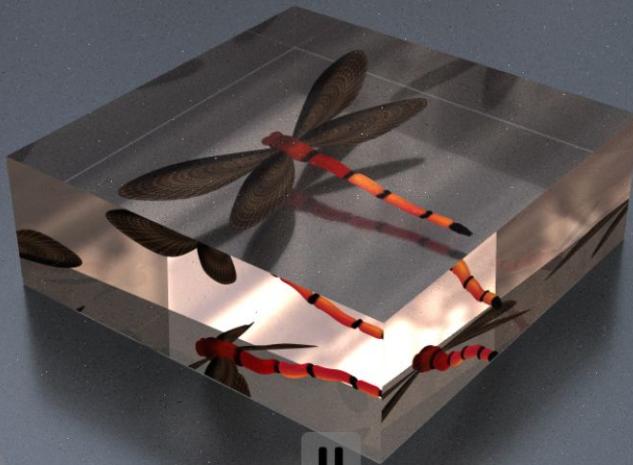
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview 200 MS (2-4651)

Static GLSL Preview

200 MS (2-4651)



A dragonfly with brown wings and a red body is shown inside a clear glass rectangular box. The dragonfly is positioned near the bottom right corner of the box. The scene is set against a dark background.

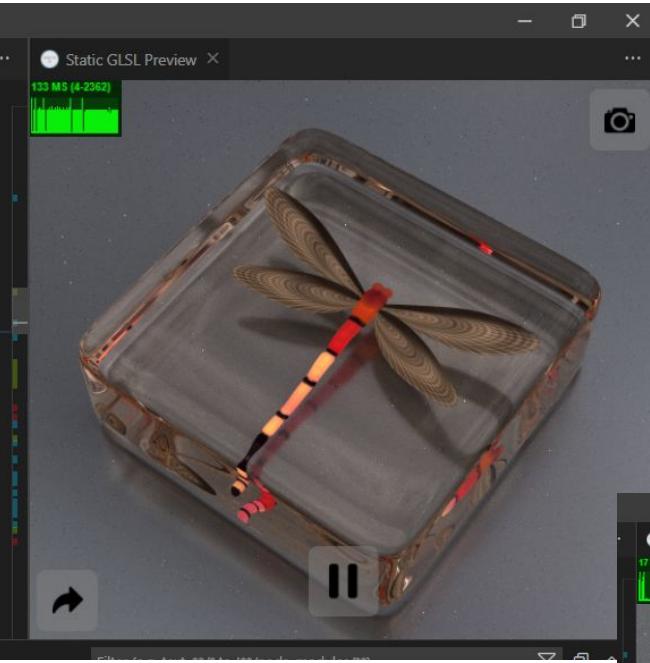
11ca5e4acf20be9b783c91d71013e1f7.jpg - Win...

File Print E-mail Burn Open



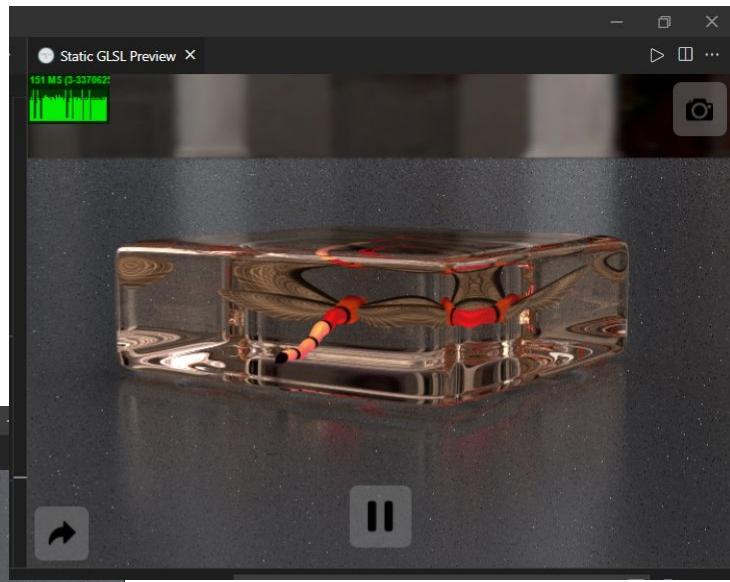
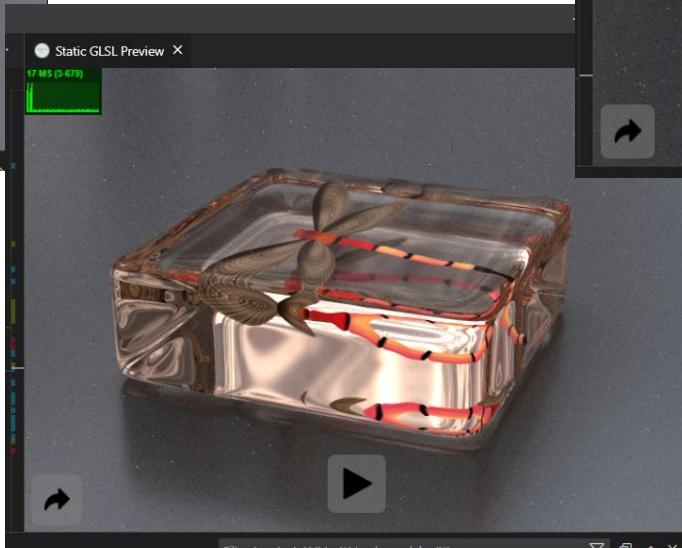
A dragonfly with brown wings and a red body is shown against a plain white background. The dragonfly is positioned towards the bottom left of the frame.

Put the dragonfly I modeled on the previous day inside the glass



Try cuboid with rounded edges.
Some screenshots from
different angles.

Here the dragonfly's wing is
opaque (Cook-Torrance BRDF).
I tried subsurface scattering
but it doesn't look that nice.



File Edit Selection View Go Run Terminal Help

flower_01_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER ...

OPEN EDITORS

GROUP 1

- dragonfly_1_sdf.gsl
- flower_01_sdf.gsl U
- dragonfly_1_glass.gsl

GROUP 2

- Get Started
- Static GLSL Preview...
- Static GLSL Preview...

SHADERTOY

- > references
- buffer_test.gsl
- glassball-01-basic.gsl
- glassball-02-scatter...
- glassball-03-scatter...
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter...
- glassball-09-scatter...
- glassball-10-emissio...
- glassball-11-mix.gsl
- glassball-12-mix.gsl

isp-life

- dragonfly_1_glass.gsl
- dragonfly_1_sdf.gsl
- flower_01_sdf.gsl U
- fungi_1_sdf.gsl

primitives

- In_norm-ellipsoid.gsl
- spiral
- weather-abstraction
- colorwheel.gsl
- sdf_template.gsl
- sdf_visualizer_2.gsl
- sdf_visualizer.gsl
- sdf2d_visualizer.gsl
- simplex_terrain.gsl

OUTLINE

TERMINAL

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

flower_01_sdf.gsl - Shadertoy - Visual Studio Code

17 MS (3-379)

Get Started Static GLSL Preview Static GLSL Preview

#9-Paul-J-Stankard,-Floral-Bouquet-with-Prickly... File Print E-mail Burn Open

2021/11/08 Model a flower, taking Paul's work as reference. Choose a relatively simple flower to get started.

I find referencing a photo is different from referencing a real object because it can sometimes be inaccurate. I wish I could reference a real flower or other plants in my later creative process, but it's likely I will not be able to do that due to the coming winter.

File Edit Selection View Go Run Terminal Help

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER

OPEN EDITORS

- GROUP 1
- dragonfly_1_sdf.gls... 96
- flower_01_sdf.gls... 97
- flower_01_g... U 98
- dragonfly_1_glas... 99
- GROUP 2
- Get Started 100
- Static GLSL Prev... 101
- Static GLSL Prev... 102
- Static GLSL Prev... 103
- SHADERTOY
- > references 104
- buffer_test.gsl 105
- glassball-01-basic.gsl 106
- glassball-02-scatter... 107
- glassball-03-scatter... 108
- glassball-04-nonunif... 109
- glassball-05-nonunif... 110
- glassball-06-scatter... 111
- glassball-07-scatter... 112
- glassball-08-scatter... 113
- glassball-09-scatter... 114
- glassball-10-emissio... 115
- glassball-11-mix.gsl 116
- glassball-12-mix.gsl 117
- isp-life
- dragonfly_1_glass.gsl 118
- dragonfly_1_sdf.gls... 119
- flower_01_sdf.g... U 120
- fungi_1_sdf.gsl 121
- primitives
- In_norm-ellipsoid.gsl
- > spiral
- > weather-abstraction
- colorwheel.gsl
- sdf_template.gsl
- sdf_visualizer_2.gsl
- sdf_visualizer.gsl
- sdf_2d_visualizer.gsl
- simplex_terrain.gsl

isp-life > flower_01_sdf.gsl

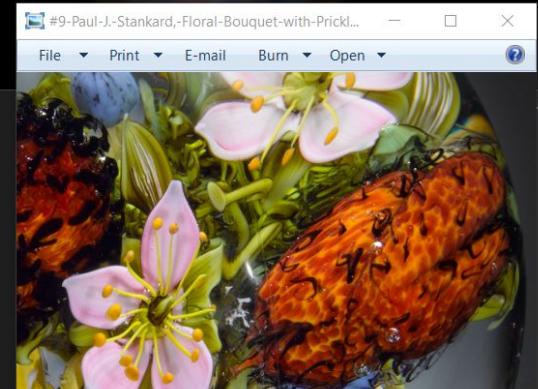
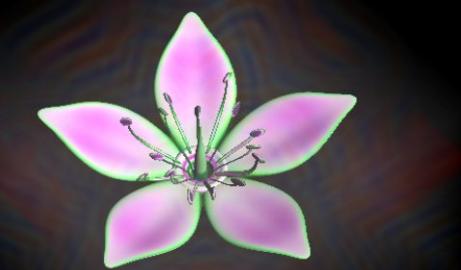
```
float h = 0.2*w+0.1*exp(-sqr(3.0*(x+0.8)));
float petal = sdEllipsoid(a, vec3(1.0, w, h));
// style/sepal
q = vec3(r, a, p.z);
float leaf = smin( // green part
    sdSegment(q.xz, vec2(0.24, -0.05), vec2(0.32, 0.0))-0.05, // ring
    sdSegment(q.xz+0.05*sin(8.0*q.z), vec2(0.12, -0.4), vec2(0.22, -0.05))-0.05, // wall
    0.05);
leaf = smin(leaf,
    sdSegment(p-vec3(0.01*sin(10.0*r), 0, 0), vec3(0.0, -0.6), vec3(0.0, 1.0))
    -max(0.06/(1.0+exp(10.0*(q.z-0.5)))+0.02, 0.), // style
    0.1);
// filament/anther
a_ = asin(0.99*sin(7.5*atan(p_-y, p_-x)))/7.5;
p_ = vec3(r*vec2(cos(a_), sin(a_)), p.z);
q = p_ - vec3(0.1+(0.7+0.2*sin(7.0*a))/(1.0+exp(-8.0*(p.z-0.2))), 0, -0.2);
h = 0.8+0.2*sin(4.0*a);
float filament = 0.5*sdCapsule(q, h, 0.01+0.01*exp(-sqr(4.0*(p.z-0.2))));
float anther = sdEllipsoid(q-vec3(0.02, 0, h), vec3(0.08, 0.04, 0.05));
float d = min(min(petal, leaf), min(filament, anther));
//d = max(d, p.y);
return d;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Get Started Static GLSL Preview Static GLSL Preview

19 MS (7-115)



Finished modeling

I haven't colored it yet, although my dad says this color looks nice. Pink/magenta represents high surface gradient and green represents low surface gradient.

File Edit Selection View Go Run Terminal Help flower_01_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 SHADERTOY isp-life flower_01_sdf.gsl

```
108 sdSegment(q.xz, vec2(0.24, -0.05), vec2(0.32, 0.0))-0.05, // ring
109 sdSegment(q.xz+0.05*sin(8.0*q.z), vec2(0.12, -0.4), vec2(0.22, -0.05))-0.05, // wall
110 0.05);
111 leaf_d = smin(leaf_d, sdEllipsoid(p_-vec3(0.55, 0, -0.1), vec3(0.4, 0.1, 0.05)), 0.05); // se
112 leaf_d = smin(leaf_d,
113 sdSegment(p_-vec3(0.01*sin(10.0*r), 0, 0), vec3(0.0, -0.6), vec3(0.0, 1.0))
114 | -max(0.06/(1.0+exp(10.0*(q.z-0.5)))+0.02, 0.), // style
115 0.1);
116 vec4 leaf = vec4(0.5, 0.7, 0, leaf_d);
117 // filament/anther
118 a_ = asin(0.99*sin(7.5*atan(p_-y, p_-x)))/7.5;
119 p_ = vec3(r_*vec2(cos(a_), sin(a_)), p_z);
120 q_ = p_ - vec3(0.1+(0.7+0.2*sin(7.0*a))/(1.0+exp(-8.0*(p.z-0.2))), 0, -0.2);
121 h = 0.8+0.2*sin(4.0*a);
122 vec4 filament = vec4(0.85, 0.85, 0.,
123 0.5*sdCapsule(q_, h, 0.01+0.01*exp(-sqr(4.0*(p.z-0.2)))));
124 vec4 anther = vec4(0.75, 0.55, 0.,
125 sdEllipsoid(q_-vec3(0.02, 0, h), vec3(0.08, 0.04, 0.05)));
126 // put all together
127 vec4 d = cmin(smin(petal, leaf, 0.05-0.03*exp(-r)), smin(filament, anther, 0.01));
128 //d = max(d, p_y);
129 return d;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

flower_01_sdf.gsl

dragonfly_1_glass.gsl

isp-life

fungi_1_sdf.gsl

primitives

In_norm-ellipsoid.gsl

spiral

weather-abstraction

colorwheel.gsl

sdf_template.gsl

sdf_visualizer_2.gsl

sdf_visualizer.gsl

sdf_2d_visualizer.gsl

simplex_terrain.gsl

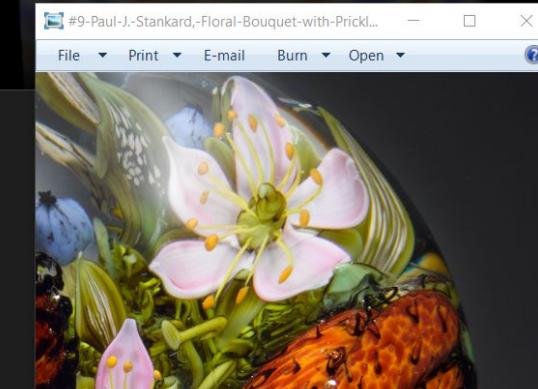
OUTLINE

TIMELINE

master* 0 0 △ 0

Get Started Static GLSL Preview Static GLSL Preview

33 MS (2-193)



File Edit Selection View Go Run Terminal Help

GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER

OPEN EDITORS

- GROUP 1
 - dragonfly_1_sdf.gls...
 - flower_01_sdf.gls...
 - flower_01_...
- GROUP 2
 - Get Started
 - Static GLSL Preview...
 - GLSL Preview

SHADERTOY

- > imgs
- > references
- buffer_test.gls...
- glassball-01-basic.gls...
- glassball-02-scatter....
- glassball-03-scatter....
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter....
- glassball-09-scatter....
- glassball-10-emissio...
- glassball-11-mix.gls...
- glassball-12-mix.gls...

isp-life

- dragonfly_1_glass.gls...
- dragonfly_1_sdf.gls...
- flower_01_glass... U
- flower_01_sdf.gls...
- fungi_1_sdf.gls...
- primitives
 - In_norm-ellipsoid.gls...
 - spiral
 - weather-abstraction
 - colorwheel.gls...
 - sdf_template.gls...
 - sdf_visualizer_2.gls...
 - sdf visualizer.gls...

OUTLINE

TIMELINE

dragonfly_1_sdf.gls... flower_01_glass.gls... flower_01_sdf.gls...

```
369     if (inside_object);
370     else if (inside_glass) m_col *= exp(-0.1*vec3(0.0,0.2,0.4)*min_t);
371     min_n = dot(rd, min_n) < 0. ? min_n : -min_n; // ray hits into the surface
372     ro = min_ro, rd = min_rd;
373     if (material == MAT_PLANE) {
374         rd = sampleCookTorrance(-rd, min_n, 0.05, 0.3, 0.2, col, col, m_col);
375     }
376     else if (material == MAT_GLASS) {
377         vec2 eta = inside_glass ? vec2(1.5, 1.0) : vec2(1.0, 1.5);
378         rd = sampleFresnelDielectric(rd, min_n, eta.x, eta.y);
379         if (dot(rd, min_n) < 0.0) inside_glass = !inside_glass;
380     }
381     else if (material == MAT_CONTENT) {
382         t_col += 0.5 * m_col * col;
383         rd = sampleCookTorrance(-rd, min_n, 0.5, 0.8, 0.4, vec3(1.0), vec3(1.0), m_col);
384         m_col *= 1.2*col*(col+0.5);
385         if (dot(rd, min_n) < 0.0) inside_object = !inside_object;
386     }
387     if (m_col == vec3(0.0)) return t_col;
388     //if (mapContent(ro) < 0.0) return vec3(100.0, -100.0, -100.0);
389     if (inside_object) return vec3(100.0, -100.0, -100.0);
390 }
391 return m_col + t_col;
392 }
393
394
395 void mainImage(out vec4 fragColor, in vec2 fragCoord) {
396     // random number seed

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Get Started Static GLSL Preview GLSL Preview

101 MS (5-64)

101 MS (5-64)

2021/11/09 I place the flower I modeled on the previous day inside glass. The flower looked dim. I tried to fix it by adding some emission, however, it made the flower look bright and unrealistic. I think I need further experimentation of material and lighting.

File Edit Selection View Go Run Terminal Help

flower_01.glass.gsl - Shadertoy - Visual Studio Code

EXPLORER ...

OPEN EDITORS

- dragonfly_1.sdf.gsl
- flower_01.glass.gsl
- flower_01.glass.gsl U
- dragonfly_1.glass.gsl

GROUP 2

- Get Started
- Static GLSL Preview
- Static GLSL Preview
- GLSL Preview

SHADERTOY

- > imgs
- > references
- buffer_test.gsl
- glassball-01-basic.gsl
- glassball-02-scatter...
- glassball-03-scatter...
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter...
- glassball-09-scatter...
- glassball-10-emissio...
- glassball-11-mix.gsl
- glassball-12-mix.gsl

isp-life

- dragonfly_1.glass.gsl
- dragonfly_1.sdf.gsl
- flower_01.glass.gsl
- flower_01.glass.gsl U
- flower_01.sdf.gsl
- fungi_1.sdf.gsl
- primitives
- In_norm-ellipsoid.gsl
- spiral
- weather-abstraction
- colorwheel.gsl
- sdf_template.gsl
- sdf visualizer 2.gsl

OUTLINE

TIMELINE

100 MS (4-1729)

Get Started Static GLSL Preview GLSL Preview

100 MS (4-1729)

```
293     }
294     t = t0;
295     return true;
296   }
297   return false;
298 }

// Rendering

303 vec3 light(vec3 rd) {
304   const vec3 sunpos = normalize(vec3(-0.2, -0.5, 0.5));
305   vec3 col = texture(iChannel1, rd.xyz).xyz;
306   vec3 amb = vec3(1.0) + vec3(2.0) * pow(max(dot(rd, sunpos), 0.), 4.);
307   vec3 sun = (dot(rd,sunpos)>0.9 ? 1.0 : 0.0) * vec3(10.0);
308   return col * 0.1*amb + sun;
309 }

310 vec3 mainRender(vec3 ro, vec3 rd) {
311   vec3 m_col = vec3(1.0), t_col = vec3(0.0), col;
312   bool inside_glass = false, inside_object = false;

313   for (int iter = 0; iter < 64; iter++) {
314     ro += EPSILON*rd;
315     float t, min_t = 1e12;
316     vec3 n, min_n;
317     vec3 min_ro = ro, min_rd = rd;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

I tried to produce shadow on the petal casted by the filament by using a “sun” light source. This produces a image with higher contrast and three-dimensionality. However, there is a significant increase of the variance of noise.

File Edit Selection View Go Run Terminal Help flower_01.glass.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 2 SHADERTOY PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

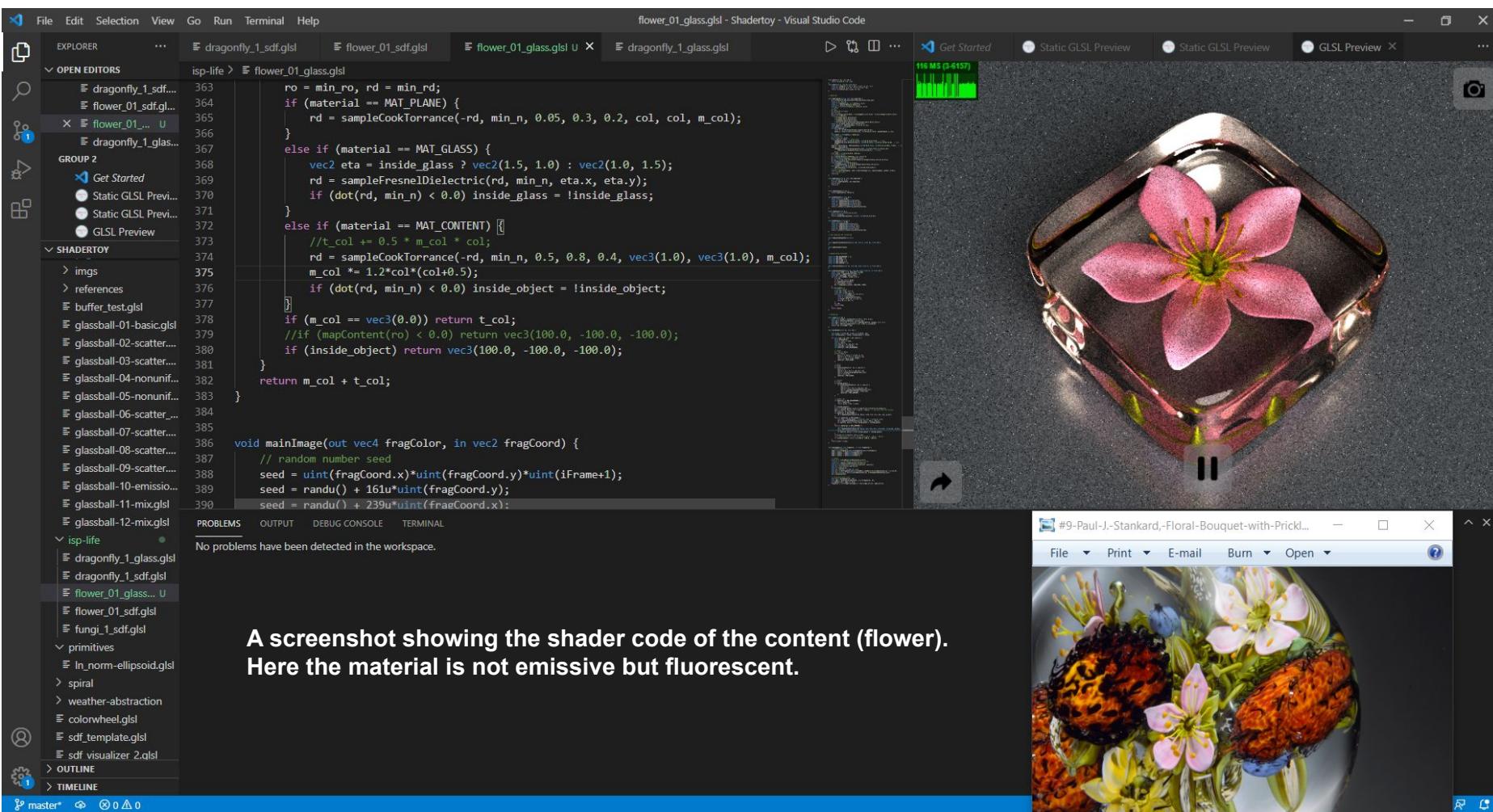
No problems have been detected in the workspace.

isp-life > flower_01.glass.gsl

```
363     ro = min_ro, rd = min_rd;
364     if (material == MAT_PLANE) {
365         rd = sampleCookTorrance(-rd, min_n, 0.05, 0.3, 0.2, col, col, m_col);
366     }
367     else if (material == MAT_GLASS) {
368         vec2 eta = inside_glass ? vec2(1.5, 1.0) : vec2(1.0, 1.5);
369         rd = sampleFresnelDielectric(rd, min_n, eta.x, eta.y);
370         if (dot(rd, min_n) < 0.0) inside_glass = !inside_glass;
371     }
372     else if (material == MAT_CONTENT) {
373         //t_col += 0.5 * m_col * col;
374         rd = sampleCookTorrance(-rd, min_n, 0.5, 0.8, 0.4, vec3(1.0), vec3(1.0), m_col);
375         m_col *= 1.2*col*(col+0.5);
376         if (dot(rd, min_n) < 0.0) inside_object = !inside_object;
377     }
378     if (m_col == vec3(0.0)) return t_col;
379     //if (mapContent(ro) < 0.0) return vec3(100.0, -100.0, -100.0);
380     if (inside_object) return vec3(100.0, -100.0, -100.0);
381 }
382 return m_col + t_col;
383 }
384
385 void mainImage(out vec4 fragColor, in vec2 fragCoord) {
386     // random number seed
387     seed = uint(fragCoord.x)*uint(fragCoord.y)*uint(iFrame+1);
388     seed = randu() + 161u*uint(fragCoord.y);
389     seed = randu() + 239u*uint(fragCoord.x);
390 }
```

Get Started Static GLSL Preview Static GLSL Preview GLSL Preview

116 MS (2-6157)



A screenshot showing the shader code of the content (flower).
Here the material is not emissive but fluorescent.

File Edit Selection View Go Run Terminal Help

GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER ... dragonfly_1.sdf.gls... flower_01.sdf.gls... flower_01_glass.gls... dragonfly_1.glass.gls...

OPEN EDITORS ...

GROUP 2

- Get Started
- Static GLSL Preview...
- Static GLSL Preview...
- GLSL Preview

SHADERTOY

- > imgs
- > references
- buffer_test.gls...
- glassball-01-basic.gls...
- glassball-02-scatter...
- glassball-03-scatter...
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter...
- glassball-09-scatter...
- glassball-10-emissio...
- glassball-11-mix.gls...
- glassball-12-mix.gls...

isp-life

- dragonfly_1.glass.gls...
- dragonfly_1.sdf.gls...
- flower_01.glass.gls...
- flower_01.sdf.gls...

primitives

- > In_norm-ellipsoid.gls...
- > spiral
- > weather-abstraction
- colorwheel.gls...
- sdf_template.gls...
- sdf visualizer 2.gls...

OUTLINE

TIMELINE

master* 0 0 △ 0 0

```

isp-life > flower_01.glass.gls...
    ro = min(ro, rd = min_rd;
    if (material == MAT_PLANE) {
        rd = sampleCookTorrance(-rd, min_n, 0.05, 0.3, 0.2, col, col, m_col);
    }
    else if (material == MAT_GLASS) {
        vec2 eta = inside_glass ? vec2(1.5, 1.0) : vec2(1.0, 1.5);
        rd = sampleFresnelDielectric(rd, min_n, eta.x, eta.y);
        if (dot(rd, min_n) < 0.0) inside_glass = !inside_glass;
    }
    else if (material == MAT_CONTENT) {
        //t_col += 0.5 * m_col * col;
        rd = sampleCookTorrance(-rd, min_n, 0.5, 0.8, 0.4, vec3(1.0), vec3(1.0), m_col);
        m_col *= 1.2*col*(col+0.5);
        if (dot(rd, min_n) < 0.0) inside_object = !inside_object;
    }
    if (m_col == vec3(0.0)) return t_col;
    //if (mapContent(ro) < 0.0) return vec3(100.0, -100.0, -100.0);
    if (inside_object) return vec3(100.0, -100.0, -100.0);
}
return m_col + t_col;

void mainImage(out vec4 fragColor, in vec2 fragCoord) {
    // random number seed
    seed = uint(fragCoord.x)*uint(fragCoord.y)*uint(iFrame+1);
    seed = randu() + 161u*uint(fragCoord.y);
    seed = randu() + 239u*uint(fragCoord.x);
}

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```

No problems have been detected in the workspace.

Get Started Static GLSL Preview Static GLSL Preview GLSL Preview

116 MS (2-17222)

#9-Paul-J-Stankard,-Floral-Bouquet-with-Prickl...

The scene with same parameters but viewed from another angle, with light coming from the right side of the camera, which produces reflection on the glass. In the previous two renderings, light comes from the back of viewport.

Images rendered with light in front of the viewport (shot against the light) doesn't look nice.

File Edit Selection View Go Run Terminal Help

dragonfly_1_sdf.glsl flower_01_sdf.glsl flower_02_sdf.glsl

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 Static GLSL Preview SHADERTOY isp-life > flower_02_sdf.glsl

```
90 vec4 mapPetal(vec3 p, float curve, bool col_required) {  
91     p.z -= min(curve*(sqrt(p.x)+sqrt(p.y)),1.0);  
92     vec3 pr = vec3(1.0, 0.5, 0.1);  
93     pr.y = 0.7 - 0.0*exp(-sqrt(2.0*(p.x+0.8))) + 0.6*exp(-sqrt(1.2*(p.x-0.6)));  
94     float petal = sdEllipsoid(p, 0.9*pr);  
95     return vec4(0,0,0, petal);  
96 }  
97  
98 vec4 mapFlower(vec3 p, bool col_required) {  
99     float r = length(p.xy), a = atan(p.y, p.x);  
100    vec3 p_ = vec3(r*cossin(asin(0.99*sin(2.5*a))/2.5), p.z);  
101    float x, y; vec3 q;  
102    // petals  
103    q = vec3(r*cossin(asin(0.999*sin(2.5*a-1.3))/2.5), p.z);  
104    float d0 = mapPetal(roty(0.2+0.15*sin(3.0*a))*(q-vec3(1.0,0,-0.2))/0.5, 0.5, col_required);  
105    q = vec3(r*cossin(asin(0.999*sin(2.5*a))/2.5), p.z);  
106    float d1 = mapPetal(roty(0.75+0.2*cos(4.0*a))*(q-vec3(1.2,0,0))/0.7, 0.5, col_required);  
107    q = vec3(r*cossin(asin(0.999*sin(2.5*a+0.8))/2.5), p.z);  
108    float d2 = mapPetal(roty(0.85-0.2*sin(5.0*a-1.0))*(q-vec3(1.15,0,0.2+0.05*sin(a))/0.5, 0.5, col_required));  
109    q = vec3(r*cossin(asin(0.999*sin(2.5*a+1.5))/2.5), p.z);  
110    float d3 = mapPetal(roty(1.05+0.1*sin(4.0*a+1.0))*(q-vec3(1.0,0,0.4+0.1*cos(a))/0.5, 0.5, col_required));  
111    q = vec3(r*cossin(asin(0.999*sin(2.5*a+2.7))/2.5), p.z);  
112    float d4 = mapPetal(roty(1.24+0.1*cos(3.0*a))*(q-vec3(0.85,0,0.35-0.05*sin(a))/0.5, 0.5, col_required));  
113    const float petal_k = 0.02;  
114    float d = 0.8*smin(d0, smin(d1, d2, petal_k), smin(d3, d4, petal_k), petal_k);  
115    //d = max(d, p.y);  
116    return vec4(1,1,1, d);  
117 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview x 33 MS (2-176)

11ca5e4acf20be9b783c91d71013e1f7.jpg - Win... File Print E-mail Burn Open

Start modeling another flower. Try one with multiple layers of petals (which is popular in Paul's work).

When modeling by writing code, I found the biggest challenge is to control the orientation of the layers of petals to make it aesthetically pleasing.

File Edit Selection View Go Run Terminal Help

flower_02_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER ⌂ flower_02_sdf.gsl

OPEN EDITORS ⌂ flower_02_sdf.gsl

GROUP 1 ⌂ flower_02_sdf.gsl

float p2 = mapPetal(roty(0.85-0.2*sin(5.0*a-1.0))*(q-vec3(1.15,0,0.25+0.05*sin(a))), p.z);
q = vec3(r*cosin(asin(0.999*sin(2.5*a+1.0))/2.5), p.z);
float p3 = mapPetal(roty(1.05+0.1*sin(4.0*a+1.0))*(q-vec3(1.0,0,0.45+0.1*cos(a))), p.z);
q = vec3(r*cosin(asin(0.999*sin(2.5*a+2.0))/2.5), p.z);
float p4 = mapPetal(roty(1.0+0.1*cos(3.0*a))*(q-vec3(0.85-0.05*sin(4.0*a)), 0,0.3));
const float petal_k = 0.02;
float petal = smin(p0, smin(smin(p1, p2, petal_k), smin(p3, p4, petal_k)), petal_k);
// filament

q = vec3(r*cosin(asin(0.999*sin(11.0*a-1.3))/11.0), p.z);
float f1 = mapFilament(roty(-0.4)*(q-vec3(0.25+0.15/(1.0+exp(-4.0*(p.z-0.8))))+0.1);
q = vec3(r*cosin(asin(0.999*sin(13.0*a-0.8))/13.0), p.z);
float f2 = mapFilament(roty(-0.2)*(q-vec3(0.25+0.15/(1.0+exp(-4.0*(p.z-0.8))))+0.1);
float filament = smin(f1, f2, 0.01);
// disk
q = vec3(r*cosin(asin(0.98*sin(2.5*a))/2.5), p.z);
vec3 br = vec3(0.6, 0.4-0.3*exp(-sqrt(2.0*(q.x-1.0))), 0.1);
float d1 = sdEllipsoid(roty(0.1)*(q-vec3(0.5,0,-0.25)), br);
q = vec3(r*cosin(asin(0.9*sin(2.5*a))/2.5), p.z);
float d2 = sdEllipsoid(q-vec3(0.1,0,-0.1), vec3(0.3,0.2,0.2));
float d3 = sdSegment(q-vec3(0.05,0,0), vec3(0,0,-0.55), vec3(0,0,-0.2))-0.08;
float disk = smin(d1, d2, 0.1), d3, 0.05);
// put them together
float d = smin(min(petal, filament), disk, 0.05);
return vec4(1,1,1, d);

SHADERTOY

isp-glass

> imgx

> references

buffer_test.gsl

glassball-01-basic.gsl

glassball-02-scatter...

glassball-03-scatter...

glassball-04-nonunif...

glassball-05-nonunif...

glassball-06-scatter...

glassball-07-scatter...

glassball-08-scatter...

glassball-09-scatter...

glassball-10-emissio...

glassball-11-mix.gsl

glassball-12-mix.gsl

isp-life

dragonfly_1.glass.gsl

dragonfly_1.sdf.gsl

flower_01_glass.gsl

flower_01_sdf.gsl

flower_02_sdf.gsl

fungi_1.sdf.gsl

primitives

> ln_norm-ellipsoid.gsl

> spiral

> weather-abstraction

colorwheel.gsl

sdf_template.gsl

sdf_visualizer_2.gsl

sdf_visualizer.gsl

> OUTLINE

> TIMELINE

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview 117 MB (6-102)

flower_02_sdf.gsl - Shadertoy - Visual Studio Code

#2-Paul-J-Stankard-Tea-Rose-Bouquet-with-M...

flower_02_sdf.gsl

File Print E-mail Burn Open

Five layers of petals and two layers of filaments.

File Edit Selection View Go Run Terminal Help

flower_02_sdf.glsl - Shadertoy - Visual Studio Code

EXPLORER ⌂

OPEN EDITORS

- GROUP 1
- dragonfly_1_sdf.glsl
- flower_01_sdf.glsl
- flower_02_sdf.glsl U

GROUP 2

- flower_02_sdf.glsl U

Static GLSL Preview ⌂

SHADERTOY

- isp-glass
- > imgs
- > references
- buffer_test.glsl
- glassball-01-basic.glsl
- glassball-02-scatter...
- glassball-03-scatter...
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter...
- glassball-07-scatter...
- glassball-08-scatter...
- glassball-09-scatter...
- glassball-10-emissio...
- glassball-11-mix.gls...
- glassball-12-mix.gls...

isp-life

- dragonfly_1_glass.gls...
- dragonfly_1_sdf.gls...
- flower_01_glass.gls...
- flower_01_sdf.gls...
- flower_02_sdf.gls...
- fungi_1_sdf.gls...

primitives

- In_norm-ellipsoid.gls...
- > spiral
- > weather-abstraction
- colorwheel.gls...
- sdf_template.gls...
- sdf_visualizer_2.gls...
- sdf_visualizer.gls...

> OUTLINE

> TIMELINE

master* 0 0 △ 0

flower_02_sdf.glsl

```
118    vec4 p2 = mapPetal(roty(0.85-0.2*sin(5.0*a-1.0))*(q-vec3(1.15,0,0.25+0.05*sin(a-1.0))), p.z);
119    q = vec3(r*cossin(asin(0.999*sin(2.5*a+1.5))/2.5), p.z);
120    vec4 p3 = mapPetal(roty(1.05+0.1*sin(4.0*a+1.0))*(q-vec3(1.0,0,0.45+0.1*cos(a))), p.z);
121    q = vec3(r*cossin(asin(0.999*sin(2.5*a+2.7))/2.5), p.z);
122    vec4 p4 = mapPetal(roty(1.0+0.1*cos(3.0*a))*(q-vec3(0.85-0.05*sin(4.0*a), 0,0.35)), p.z);
123    const float petal_k = 0.02;
124    vec4 petal = smin(p0, smin(smin(p1, p2, petal_k), smin(p3, p4, petal_k)), petal_k);
125    // filament
126    q = vec3(r*cossin(asin(0.999*sin(11.0*a-1.3))/11.0), p.z);
127    vec4 f1 = mapfilament(roty(-0.4)*(q-vec3(0.25+0.15/(1.0+exp(-4.0*(p.z-0.8))))+0.05));
128    q = vec3(r*cossin(asin(0.999*sin(13.0*a-0.8))/13.0), p.z);
129    vec4 f2 = mapfilament(roty(-0.2)*(q-vec3(0.25+0.15/(1.0+exp(-4.0*(p.z-0.8))))+0.05));
130    vec4 filament = 0.9*smin(f1, f2, 0.01);
131    // disk
132    q = vec3(r*cossin(asin(0.98*sin(2.5*a))/2.5), p.z);
133    vec3 br = vec3(0.6, 0.4-0.3*exp(-sqr(2.0*(q.x-1.0))), 0.1);
134    vec4 d1 = vec4(0.75,0.55,0.0, sdEllipsoid(roty(0.1)*(q-vec3(0.5,0,-0.25)), br));
135    q = vec3(r*cossin(asin(0.9*sin(2.5*a))/2.5), p.z);
136    vec4 d2 = vec4(0.95,0.7,0.0, sdEllipsoid(q-vec3(0.1,0,-0.1), vec3(0.3,0.2,0.2)));
137    vec4 d3 = vec4(0.65,0.6,0.05, sdSegment(q-vec3(0.05,0,0), vec3(0,0,-0.55), vec3(0.0,0.0,0.05)));
138    vec4 disk = smin(smin(d1, d2, 0.1), d3, 0.05);
139    // put them together
140    vec4 d = smin(cmin(petal, filament), disk, 0.05);
141
142
143
144
145    vec4 map(vec3 p, bool col_required) {
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

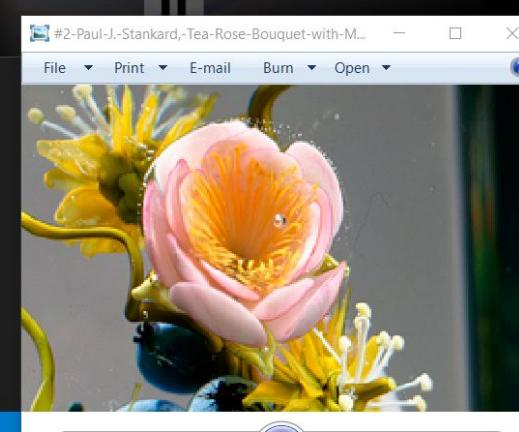
No problems have been detected in the workspace.

Static GLSL Preview 50 MS (2.3774)



#2-Paul-J-Stankard,-Tea-Rose-Bouquet-with-M...

File Print E-mail Burn Open



File Edit Selection View Go Run Terminal Help

flower_03_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER ... flower_01_sdf.gsl flower_02_sdf.gsl flower_03_sdf.gsl

GROUP 1
flower_01_sdf.gsl
flower_02_sdf.gsl
flower_03_sdf.gsl

GROUP 2
Static GLSL Preview
Static GLSL Preview

SHADERTOY
isp-glass
imgs
references
buffer_test.gsl
glassball-01-basic.gsl
glassball-02-scatter...
glassball-03-scatter...
glassball-04-nonunif...
glassball-05-nonunif...
glassball-06-scatter...
glassball-07-scatter...
glassball-08-scatter...
glassball-09-scatter...
glassball-10-emissio...
glassball-11-mix.gsl
glassball-12-mix.gsl

isp-life
dragonfly_1.glass.gsl
dragonfly_1.sdf.gsl
flower_01.glass.gsl
flower_01.sdf.gsl
flower_02.sdf.gsl
flower_03.sdf.gsl

primitives
ln_norm-ellipsoid.gsl
spiral
weather-abstraction
colorwheel.gsl
sdf_template.gsl

OUTLINE
TIMELINE

flower_03_sdf.gsl

```

102    4 mapFlower(vec3 p, bool col_required) {
103        //p += 0.04*sin(4.0*p.yzx)*cos(4.0*p.xyz)*sin(4.0*p.zxy);
104        p.y += 0.02*sin(8.0*p.z);
105        float r = length(p.xy), a = atan(p.y, p.x);
106        float x, y; vec3 q;
107        // petals
108        q = vec3(r*cossin(asin(0.999*sin(3.5*a-0.2*cos(4.0*r)*sin(5.0*a)+0.9))/3.5), p.z);
109        vec4 p0 = mapPetal(roty(-0.1)*(q-vec3(0.8,0,-0.12)), 0.45, -0.1, col_required);
110        q = vec3(r*cossin(asin(0.999*sin(3.5*a-0.2*sin(4.0*r)*cos(5.0*a)+0.0))/3.5), p.z);
111        vec4 p1 = mapPetal(roty(0.05)*(q-vec3(0.9,0,0)), 0.5, -0.2, col_required);
112        q = vec3(r*cossin(asin(0.999*sin(3.0*a-0.2*cos(4.0*r)*cos(3.0*a)-0.9))/3.0), p.z);
113        vec4 p2 = mapPetal(roty(0.1)*(q-vec3(0.9,0,0.1)), 0.55, -0.15, col_required);
114        vec4 petal = smin(smin(p0, p1, 0.01), p2, 0.01);
115        // disk
116        q = vec3(r*cossin(asin(0.98*sin(3.5*a))/3.5), p.z);
117        vec3 br = vec3(0.4, 0.3-0.2*exp(-sqr(2.0*(q.x-1.0))), 0.05);
118        vec4 d1 = vec4(0,0,0, sdEllipsoid(roty(0.2)*(q-vec3(0.2,0,-0.25)), br)); // sepal
119        q = vec3(r*cossin(asin(0.8*sin(3.5*a))/3.5), p.z);
120        vec4 d2 = vec4(0,0,0, sdEllipsoid(q-vec3(0.05,0,-0.2), vec3(0.25,0.2,0.3))); // o
121        vec4 d3 = vec4(0,0,0, sdCapsule(q-vec3(0.05,0,0), 0.45, 0.08-0.03*sin(2.0*p.z))); // o
122        vec4 d4 = vec4(0,0,0, length(q-vec3(0.01,0,0.45))-0.06); // stigma
123        vec4 disk = smin(smin(d1, d2, 0.1), smin(d3, d4, 0.05), 0.1);

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

flower_03_sdf.gsl Static GLSL Preview

Static GLSL Preview

33 MS (3-1642)

flower_03_sdf.gsl

11ca5e4acf20be9b783c91d71013e1f7.jpg

File Print E-mail Burn

#2-Paul-J-Stankard,-Tea-Rose-Bouquet-wit...

File Output Print E-mail Burn Open

2021/11/10 Studying another flower. A lot of code copied from previous day's code.

Not so satisfied until this screenshot. I find it challenging to create the “blooming” of the petals.

114 Col 53 Spaces: 4 UTF-8 CRLF GLSL

File Edit Selection View Go Run Terminal Help

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER

OPEN EDITORS

GROUP 1

- flower_01_sdf.gls...
- flower_02_sdf.gls...
- flower_03_sdf.gls...

GROUP 2

- Static GLSL Preview...
- Static GLSL Preview...

SHADERTOY

isp-life

```
129 // filaments
130 q = vec3(r*ccosin(asin(0.999*sin(3.5*a+0.9))/3.5), p.z);
131 vec4 f1 = mapFilament(roty(-0.7-0.1*cos(4.0*a))*(q-vec3(0.2,0,0.0)), 0.8, col_re...
132 q = vec3(r*ccosin(asin(0.999*sin(4.0*a+1.5))/4.0), p.z);
133 vec4 f2 = mapFilament(roty(-0.8+0.1*sin(3.0*a))*(q-vec3(0.18,0,0.0)), 0.8, col_re...
134 filament = smin(f1, f2, 0.01);
135 // disk
136 q = vec3(r*ccosin(asin(0.98*sin(3.5*a-0.5))/3.5), p.z);
137 vec3 br = vec3(0.4, 0.3-0.2*exp(-sqrt(2.0*(q.x-1.0))), 0.05);
138 vec4 d1 = vec4(0.4,0.35,0.0, sdEllipsoid(roty(0.2)*(q-vec3(0.2,0,-0.25)), br));
139 q = vec3(r*ccosin(asin(0.8*sin(3.5*a))/3.5), p.z);
140 vec4 d2 = vec4(0.6,0.5,0.0, sdEllipsoid(q-vec3(0.05,0,-0.1), vec3(0.25,0.2,0.3)));
141 vec4 d3 = vec4(0.9,0.8,0.0, sdCapsule(q-vec3(0.05,0,0),0.56,0.08-0.03*sin(2.0*p...
142 vec4 d4 = vec4(0.95,0.95,0.6, length(q-vec3(0.01,0,0.56))-0.06); // stigma
143 vec4 disk = smin(smin(d1, d2, 0.1), smin(d3, d4, 0.05), 0.1);
144 // put them together
145 vec4 d = smin(cmin(petal, filament), disk, 0.01);
146 return d;
147 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview

50 MS [2-127]

#2-Paul-J-Stankard-Tea-Rose-Bouquet-wit...

File Print E-mail Burn Open

Finished modeling with color. Not so bad.

I feel this one has a more even use of space compared to the one on the previous day.



master* 0 0 △ 0



File Edit Selection View Go Run Terminal Help

flower_01_sdf.gls flower_02_sdf.gls flower_03_sdf.gls fruit_01_sdf.gls - Shadertoy - Visual Studio Code

EXPLORER ... flower_01_sdf.gls flower_02_sdf.gls flower_03_sdf.gls fruit_01_sdf.gls

OPEN EDITORS GROUP 1 flower_01_sdf.gls flower_02_sdf.gls flower_03_sdf.gls fruit_01_sdf.gls

GROUP 2 Static GLSL Preview... Static GLSL Preview... Static GLSL Preview...

SHADERTOY glassball-01-basic.gls glassball-02-scatter.... glassball-03-scatter.... glassball-04-nonunif.... glassball-05-nonunif.... glassball-06-scatter.... glassball-07-scatter.... glassball-08-scatter.... glassball-09-scatter.... glassball-10-emissio.... glassball-11-mix.gls glassball-12-mix.gls

isp-life dragonfly_1_glass.gls flower_01_glass.gls flower_01_sdf.gls flower_02_sdf.gls flower_03_sdf.gls fruit_01_sdf.gls

primitives ln_norm-ellipsoid.gls spiral weather-abstraction colorwheel.gls sdf_template.gls sdf_visualizer_2.gls

OUTLINE TIMELINE

Static GLSL Preview Static GLSL Preview Static GLSL Preview

34 MS (2-8468)

float x, y; vec3 q;

q = vec3(length(vec2(r, 0.02))*cossin(asin(0.9*sin(2.5*a-0.5))/2.5), p.z);

float bottom_hole = -smin(

sdlNrmEllipsoid(q-vec3(0,0,-1.0), vec3(0.3,0.3,0.3), 5.0),

sdlTorus(q-vec3(0,0,-0.7), 0.04, 0.05),

0.05);

vec4 d = vec4(0.05,0.7,0.9, smax(

sdlEllipsoid(q, vec3(1.15,1.15,1.0-0.4/(1.0+10.0*length(vec3(q.xy,0.2))))

+ 0.02*sin(4.0*p.x)*sin(4.0*p.y)*sin(4.0*p.z),

bottom_hole, 0.02);

if (col_required) {

const vec3 c1 = vec3(0.15,0.25,0.4);

const vec3 c2 = vec3(0.3,0.45,0.6);

const vec3 c3 = vec3(0.65,0.75,0.85);

float t = dot(p, vec3(0.5,0.5,1)) + 0.5*sin(6.0*p.x)*sin(6.0*p.y)*sin(6.0*p.z);

d.xyz = mix(mix(c1, c2, 0.5+0.5*tanh(1.0*t)), c3, 0.5+0.5*tanh(1.0*t-1.0));

t = 0.1*sin(10.0*b+a)+0.03*exp(-p.z)*(cos(33.0*a)+cos(40.0*a+3.0*b))+p.z;

d.xyz *= 0.8+0.2*tanh(t);

d.xyz *= vec3(1.0,1.1,1.2);

}

d = smin(d, vec4(0.5*vec3(0.1,0.12,0.15),

sdlTorus(q-vec3(0,0,-0.92), 0.33, 0.05),

0.05);

q = vec3(length(vec2(r, 0.02))*cossin(asin(0.999*sin(2.5*a-0.5))/2.5), p.z);

d = smin(d, vec4(0.5*vec3(0.25,0.3,0.4),

smax(

sdlNrmEllipsoid(roty(-0.9)*(q-vec3(0.2+0.2/(1.0+10.0*length(vec3(q.xy,0.2))))),

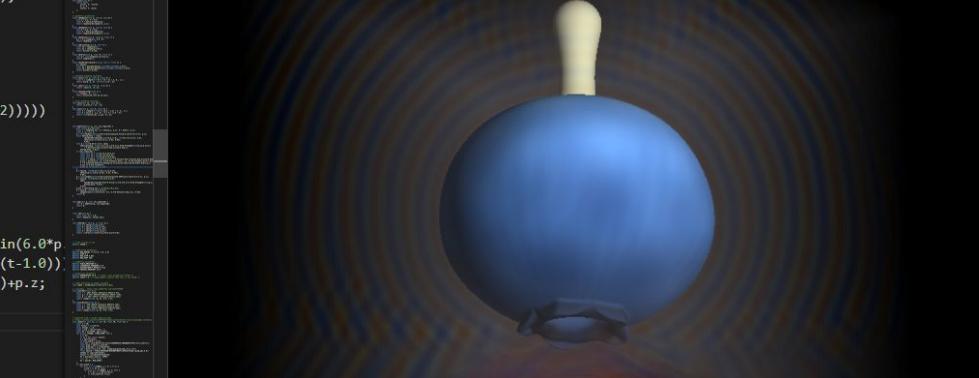
bottom_hole, 0.02));

commodity-blueberry.jpg - Windows Photo... File Print E-mail Burn Open

glass-11.jpg - Windows Photo Viewer File Print E-mail Burn Open

2021/11/11 Start studying fruit.

The color and texture in Paul's work is different from in a photograph, yet it looks realistic.



File Edit Selection View Go Run Terminal Help

flower_01_sdf.gls... flower_02_sdf.gls... flower_03_sdf.gls... fruit_01_sdf.gls... Static GLSL Preview Static GLSL Preview Static GLSL Preview

EXPLORER OPEN EDITORS GROUP 1 flower_01_sdf.gls... flower_02_sdf.gls... flower_03_sdf.gls... fruit_01_sdf.gls... M GROUP 2 Static GLSL Preview Static GLSL Preview Static GLSL Preview SHADERTOY glassball-01-basic.gls... glassball-02-scatter.... glassball-03-scatter.... glassball-04-nonunif.... glassball-05-nonunif.... glassball-06-scatter.... glassball-07-scatter.... glassball-08-scatter.... glassball-09-scatter.... glassball-10-emissio... glassball-11-mix.gls... glassball-12-mix.gls... isp-life dragonfly_1_glass.gls... dragonfly_1_sdf.gls... flower_01_glass.gls... flower_01_sdf.gls... flower_02_sdf.gls... flower_03_sdf.gls... fruit_01_sdf.gls... M fungi_1_sdf.gls... primitives ln_norm-ellipsoid.gls... spiral weather-abstraction colorwheel.gls... sdf_template.gls... sdf_visualizer_2.gls... OUTLINE TIMELINE

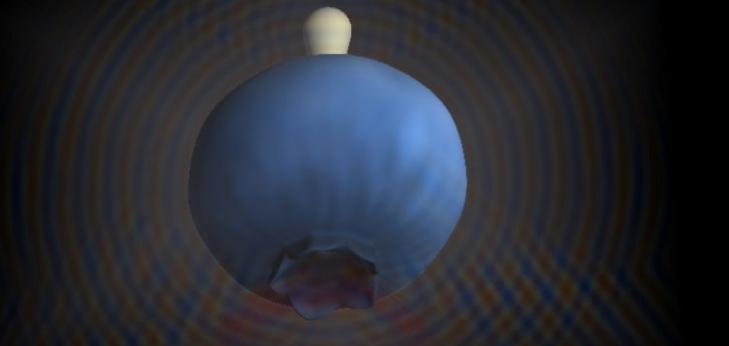
isp-life > fruit_01_sdf.gls...

154 0.05);
155 vec4 d = vec4(0.05,0.7,0.9, smax(
156 sdEllipsoid(q, vec3(1.15,1.15,1.0-0.4/(1.0+10.0*length(vec3(q.xy,0.2))))
157 + 0.02*sin(5.0*p.x)*sin(5.0*p.y)*sin(5.0*p.z),
158 bottom_hole, 0.02));
159 if (col_required) {
160 const vec3 c1 = vec3(0.15,0.25,0.4);
161 const vec3 c2 = vec3(0.3,0.45,0.6);
162 const vec3 c3 = vec3(0.85,0.75,0.85);
163 float t = dot(p, vec3(0.5,0.5,1)) + 0.8*SimplexNoise3D(1.5*p);
164 d.xyz = mix(mix(c1, c2, 0.5+0.5*tanh(1.0*t)), c3, 0.5+0.5*tanh(1.0*(t-1.0)));
165 t = 0.4*GradientNoise2D(vec2(6.0*a,3.0*b))-4.0*(b/PI-0.5)+0.5;
166 d.xyz *= smootherstep(0.7+0.3*tanh(1.2*t));
167 }
168 d = smin(d, vec4(0.5*vec3(0.1,0.12,0.15),
169 sdTorus(q-vec3(0,0,-0.92), 0.33, 0.05)),
170 0.05);
171 q = vec3(length(vec2(r,0.02))*cossin(asin(0.999*sin(2.5*a-0.5))/2.5), p.z);
172 d = smin(d, vec4(0.5*vec3(0.25,0.3,0.4),
173 smax(
174 sdLnNormEllipsoid(roty(-1.1)*(q-vec3(0.2+0.2/(1.0+10.0*length(vec2(q.y,
175 bottom_hole, 0.02)),
176 0.08);
177 if (col_required) {
178 d.xyz *= 0.2+0.8*smootherstep(10.0*sdTorus(p-vec3(0,0,-0.78),0.18,0.08));
179 d.xyz = saturate(d.xyz * vec3(0.8,1.1,1.3));
180 }
181 d = smin(d, vec4(0.75,0.75,0.6,

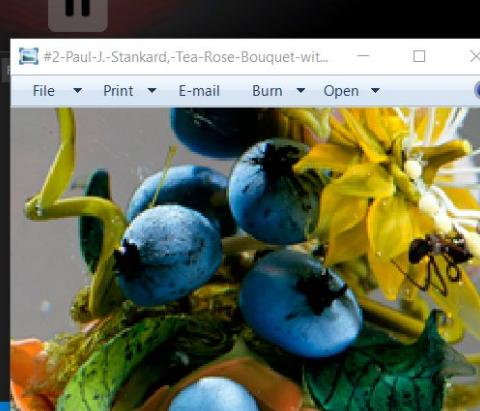
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview

16 MS (1-2038) 

commodity-blueberry.jpg - Windows Photo... 

#2-Paul-J-Stankard-Tea-Rose-Bouquet-wit... 

2021/11/13 Use gradient noise instead of cheap sinusoidal function for the texture of the blueberry to make it look more natural.

File Edit Selection View Go Run Terminal Help

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER

OPEN EDITORS

- GROUP 1
- flower_02_sdf.glsli
- flower_03_sdf.glsli
- fruit_01_sdf.glsli M
- fruit_02_sdf.glsli U

GROUP 2

- Static GLSL Preview...
- Static GLSL Preview...

SHADERTOY

- glassball-01-basic.glsli
- glassball-02-scatter....
- glassball-03-scatter....
- glassball-04-nonunif...
- glassball-05-nonunif...
- glassball-06-scatter....
- glassball-07-scatter....
- glassball-08-scatter....
- glassball-09-scatter....
- glassball-10-emissio...
- glassball-11-mix.glsli
- glassball-12-mix.glsli

isp-life

- dragonfly_1_glass.glsli
- dragonfly_1_sdf.glsli
- flower_01_glass.glsli

flower_01_sdf.glsli

flower_02_sdf.glsli

flower_03_sdf.glsli

fruit_01_sdf.glsli M

fruit_02_sdf.glsli U

fungi_1_sdf.glsli

primitives

- In_norm-ellipsoid.glsli
- spiral
- weather-abstraction
- colorwheel.glsli
- sdf_template.glsli
- sdf_visualizer_2.glsli

OUTLINE

TIMELINE

flower_02_sdf.glsli

fruit_02_sdf.glsli

16 MS (3-158)

```
99     fruit.xyz = mix(vec3(0.55,0.2,0.0),vec3(0.95,0.85,0.0),
100         smootherstep(0.4*(q.z+1.0*(r-0.9)-0.0+smax(q.z-1.2,0.0,0.1))
101             +0.012*sin(20.0*p.x)*sin(20.0*p.y)*sin(20.0*p.z))
102     );
103 }
104 q = vec3(r*cossin(asin(0.99*sin(2.5*a+0.8))/2.5), p.z);
105 fruit = smin(fruit, vec4( // hair
106     mix(vec3(0.1,0.02,0.06),vec3(0.25,0.02,0.0),smootherstep(r/0.3)),
107     sdEllipsoid(roty(0.2-0.05*cos(3.0*a))*(q-vec3(0.08,0,1.54)), vec3(0.2+0.03*
108 // disk
109 q = vec3(r*cossin(asin(0.98*sin(2.5*a-1.2))/2.5), p.z);
110 q -= vec3(0.2,0,0);
111 vec3 br;
112 br.x = 1.0+0.05*sin(3.0*a);
113 br.y = 1.2*(0.3-0.2*exp(-sqrt(2.0*(q.x-1.0)))+0.2*exp(-sqrt(4.0*(q.x-0.7))));
114 br.z = 0.1*pow(smax(br.y,0.0,0.1),0.2);
115 br *= 1.2;
116 q = roty(0.3)*(q-vec3(0.2,0,-0.25));
117 q.z += 0.05*sin(6.0*q.x);
118 vec4 d1 = vec4(0.4,0.35,0.0, sdEllipsoid(q, br)); // sepals
119 q = vec3(r*cossin(asin(0.95*sin(2.5*a-0.9))/2.5), p.z);
120 vec4 d2 = vec4(0.25,0.15,0.05, sdCapsule(q-vec3(0.05,0,-0.6), 1.0, 0.1)); // st
121 vec4 disk = smin(d1, d2, 0.1);
122 // put them together
123 vec4 d = smin(disk, fruit, 0.05);
124 return d;
125 }
126 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Study another fruit-like plant structure.

11ca5e4acf20be9b783c91d71013e1f7.jpg

File Print E-mail Burn Open ?

File Edit Selection View Go Run Terminal Help

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER ... fruit_01_sdf.gsls fruit_02_sdf.gsls leaf_01_sdf.gsls ...

OPEN EDITORS GROUP 1 fruit_01_sdf.gsls ... fruit_02_sdf.gsls ... leaf_01_sdf.gsls ... U GROUP 2 Static GLS... Static GLS... Static GLS... SHADERTOY glassball-01-basic.gsls glassball-02-scatter.... glassball-03-scatter.... glassball-04-nonunif... glassball-05-nonunif... glassball-06-scatter... glassball-07-scatter... glassball-08-scatter... glassball-09-scatter... glassball-10-emissio... glassball-11-mix.gsls glassball-12-mix.gsls isp-life dragonfly_1.glass.gsls dragonfly_1.sdf.gsls flower_01.glass.gsls flower_01.sdf.gsls flower_02.sdf.gsls flower_03.sdf.gsls fruit_01.sdf.gsls fruit_02.sdf.gsls fungi_1.sdf.gsls leaf_01.sdf.gsls ... primitives In_norm-ellipsoid.gsls > spiral > weather-abstraction colorwheel.gsls sdf_template.gsls

OUTLINE TIMELINE

17 MS (2-122673)

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

2021/11/14 Modeling plant swirls, which are very common in leaves and roots of Paul's work.

I struggled with a technical issue: the high gradient of the distance field caused by the twisting. I tried to solve it by dividing by the automatic derivative of the angle function.

17 MS (2-122673)

#2-Paul-J-Stankard,-Tea-Rose-Bouquet-wit... File Print E-mail Burn Open ?

Visual Studio Code interface showing Shadertoy code for plant swirls and a preview window displaying a green, swirling plant structure. Below the code editor is a note about modeling plant swirls and a technical issue with distance fields. A screenshot of a photo application shows a close-up of blueberries and flowers.

The screenshot shows a Visual Studio Code workspace for Shadertoy. The left sidebar lists files under 'OPEN EDITORS' and 'SHADERTOY'. The main editor pane displays GLSL code for 'isp-life' and 'leaf_01_sdf.gsl'. The right side features a 3D rendering of swirling green and magenta shapes against a red gradient background, with a performance counter of '50 MS (5-223)'. Below the rendering is a smaller image of a real-world still life with flowers.

```
145 float d = sdCapsule((p-vec3(w,0,-0.5))/vec3(1.1,1.2+0.3*k,1.0), 4.5, r);
146 d = d / mix(1.0, max(1.0*pow(k,0.9),0.9), smoothstep(0.0,0.0,5.0*(d-r))) - 0.0;
147 d = smin(1.1*d, 0.5*(d+0.7), 0.1);
148 return vec4(0,0,0, d);
149 }

152 vec4 map(vec3 p, bool col_required) {
153     vec3 q = p - vec3(0.8,-0.8,0.0);
154     float d1 = mapSwirl01(roty(-0.4)*q, false).w;
155     float d2 = mapSwirl02(roty(-0.2)*q, false).w;
156     vec4 c1 = vec4(
157         mix(vec3(0.6,0.65,0.0), vec3(0.45,0.4,0.0), 0.5+0.5*sin(10.0*q.x)*sin(10.0*q.y)*sin(10.0*q.z)),
158         smin(d1, d2, 0.01));
159     q = p + vec3(0.5,-0.5,0.0);
160     float d3 = mapSwirl03(rotx(0.2)*(q-vec3(-0.3,0.3,0)), false).w;
161     float d4 = mapSwirl04(roty(-0.1)*q/0.8, false).w*0.8;
162     vec4 c2 = vec4(
163         mix(vec3(0.6,0.6,0.2), vec3(0.25,0.25,0.05), 0.5+0.5*sin(4.0*q.x)*sin(4.0*q.y)*sin(10.0*q.z)),
164         smin(d3, d4, 0.01));
165     vec4 c = smin(c1, c2, 0.01);
166     return c;
167 }
168
169
170
171 float sdf(vec3 p) {
172     const float cr = 1.0;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

0036e1f7c005fcfc82f178d5d8cd29d9.jpg

Finished modeling of swirls with a horrible distance field.

Again, green and magenta on surface represents too low and too high gradient, red in space represents too high directional derivative along the ray.

File Edit Selection View Go Run Terminal Help

Static GLSL Preview - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 SHADERTOY isp-life leaf_01_sdf.gsls

```
145 float d = sdCapsule((p-vec3(w,0,-0.5))/vec3(1.1,1.2+0.3*k,1.0), 4.5, r);
146 d = d / mix(1.0, max(1.0*pow(k,0.9),0.9), smoothstep(1.0,0.0,5.0*(d-r))) - 0.0;
147 d = smin(1.1*d, 0.5*(d-0.7), 0.1);
148 return vec4(0,0,0, d);
149 }

150

151 vec4 map(vec3 p, bool col_required) {
152     vec3 q = p - vec3(0.8,-0.8,0.0);
153     float d1 = mapSwirl01(roty(-0.4)*q, false).w;
154     float d2 = mapSwirl02(roty(-0.2)*q, false).w;
155     vec4 c1 = vec4(
156         mix(vec3(0.6,0.65,0.0), vec3(0.45,0.4,0.0), 0.5+0.5*sin(10.0*q.x)*sin(10.0*q.y)*sin(10.0*q.z)),
157         smin(d1, d2, 0.01));
158     q = p + vec3(0.5,-0.5,0.0);
159     float d3 = mapSwirl03(rotx(0.2)*(q-vec3(-0.3,0.3,0)), false).w;
160     float d4 = mapSwirl04(roty(-0.1)*q/0.8, false).w*0.8;
161     vec4 c2 = vec4(
162         mix(vec3(0.6,0.6,0.2), vec3(0.25,0.25,0.05), 0.5+0.5*sin(4.0*q.x)*sin(4.0*q.y)*sin(10.0*q.z)),
163         smin(d3, d4, 0.01));
164     );
165     vec4 c = smin(c1, c2, 0.01);
166     return c;
167 }

168 }

169 float sdf(vec3 p) {
170     const float sc = 1.0:
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

No problems have been detected in the workspace.

Static GLSL Preview Static GLSL Preview Static GLSL Preview

51 MS (3-267)

0036e1f7c005fcfc82f178d5d8cd29d9.jpg ~ ...

File Print E-mail Burn Open

Colored version. Now the uneven thickness of the swirl is more obvious. It is challenging to model this type of shape using SDF.

I plan to reconstruct the surface using marching cube and use BVH-accelerated intersection algorithm in the final rendering. (because SDF is too expensive and unstable!)

File Edit Selection View Go Run Terminal Help

root_01.sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 GROUP 2 SHADERTOY

Static GLSL Preview Static GLSL Preview Static GLSL Preview

isp-life > root_01.sdf.gsl

```
136 float r = randt(seed,0.1,0.03)*exp(-(randt(seed,0.5,0.2)*p.z+randt(seed,0.1,0.1)*sin(randt(seed,3.14159*p.x,0.01)+0.5)));  
137 r = smin(r, 0.5, 0.1);  
138 float k = length(vec2(length(p.xy)*y,1.0));  
139 float d = sdCapsule((p-vec3(w,0,0))/vec3(1.0,1.0+0.2*k,1.0), 2.5, r);  
140 d = d / mix(1.0, max(1.0*pow(k,0.7),0.9), smoothstep(1.0,0.0,10.0*(d-r))) - 0.02;  
141 d = smin(1.1*d, 0.5*(d+0.7), 0.1);  
142 return d;  
143 }  
144  
145 vec4 mapRoots1(vec3 p, bool col_required) {  
146     p.y += 0.3*sin(1.8*p.z);  
147     vec4 c = vec4(1,0,0, 1e12), d;  
148     for (float i=ZERO-1.; i<1.; i+=1.) {  
149         for (float j=ZERO-1.; j<1.; j+=1.) {  
150             int seed = int(65536.0*hash12(vec2(i,j)+0.1));  
151             vec3 q = p;  
152             q.xy -= vec2(0.5,0.4) * (vec2(i,j) + 0.7 * (hash22(vec2(i,j))-0.5)) * smoothstep(1.0,0.5,-  
153             q.z = randt(seed,1.0,0.3)*q.z - randt(seed,0.0,0.5);  
154             d.w = mapRoot1(vec3(1,1,-1)*q, seed);  
155             if (col_required) {  
156                 float t = 0.5+randt(seed,0.5,0.2)*sin(randt(seed,4.0,4.0)*p.z+2.0*PI*rand(seed));  
157                 d.xyz = mix(vec3(0.3,0.2,0.05), vec3(0.75,0.55,0.25), smootherstep(t));  
158             }  
159             c = smin(c, d, 0.02);  
160         }  
161     }  
162 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

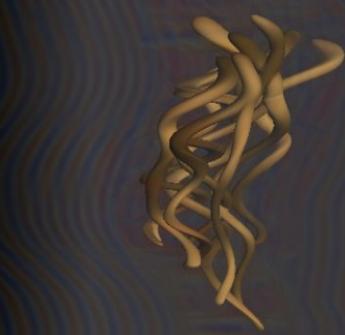
No problems have been detected in the workspace.

67 MS (3-3688)

11ca5e4acf20be9b783c91d71013e1f7.jpg

2021/11/15 Use swirls to model roots.

Paul's artwork shown in the reference picture contains three different types of roots. I choose to study the one that has more connection with what I did on the previous day, which is more botanically correct and is technically easier to create.



File Edit Selection View Go Run Terminal Help

group_01_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 group_01_sdf.gsl M main.py U gsl2cpp.h U .gsl.cpp 9+, U

GROUP 2 Static GLSL Preview 68 MS (3-103909)

SHADERTOY references cook-torrance-ggx.i... cook-torrance-ggx.g... bunny cubemaps gsl2cpp .gsl.cpp 9+, U gsl2cpp_h_gen... U gsl2cpp.h U main.py U README.md ui.cpp isp-glass isp-life dragonfly_1_glass.gsl dragonfly_1_sdf.gsl flower_01_glass.gsl flower_01_sdf.gsl flower_02_sdf.gsl flower_03_sdf.gsl fruit_01_sdf.gsl fruit_02_sdf.gsl fungi_1_sdf.gsl group_01_sdf... M leaf_01_sdf.gsl root_01_sdf.gsl primitives In_norm-ellipsoid.gsl spiral iq_snail_shell_sdf.gsl OUTLINE TIMELINE

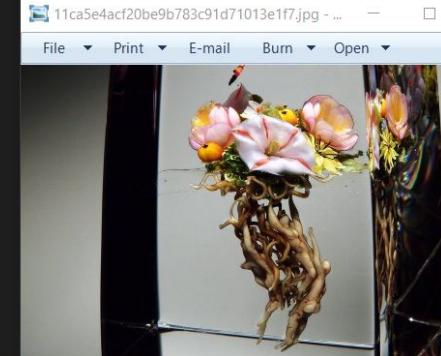
isp-life > group_01_sdf.gsl

```
471    vec4 fruit1 = mapFruit02(q/vec3(0.2,0.2,0.2), col_required)*vec4(1,1,1,0.2);  
472    q = rotx(-0.6)*rotz(-0.5)*(p-vec3(0.1,-0.6,0.2));  
473    vec4 flower2 = mapFlower01(q/vec3(0.3,0.3,0.4), col_required)*vec4(1,1,1,0.3);  
474    q = roty(-0.5)*rotz(0.2)*(p-vec3(0.9,0.6,0.35));  
475    vec4 flower3 = mapFlower02(q/vec3(0.4,0.4,0.4), col_required)*vec4(1,1,1,0.4);  
476    q = roty(-0.4)*rotz(0.3)*(p-vec3(0.8,-0.2,0.1));  
477    vec4 flower4 = mapFlower03(q/vec3(0.35,0.35,0.35), col_required)*vec4(1,1,1,0.35);  
478    q = rotx(1.0)*rotz(-0.6)*(p-vec3(-0.55,0.6,0.25));  
479    vec4 flower5 = mapFlower01(q/vec3(0.3,0.3,0.4), col_required)*vec4(1,1,1,0.3);  
480    q = rotx(0.4)*rotz(-0.2)*(p-vec3(0.3,0.9,0.3));  
481    vec4 flower6 = mapFlower03(q/vec3(0.35,0.35,0.4), col_required)*vec4(1,1,1,0.35);  
482    q = roty(-0.3)*rotz(0.0)*(p-vec3(0.2,0.1,0.4));  
483    vec4 fruit2 = mapFruit02(q/vec3(0.2,0.2,0.2), col_required)*vec4(1,1,1,0.2);  
484    q = p.yxz-vec3(0.0,3,-0.8);  
485    vec4 roots = mapRoots01(q/vec3(0.6,0.6,0.6), col_required)*0.6;  
486    const float k = 0.01;  
487    vec4 c = cmin(axes,  
        smin(  
            smin(  
                smin(smin(flower1, fruit1, k), flower5, k),  
                smin(flower2, flower3, k), k),  
            k),  
        roots, k)  
488    );  
489    return c;
```

PROBLEMS 250 OUTPUT DEBUG CONSOLE TERMINAL

PS D:\Coding\Github\Shadertoy> python -u "d:\Coding\Github\Shadertoy\gls12cpp\main.py"
2021/11/16 Finally the time to put all components together.
The biggest obstacle at this stage is shader compilation time.
I wrote a script to convert GLSL code to C++-compatible code.
GLSL takes >100s to compile and 0.05s to render one frame.
C++ takes about 10s to compile and about 2.0s to render one frame.
It is hard to apply artistic principles with a limited computation resource.

68 MS (3-103909)



File Edit Selection View Go Run Terminal Help group_01_sdf.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS

isp-life > group_01_sdf.gsl M x gis12cpp.py c gis12cpp.h & .gsl.cpp 9+

```

2021/11/17 Mentor artist page due date.

I spent hours to set up a Python script that automatically converts
GLSL code to C++ code once I made a change, and a C++ script that
reconstructs the isosurface of the distance field using an adaptive
marching cube algorithm and write it to a PLY file. With these tools, I'm
able to visualize complex flower models at an acceptable rate.

        
```

glsl2cpp.h glsl2cpp.py 477

shaders

bunny

CodeForces

bsp-tree

dragonfly_1.glass.gsl

dragonfly_1.sdf.gsl

flower_01.glass.gsl

flower_01.sdf.gsl

flower_02.glass.gsl

flower_02.sdf.gsl

flower_03.glass.gsl

flower_03.sdf.gsl

fruit_01.glass.gsl

fruit_02.sdf.gsl

fungi_1.sdf.gsl

group_01_sdf.gsl M

leaf_01.sdf.gsl

primitives

In_norm-ellipsoid.gsl

spiral

iq_snail_shell_sdf.gsl

logarithmic_snail.gsl

nautilus_shell_debug

nautilus_shell.gsl

OUTLINE

TIMELINE

master* Python 3.9.1 64-bit 250 A 0

File Edit View Project Build Debug Team Tools Harry Chen HC

Graphics - Microsoft Edge Quick Launch (Ctrl+Q)

Solution Explorer

trigs2mesh.h triangulate.cpp Graphics.cpp Properties

Miscellaneous Files (Global Scope)

```

34    ivec3 box0 = ivec3(
35         1 << (int)ceil(log2(2.0*BOX_RADIUS)),
36         1 << (int)ceil(log2(2.0*BOX_RADIUS)),
37         1 << (int)ceil(log2(2.0*BOX_RADIUS))
38     ) / 2;
39     int boxe = (int)round(log2(STEP / MIN_BOX));
40     boxe = std::stoi(argv[2]);
41     vec3 cell_size = 2.0*BOX_RADIUS / (vec3(epsilon));
42     float epsilon = 0.001f * std::min({ cell_size.x, cell_size.y, cell_size.z });
43     printf("%d %d %d %d epsilon=%f\n",
44
45     // marching cube
46     int eval_count = 0;
47     auto triangulate_start = std::chrono::high_resolution_clock::now();
48     std::vector<triangle_3d> trigs = Scala(
49         [&](vec3 p) { eval_count++; return
50             -BOX_RADIUS, BOX_RADIUS,
51             box0, boxe
52     );
53     float triangulate_time = std::chrono::duration_cast<chrono::microseconds>(std::chrono::high_resolution_clock::now() - triangulate_start).count();
54
55     Microsoft Visual Studio Debug Console
56     536208 triangles => 268712 vertices, 535648 faces
57     2738.0ms coloring
58
59     D:\Coding\GitHub\x64\Release\Graphics.exe (process 27760) exited with code 0.
60     To automatically close the console when debugging stops, enable Tools->Options->Debugging stops.
61     Press any key to continue . . .
62
63     C:\WINDOWS\system32\cmd.exe
64
65     D:\Homework\AVI4M\AVI4M-ISP>
66     copy D:\Coding\GitHub\Shadertoy\isp-life\group_01_sdf.gsl glsl .gsl1
67     python glsl2cpp/glsl2cpp.py .gsl1 .glsl.cpp
68     pause
69
70     1 file(s) copied.
71     Open GLSL source: .glsl
72     Write C++ source to: .glsl.cpp
73     Press any key to continue . . .
    
```

PROBLEMS 250 OUTPUT DEBUG CONSOLE TERMINAL

D:\ply [vn=268712, fn=535648, surface...

Ln 494, Col 14 Spaces: 4 UTF-8 CRLF GLSL

File Edit Selection View Go Run Terminal Help

group_01_sdf.gsl - Shadertoy - Visual Studio Code

group_01_sdf.gsl

isp-life > group_01_sdf.gsl

```
571 }  
572 > vec4 mapWing1(vec3 p, bool col_required) { ...  
591 }  
592 > vec4 mapWing2(vec3 p, bool col_required) { ...  
611 }  
612 > vec4 mapDragonfly(vec3 p, bool col_required) { ...  
621 }  
622 }  
  
624 vec4 mapFlowers(vec3 p, bool col_required) {  
625 q = rotz(-0.4)*rotz(-0.4)*(p-vec3(-0.1, -0.2, 0.2))  
626 > mapFlower01(q/vec3(0.2, 0.2, 0.2), col_required)*vec  
627 q = rotx(-0.4)*rotz(-0.4)*(p-vec3(-0.65, -0.93, 0.15));  
628 > mapFlower02(q/vec3(0.2, 0.2, 0.2), col_required)*vec  
629 q = rotx(-0.6)*rotz(-0.5)*(p-vec3(0.05, -0.6, 0.2));  
630 vec4 flower2 = mapFlower01(q/vec3(0.3, 0.3, 0.4), col_required)*vec  
631 q = roty(-0.5)*rotz(0.2)*(p-vec3(0.9, 0.6, 0.35));  
632 > mapFlower02(q/vec3(0.4, 0.4, 0.4), col_required)*vec  
633 q = roty(-0.4)*rotz(0.3)*(p-vec3(0.8, -0.2, 0.1));  
634 > mapFlower03(q/vec3(0.35, 0.35, 0.35), col_required)*vec  
635 flower4 = mapFlower03(q/vec3(0.35, 0.35, 0.35), col_required)  
636 q = rotx(1.0)*rotz(-0.6)*(p-vec3(-0.55, 0.6, 0.25));  
637 > mapFlower01(q/vec3(0.3, 0.3, 0.4), col_required)*vec  
638 q = rotx(0.4)*rotz(-0.2)*(p-vec3(0.3, 0.95, 0.3));  
639 > mapFlower02(q/vec3(0.35, 0.35, 0.4), col_required)*vec  
640 > mapFlower03(q/vec3(0.35, 0.35, 0.4), col_required)*vec  
641 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
PS D:\Coding\Github\Shadertoy> python -u "d:\Coding\Github\Shadertoy\gls12"
PS D:\Coding\Github\Shadertoy> 
```

17:05 P.M. Final composition. Based on one of Paul's compositions with modification.



File Edit View Project Build Debug Team Tools Test Analyze Window Help

Graphics - Microsoft Visual Studio

group_01_sdf.gsl - Shadertoy - Visual Studio Code

group_01_sdf.gsl

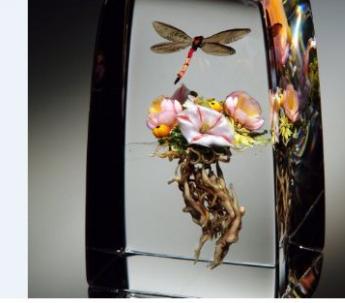
Quick Launch (Ctrl+Q)

File Edit View Project Build Debug Team Tools Harry Chen HC

D:\ply [vn=938800, fn=1873974, surface] normal=ccw ...

Solution Explorer

File Print E-mail Burn Open



Properties

11ca5e4ac20be9b783c91d71013e1f7.jpg

Navigation buttons: back, forward, search, etc.

Microsoft Visual Studio Debug Console

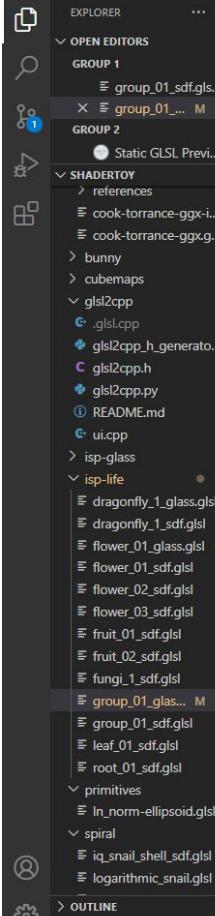
```
42 in
43
44
45 64 64 128 8 epsilon=6.6e-06
46 18779.5ms, 3123714 evaluations
47 1875884 triangles => 938800 vertices, 1873974 faces
48 6479.3ms coloring
49 D:\Coding\Github\x64\Release\Graphics.exe (process 20900) exited with code 0.
50 To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console.
51 Press F5 or Shift+F5 to start debugging.
52 D:\Homework\AVI4M\AVI4M-ISP>
53 copy D:\Coding\Github\Shadertoy\isp-life\group_01_
54 sdf.gsl1.gsl1
55 python gls12cpp/gls12cpp.py .gsl1 .gls1.cpp
56 pause
57 )
58 1 file(s) copied.
59 Open GLSL source: .gsl1
60 Write C++ source to: .gsl1.cpp
61 Press any key to continue . . .
```

23:54 P.M. First full-resolution path-traced rendering.

I used Bounding Volume Hierarchy (BVH) to accelerate ray-surface intersection.

I didn't have enough time to experiment with surface and lighting. I observed in Paul's work that there is something light just behind the glass that makes the subject stand out, and there is possibly a depth of field. I may do further experimentations in the future.





```
isp-life > group_01_glass.gsl M
287
288 void mainImage(out vec4 fragColor, in vec2 fragCoord) {
289     // random number seed
290     seed = uint(fragCoord.x)*uint(fragCoord.y)*uint(iFrame+1);
291     seed = randu() + 161u*uint(fragCoord.y);
292     seed = randu() + 239u*uint(fragCoord.x);
293     seed = randu() + 197u*uint(iFrame+1);
294
295     // constants
296     const vec3 CENTER = vec3(0, 0, 3.0);
297     const float DIST = 16.0; // larger = smaller
298     const float VIEW_FIELD = 0.9; // larger = more perspective
299     const float APERTURE = 0.1; // larger = blurred
300
301     // camera
302     float rx = iMouse.y==0.0 ? 0.33 : 1.8*(iMouse.y/iResolution.y)-0.3;
303     float rz = iMouse.x==0.0 ? -7.6 : -iMouse.x/iResolution.x*4.0*3.14;
304     //rx = 0.33, rz = -7.6;
305     vec3 w = vec3(cos(rx)*vec2(cos(rz),sin(rz)), sin(rx));
306     vec3 u = vec3(-sin(rz),cos(rz),0);
307     vec3 v = cross(w,u);
308     vec3 ro = DIST*w + CENTER;
309     vec2 uv = 2.0*(fragCoord.xy+vec2(rand01(),rand01())-0.5)/iResolution.xy - vec2(1.0);
310     vec3 rd = mat3(u,v,-w)*vec3(VIEW_FIELD*uv*iResolution.xy, length(iResolution.xy));
311     rd = normalize(rd);
312
313     // calculate pixel color
314     vec3 col = mainRender(ro, rd);
315     vec4 rgbn = texelFetch(iChannel0, ivec2(int(fragCoord.x), int(fragCoord.y)), 0);
316     if (iMouse.z>0.) rgbn.w = 0.0;
317     fragColor = vec4((rgbn.xyz*rgbn.w + col)/(rgbn.w+1.0), rgnb.w+1.0);
318
319 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
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PS D:\Coding\Github\Shadertoy>



powershell +

Windows PowerShell

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2021/11/20 Experiment with lighting

File Edit Selection View Go Run Terminal Help

group_01_glass.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 group_01_sdf.gsls... X group_01_glass.gsls... M GROUP 2 Static GLSL Preview 52 MS (3-594)

isp-life > group_01_glass.gsls 218 return sqrt(rand01())*vec2(cos(a), sin(a)); 219 } 220 221 > vec3 mainRender(vec3 ro, vec3 rd) { ... 291 } 292 293 void mainImage(out vec4 fragColor, in vec2 fragCoord) { 294 // random number seed 295 seed = uint(fragCoord.x)*uint(fragCoord.y)*uint(iFrame+1); 296 seed = randu() + 16u*uint(fragCoord.y); 297 seed = randu() + 239u*uint(fragCoord.x); 298 seed = randu() + 197u*uint(iFrame+1); 299 300 // constants 301 const vec3 CENTER = vec3(0, 0, 3.0); 302 const float DIST = 16.0; // larger = smaller 303 const float VIEW_FIELD = 0.9; // larger = more perspective 304 const float APERTURE = 1.0; // larger = blurred 305 306 // camera 307 float rx = iMouse.y==0.0 ? 0.33 : 1.8*(iMouse.y/iResolution.y)-0.3; 308 float rz = iMouse.x==0.0 ? -7.6 : -iMouse.x/iResolution.x*4.0*3.14; 309 //rx = 0.33, rz = -7.6; 310 vec3 w = vec3(cos(rx)*vec2(cos(rz),sin(rz)), sin(rx)); 311 vec3 u = vec3(-sin(rz),cos(rz),0); 312 vec3 v = cross(w,u); 313 vec3 ro = DIST*w + CENTER; 314 vec2 uv = 2.0*(fragCoord.xy+vec2(rand01(),rand01())-0.5)/iResolution.xy - vec2(1.0); 315 vec2 sc = iResolution.xy/length(iResolution.xy); 316 vec2 offset = APERTURE*randomUnitDisk(); 317 vec3 rd = mat3(u,v,-w)*vec3(VIEW_FIELD*uv*sc+offset/DIST, 1.0); 318 rd = normalize(rd); 319 rd -= offset.x*u+offset.y*v; 320 }

SHADERTOY references cook-torrance-ggx-i... cook-torrance-ggxg... bunny cubemaps glsl2cpp .glsl.cpp glsl2cpp_h_generator... glsl2cpp.h glsl2cpp.py README.md ui.cpp isp-glass isp-life dragonfly_1_glass.gsl dragonfly_1_sdf.gsl flower_01_glass.gsl flower_01_sdf.gsl flower_02_sdf.gsl flower_03_sdf.gsl fruit_01_sdf.gsl fruit_02_sdf.gsl fungi_1_sdf.gsl group_01_glass... M group_01_sdf.gsl leaf_01_sdf.gsl root_01_sdf.gsl primitives ln_norm_ellipsoid.gsl spiral iq_snail_shell_sdf.gsl logarithmic_snail.gsl

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

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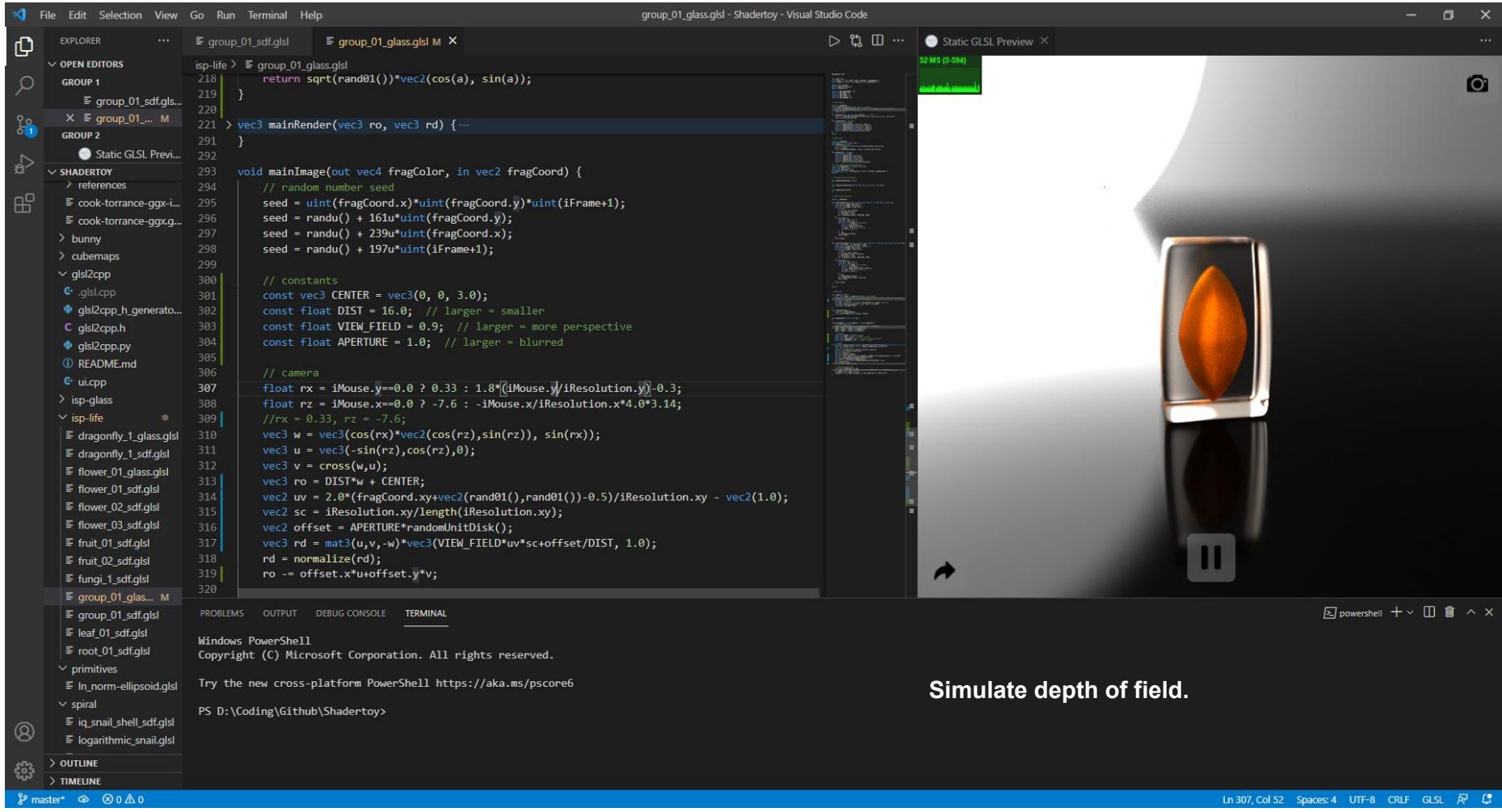
PS D:\Coding\Github\Shadertoy

master* 0 0 △ 0

Static GLSL Preview 52 MS (3-594)

group_01_glass.gsl - Shadertoy - Visual Studio Code

Simulate depth of field.



File Edit Selection View Go Run Terminal Help

group_01_glass.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 group_01_sdf.gsls... X group_01_glass.gsls... M GROUP 2 Static GLSL Preview SHADERTOY references cook-torrance-ggx-i... cook-torrance-ggxg... bunny cubemaps glsl2cpp .glsl.cpp glsl2cpp_h_generator... glsl2cpp.h glsl2cpp.py README.md ui.cpp ipsglass isp-life dragonfly_1_glass.gsl dragonfly_1_sdf.gsl flower_01_glass.gsl flower_01_sdf.gsl flower_02_glass.gsl flower_02_sdf.gsl flower_03_glass.gsl fruit_01_sdf.gsl fruit_02_glass.gsl fungi_1_sdf.gsl group_01_glas... M group_01_sdf.gsl leaf_01_sdf.gsl root_01_sdf.gsl primitives ln_norm_ellipsoid.gsl spiral iq_snail_shell_sdf.gsl logarithmic_snail.gsl

isp-life > group_01_glass.gsls
193 }
194 t = t0;
195 n = gradContent(ro+rd*t);
196 col = mapContent(ro+rd*t, true).xyz;
197 return true;
198 }
199 return false;
200 #endif
201
202 // Rendering
203
204 vec3 light(vec3 rd) {
205 const vec3 sunpos = normalize(vec3(0.2, -0.5, 0.2));
206 vec3 col = vec3(0.8);
207 col *= 1.0 + 2.0 * pow(max(dot(rd, sunpos), 0.), 4.);
208 col *= mix(1.0, 2.5, 1.0-rd.z);
209 vec3 sun = (dot(rd,sunpos)>0.9 ? 1.0 : 0.0) * vec3(8.0);
210 return 0.5*col + sun;
211 }
212
213 vec2 randomUnitDisk() {
214 float a = 2.0*PI*rand01();
215 return sqrt(rand01())*vec2(cos(a), sin(a));
216 }
217
218 > vec3 mainRender(vec3 ro, vec3 rd) { ...
219 }
220
221 void mainImage(out vec4 fragColor, in vec2 fragCoord) {
222 // random number seed
223 seed = uint(fragCoord.x)*uint(fragCoord.y)*uint(iFrame+1);
224 }

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

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PS D:\Coding\Github\Shadertoy>

Static GLSL Preview 34 MS (3-705)

3D Preview of a glass cube containing an orange fruit.

Try to make the top appear lighter to make it stand out from text when inserted into a page.

File Edit Selection View Go Run Terminal Help

group_01_glass.gsl - Shadertoy - Visual Studio Code

EXPLORER OPEN EDITORS

GROUP 1

- group_01_sdf.gsl
- group_01_glass.gsl M**

GROUP 2

- isp-life > group_01_glass.gsl
- 266 //if (iter == 0) return vec3(0.0);
 267 col = light(rd);
 268 return m_col * col + t_col;
 269 }
- 270 if (inside_object);
 271 else if (inside_glass) m_col *= exp(-0.1*vec3(0.0,0.2,0.4)*min_t);
 272 min_n = dot(rd, min_n) < 0. ? min_n : -min_n; // ray hits into the surface
 273 ro = min_ro, rd = min_rd;
- 274 if (material == MAT_PLANE) {
 275 // faked light behind the glass
 276 vec2 xy = min_ro.xy;
 277 float c = length(rot2(-1.0)*(xy-vec2(0.0,15.0))/vec2(2.0,1.0))-10.0;
 278 col = vec3(0.5)-0.2*tanh(0.4*c);
 279 rd = sampleCookTorrance(-rd, min_n, 0.01, 0.1, 0.01, col, col, m_col);
 280 }
- 281 else if (material == MAT_GLASS) {
 282 vec2 eta = inside_glass ? vec2(1.5, 1.0) : vec2(1.0, 1.5);
 283 rd = sampleFresnelDielectric(rd, min_n, eta.x, eta.y);
 284 if (dot(rd, min_n) < 0.0) inside_glass = !inside_glass;
 285 }
- 286 else if (material == MAT_CONTENT) {
 287 rd = sampleCookTorrance(-rd, min_n, 0.5, 0.8,
 288 m_col *= 1.6*pow(col, vec3(1.0));
 289 if (dot(rd, min_n) < 0.0) inside_object = !inside_object;
 290 }
- 291 if (m_col == vec3(0.0)) return t_col;
 292 if (inside_object) return 1e12f*vec3(1,-1,-1);
 293 }
- 294 return m_col + t_col;
 295 }
- 296 }
- 297 vec2 randomUnitDisk() {

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

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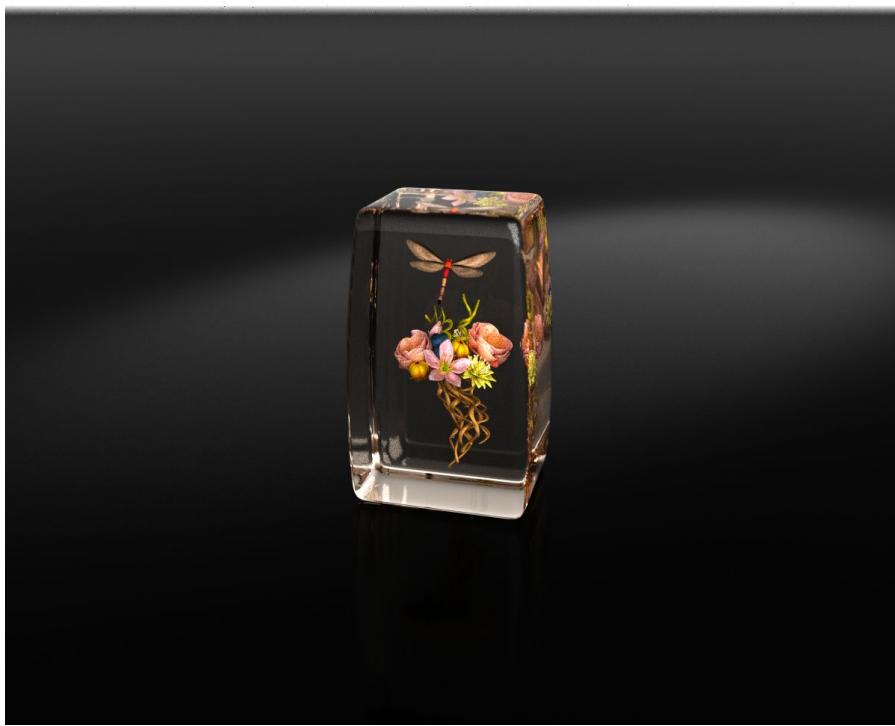
Try the new cross-platform PowerShell <https://aka.ms/pscore6>

PS D:\Coding\Github\Shadertoy>

Static GLSL Preview 16 MS (3-13)

11ca5e4acf20be9b783c91d71013e1f7.jpg

Add a (faked) lighting behind the glass.



Side-by-side comparison of the new (left) and the original (right) renderings. I fail to reproduce the lighting in the photographs of Paul's work.

I searched online for photographs of glass paperweights. Some of them are simply placed on paper but look nice. I think I should not limit my lighting experimentation on a dark glossy surface.

Technical Experiments

Acceleration structure, WebGL

Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [23024] Graphics.exe Lifecycle Events Thread: [27676] Main Thread Stack Frame: ScalarFieldTriangulator_octree::pr

Call Stack Name

Diagnostic To Call Stack B

Diagnostics

Events

Process Monitor

CPU (% of all processors)

2021/11/27 Start technical experiments after a one-week pause.

I try to create a web-based interface to present my work for the final product to show that my artwork is created by writing code in an “artistic” way. I need to run the ray-tracing code on GPU (WebGL) to achieve real-time rendering.

Building and testing a ray-surface intersection acceleration structure that can be placed inside an integer buffer.

245.7ms (4.1 fps) [400x400]

octree.h test.cpp Graphics.cpp

(Global Scope)

```
if (!t > 0.0 && t < min_t) cur.ptr = 0;

// go into subtree
if (cur.ptr != 0) {
    // triangles
    if (cell_size == 1) {
        uint n = getUInt16(cur.ptr);
        for (int ti = 0; ti < n; ti++) {
            vec3 a = getVec3(cur.ptr + 11 * ti + 1);
            vec3 b = getVec3(cur.ptr + 11 * ti + 4);
            vec3 c = getVec3(cur.ptr + 11 * ti + 7);
            t = intersectTriangle(ro, rd, a, b, c);
            if (t > 0.0 && t < min_t) {
                min_t = t, min_n = cross(b - a, c - a);
                uint rg = getUInt16(cur.ptr + 11 * ti + 2);
                uint b = getUInt16(cur.ptr + 11 * ti + 3);
                col = vec3(rg % 256, rg / 256, b) / 255;
            }
        }
        cur.ptr = 0;
    }
}
```

Started with `prod(SEARCH_DIF)` pointers, the start of the top layer (grid), in flattened `[z][y][x]` order;

A block in a middle layer contains `8` pointers, the children in the next layer;

A block in the bottom layer contains an integer `n`, the number of triangles, followed by `n` groups of `3x3+2=11` integers for the coordinates of the vertices and the 32-bit RGBA color;

All integers are 16-bit unsigned. All pointers are 32-bit little endian. A null pointer is represented by `0x0000 0x0000`.

D:\Coding\GitHub\Relay\src\main.cpp Tree sampler: 0.02 MB

D:\Homework\AVI4M\AVI4M-ISP\octree_buffer\README.md - EmEditor

File Edit Search View Tools Window Help

README.md Untitled-9 *.bin

D:\ply [vn=414, fn=728, surface] norm...

Project Graphic

Ln 467 Col 7 Ch 4 INS ↑ 0 ↪ 0 ↩ 0 Graphics master

The image shows a developer's environment with two main windows. On the left is a Visual Studio Code editor window titled "script.js - AVI4M-ISP - Visual Studio Code". It displays a fragment shader (frag.gls) for ray tracing. The code includes texture loading logic and OpenGL calls for setting up texture filters. A 3D rendering of a low-poly skull is visible in the background of the editor. On the right is a web browser window showing the same skull rendered with a multi-colored, faceted appearance, indicating a GPU-based WebGL rendering. The browser's address bar shows "localhost:8000/webgl-test/octatree/". Below the browser are the DevTools Network and Console tabs, which show a warning about synchronous XMLHttpRequests and a list of script.js log messages.

```
script.js: canvas.addEventListener("wheel") callback > [sc]
script.js: loadTexture
script.js:     texture();
script.js:     JRE_2D, tex);
script.js:     .length);
script.js:     24;
script.js:     new Uint8Array(BUFFER_SIZE * BUFFER_SIZE * 4);
script.js:     freeBuffer, 0);
script.js:     Padded.length);
script.js:     RE_2D, 0, gl.RGBA8UI,
script.js:     1.UNSIGNED_BYTE,
script.js:     KTURE_2D, gl.TEXTURE_MAG_FILTER, gl.NEAREST);
script.js:     KTURE_2D, gl.TEXTURE_MIN_FILTER, gl.NEAREST);
script.js:     KTURE_2D, gl.TEXTURE_BASE_LEVEL, 0);
script.js:     KTURE_2D, gl.TEXTURE_MAX_LEVEL, 0);

script.js:     texture.texture = tex;
script.js:     viewport.renderNeeded = true;
script.js: }

function render() {
    if (volume === null)
        = "<span style='color:red;'>Failed to load volume.</span>";
    document.getElementById('volume-select').disabled = false;
}

if (requestCache[url] != undefined) {
    return;
}

var req = new XMLHttpRequest();
req.open("GET", url, true);
req.responseType = "arraybuffer";
```

2021/11/28 Run ray-tracing in a web browser. [link](#)

Left: CPU rendering in Win32; Right: GPU rendering with WebGL.

It isn't fast enough to achieve 60fps in full-screen mode. I need to do more optimization for ray-surface intersection.

98.0ms (10.2 fps) [400x400]

localhost:8000/webgl-test/octatree/

Index Coding Math School temp

60.1 fps

Elements Console Sources Network Performance

[Deprecation] Synchronous XMLHttpRequest on the main thread script.js:28

request glsl code: 17.862060546875 ms

compile shader: 6.893310546875 ms

19120

4194304

script.js:112

script.js:138

script.js:44

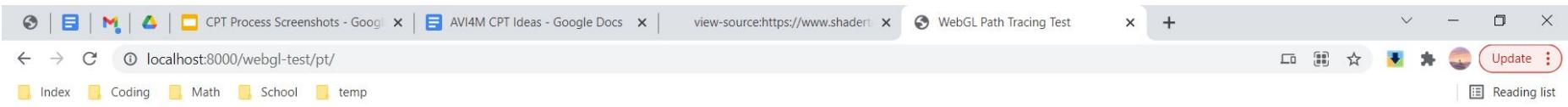
script.js:49

master ▾ 98.0ms (10.2 fps) [400x400] ▾ 60.1 fps

OUTLINE

TIMELINE

Line 252, Col 34 Spaces: 4 UTF-8 CRLF {} JavaScript



Frame 7529

60.2 fps

Evening: Test WebGL path tracing. [link](#)

I'm new to framebuffers in WebGL. I got the demo working after three frustrating hours, most time was spent on web search.

Edit Nov 29: it doesn't work on school library computers :(

Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [31864] Graphics.exe Lifecycle Events Thread: [65088] Main Thread Stack Frame: ScalarFieldTree::Octree::Octree

Quick Launch (Ctrl+Q) Harry Chen HC

Solution Explorer Find Symbol Results

Call Stack Name Lang

vector nautilus_shell.h octree.h test.cpp Graphics.cpp

675.7ms (1.5 fps) [632x400]

Graphics

```
532 int j = (z * GRID_DIF.y + y) * GRID_DIF.x;
533 if (top_layer[j] != -1) {
534     cell_ptr_map.push_back((int)layer);
535     Node n = middle_layers.back()[top_layer[j]];
536     layer.push_back(n);
537 } else cell_ptr_map.push_back(-1);
538 }
539 middle_layers.back() = layer;
540
541 GRID_DIF /= 2;
542 std::vector<int> prev_top_layer;
543 layer.clear();
544 for (int z = 0; z < GRID_DIF.z; z++) {
545     Node n;
546     bool is_empty = true;
547     for (int i = 0; i < 8; i++) {
548         ivec3 p = ivec3(x, y, z) * 2 + ivec3(i, 0, 0);
549         int j = (p.z * 2 * GRID_DIF.y + p.y) * GRID_DIF.x;
550         n.c[i] = cell_ptr_map[j];
551         if (n.c[i] != -1) is_empty = false;
552     }
553     if (is_empty) prev_top_layer.push_back(-1);
554 }
```

Diagnostics Tools

Diagnostics session: 1:31 minutes

Events

Process Memory (MB) Snapshot Private Bytes

CPU (% of all processors)

2021/11/29 Add an option to “shrink” the top layer (grid) when exporting buffer for rendering. Allows a smaller number of grid cell intersection tests during rendering. This makes it possible to render a model with thin faces like this nautilus shell.

The nautilus shell rendering in the screenshot has noise inside the reflection that I think it's a bug. It also appears in renderings of the sphere model I did on the previous days. I plan to look at it tomorrow.

Summary Events Memory Usage CPU Usage

Event Show Error List

Memory Usage

File Line Sup

Project Graphics test.cpp 142

File Graphics test.cpp 143

Ln 544 Col 23 Ch 17 INS ↑ 0 ↗ 0 ↘ Graphics master

Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: 890.0ms (1.1 fps) [400x400]

Solution Explorer Find Symbol Results

Call St

Call St

Diagn

Diagn

Events

Pro

473

0

CPU (% of all processors)

Summary Events Memory Usage CPU Usage

Events (0 of 0)

Entire Solution 0 Errors 0 Warnings 0 Messages

2021/11/30 Fix a bug in ray-surface intersection that causes “noise” in reflections.

The screenshot shows renderings after the bug is fixed, in native C++ and in WebGL.

Call St

Na

Graphics.cpp

Global Scope

```
vec4 inhouse = vec4(0, 0, 0, 0);

vec4 *FrameBuffer = nullptr;

#define P0 vec3(-2.0, -2.0, -1.5) /* min coordinate */
#define P1 vec3(2.0, 2.0, 1.5) /* max coordinate */
#define GRID_DIF ivec3(2, 2, 1) /* initial grid size */
#define PLOT_DEPTH 8 /* depth of the tree */
#define GRID_SIZE (GRID_DIF*(1<<PLOT_DEPTH))
#define EDGE_ROUNDING 255 /* divide edge into triangles */
#define MESH_SIZE (GRID_SIZE*EDGE_ROUNDING)

#define GRID_EXPAND 4 /* pre-sample this number of points */
#define SEARCH_DIF_EXP (GRID_DIF*(1<<GRID_EXPAND))
#define PLOT_DEPTH_EXP (PLOT_DEPTH+GRID_EXPAND)
```

#if 1
#include "test-models/nautilus_shell.h"
#else
vec4 map(vec3 p, bool col_required) {
 float d = length(p) - 1.0 + 0.2*sin(10.0*p.x);
 //float d = min(length(vec2(length(p.xy())*sin(1.57*p.x)*sin(1.57*p.y)*sin(1.57*p.z), p.z)), 1.0);
}

130
131
132
133
134

12.0 fps

Elements Console Sources Network

top Filter

6 messages

4 user messages

No errors

1 warning

4 info

1 verbose

[Deprecation] Synchronous thread is deprecated because it's not thread-safe. For more help, see [request glsl code: 11.194091](#)

compile shader: 11.194091

11540

4194304

Console What's New Issues

Highlights from the Chrome 96 update

New preview feature: CSS Overview panel

Use the CSS overview panel to identify CSS improvements.

Enable emulating prefers-contrast media and a11y

Emulate the user preference on using a different color scheme for the page and Chrome's auto dark mode.

New Payload tab in the Network panel

D:\Coding\Github\Release\Graphics.exe

sample octatree root - 27.2 ms
subdivide octatree layer 1/4 - 11.4 ms
subdivide octatree layer 2/4 - 68.7 ms
subdivide octatree layer 3/4 - 374.7 ms
subdivide octatree layer 4/4 - 1611.4 ms
reconstruct triangles - 625.4 ms
restore layers - 152.4 ms
reconstruct grid - 1.5 ms
destroy octatree - 160.0 ms
shrink grid - 0.5 ms
triangles to mesh - 832.2 ms
coloring - 1175.1 ms
encode buffer - 142.8 ms
Tree sampler: 26.19 MB

Ln 119 Col 45

Ready

Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help Harry Chen HC

Process 124.9ms (8.0 fps) [610x400]

Call Stack

Call History

Watch

Name

354 vec3 n, col = vec3(0.0);
355 if (!IntersectObject(ro, rd, t, 1e-5))
356 return col;
357 else {
358 vec3 hit_pos = ro + rd * t;

2021/12/03 Attempt to optimize octree lookup by checking the cell that is closest to the camera first and terminate when the ray hits a triangle. 100%

The code runs at about 5 fps on CPU. GPU is usually 10-50 times as fast as CPU, so I expected it to be fully 60 fps with WebGL. However, it is only slightly faster than what I run natively.

Autos Locals Watch 1 Watch 2 Memory 1 Diagnostic...
Ln 343 Col 5 Ch 2 INS ↑ 0 ↗ 0 Graphics master ▲

Quick Launch (Ctrl+Q)

harry7557558.github.io/AVI4M-ISP/webgl-test/octatree/index.html

Index Coding Math School temp Reading list

767 x 446
84 ms, 11.9 fps

Elements Console Sources Network Performance Memory Application Security > Default levels 1 Issue: script.js:1

Filter

top ▾

5 messages

4 user messages

No errors

1 warning

4 info

No verbose

⚠ [Deprecation] Synchronous XMLHttpRequest on the main thread is deprecated because of its detrimental effects to the end user's experience. For more help, check <https://xhr.spec.whatwg.org/>.

request glsl code: 49.028076171875 ms script.js:194
compile shader: 6.843994140625 ms script.js:199
3930012 script.js:48
4194304 script.js:53

File Edit Selection View Go Run Terminal Help

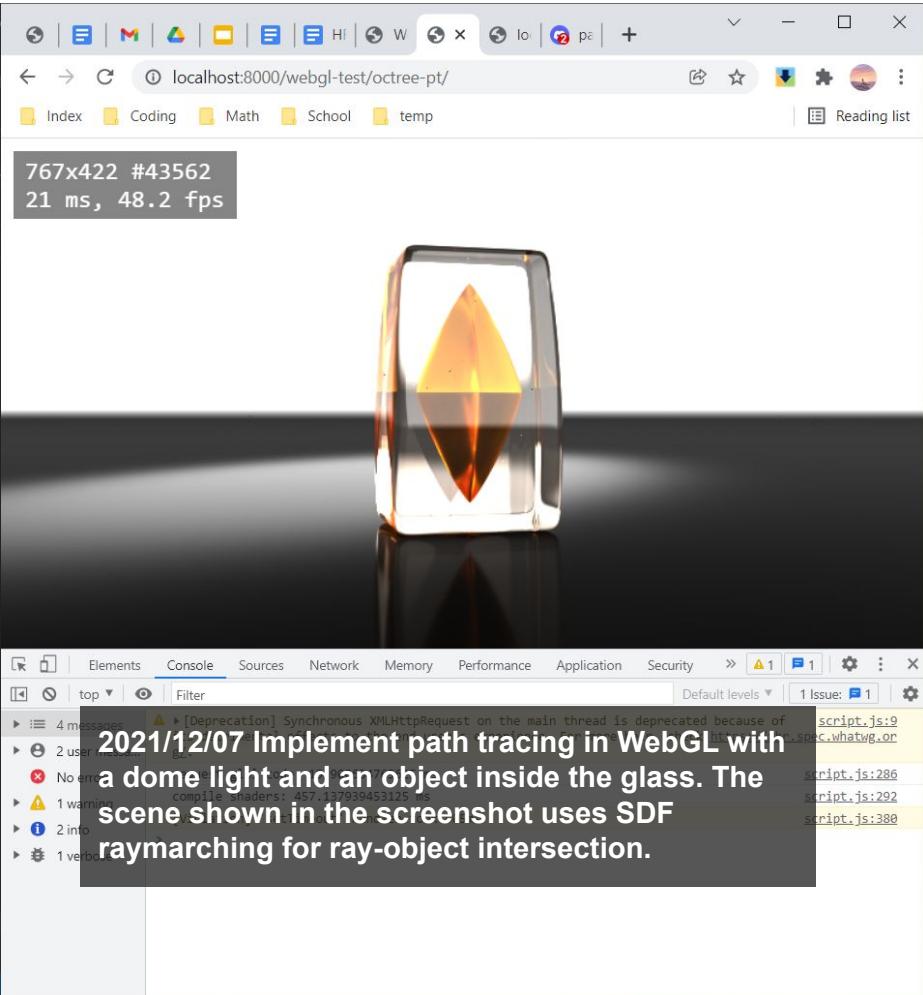
frag-raymarch.gls - AVI4M-ISP - Visual Studio Code

frag-raymarch.gls

```
webgl-test > octree-pt > frag-raymarch.gls
```

```
234     vec3 min_emi = vec3(0.0); > abs
235     int material = MAT_BACKGROUND;
236
237     // plane
238     t = -ro.z / rd.z;
239     if (t > 0.0) {
240         min_t = t, min_n = vec3(0, 0, 1);
241         min_ro = ro + rd * t, min_rd = rd;
242         material = MAT_PLANE;
243     }
244
245     // glass
246     t = 0.0;
247     if (intersectGlass(ro, rd, t, min_t, min_n)) {
248         min_t = t;
249         min_ro = ro + rd * t, min_rd = rd;
250         min_n = normalize(min_n);
251         col = vec3(1.0);
252         material = MAT_GLASS;
253     }
254
255     // content
256     t = 0.0;
257     if (inside_glass) {
258         if (intersectContent(ro-vec3(0.0,0.0,3.0), rd, t, min_t, min_n, col)) {
259             min_t = t;
260             min_ro = ro + rd * t, min_rd = rd;
261             min_n = normalize(min_n);
262             material = MAT_CONTENT;
263         }
264     }
265
266     // update ray
267     if (material == MAT_BACKGROUND) {
268         //if (iter == 0) return vec3(0.0);
269         col = light(rd);
270         return m_col * col + t_col;
271     }
272     if (inside_object);
273     else if (inside_glass) m_col *= exp(-0.1*vec3(0.0,0.2,0.4)*min_t);
274     min_n = dot(rd, min_n) < 0. ? min_n : -min_n; // ray hits into the surface
275     ro = min_ro, rd = min_rd;
276     if (material == MAT_PLANE) {
277         // faked light behind the glass
278         vec2 xy = min_ro.xy;
279         float c = length(rot2(-1.0)*(xy-vec2(0.0,15.0))/vec2(2.0,1.0))-10.0;
```

Ln 258, Col 53 Spaces:4 UTF-8 CRLF GLSL



File Edit Selection View Go Run Terminal Help

frag-octree.gsl - AVIM

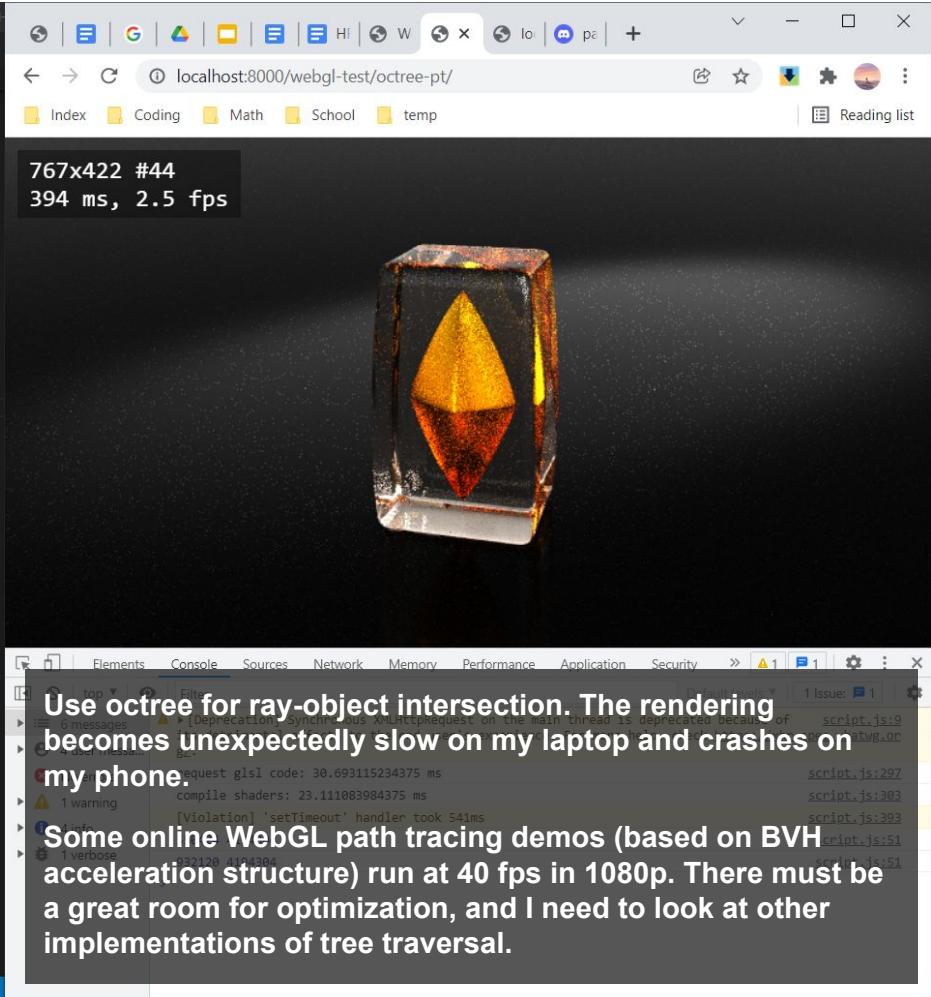
```

webgl-test > octree-pt > frag-octree.gsl
325     min_ro = ro + rd * t, min_rd = rd;
326     material = MAT_PLANE;
327 }
328
329 // glass
330 t = 0.0;
331 if (intersectGlass(ro, rd, t, min_t, min_n)) {
332     min_t = t;
333     min_ro = ro + rd * t, min_rd = rd;
334     min_n = normalize(min_n);
335     col = vec3(1.0);
336     material = MAT_GLASS;
337 }
338
339 // content
340 t = 0.0;
341 if (inside_glass) {
342     if (intersectContent(ro-vec3(0.0,0.0,3.0), rd, t, min_t, min_n, col)) {
343         min_t = t;
344         min_ro = ro + rd * t, min_rd = rd;
345         min_n = normalize(min_n);
346         material = MAT_CONTENT;
347     }
348 }
349
350 // update ray
351 if (material == MAT_BACKGROUND) {
352     m_col *= light(rd);
353     break;
354 }
355 if (inside_object);
356 else if (inside_glass) m_col *= exp(-0.1*vec3(0.0,0.2,0.4)*min_t);
357 min_n = dot(rd, min_n) < 0. ? min_n : -min_n; // ray hits into the surface
358 ro = min_ro, rd = min_rd;
359 if (material == MAT_PLANE) {
360     // faked light behind the glass
361     vec2 xy = min_ro.xy;
362     float c = length(rot2(-1.0)*(xy-vec2(0.0,15.0))/vec2(2.0,1.0))-10.0;
363     col = vec3(0.5)-0.3*tanh(0.4*c);
364     rd = sampleCookTorrance(-rd, min_n, 0.01, 0.1, 0.01, col, col, m_col);
365 }
366 else if (material == MAT_GLASS) {
367     vec2 eta = inside_glass ? vec2(1.5, 1.0) : vec2(1.0, 1.5);
368     rd = sampleFresnelDielectric(rd, min_n, eta.x, eta.y);
369     if (dot(rd, min_n) < 0.0) inside_glass = !inside_glass;
370 }

```

frag-octree.gsl M JS script.js U frag-octree.gsl U frag-raymarch.gsl U

master* 0 0 △ 0 0



Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [31456] Graphics.exe

Call Stack

Autos

132.5ms (7.5 fps) [400x400]

test.cpp Graphics.cpp

```
bool triangle_found = false
for (int ti = 0; ti < n; ti++) {
    trig_int_count++;
    ivec3 vi0 = getUvec3(p);
    ivec3 vi1 = getUvec3(p);
    ivec3 vi2 = getUvec3(p);
    vec3 v0 = mix(P0, P1,
    vec3 v01 = ((P1 - P0));
    vec3 v02 = ((P1 - P0));
    t = intersectTriangle(
        if (t > 0.0 && t < min_t)
            min_t = t, min_n =
            col = vec3(getUvec3(p));
            triangle_found = true;
        }
        if (triangle_found) break;
    }

    // march
    t0 = t01.y;
```

767 x 712
85 ms, 11.8 fps

2021/12/09 Implement octree-based raymarching. The ray keeps finding its next intersection with the grid and stops when hitting a triangle.

The tree lookup is iterative and stack-free. There is a large number of repeated box intersections. I plan to optimize it using a stack.

This algorithm is slightly slower than the original algorithm on CPU, but about the same performance on GPU. I hope the optimization can make it faster than the original one.

Autos Locals Watch 1 Watch 2 Memory 1 Diagnostic... Output Error List

Ready

The screenshot shows a Microsoft Visual Studio interface with a code editor and a rendering window. The code editor displays C++ code for raymarching, specifically for octree-based raymarching. The rendering window shows a 3D model of a brain, colored with a gradient from purple to green. A text overlay provides context about the implementation and performance goals.

Graphics - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Debug x86 Local Windows Debugger

disambiguation.cpp octree.h test.cpp Graphics.cpp

Miscellaneous Files (Global Scope)

```
468     if (ci) assert(!cubes[ci].triangulationCases.empty());  
469  
470 // spread to all cube cases (BFS)  
471 for (int i_ = 0; i_ < (int)cube_ids.size(); i_++) {  
    int i = cube_ids[i_];  
  
    index  
    Index = 256 * cubes[i].Index;  
    CubeCase cbc = Cubecase(index);  
    cbc.calcFaceIndices();  
    cbc.isAmbiguous = cubes[i].isAmbiguous;  
  
    assert(f1 == 0 && f1 == 18);  
    fi = fi == 16 ? 17 : fi == 17 ? 16 : 15 - fi;  
    assert(cbc.FaceIndex[1] == fi || (cbc.FaceIndex[1] == 5 && fi == 16) || (cbc.FaceIndex[1] == 10 && fi == 15));  
  
    1 2 1 1 2 5 1 1 1 2 1 2 1 2 4 1 1  
    1 1 1 2 4 1 1 2 1 4 1 2 2 2 1  
    1 2 2 1 2 1 1 2 5 4 1 1 1 1  
    2 2 5 4 2 2 4 2 5 4 1 5 4 2 5 2  
    2 1 1 1 4 1 1 2 2 4 2 1 2 1 1  
    1 1 1 1 2 1 1 4 2 5 2 2 1 2 1  
    1 2 1 2 2 5 2 4 1 1 2 1 1 1 1  
    1 2 2 1 2 4 2 2 1 1 4 1 1 1 2 1  
    2 5 2 4 5 1 4 5 2 4 2 2 4 5 2 2  
    1 1 1 4 5 2 2 1 1 2 1 2 2 1 1  
    1 2 2 2 1 4 1 2 1 1 4 2 1 1 1  
    1 1 4 2 1 2 2 1 1 5 2 1 1 2 1  
    1 4 1 2 1 5 1 2 1 2 2 1 1 2 1 1  
    1 1 1 1 2 1 1 1 1 2 1 1 1 1 0  
256 cubes complete  
152.5ms, 811 evaluations  
836 triangles => 414 vertices, 836 faces  
0.7ms coloring
```

D:\Coding\Github\Debug\Graphics.exe (process 9212) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .

100 %

Error List Output

>Loading symbols for imm32.dll

Ln 487 Col 48 Ch 33 INS ↑ 0 ↗ 0 ⚙️ Graphics 🌐 master ▾



Microsoft Visual Studio Debug Console

```
1 2 1 1 2 5 1 1 1 2 1 2 1 2 4 1 1  
1 1 1 2 4 1 1 2 1 4 1 2 2 2 1  
1 2 2 1 2 1 1 2 5 4 1 1 1 1  
2 2 5 4 2 2 4 2 5 4 1 5 4 2 5 2  
2 1 1 1 4 1 1 2 2 4 2 1 2 1 1  
1 1 1 1 2 1 1 4 2 5 2 2 1 2 1  
1 2 1 2 2 5 2 4 1 1 2 1 1 1 1  
1 2 2 1 2 4 2 2 1 1 4 1 1 1 2 1  
2 5 2 4 5 1 4 5 2 4 2 2 4 5 2 2  
1 1 1 4 5 2 2 1 1 2 1 2 2 1 1  
1 2 2 2 1 4 1 2 1 1 4 2 1 1 1  
1 1 4 2 1 2 2 1 1 5 2 1 1 2 1  
1 4 1 2 1 5 1 2 1 2 2 1 1 2 1 1  
1 1 1 1 2 1 1 1 1 2 1 1 1 1 0  
256 cubes complete  
152.5ms, 811 evaluations  
836 triangles => 414 vertices, 836 faces  
0.7ms coloring
```

D:\Coding\Github\Debug\Graphics.exe (process 9212) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .

Graphics - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Release x86 Local Windows Debugger

Harry Chen HC

Solution Explorer

disambiguation.cpp octatree.h test.cpp Graphics.cpp

Miscellaneous Files (Global Scope)

```

481     octatree_main();
482 #if 0
483     for (int i = 0, cn = (int)cells.size(); i < cn; i++) {
484         vec3 p[8];
485         for (int j = 0; j < 8; j++) p[j] = i2f(cells[i]->p(j));
486         auto v_table = TRIG_TABLE[CalcIndex(cells[i]->v)];
487         for (int u = 0; ; u += 3) {
488             if (v_table[u] == -1) break;
489             vec3 a = getInterpolation(p, cells[i]->v, v_table[u]);
490             vec3 b = getInterpolation(p, cells[i]->v, v_table[u + 1]);
491             vec3 c = getInterpolation(p, cells[i]->v, v_table[u + 2]);
492             trigs.push_back(triangle_3d(a, b, c));
493         }
494     }
495 #else
496     // initializationTable();
497     for (int j = 0; j < 8; j++) p[j] = i2f(cells[i]->p(j));
498     index = CalcIndex(cells[i]->v);
499     if (!DISAMBIGUATION_LUT[index].empty()) continue;
500     if (!DISAMBIGUATION_LUT[index][0].empty()) fprintf(stderr, "Empty (%d)\n", index); continue;
501     if (DISAMBIGUATION_LUT[index][0].empty())
502         if (DISAMBIGUATION_LUT[index][1].empty())
503             if (DISAMBIGUATION_LUT[index][2].empty())
504                 if (DISAMBIGUATION_LUT[index][3].empty())
505                     if (DISAMBIGUATION_LUT[index][4].empty())
506                         if (DISAMBIGUATION_LUT[index][5].empty())
507                             if (DISAMBIGUATION_LUT[index][6].empty())
508                                 if (DISAMBIGUATION_LUT[index][7].empty())
509                                     if (DISAMBIGUATION_LUT[index][8].empty())
510                                         if (DISAMBIGUATION_LUT[index][9].empty())
511                                         if (DISAMBIGUATION_LUT[index][10].empty())
512                                         if (DISAMBIGUATION_LUT[index][11].empty())
513                                         if (DISAMBIGUATION_LUT[index][12].empty())
514                                         if (DISAMBIGUATION_LUT[index][13].empty())
515                                         if (DISAMBIGUATION_LUT[index][14].empty())
516                                         if (DISAMBIGUATION_LUT[index][15].empty())
517 // export the entire tree. see `README.md` for details
    
```

2021/12/20 Resolved yesterday's problem. Test marching cube on a nautilus shell SDF model, and the generated mesh is a perfect manifold.

Although I generated table with the consideration of various face orientation cases, the algorithm has nothing different from the static lookup-table marching cube because I only use the first triangulation case in the lookup table to generate the mesh. There are still "holes" on "thin layers" of the nautilus shell.

Looking forward to have more things done tomorrow.

Quick Launch (Ctrl+Q)

D:\ply [vn=1060082, fn=2122514, surface] normal=ccw 624x360 6.4fps

Microsoft Visual Studio Debug Console

```

Subdivide octatree layer 5/5 - 2148.5 ms
0(8) 1(1) 9(2) 14(5) 15(8) 30(12) 39(9) 46(14) 65(4) 71(11) 73(6) 85(10) 88(7) 129(3)
165(13)
9 1 1 1 1 2 1 1 1 1 2 1 1 1 1 1
1 1 2 1 1 2 2 1 2 1 5 1 2 4 1 4 1
2 1 1 2 1 2 2 1 2 1 2 2 1 2 4 1 1
1 1 1 1 2 4 1 1 2 1 4 1 2 2 2 1
1 1 2 2 1 2 1 1 2 2 5 4 1 1 1 1
1 2 5 4 2 2 4 2 5 4 2 5 4 2 5 2
2 1 1 1 4 1 1 2 2 4 2 1 2 1 1
1 1 1 2 1 1 4 2 5 2 2 1 2 1
1 1 2 1 1 4 1 2 1 1 1 1 1 1
2 1 2 2 5 2 4 1 1 2 1 1 1 1 1
2 1 2 2 4 2 2 1 1 4 1 1 1 2 1
2 5 2 4 5 2 4 5 2 4 2 2 4 5 2 2
1 1 1 4 5 2 2 1 1 2 1 2 2 1 1
2 2 2 2 1 4 1 2 1 1 4 2 1 1 1 1
2 1 1 4 2 1 2 2 1 1 1 5 2 1 1 2 1
2 4 1 2 1 5 1 2 1 2 2 1 1 2 1 1
2 1 1 1 1 2 1 1 1 2 1 1 1 1 1 0
256 cubes complete
3236.7ms, 2714168 evaluations
2124588 triangles => 1060082 vertices, 2122514 faces
1434.5ms coloring
    
```

Item(s) Saved

Ln 502 Col 104 Ch 98 INS

Graphics master

Graphics - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Release x86 Local Windows Debugger

D:\ply [vn=92366, fn=184320, surface] normal=ccw 624x361 23.9fps

Solution Explorer

octree.h

Properties

Graphics

671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695 2021/12/21 Finally get it working.
696 Disambiguation::initDisambiguationTable();
697 std::vector<const std::vector<vec3>> triangulations;
698 for (int i = 0; i < cells.size(); i++)
699 {
700 vec3 p[8];
701 const std::vector<vec3> &t = triangulations[i];
702 t[0] = p[0] = getInterpolation(p, cells[i]->v, t.x);
703 t[1] = p[1] = getInterpolation(p, cells[i]->v, t.y);
704 t[2] = p[2] = getInterpolation(p, cells[i]->v, t.z);
705 t[3] = p[3] = getInterpolation(p, cells[i+1]->v, t.x);
706 t[4] = p[4] = getInterpolation(p, cells[i+1]->v, t.y);
707 t[5] = p[5] = getInterpolation(p, cells[i+1]->v, t.z);
708 t[6] = p[6] = getInterpolation(p, cells[i+2]->v, t.x);
709 t[7] = p[7] = getInterpolation(p, cells[i+2]->v, t.y);
710 trigs.push_back(triangle_3d(a, b, c));
711 }

Right: static lookup table; Left: with disambiguation.

It doesn't work as good as I expected. I feel it's not worthy for me to spend a quarter of my Christmas break on this. But I at least tried and made an improvement.

100% Error List Output

Ready

Ln 681 Col 21

D:\ply [vn=92366, fn=183894, surface] normal=ccw 624x360 23.9fps

D:\Coding\Github\AVI4M-ISP.bat - EmEditor

File Edit Search View Tools Window Help

Microsoft Visual Studio Debug Console

16 16 16 16 epsilon=1.6e-05
sample octtree root - 5.5 ms
subdivide octtree layer 1/4 - 4.1 ms
subdivide octtree layer 2/4 - 14.7 ms
subdivide octtree layer 3/4 - 65.2 ms
subdivide octtree layer 4/4 - 363.6 ms
631.7ms, 292063 evaluations
184508 triangles => 92366 vertices, 184320 faces
184.3ms coloring

D:\Coding\Github\Release\Graphics.exe (process 6616) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .

Graphics - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Analyze Window Help

Release x86 Local Windows Debugger

Harry Chen HC

Solution Explorer

Properties

octa.h X te

D:\ply [vn=53771, fn=107336, surface] normal=ccw 624x360 0.7fps

D:\ply [vn=53771, fn=106372, surface] normal=ccw 624x358 7.1fps

Graphics

674 #el

675

676

677

678

679

680 }

681

682

683 //

684 void

685

686 #if

687

688

689

690

691

692

693

694

695 vec3 c = getInterpolation(p, cells[i]->v, v_table[u + 2]);

696 trigs.push_back(triangle_3d(a, b, c));

697 }

698 #else static lookup table;

699 Disambiguation initDisambiguationTable();

700 static const int lut_size = 16 * 16 * 16 / 8;

701 static const float epsilon = 3.1e-05f;

702 static const int lut_size_lut = lut_size / 8;

703 static const int lut_size_lut_lut = lut_size_lut / 8;

704 vec3 p[8];

705

706 Dynamic lookup table works only slightly better than

707 static lookup table for “thin segments” like the

708 filaments of the flowers.

709

710 vec3 a = getInterpolation(p, cells[i]->v, t.x);

Left: static lookup table; Right: dynamic lookup table.
The difference between the two methods is obvious for
models with “thin layers” like this nautilus shell.

16 16 16 8 epsilon=3.1e-05

sample octatree root - 3.3 ms

subdivide octatree layer 1/3 - 2.1 ms

subdivide octatree layer 2/3 - 17.0 ms

subdivide octatree layer 3/3 - 95.2 ms

140.9ms, 107599 evaluations

107388 triangles => 53771 vertices, 107336 faces

92.5ms coloring

D:\Coding\Github\Release\Graphics.exe (process 7424) exited with code 0.

To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.

Press any key to close this window . . .

100% Error List Output

Ln 703 Col 50 Ch 47 INS ↑ 0 ↗ 0 ↘ Graphics V master ▲

Graphics (Running) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [14584] Graphics.exe Lifecycle Events Thread: [15932] Main Thread Stack Frame: ScalarFieldTri

Call Stack

Graphics.h test.cpp Graphics.cpp

Graphics

```
747     std::vector<TriangleNode> bottom_layer;
748 #if DISAMBIGUATION
749     Disambiguation::initDisambiguationTable();
750     std::vector<const std::vector<ivec3>*> triangulations;
751     getTriangulation_trilinear(cells, triangulations);
752     for (int i = 0; i < (int)cells.size(); i++) {
753         ivec3 p[8];
754         for (int j = 0; j < 8; j++) p[j] = (cells[i]->_p)[j];
755         const std::vector<ivec3> *lut = triangulations[i];
756         if (lut == nullptr) continue;
757         TriangleNode n;
758         n.p = cells[i];
759         n.po = cells[i]->p;
760         for (int ti = 0; ti < (int)lut->size(); ti++) {
761             ivec3 t = lut->at(ti);
762             ivec3 a = getInterpolation(p, cells[i]->v, t);
763             ivec3 b = getInterpolation(p, cells[i]->v, t + ivec3{1, 0, 0});
764             ivec3 c = getInterpolation(p, cells[i]->v, t + ivec3{0, 1, 0});
765             if (a != b && a != c && b != c) {
766                 n.t[n.n++].x = (int)triangles.size();
767                 triangles.push_back(Triangle{ a, b, c });
768             }
769         }
770         if (n.n != 0)
771             bottom_layer.push_back(n);
772     }

```

Call Stack Breakpoints Threads

Autos

Name	Value	Type
------	-------	------

Output

```
D:\Coding\Github\Release\Graphics.exe
sample octree root - 3.9 ms
subdivide octree layer 1/5 - 2.5 ms
subdivide octree layer 2/5 - 17.8 ms
subdivide octree layer 3/5 - 90.8 ms
subdivide octree layer 4/5 - 458.0 ms
subdivide octree layer 5/5 - 2120.8 ms
reconstruct triangles - 1843.6 ms
restore layers - 201.8 ms
reconstruct grid - 0.5 ms
destroy octree - 211.6 ms
shrink grid - 0.4 ms
triangles to mesh - 1060.8 ms
coloring - 1515.4 ms
encode buffer - 176.5 ms
Tree sampler: 34.52 MB
mean=(0.0243,0.0208,0.0173), var=(0.104,0.0916,0.077), min=(0,0,0), max=(0.666,0.596,0.554)
```

Use dynamic lookup table in exporting octree to buffer.

The thread 0x6b78 has exited with code 0 (0x0).

The thread 0x6b88 has exited with code 0 (0x0).

The thread 0x63e8 has exited with code 0 (0x0).

Autos Locals Watch 1 Watch 2 Memory 1 Diagnostic... Output Error List

Ln 734 Col 5 Ch 5 INS ↑ 0 ↩ 0 ↵ Graphics V master ▲

File Edit Selection View Go Run Terminal Help intersector2.glsL - AVI4M-ISP - Visual Studio Code

OPEN EDITORS

- webgl-test > octree > intersector2.glsL
- frag.glsL M
- script.js M

```

53 int subcell_order[8] = i > getUve
54 float dist[8];
55 for (int i = 0; i < 8; i++) {
56     dist[i] = dot(vec3(VERTEX_LIST[i]), rd);
57 }
58 for (int i = 1; i < 8; i++) { // sorting
59     int soi = subcell_order[i];
60     float di = dist[i];
61     int j = i - 1;
62     while (j >= 0 && dist[j] > di) {
63         dist[j + 1] = dist[j];
64         subcell_order[j + 1] = subcell_order[j];
65         j--;
66     }
67     dist[j + 1] = di;
68     subcell_order[j + 1] = soi;
69 }

// stack
70 #if USE_STACK
71 StackElement stk[PLOT_DEPTH + 1];
72 int stkptr = -1;
73#endif

// debug
74 int loop_count = 0;
75 int trig_int_count = 0;
76 int box_int_count = 0;

// grid
77 for (int xi = ZE0; xi < GRID_DTE; xi++) for (int yi = ZE0; yi < GRID_DIF.y;
78     if (grid_pos == 0) continue;
79     if (grid_pos == 0) continue;
80     if (grid_pos == 0) continue;
81     if (grid_pos == 0) continue;
82     if (grid_pos == 0) continue;
83     if (grid_pos == 0) continue;
84     if (grid_pos == 0) continue;
85     if (grid_pos == 0) continue;
86     if (grid_pos == 0) continue;
87     if (grid_pos == 0) continue;
88     if (grid_pos == 0) continue;
89     if (grid_pos == 0) continue;
90     if (grid_pos == 0) continue;
91     if (grid_pos == 0) continue;
92     if (grid_pos == 0) continue;
93     if (grid_pos == 0) continue;
94     if (grid_pos == 0) continue;
95     if (grid_pos == 0) continue;
96     if (grid_pos == 0) continue;
97     if (grid_pos == 0) continue;
98     if (grid_pos == 0) continue;

```

2021/12/24 Further optimize ray-surface intersection.

Use a stack to optimize octree-based raymarching. Speed up about 30%.

Path tracing the glass scene still has less than 1fps in 1080p.

Directory list | WebGL Path | WebGL Octa | +

localhost:8000/webgl-test/octatree/

Index Coding Math School temp

Reading list

671 x 402
25 ms, 40.3 fps

Console

Default levels | 1 Issue: 1

6 messages

4 user mess...

No errors

1 warning

4 info

1 verbose

[Deprecation] Synchronous XMLHttpRequest on the main thread is deprecated because of its detrimental effects to the end user's experience. For more help, check <https://xhr.spec.whatwg.org/>.

request glsl code: 33.283935546875 ms

compile shader: 14.80517578125 ms

[Violation] 'setTimeout' handler took 76ms

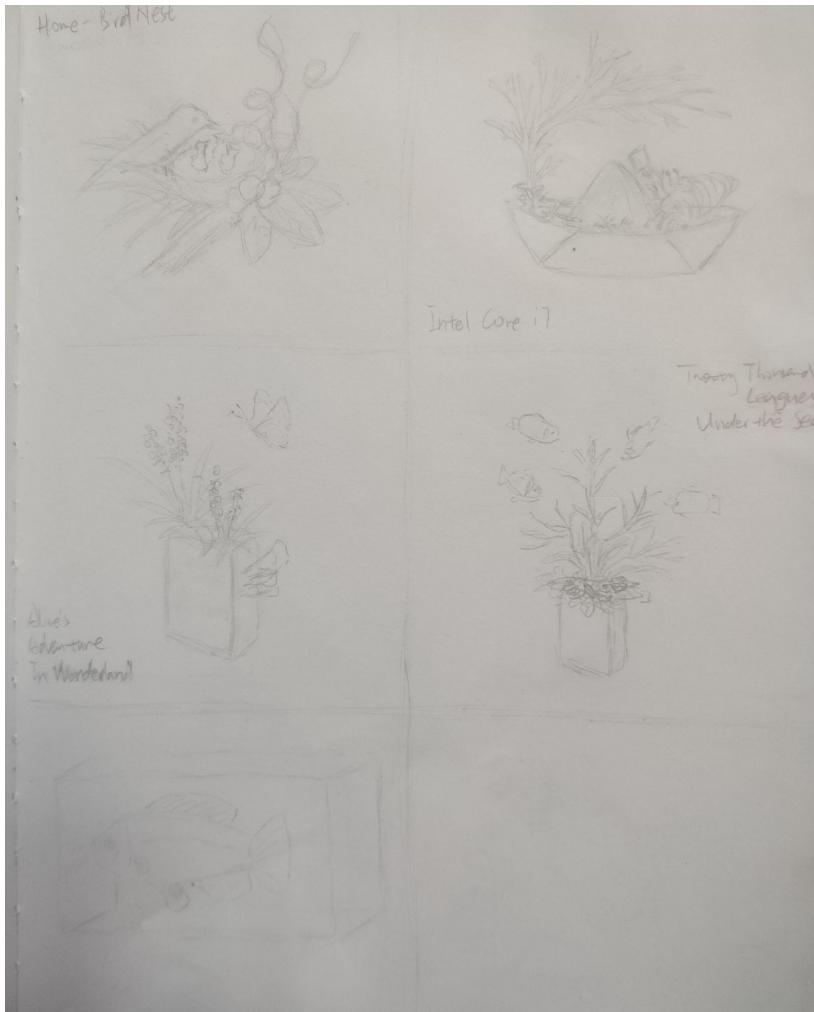
248160

4194304

Ln 69, Col 6 Tab Size 4 UTF-8 CRLF GLSL

ISP Step 3

Preliminary work



2021/12/07 Brainstorming ideas for final work. I came out with three major ideas.

The first one is a bird's nest and the theme is home and belonging. Inspired by my mentor artist, I placed different types of plants around the nest.

The two on the bottom are lives grow on books, inspired by a fungi growing on book image shown in class. I searched online and saw a picture of fungus growing on *Alice's Adventure in Wonderland* and I added plants and a butterfly to it, but I'm not sure if I can use an idea that is already used by someone else. I considered an underwater scene that a coral tree grows on *Twenty Thousand Leagues Under the Sea* with fishes and mollusks surrounding it.

My teacher gave me an idea of a hermit crab and something with a logo on it. I thought about a paper boat filled with sand that likes an ocean floor, a coral tree, and a hermit crab holding a chip with Nvidia logo on it. I was thinking about the principle of placing things that aren't obviously related together.

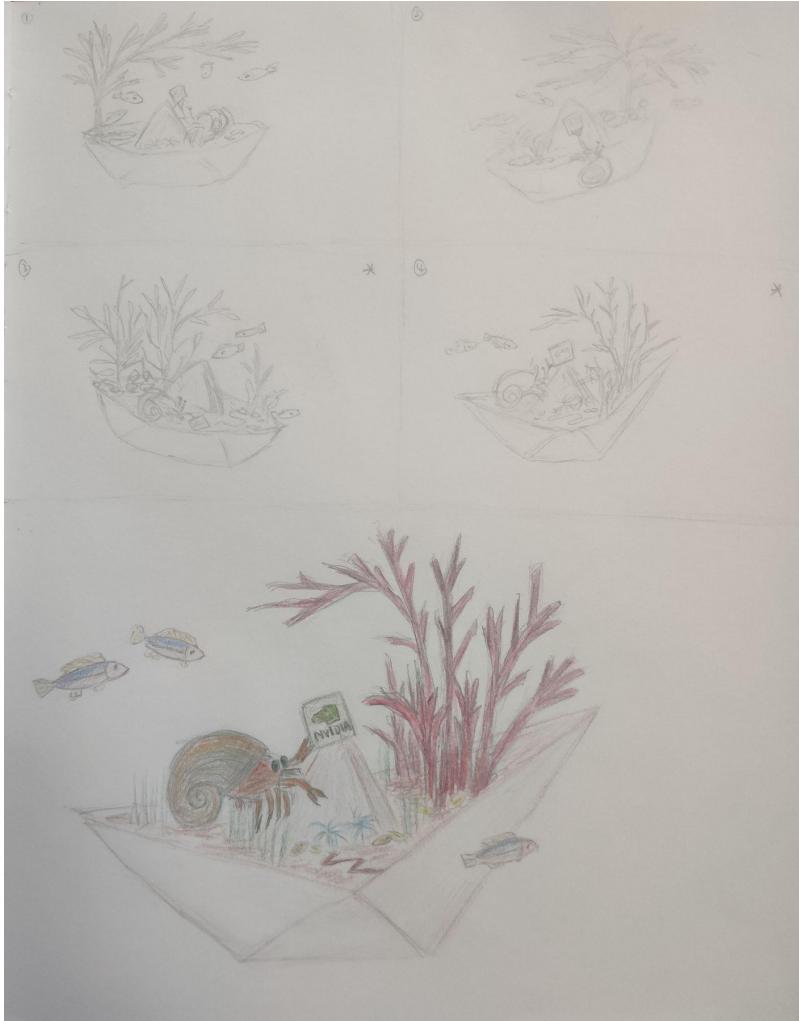
After receiving my teacher's comments, I decided to stick with the bird nest and the hermit crab idea for my final work.



2021/12/09 Explore potential compositions for the artwork as instructed by my teacher.

I was satisfied with the sketch I did previously. But this experimentation enabled me to explore more compositions of the artwork.

For the bird nest idea, I chose the third composition for the half-page sketch because it looks more dynamic, although I feel the second composition best shows the theme of home and belonging.

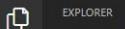


2021/12/10 Explore compositions for the hermit crab idea. I tried to include different orientations of the coral tree, the hermit crab, and the paper boat, and see which one works out best.

I chose the fourth composition for the half-page sketch, but later realized it doesn't have a good use of space that some parts look bored and empty. Since it isn't hard to switch composition when working in 3D, I may consider the third composition for the final piece.

ISP Step 4

Final work



EXPLORER

OPEN EDITORS

GROUP 1

nest_sdf.gsls

GROUP 2

Static GLSL Preview

AVI4M-ISP

.ref

glsl2cpp

images

modeling

bird-nest

nest_sdf.gsls

preliminary

dragonfly_1.glass.gsls

dragonfly_1_sdf.gsls

flower_01.glass.gsls

flower_01_sdf.gsls

flower_02.glass.gsls

flower_02_sdf.gsls

flower_03.glass.gsls

flower_03_sdf.gsls

fruit_01.glass.gsls

fruit_01_sdf.gsls

fruit_02.glass.gsls

fruit_02_sdf.gsls

fungi_1.glass.gsls

group_01.glass.gsls

group_01_sdf.gsls

leaf_01.glass.gsls

leaf_01_sdf.gsls

README.md

root_01_sdf.gsls

> models

> octatree

> octatree_buffer

> webgl-test

.bat

.gitignore

.gsls

.glsl.cpp

```

modeling > bird-nest > nest_sdf.gsls
149
150 }
151 for (float i=0.; i<8.; i++) { // upper wires
152     float t = 1.2 + 0.5 * (i+0.5) / 8.;
153     float r = 1.6*sin(t)*(0.9+0.2*rand(seed));
154     float z = pow(1.0-cos(t),1.4)-1.0+0.06*sin(6.0*atan(p.y,p.x));
155     float rot_phi = 0.02*PI*(-1.0+2.0*rand(seed));
156     vec3 q = rotx(rot_phi)*(p-vec3(0.,0.,z));
157     float d1 = sdTorus(q, r, 0.04);
158     if (col_required) col1 = mix(vec3(0.55,0.35,0.25), vec3(0.95,0.85,0.7), rand(
159         res = cmin(res, vec4(col1, d1));
160     }
161 for (float i=0.; i<18.; i++) { // cross wires
162     float t1 = 2.0*PI * i / 18.;
163     float t2 = t1+PI + 0.4*PI*(-1.+2.*vanDerCorput(i+100.,2.));
164     vec3 v1 = vec3((1.0+0.3*rand(seed))*vec2(cos(t1), sin(t1)), 0.2*rand(seed));
165     vec3 v2 = vec3((1.0+0.3*rand(seed))*vec2(cos(t2), sin(t2)), 0.2*rand(seed));
166     vec3 q = p + vec3(0,0, 0.7*sqrt(max(2.6-dot(p.xy,p.xy),0.))-0.12);
167     float d1 = sdSegment(q, v1, v2) - 0.03;
168     if (col_required) col1 = mix(vec3(0.6,0.6,0.55), vec3(0.4,0.4,0.25), rand(
169         res = cmin(res, vec4(col1, d1));
170     }
171     return res;
172 }
173
174
175 vec4 map(vec3 p, bool col_required) {
176     vec4 d = mapMost(p, col_required);

```

PROBLEMS

OUTPUT

DEBUG CONSOLE

TERMINAL

Windows PowerShell

Copyright (C) Microsoft Corporation. All rights reserved.
2021/12/29 Model the bird nest.
 Try the new cross-platform PowerShell <https://aka.ms/pscore6>

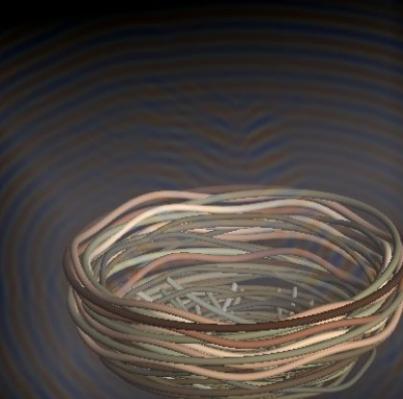
PS With the powerful marching cube algorithm, I pay less attention to the performance of the shader. In this model, I used a loop to generate every individual straw procedurally and put them together.



Static GLSL Preview

216 MB (3-4112)

...



robin-e1431602899326.jpeg - Windows Photo...

File Print E-mail Burn Open

?



> OUTLINE

> TIMELINE

master* 0 0 △ 0



nest_sdf.gsls bird_sdf.gsls

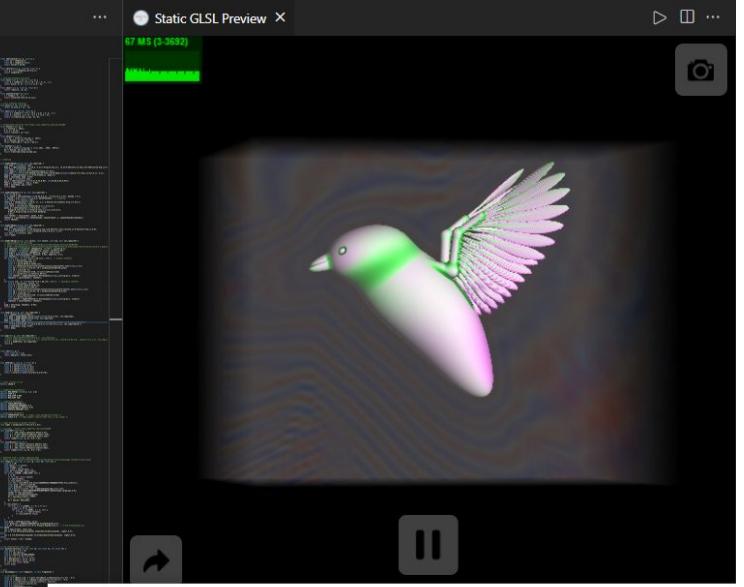
```
modeling > bird-nest > bird_sdf.gsls
161     vec4 feather = mapBirdFeather(1.0*transpose(mat3(u,v,w))*(p-q)/s, true)*s;
162     feathers = cmin(feathers, feather);
163 }
164 wing = smin(wing, feathers, 0.05);
165 return wing;
166 }
167
168 vec4 mapBird(vec3 p, bool col_required) {
169     p.y = length(vec2(p.y,0.001));
170     vec4 head = mapBirdHead(roty(0.2)*(p-vec3(-0.75,0,0.75)), col_required);
171     vec4 body = mapBirdBody(roty(0.7)*p, col_required);
172     body = smin(head, body, 0.2);
173     vec4 wing = mapBirdWing(rotz(-0.2)*roty(-0.25)*rotx(0.2)*(p-vec3(-0.1,0.2,0.6))/0.7,
174                             vec3(0.5,0.0,0.05),vec3(0.4,0.05,0.7),vec3(0.7,0.1,1.1), col_required)*0.7;
175     body = smin(body, wing, 0.05);
176     return body;
177 }
178
179
180 vec4 map(vec3 p, bool col_required) {
181     //return mapBirdFeather(p+vec3(0,0,1), col_required);
182     //return mapBirdWing(p-vec3(-1,0,-1), vec3(0.5,0.0,0.15), vec3(0.4,0.05,0.8), vec3(0.7,0.1,1.2), col_required);
183     vec4 d = mapBird(p, col_required);
184     return d;
185 }
186
187
188 float sdf(vec3 p) {
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2022/01/02 I decided to model the subject first, which is the bird.

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I modeled the torso of the bird with deformed ellipsoids. Since I may try different compositions, I pay attention to the wing and considered stretched and folded wings. After some research, I learned about the bones and primary/secondary feathers in a bird's wing and modeled them accordingly. I haven't added the skin and the converts of the wings yet.



nest_sdf.glsL

bird_sdf.glsL M X

```
241     return wing;
242 }
243
244 vec4 mapBird(vec3 p, bool col_required) {
245     p.y = length(vec2(p.y, 0.001));
246     vec4 head = mapBirdHead(roty(0.2)*(p-vec3(-0.75, 0, 0.75)), col_required);
247     vec4 body = mapBirdBody(roty(0.7)*p, col_required);
248     body = smin(head, body, 0.2);
249     vec3 rzyx = mix(vec3(-0.2, -0.3, 0.3), vec3(-1.2, 0.2, 0.9), 0.2);
250     vec4 wing = mapBirdWing(rotx(rzyx.x)*roty(rzyx.y)*rotx(rzyx.z)*(p-vec3(-0.1, 0.2, 0.6))*vec3(1, -1, 1)/0.7,
251                             vec3(0.5, 0.0, 0.05), vec3(0.4, 0.05, 0.7), vec3(0.7, 0.1, 1.1), col_required)*0.7;
252     body = smin(body, wing, 0.05);
253     return body;
254 }
255
256
257 vec4 map(vec3 p, bool col_required) {
258     //return mapBirdFeather(p+vec3(0,0,1), col_required);
259     //return mapBirdWing(p-vec3(-1,0,-1), vec3(0.5,0.0,0.15), vec3(0.4,0.05,0.8), vec3(0.7,0.1,1.2), col_required);
260     vec4 d = mapBird(p, col_required);
261     return d;
262 }
263
264 float sdf(vec3 p) {
265     const float sc = 1.0;
266     return map(p/sc, false).w*sc;
267 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell

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Try the new cross-platform PowerShell <https://aka.ms/pscore6>

PS D:\Coding\Github\AVI4M-ISP>

2022/01/03 Add skin to the wings of the bird. Model its tail.

Static GLSL Preview X

17 MS (2-42782)



img_6945.webp - Windows Photo Viewer

File Print E-mail Burn Open



nest_sdf.gsl bird_sdf.gsl M ●

```

modeling > bird-nest >  bird_sdf.gsl
189 |
190 > vec4 mapBirdBody(vec3 p, bool col_required) { ...
191 }
192 |
193 > vec4 mapBirdWing(vec3 p, vec3 joint1, vec3 joint2, vec3 tip, bool col_required) { ...
194 }
195 |
196 > vec4 mapBird(vec3 p, bool col_required) {
197   p.y = length(vec2(p.y,0.001));
198   vec4 head = mapBirdHead(roty(0.2)*(p-vec3(-0.75,0,0.75)), col_required);
199   vec4 body = mapBirdBody(roty(0.7)*p, col_required);
200   body = smin(head, body, 0.2);
201   vec4 leg = mapBirdLeg(roty(-0.3)*(p-vec3(-0.1,0.2,-0.4))*vec3(1,-1,1)/0.7,
202     | vec3(-0.3,0,-0.2), vec3(-0.05,0,-0.4), vec3(-0.2,0,-0.55), 0.12, -0.4, 0.05*PI, 0.1*PI, col_required)*0.7;
203   body = smin(body, leg, 0.2);
204   vec3 rzyx = mix(vec3(-0.2,-0.3,0.3), vec3(-1.2,0.2,0.9), 0.2);
205   vec4 wing = mapBirdWing(rotz(rzyx.x)*roty(rzyx.y)*rotx(rzyx.z)*(p-vec3(-0.1,0.25,0.55))*vec3(1,-1,1)/0.7,
206     | vec3(0.5,0.0,0.05),vec3(0.4,0.05,0.7),vec3(0.7,0.1,1.1), col_required)*0.7;
207   body = smin(body, wing, 0.05);
208   body = smin(body, wing, 0.05);
209   return body;
210 }

211 |
212 > vec4 map(vec3 p, bool col_required) {
213   //return mapBirdFeather(p+vec3(0,0,1), col_required);
214   //return mapBirdWing(p+vec3(-1,0,-1), vec3(0.5,0.0,0.15), vec3(0.4,0.05,0.8), vec3(0.7,0.1,1.2), col_required);
215   vec4 d = mapBird(p, col_required);
216   return d;
217 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

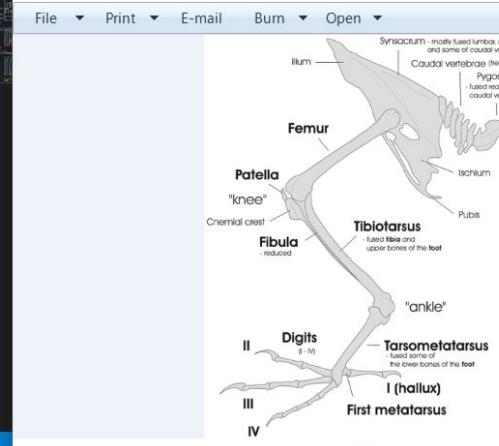
Try the new cross-platform PowerShell <https://aka.ms/pscore6>

PS D:\Coding\Github\AVI4M-ISP>

Model the feet of the bird.



Bird_leg_and_pelvic_girdle_skeleton_EN.gif - Windows Photo Viewer



File Edit Selection View Go Run Terminal Help

bird_sdf.gsl - AVI4M-ISP - Visual Studio Code

nest_sdf.gsl bird_sdf.gsl M

modeling > bird-nest > bird_sdf.gsl

```
297 }  
298  
299 vec4 mapBird(vec3 p, bool col_required) {  
300     p.y = length(vec2(p.y, 0.02));  
301     vec4 head = mapBirdHead(roty(0.2)*(p-vec3  
302         0.0, 0.0, 0.0), col_required);  
303     vec4 body = mapBirdBody(roty(0.7)*p, col_<br>  
304         _required);  
305     body = smin(head, body, 0.2);  
306     vec4 leg = mapBirdLeg(roty(-0.3)*(p-vec3  
307         0.0, 0.0, 0.0), col_required);  
308     leg = smin(body, leg, 0.2);  
309     vec3 rzyx = mix(vec3(-0.2, 0.3, 0.3), vec3  
310         0.0, 0.0, 0.05), rotz(rzyx.x)*roty  
311         (0.5, 0.0, 0.05);  
312     body = smin(body, wing, 0.05);  
313     return body;  
314 }  
315  
316 vec4 map(vec3 p, bool col_required) {  
317     //return mapBirdFeather(p+vec3(0,0,1), col_<br>  
318         _required);  
319     return mapBird(p, col_required);  
320 }  
321  
322 float sdf(vec3 p) {  
323     const float sc = 1.0;
```

D:\.ply [vn=322985, fn=645512, surface] normal=ccw 624x361 12.5fps

Static GLSL Preview

17 MS (4-30040)

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
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PS D:\Coding\GitHub\AVI4M-ISP>

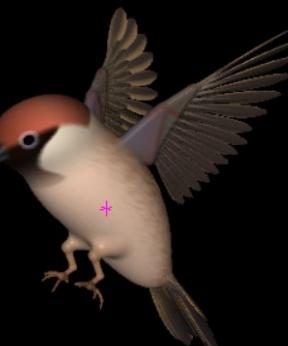
Finished sparrow model with color.

Microsoft Visual Studio Debug Console

```
16 16 16 32 epsilon=7.8e-06  
sample octree root 13.9 ms  
subdivide octree layer 1/5 - 10.7 ms  
subdivide octree layer 2/5 - 61.4 ms  
subdivide octree layer 3/5 - 243.8 ms  
subdivide octree layer 4/5 - 992.5 ms  
subdivide octree layer 5/5 - 3981.2 ms  
5753.2ms, 916406 evaluations  
645964 triangles => 322985 vertices, 645964 faces  
2184.0ms coloring
```

360_F_107662910_61dGOL84WhlazoFIDpbqQffM4wbCpG8.jpg - Windows P...

File Print E-mail Burn Open



```
nest_sdf.glsL
modeling > bird-nest > bird_sdf.glsL
102
103 j
104
105 > vec4 mapBirdBody(vec3 p, bool col_required) { ...
106 }
107
108 > vec4 mapBirdWing(vec3 p, vec3 joint1, vec3 joint2, vec3 tip)
109 }
110
111 > vec4 mapBird(vec3 p, bool col_required) {
112     p.y = length(vec2(p.y, 0.02));
113     vec4 head = mapBirdHead(roty(0.2)*(p-vec3(-0.75, 0, 0.75)));
114     vec4 body = mapBirdBody(roty(0.7)*p, col_required);
115     body = smin(head, body, 0.2);
116     //return body;
117     vec4 leg = mapBirdLeg(roty(-0.3)*(p-vec3(-0.1, 0.2, -0.4))
118         | vec3(-0.25, 0, -0.15), vec3(-0.05, 0, -0.4), vec3(-0.2
119         | body = smin(body, leg, 0.2);
120         | vec3(-0.2, -0.3, 0.3), vec3(-1.2, 0.2, 0.9)
121         | vec3 rzyx = mix(vec3(-0.2, -0.3, 0.3), vec3(-1.2, 0.2, 0.9)
122         | vec3 wing_p = rotz(rzyx.x)*roty(rzyx.y)*rotx(rzyx.z)*(p
123         | vec4 wing = mapBirdWing(wing_p/0.7,
124             | vec3(0.5, 0.0, 0.05), vec3(0.4, 0.05, 0.7), vec3(0.7, 0.
125             | body.wing * 0.15*exp(-8.0*p.wing));
126
127 }
```

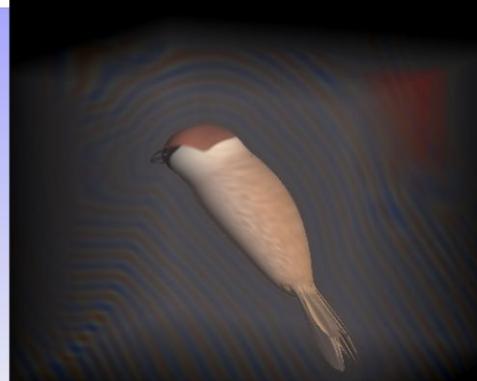
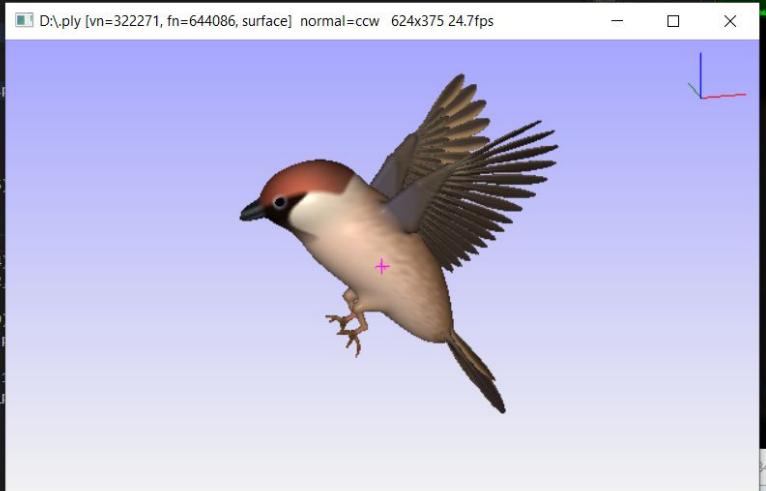
2022/01/05 Fix some issues in the sparrow model.

- Reddish color at the root of the feathers

- "Pole" on the back texture

- Stripes in the root of the wings

The foot of the sparrow model is still very different from the one in the photo. My plan for tomorrow is to fix it and start modeling some plants.



4WhtlazoFIDpbqQffM4wbCpG8.jpg - Windows P...

```
Microsoft Visual Studio Debug Console
16 16 16 32 epsilon=7.8e-06
sample octree root - 53.8 ms
subdivide octree layer 1/5 - 11.2 ms
subdivide octree layer 2/5 - 48.0 ms
subdivide octree layer 3/5 - 245.0 ms
subdivide octree layer 4/5 - 956.5 ms
subdivide octree layer 5/5 - 4387.8 ms
6190.9ms, 914408 evaluations
644550 triangles => 322271 vertices, 644086 faces
2687.7ms coloring

D:\Coding\Github\Release\Graphics.exe (process 22428) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```



nest_sdf.gsls
modeling > bird-nest > bird_sdf.gsls

```
299
300 vec4 mapBird(vec3 p, bool col_required) {
301     float y0 = p.y;
302     p.y = length(vec2(p.y, 0.02));
303     vec4 head = mapBirdHead(rotY(0.2)*(p-vec3(-0.75, 0, 0.75))/0.9, col_required)*vec4(1, 1, 1, 0.9);
304     vec4 body = mapBirdBody(p);
305     body = smin(head, body);
306     vec4 leg = mapBirdLeg(p);
307     vec3 rzyx = mix(vec3(0, 0, 1), vec3(-0.6, 0, 0.17-0.05*y0));
308     body = smin(body, leg);
309     //return body;
310     vec3 rzyx = mix(vec3(0, 0, 1), vec3(-0.6, 0, 0.17-0.05*y0));
311     vec3 wing_p = rotY(rzyx);
312     vec4 wing = mapBirdWing(wing_p);
313     vec3 rzyx = mix(vec3(0, 0, 1), vec3(0.5, 0, 0.17-0.05*y0));
314     body = smin(body, wing);
315     return body;
316 }
317
318
319
320 vec4 map(vec3 p, bool
321 //return mapBirdF
322 //return mapBirdW
323 return mapBird(p,
324
325
326 }
```

PROBLEMS OUTPUT DEBUG CONSOLE

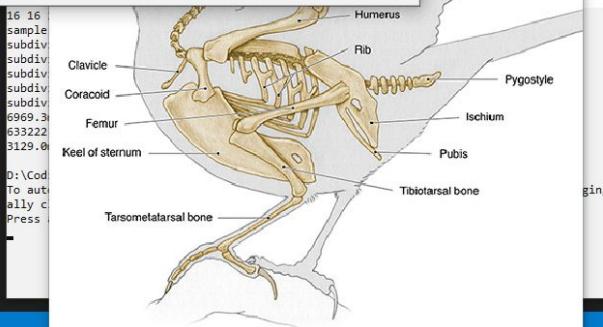
Windows PowerShell

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PS D:\Coding\Github\AVI4M-ISP>

2022/01/06 Fix sparrow feet. This took longer than what I expected.

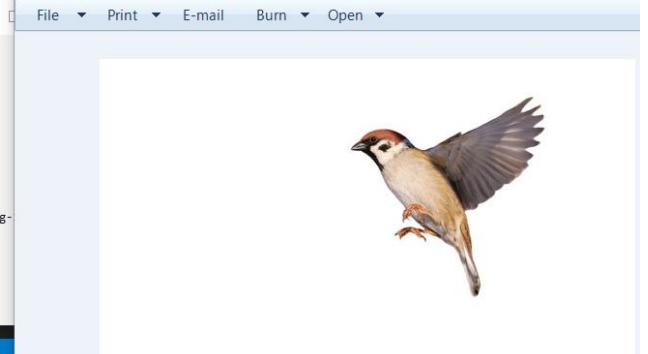


Static GLSL Preview

44 M5 (4-35342)



360_F_107662910_61dGOL84WhtlazoFIDpbqQffM4wbCpG8.jpg - Windows Photo Viewer



nest_sdf.glsl

bird_sdf.glsl

berries.glsl

group_01_sdf.glsl

```
modeling > bird-nest > berries.glsl
104    br.x = 1.0;
105    br.y = 0.85 - 0.45*exp(-sqr(1.2*(p.x-1.5))) - 0.3*exp(-sqr(2.5*(p.x+1.6)));
106    br.z = 0.08;
107    float d0z = 0.0;
108    float d2e = abs(br.y*sqrt(smax(br.x*br.x-p.x*p.x,0.0,0.1))/br.x - abs(p.y));
109    float veins = asin(0.9*sin((16.0+2.0*p.x)*(p.x-0.5*abs(p.y)-0.5*pow(abs(p.y),1.3)+0.2*pow(d2e,0.4))+sign(p.y)*0.4*PI));
110    float veins_fade = (1.0-exp(-(6.0;br.y)*abs(p.y))) * (1.0-exp(-(2.0;br.y)*d2e)) * (exp(-0.2*p.x));
111    d0z += 0.01 * veins*veins_fade;
112    d0z += 0.05 * smax(veins_fade*(veins-0.9),0.0,0.1);
113    float midrib = abs(p.y)-1.0;
114    float midrib_fade = (1.0-exp(-4.0;br.y)*abs(p.y)) * (exp(-0.4*p.x));
115    d0z += 0.05 * midrib*midrib_fade;
116    vec3 q = p;
117    q.z -= 0.5*(1.0-exp(-0.5*length(vec2(p.y,0.01))));
118    q.z -= 0.1*cos(p.x);
119    vec4 leaf = vec4(0,0,0, sdEllipsoid(q+vec3(0,0,d0z), br));
120    if (col_required) leaf.xyz = mix(vec3(0.3,0.45,0.05), vec3(0.55,0.7,0.15), -0.5-20.0*d0z);
121    vec4 stem = vec4(0.3,0.35,0.05, sdSegment(q-vec3(0,0,-0.00), vec3(-1.8,0,0), vec3(1.0,0,0)) - 0.06*exp(-0.2*abs(p.x+1.8)));
122    return smin(leaf, stem, mix(0.05,0.001,clamp(p.x+1.8,0.,1.)));
123 }
124
125 vec4 mapBerries(vec3 p, bool col_required) {
126     vec4 res = vec4(0, 0, 0, 1e8);
127     return mapBerriesFruit(p, col_required);
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell

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PS D:\Coding\Github\AVI4M-ISP>

2022/01/07 Start modeling plants.

Model a leaf. It is more from imagination than from observation.

Static GLSL Preview x

19 MS (2-473)



Duchesnea indica-1024x837.jpg - Windows Photo Viewer

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File Edit Selection View Go Run Terminal Help Static GLSL Preview - AVI4M-ISP - Visual Studio Code

nest_sdf.gsls bird_sdf.gsls berries.gsls group_01_sdf.gsls

modeling > bird-nest > berries.gsls

```
121
122 vec4 mapBerriesFruit(vec3 p, bool col_required) {
123     p += vec3(0,0,0.5);
124     float r = length(p.xy), a = atan(p.y, p.x);
125     float x, y; vec3 q;
126     // fruit
127     q = vec3(r*cos(inf(asin(0.97*sin(2.5*a))/2.5)), p.z);
128     vec4 fruit = vec4(0,0,0, sdEllipsoid(q-vec3(0.4,0,0.68), vec3(0.8+0.1*p.z,1.1,0.95)));
129     if (col_required) {
130         float noise = SimplexNoise3D(4.0*p);
131         fruit.xyz = mix(vec3(0.5,0.05,0.1),vec3(0.8,0.1,0.05),
132                         smootherstep(0.6*(q.z+1.0*(r-0.9))-0.5+smax(q.z-1.2,0.0,0.1)));
133         + vec3(0.15)*(-noise+0.5);
134         fruit.xyz = mix(fruit.xyz, vec3(0.8,0.8,0.0), 0.25+0.1*p.z);
135         fruit.xyz = mix(fruit.xyz, vec3(0.8,0.0,0.5), 0.2);
136     }
137     q = vec3(r*cos(inf(asin(0.95*sin(2.5*a+0.8))/2.5)), p.z);
138     fruit = smin(fruit, vec4( // hair
139         mix(mix(vec3(0.8,0.75,0.0),vec3(0.9,0.85,0.5),smootherstep(r/0.3)), vec3(0.8,0.4,0.0), 0.2),
140         sdEllipsoid(roty(0.2-0.05*cos(3.0*a))*(q-vec3(0.08,0,1.61)), vec3(0.2+0.03*sin(4.0*a),0.12,0.05))), 0.05);
141     // sepal/stem
142     q = vec3(r*cos(inf(asin(0.98*sin(2.5*a-1.2))/2.5), p.z);
143     q -= vec3(0,2,0,0);
144     vec3 br = 1.2*vec3(
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
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PS D:\Coding\Github\AVI4M-ISP>

... Static GLSL Preview x 17 MS (2-1352)

17 MS (2-1352)

Duchesnea indica-1024x837.jpg - Windows Photo Viewer

File Print E-mail Burn Open ?

Modifying a fruit I modeled previously.

The fruit looks weird. I probably need to look at the composition before deciding what change to make.

```
nest_sdf.gsl    bird_sdf.gsl    berries.gsl    liriope.gsl ✘
modeling > bird-nest > liriope.gsl
128     vec4 flower = vec4(mix(vec3(0.65,0.45,0.7), vec3(0.85,0.75,0.95), (3.0*(q1.x-1.0)+0.5)+0.15*sin(5.0*a1)),
129         sdEllipsoid(q1+vec3(1.0,0.0,0.05), vec3(0.45,vec2(0.3+0.1*(q1.x-1.0))));)
130     vec4 d = smin(stem, flower, 0.1);
131     return d;
132 }
133
134 vec4 mapLiriopeFlowers(vec3 p, bool col_required) {
135     p.x += 0.1*cos(p.z);
136     vec4 bound = vec4(1,1,1, max(length(p.xy)-1.0, max(p.z-2.6, -3.5-p.z))), boundw = vec4(0,0,0,0.4);
137     if (bound.w > 0.0) return bound+boundw; // clipping
138     vec4 stem = vec4(0,0,0, sdSegment(p, vec3(0,0,-3.0), vec3(0,0,2))-0.06);
139     if (col_required) {
140         stem.xyz = mix(vec3(0.6,0.35,0.65), vec3(0.9,0.8,0.95), smootherstep((p.z+1.0)/3.0));
141         stem.xyz *= mix(vec3(0.35,0.2,0.25), vec3(1.0), 0.2+0.8*smootherstep((p.z+2.5)/2.5));
142     }
143     float seed = 0.0;
144     for (float t=0.0; t<1.0; t+=1.0/11.0) [
145         float h = mix(-1.5, 2.0, 1.0-pow(1.0-t,1.2));
146         h += 0.5*t*(1.0-t)*(2.0*rand(seed)-1.0);
147         vec3 q = p-vec3(0,0,h);
148         q.xy = rot2(2.0*PI*rand(seed))*q.xy;
149         float elev = 0.05*PI + 0.15*PI*t + mix(0.05*PI, 0.2*PI, rand(seed));
150         float sc = 0.08*(1.0+0.3*t-1.3*t*) + mix(0.25, 0.4, smootherstep(0..1,(p.x+1.0)/2.0)) * (1.0+0.1*rand(seed));
151         vec4 d = mapLiriopeFlowersLayer(elev, q/sc, col_required)*vec4(1,1,1,sc);
152         if (col_required) d.xyz = mix(d.xyz, mix(vec3(0.65,0.45,0.75), vec3(0.8,0.7,0.9), t), 0.2);
153         stem = smin(stem, d, 0.05);
154     ]
155     //stem = mix(stem, bound+boundw, smoothstep(0.,1.,(bound.w+boundw.w)/boundw.w)); // smooth clipping
156     return stem;
157 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

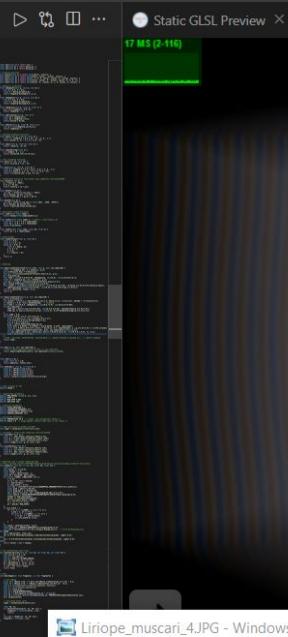
Windows PowerShell

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2022/01/08 Model another type of plant that surrounds the bird nest.
Try the new cross-platform PowerShell <https://aka.ms/pscoreo>

PS D:\Coding\Github\AVI4M-ISP>

Google tells me the name of this plant is “liriope”.



File Edit Selection View Go Run Terminal Help

Static GLSL Preview - AVI4M-ISP - Visual Studio Code

nest_sdf.gsls bird_sdf.gsls berries.gsls liriope.gsls

```
modeling > bird-nest > liriope.gsls
158 vec4 mapLiriopeLeaf(vec3 p, bool col_required) {
159     p.z -= 0.4*cos(0.25*PI*p.x);
160     float bound = sdSegment(p,vec3(-2.0,0,0),vec3(2.0,0,0))-0.5, boundw = 0.3;
161     if (bound > 0.0) return vec4(1,0,0, bound+boundw); // clipping
162     float near_stem = 1.0-0.3/(1.0+pow(abs(0.5*(p.x+2.0)),4.0));
163     float w = pow(max(1.0-sqr(p.x/2.0), 0.0), 0.5) * (0.2/(1.0+sqr(0.3*(p.x-0.5)))) * near_stem;
164     float u = clamp(p.y/w, -1.0, 1.0);
165     float thickness = 0.2*w * pow(max(1.0-u*u,0.0),0.5) * (1.0+sqr(p.y/0.3)) * (exp(-0.1*(p.x+2.0))) / pow(near_stem, 3.5);
166     float veins = 0.03*cos(15.0*u)*(1.0-u*u);
167     float zd = 0.05*sqrt(1.0+sqr(p.y/0.1));
168     vec4 leaf = vec4(0,0,0, sdSegment(p.yz+vec2(0,zd), vec2(-w,0), vec2(w,0)) - thickness * (1.0+veins));
169     if (col_required) {
170         leaf.xyz = pow(mix(vec3(0.35,0.55,0.25), vec3(0.65,0.8,0.5), (p.x+2.0)/4.0), vec3(1.8));
171         leaf.xyz = mix(leaf.xyz, vec3(0.45,0.65,0.3), 1.0-20.0*zd) * vec3(1.0+1.0*veins);
172     }
173     return leaf;
174 }
175
176
177 vec4 map(vec3 p, bool col_required) {
178     //return mapLiriopeFlowersLayer(0.2*PI, p, col_required);
179     //return mapLiriopeFlowers(p/0.8, col_required)*vec4(1,1,1,0.8);
180     return mapLiriopeLeaf(p, col_required);
181 }
182
183
184 float sdf(vec3 p) {
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
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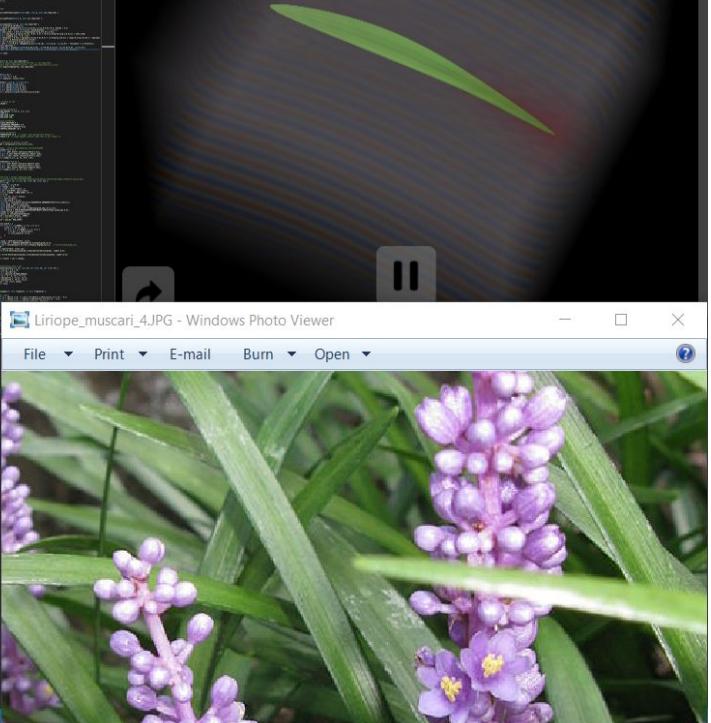
Try the new Windows Terminal at [https://aka.ms/WindowsTerminal](#)

PS D:\Coding\Github\AVI4M-ISP []

Model a blade of leaf of the liriope.

It can be handy to put these components together by writing code. My plan is to convert these models to mesh, layout them in Blender, and write a script to export the transformation matrices to GLSL code.

Static GLSL Preview X
17 MS (2.94)



User Perspective
(1) Collection | Torus

View Text Edit Format Templates Text Register Run

```

65 matrix /= matrix[3][3] # normalize scaling
66 assert not np.any(matrix[3][0:3]) # no perspective
67 assert matrix[3][3] == 1.0
68
69 # get translation components
70 translate = matrix.T[3][0:3]
71
72 # get scaling components
73 matrix3 = matrix[0:3, 0:3]
74 scale = np.zeros((4)) # |sx|, |sy|, |sz|, reflection
75 scale[0] = np.linalg.norm(matrix3.T[0])
76 scale[1] = np.linalg.norm(matrix3.T[1])
77 scale[2] = np.linalg.norm(matrix3.T[2])
78 determinant = np.linalg.det(matrix3)
79 assert abs(determinant) > EPSILON
80 scale[3] = determinant / np.prod(scale[0:3])
81 assert 1.0-EPSILON < abs(scale[3]) < 1.0+EPSILON
82 clean_round_arr(scale, 1.)
83 clean_round_arr(scale, -1.)
84
85 # get rotation components
86 rotmat = np.matmul(matrix3, np.diag(1.0/scale[0:3]))
87 assert np.linalg.norm(np.matmul(rotmat, rotmat.T) - np.identity(3)) < EPSILON # orthogonal
88 rotate_mode = 'XYZ'
89 angles = get_euler_angles(rotmat, rotate_mode)
90
91 print(name, translate, scale, angles*180/PI, rotate_mode)

```

Console Autocomplete

Command History: Up/Down Arrow
Cursor: Left/Right Home/End
Remove: Backspace/Delete
Execute: Enter
Autocomplete: Ctrl-Space
Zoom: Ctrl +/-, Ctrl-Wheel

2022/01/09 I use Blender's built-in Python IDE to write a script that obtains the transformation matrices of the objects and extract information about translation, rotation, and scaling transformations. I plan to do the handy layout in Blender and use the script to export GLSL code.

2022/01/09 I use Blender's built-in Python IDE to write a script that obtains the transformation matrices of the objects and extract information about translation, rotation, and scaling transformations. I plan to do the handy layout in Blender and use the script to export GLSL code.

Saved "get-object-transform.blend"
 bpy.ops.text.run_script()
 bpy.ops.text.run_script()
 bpy.ops.text.run_script()
 bpy.ops.text.run_script()
 bpy.ops.text.run_script()

Text: Internal

C:\Program Files\Blender Foundation\Blender\blender.exe

```

[-0.82935661 0. 1.2773515 ]
[2.33404406 3.05599546 2.71519761 1. ]
[ 31.70262379 -19.02400507 13.43062626]

Info: Saved "get-object-transform.blend"
===== Get Transform =====
bird
print transform[[-1.34930837 2.5143497 4.29470587]
[1. 1. 1. 1.]
[ 0. 0. 65.05182863]
Cube
[ 4.35002148e-04 -3.72393668e-01 9.91624713e-01]
[1.01254132 1.00851562 1.46289643 1. ]
[-6.98304228 -8.40115498 11.99999993]
Torus
[-0.82935661 0. 1.2773515 ]
[2.33404406 3.05599546 2.71519761 1. ]
[ 31.70262379 -19.02400507 13.43062626]

```

Scene

Collection
Camera
Cube
Light
Torus

Current File
Brushes
Cameras
Collections
Images
Lights
Line Styles

Torus

Transform

Location X	-0.82936m
Y	0m
Z	1.2774m
Rotation X	31.7°
Y	-19°
Z	13.4°
Scale X	2.334
Y	3.056
Z	2.715
Rotation Mode	XYZ Euler
Delta Location X	0m
Y	0m
Z	0m
Delta Rotation X	0°
Y	0°

Scrollbar Set Selection Call Menu

Text: Internal

Tris:197,130 | Objects:0/5 | Mem: 61.9 MB | v2.80.75

File Edit Selection View Go Run Terminal Help

nest_sdf.gsl bird_sdf.gsl berries.gsl liriope.gsl M export_linear_trans

nest_sdf.gsl modeling... 132 } 133 }

bird_sdf.gsl modeling... 134 > vec4 mapLiriopeFlowers(vec3 p, bool col_required) { 135 float bound = p.z/(0.25*PI); 136 if (bound > 0.0) return vec4(1.0,0,0,bound+boundw); // clipping 137 float near_sdf = 1.0*p.z/(1.0+pow((1.0+0.6*(p.x+2.0)),4.0)); 138 float far_sdf = 1.0*p.z/(1.0+pow((1.0+0.6*(p.x+2.0)),4.0)); 139 float w = 0.01*cos(15.0*p.y)*exp(-0.01*p.z); 140 leaf.w += 0.01; 141 leaf.xyz = pow(mix(vec3(0.35,0.55,0.25), vec3(0.65,0.8,0.5), (p.x+2.0)/10.0), 4.0); 142 leaf.xyz = mix(leaf.xyz, vec3(0.45,0.65,0.3), 1.0-20.0*zd) * vec3(1.0); 143 leaf.w += 0.01;

berries.gsl

nest_sdf.gsl

liriope.gsl M

nest_sdf.gsl modeling... 161 if (bound > 0.0) return vec4(1.0,0,0,bound+boundw); // clipping 162 float near_sdf = 1.0*p.z/(1.0+pow((1.0+0.6*(p.x+2.0)),4.0)); 163 float far_sdf = 1.0*p.z/(1.0+pow((1.0+0.6*(p.x+2.0)),4.0)); 164 float w = 0.01*cos(15.0*p.y)*exp(-0.01*p.z); 165 leaf.w += 0.01; 166 leaf.xyz = pow(mix(vec3(0.35,0.55,0.25), vec3(0.65,0.8,0.5), (p.x+2.0)/10.0), 4.0); 167 leaf.xyz = mix(leaf.xyz, vec3(0.45,0.65,0.3), 1.0-20.0*zd) * vec3(1.0); 168 leaf.w += 0.01;

mapLiriopeGroup01.blend

gsl2cpp

images

modeling

bird-nest

berries.gsl

bird_sdf.gsl

liriope.gsl M

nest_sdf.gsl

preliminary

dragonfly_1_glass.gsl

dragonfly_1_sdf.gsl

flower_01_glass.gsl

flower_01_sdf.gsl

flower_02_sdf.gsl

flower_03_sdf.gsl

fruit_01_sdf.gsl

fruit_02_sdf.gsl

fungi_1_sdf.gsl

group_01_glass.gsl

group_01_sdf.gsl

leaf_01_sdf.gsl

README.md

root_01_sdf.gsl

OUTLINE

TIMELINE

master++ Python 3.9.1 64-bit 0 △ 1

Static GLSL Preview - AVI4M-ISP - Visual Studio Code

Print 3D - mapLiriopeFlowers

I use the octree-accelerated marching I wrote in the beginning of the break to convert the liriope flowers and leaf models to PLY mesh so I can import them into Blender.

The leaf was too thin and had problems with marching cube initially. I increased the average thickness of the leaf and made its thickness distribute more evenly.

File's units

Units

μm mm cm

in ft m

OK

D:\mapLiriopeLeaf.ply [vn=10928,fn=21852,surface] normal=ccw 624x361 4.2fps

blender/get-object-transform.blender

blender/mapLiriopeGroup01.blend

PS D:\Coding\Github\AVI4M-ISP> git status

On branch master

Changes to be committed:

(use "git reset HEAD <file>" to unstage)

new file: blender/export_linear...

Changes not staged for commit:

(use "git add <file>..." to update what will be committed)

(use "git checkout -- <file>..." to dis...

modified: modeling/bird-nest/l...

modified: octatree_buffer/test...

Print

Top left: Blender viewport rendering of the model

Bottom right: generated GLSL code

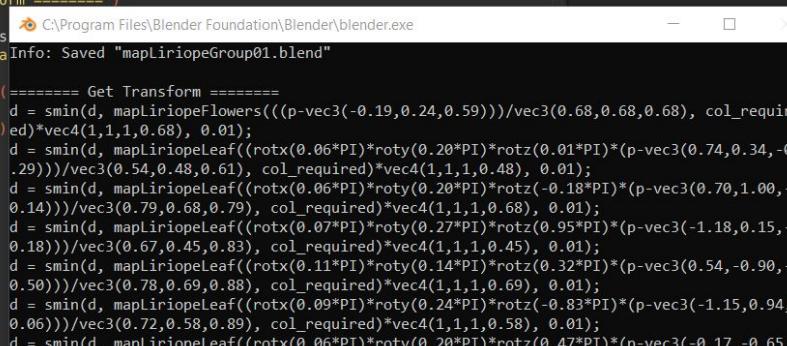
Bottom left: PLY model generated using marching cube

2022/01/10 Test modeling the plant in Blender. Get the GLSL code exporting script working.

98 # export code
 99 code_t = "(p-vec3((c_pos[0:3].inarray).translate(-c_pos[3])))"
 100 code_r = ""
 101 for i in range(3):
 102 if abs(angles[i])<=0.01:
 103 continue
 104 axis = rotate_mode[1]
 105 code_r += "rot"+axis+"((c_pos[0:3].inarray)[0:3])*"+
 106 code_s = "vec3((c_pos[0:3].inarray)[0:3])*"+
 107 code_s1 = "*vec4(1,1,1,0.01)"
 108 code = name+("(*code_r*code_s*code_s1)*"+code_r+code_s+code_s1)
 109 code_full = "d = smin(d, "+code+")
 110 print(code_full)
 111
 112 |
 113
 114 if __name__ == "__main__":
 115
 116 print("===== Get Transform =====")
 117
 118 for obj in bpy.data.objects:
 119 if obj.name in ["Camera",
 120 continue
 121
 122 t===== Get Transform ======

D:\ply [vn=51486, fn=103012, surface] normal=ccw 624x361 0.7tps

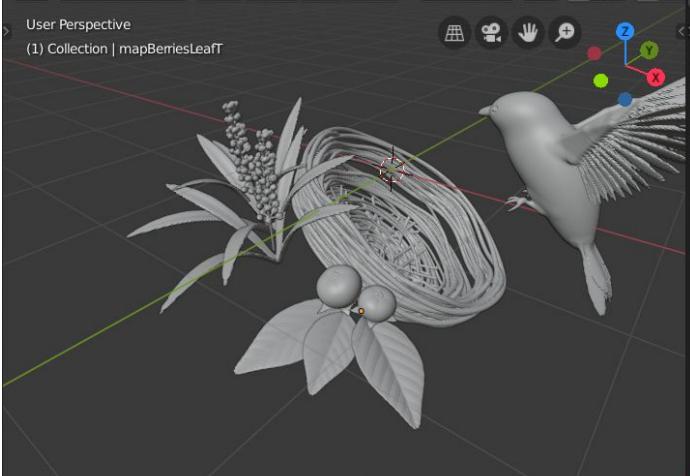
Info: Saved "mapLiriopeGroup01.blend"

Collection | Verts:112,361 | Faces:224,734 | Tris:224,734 | Objects:0/8 | Mem: 140.8 MB | v2.80.75

Console Autocomplete: Ctrl
 Zoom: Ctrl
 Built-in Modules: bpy,
 .utils, bgl, blf, mathutil
 Convenience Imports: from
 Convenience Variables: C
 >>> obj
 Traceback (most recent call last):
 File "<blender console>" in <module>
 NameError: name 'obj' is not defined
 >>> |
 1 objects pasted
 bpy.context.object.scale[0]
 bpy.context.object.scale[1]
 bpy.context.object.scale[2]
 bpy.context.object.location
 bpy.context.object.rotation
 bpy.ops.object.delete(use_global=False)
 Deleted 1 object(s)

User Perspective
(1) Collection | mapBerriesLeafT



3D Viewport Tools: Object Mode, View, Select, Add, Object, Global, Viewport Shading, Viewport Render, Viewport Compositing, Viewport Scripting, Viewport Scene, Viewport Register, Viewport Run, Viewport View Layer.

```

88 assert 1.0-EPSILON < abs(scale[3]) < 1.0+EPSILON
89 clean_round_arr(scale, 1.)
90 clean_round_arr(scale, -1.)
91
92 # get rotation components
93 rotmat = np.matmul(matrix3, np.diag(1.0/scale[0:3]))
94 assert np.linalg.norm(np.matmul(rotmat, rotmat.T) - np.identity(3)) < EPSILON
95 rotate_mode = 'XYZ'
96 angles = get_euler_angles(rotmat, rotate_mode)
97
98 # export code
99 code_t = ("p=vec3(" + string_join_array(translat
100 code_r = ""
101 for i in range(3):
102     if abs(angles[i]) == 0.0:
103         continue
104     axis = rotate_mode[i]
105     code_r += "rot"+axis.lower()+" + \
106             (" + string_join_array([angles[i]/PI]) + \
107             "/vec3(" + string_join_array(scale[0:3])
108 code_s = "+vec4(1,1,1," + string_join_array([min(
109 code_s1 = "+vec4(1,1,1," + string_join_array([min(
110 code = name+"(( "+code_r+code_t+" )"+code_s+", col
111 code_full = "d = smin(d, " + code + ", 0.01);"
112 print(code_full)
113
114
115 if __name__ == "__main__":
116     print("===== Get Transform =")
117     for obj in bpy.data.objects:
118         if not obj.visible_get():
119             continue
120             if obj.name == "Camera":
121                 continue
122             if not obj.type == "MESH":
123                 continue
124             if obj.name == "mapBird":
125                 continue
126             if obj.name == "mapLiriopLeaves5":
127                 continue
128             if obj.name == "mapBerriesLeafT":
129                 continue
130             if obj.name == "mapFlowers1":
131                 continue
132             if obj.name == "mapFlowers2":
133                 continue
134             if obj.name == "mapFlowers3":
135                 continue
136             if obj.name == "mapFlowers4":
137                 continue
138             if obj.name == "mapNest":
139                 continue
140             if obj.name == "mapLiriopLeaves4":
141                 continue
142             if obj.name == "mapLiriopLeaves5":
143                 continue
144             if obj.name == "mapLiriopLeaves6":
145                 continue
146             if obj.name == "mapLiriopLeaves7":
147                 continue
148             if obj.name == "mapLiriopLeaves8":
149                 continue
150             if obj.name == "mapLiriopLeaves9":
151                 continue
152             if obj.name == "mapLiriopLeaves10":
153                 continue
154             if obj.name == "mapLiriopLeaves11":
155                 continue
156             if obj.name == "mapLiriopLeaves12":
157                 continue
158             if obj.name == "mapLiriopLeaves13":
159                 continue
160             if obj.name == "mapLiriopLeaves14":
161                 continue
162             if obj.name == "mapLiriopLeaves15":
163                 continue
164             if obj.name == "mapLiriopLeaves16":
165                 continue
166             if obj.name == "mapLiriopLeaves17":
167                 continue
168             if obj.name == "mapLiriopLeaves18":
169                 continue
170             if obj.name == "mapLiriopLeaves19":
171                 continue
172             if obj.name == "mapLiriopLeaves20":
173                 continue
174             if obj.name == "mapLiriopLeaves21":
175                 continue
176             if obj.name == "mapLiriopLeaves22":
177                 continue
178             if obj.name == "mapLiriopLeaves23":
179                 continue
180             if obj.name == "mapLiriopLeaves24":
181                 continue
182             if obj.name == "mapLiriopLeaves25":
183                 continue
184             if obj.name == "mapLiriopLeaves26":
185                 continue
186             if obj.name == "mapLiriopLeaves27":
187                 continue
188             if obj.name == "mapLiriopLeaves28":
189                 continue
190             if obj.name == "mapLiriopLeaves29":
191                 continue
192             if obj.name == "mapLiriopLeaves30":
193                 continue
194             if obj.name == "mapLiriopLeaves31":
195                 continue
196             if obj.name == "mapLiriopLeaves32":
197                 continue
198             if obj.name == "mapLiriopLeaves33":
199                 continue
199
200             if obj.type == "MESH":
201                 d = smin(d, mapBird((rotY(-0.03*PI)*(p-vec3(1.29,0.00,0.29))/vec3(0.45,0.45,0.45), col
202                     _required)*vec4(1,1,1,0.45), 0.01);
203             d = smin(d, mapLiriopLeaves1((rotX(-0.04*PI)*rotY(0.04*PI)*rotZ(-0.03*PI)*(p-vec3(-0.
204                     75,-0.80,-0.43))/vec3(0.50,0.50,0.50), col_required)*vec4(1,1,1,0.50), 0.01);
205             d = smin(d, mapLiriopLeaves2((rotX(-0.02*PI)*rotY(-0.02*PI)*rotZ(-0.05*PI)*(p-vec3(-0.
206                     54,-0.93,-0.56))/vec3(0.50,0.50,0.50), col_required)*vec4(1,1,1,0.50), 0.01);
207             d = smin(d, mapLiriopLeaves4((rotX(-0.07*PI)*rotY(0.05*PI)*rotZ(-0.04*PI)*(p-vec3(-0.5
208                     0,-0.90,-0.66))/vec3(0.59,0.59,0.59), col_required)*vec4(1,1,1,0.59), 0.01);
209             d = smin(d, mapLiriopLeaves4((rotX(0.02*PI)*rotY(0.03*PI)*rotZ(0.04*PI)*(p-vec3(-0.95,
210                     -0.66,-0.48))/vec3(0.43,0.43,0.51), col_required)*vec4(1,1,1,0.43), 0.01);
211             d = smin(d, mapLiriopLeaves5((rotX(-0.09*PI)*rotY(0.08*PI)*rotZ(-0.09*PI)*(p-vec3(-0.7
212                     1,-0.70,-0.56))/vec3(0.61,0.61,0.61), col_required)*vec4(1,1,1,0.61), 0.01);
213             d = smin(d, mapNest((rotY(-0.18*PI)*(p-vec3(0.14,0.00,-0.40))/vec3(0.58,0.52,0.58),
214                     col_required)*vec4(1,1,1,0.52), 0.01));
214
215             Info: Saved "mapSceneBN01.blend"
```

Text: Internal

Collection | mapBerriesLeafT Verts:441,904 | Faces:716,774 | Tris:885,178 | Objects:0/12 | Mem: 751.9 MB | v2.80.75

User Perspective
(1) Bird | mapLiriopeLeaves5.001

Scene Collection

- Collection
- Bird
- Berries.001
- Berries.002
- Liriope.001
- Liriope.002

mapLiriopeLeaves5.001

mapLiriopeLeaves5.001

Transform

Location X	0.50268m
Y	0.73556m
Z	-0.98899m
Rotation X	12.2°
Y	25.7°
Z	94.6°
Scale X	0.402
Y	0.402
Z	0.550

Rotation Mode XYZ Euler

2022/01/11 Working with layout in Blender.

Blender uses over 3.5 GB of RAM, which made my Windows 10 computer extremely laggy when I switch to or switch from another program.

Playback Keying View Marker

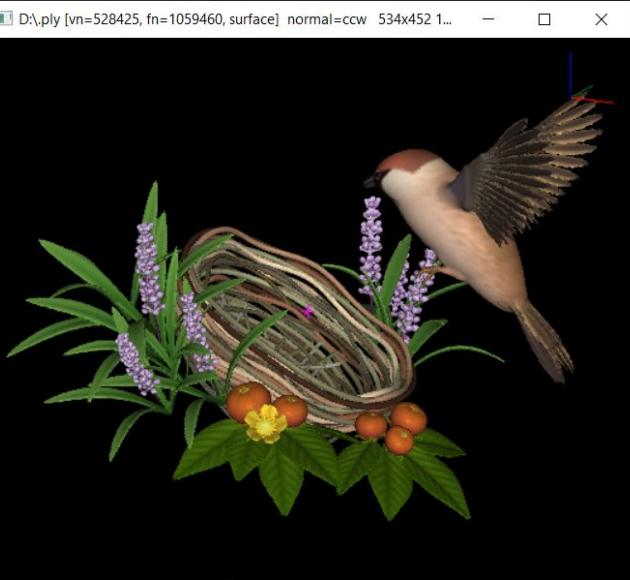
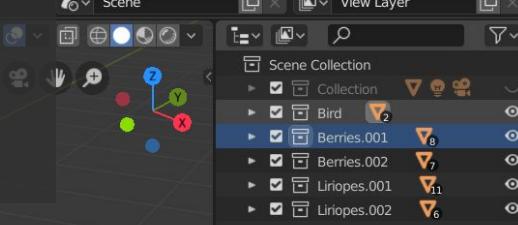
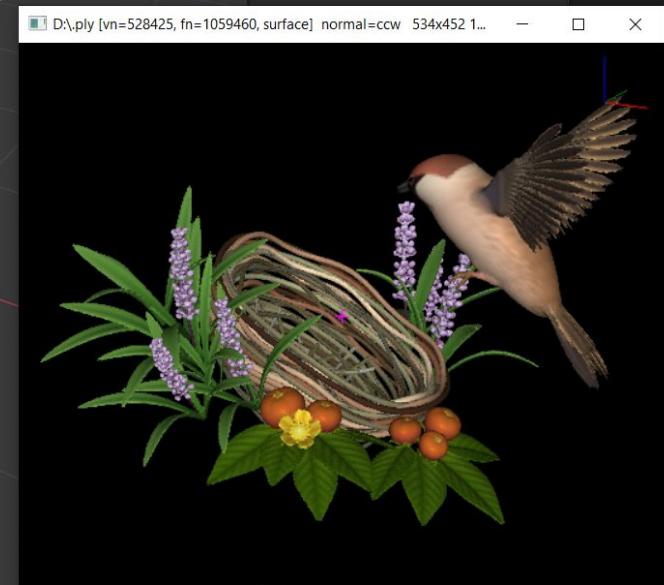
1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 Start: 1 End: 250

Select Box Select Rotate View Object Context Menu

Bird | mapLiriopeLeaves5.001 | Verts:718,303 | Faces:1,269,364 | Tris:1,437,768 | Objects:0/33 | Mem: 599.8 MB | v2.80.75

2022/01/12 I haven't finished creating all components yet. I tried to export a colored model to see what it looks like, and the result is quite satisfying for me.

I'm thinking about what to add behind the bird nest. My sketchbook design was some sprouts, but I feel they may look weird when added to the scene. I think I should work on the baby birds before getting an idea.



Keying View Marker

20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

1 Start: 1 End: 250

and Drop

Pan View

Context Menu

Berries.001 | mapNest | Verts:737,253 | Faces:1,307,384 | Tris:1,475,788 | Objects:0/34 | Mem: 354.2 MB | v2.80.75

Graphics master ▾

▶ Visibility
▶ Viewport Display
▶ Custom Properties

A blue (instead of black) background makes the colored model look nicer.

I think I may not limit to placing it on a dark glossy surface like my mentor artist did. I can try a bright background, like placing it on a piece of white paper, on a wooden shelf, or in front of a window.



File Edit Selection View Go Run Terminal Help

Static GLSL Preview - AVI4M-ISP - Visual Studio Code

EXPLORER

OPEN EDITORS

GROUP 1

- preview.gsls M
- sdf_baby.gsls U
- sdf_bird.gsls M
- common.gsls M
- export_linear_tr... M

GROUP 2

- Static GLSL Preview

AVI4M-ISP

blender

- export_linear_transf... M
- get-object-transform.ble...
- mapLiropeGroupTest01...
- mapSceneBN01.blend
- mapSceneBN01.blend1

glsl2cpp

- glsl2cpp.py
- glslmath.h
- README.md
- ui_pt_glass.cpp
- ui.cpp

images

modeling

bird-nest

- common.gsls M
- preview.gsls M
- sdf_baby.gsls U
- sdf_berries.gsls M
- sdf_bird.gsls M
- sdf_lirope.gsls M
- sdf_nest.gsls M
- sdf.gsls U

preliminary

- dragonfly_1_glass.gsls
- dragonfly_1_sdf.gsls
- flower_01_glass.gsls
- flower_01_sdf.gsls

OUTLINE

TIMELINE

master* 0 0 0 0 0 0

```
30    p = roty(0.05*PI)*p / 0.8;
31    p.z += 1.1;
32    vec3 q;
33    q = roty(-0.05*PI)*(p-vec3(-0.2,0,0));
34    vec4 body = vec4(vec3(0.7,0.45,0.35)-vec3(0.15)*q.x, sdEllipsoid(q, vec3(vec2(0.8*(0.95+0.25*tanh(-p.z))),1.0)));
35    q = roty(-0.3*PI)*(p-vec3(-0.6,0,-0.6));
36    vec4 tail = vec4(0.6,0.4,0.25, sdEllipsoid(q, vec3(0.3,0.3,0.5)));
37    body = smin(body, tail, 0.8);
38    q = p;
39    vec4 neck = vec4(0.75,0.55,0.2, sdSegment(q, vec3(0,0,0), vec3(0,0,1.5))-0.3);
40    body = smin(body, neck, 0.5);
41    q = roty(-0.2*PI)*(p-vec3(-0.1,0,2.1));
42    vec4 head = mapBabyHead(q/0.9, col_required)*0.9;
43    body = smin(body, head, 0.2*(1.0-tanh(3.0*p.x)));
44    q = vec3(p.x, abs(p.y), p.z);
45    vec4 thigh = vec4(0.7,0.45,0.25, sdSegment(q, vec3(-0.3,0.45,-0.7), vec3(0.1,0.7,-0.4))-0.15);
46    vec4 shank = vec4(0.7,0.45,0.25, sdSegment(q, vec3(0.1,0.7,-0.4), vec3(0.0,0.8,-1.1))-(0.12+0.05*tanh(4.0*(q.z+0.8))));
47    vec4 feet = vec4(0.55,0.35,0.3, sdSegment(q, vec3(0,0,0.8,-1.1), vec3(0.3,0.8,-1.3))-0.08);
48    body = smin(body, smin(smin(thigh, shank, 0.2), feet, 0.2), 0.2);
49    return body * vec4(1,1,1,0.8);
50 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell

Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell <https://aka.ms/pscore魄>

PS D:\Coding\Github\AVI4M-ISP>

Model the baby bird.

altricial-5a1d6cf0494ec900371d3348.jpg - Windows Photo Viewer

File Print E-mail Burn Open

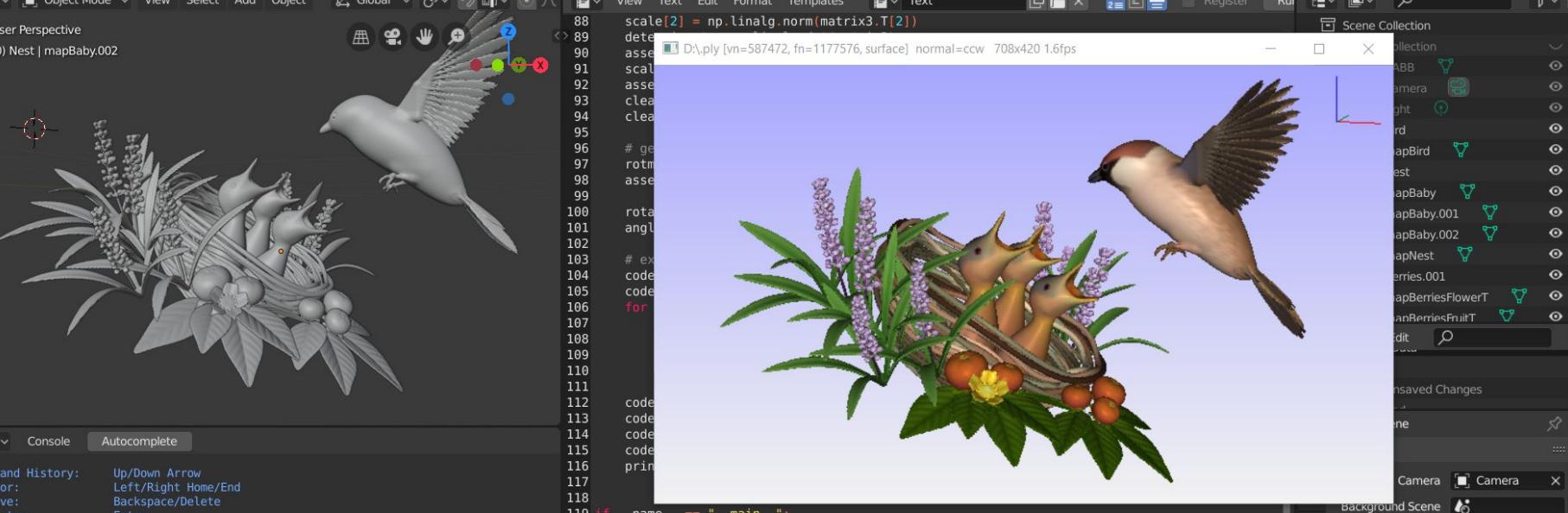


7661.jpg - Windows Photo Viewer

File Print E-mail Burn Open



User Perspective
(0) Nest | mapBaby.002



File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting + Scene

Object Mode View Select Add Object Global View Text Edit Format Templates Text Scene Collection

88 scale[2] = np.linalg.norm(matrix3.T[2])
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119 if __name__ == "__main__":
120
121 print("===== Get Transform =====")
122
123 for obj in bpy.data.objects:
124 if obj.name in ["Camera", "Light"]:
125 continue
126 if not obj.visible_get():
127 continue
128 get_transform_code(obj)
129
130 print(end='\n')
131

Console Autocomplete

Command History: Up/Down Arrow
Cursor: Left/Right Home/End
Remove: Backspace/Delete
Execute: Enter
Autocomplete: Ctrl-Space
Zoom: Ctrl +/-, Ctrl-Wheel
Built-in Modules: bpy, bpy.data, bpy.ops, bpy.props, bpy.types, bpy.context, bpy.utils, bgl, blf, mathutils
Convenience Imports: from mathutils import *; from math import *
Convenience Variables: C = bpy.context, D = bpy.data

```
>>> |  
jected+=raise)  
bpy.ops.object.select_all(action='SELECT')  
Saved "mapSceneBN01.blend"  
bpy.ops.text.run_script()  
bpy.ops.transform.rotate(value=0.0599789, orient_axis='Y', orient_type='GLOBAL', orient_matrix=((1, 0, 0), (0, 1, 0), (0, 0, 1)), orient_matrix_type='GLOBAL', constraint_axis=(False, True, False), mirror=True, use_proportional_edit=False, proportional_edit_falloff='SMOOTH', proportional_size=1, use_proportional_connected=False, use_proportional_projected=False)
```

Add baby birds to the scene.

Text: Internal

Nest | mapBaby.002 | Verts:765,888 | Faces:1,364,642 | Tris:1,533,046 | Objects:0/37 | Mem: 631.7 MB | v2.80.75

User Perspective
(0) Nest | mapEggBrokenS2

Object Mode View Select Add Object Global

View Text Edit Format Templates Text D:\mapEggBrokenBE.ply [vn=21608, fn=43216, surface] normal=ccw 624x361 3.2fps

Scene Collection Collection Camera Light Bird Nest mapBird mapBaby mapBaby.001 mapBaby.002 mapEggBrokenBE mapEggBrokenLE mapEggBrokenS1 mapEggBrokenS2 mapFarBrokenS2

Console Autocomplete

Command History: Up/Down Arrow
Cursor: Left/Right Home/End
Remove: Backspace/Delete
Execute: Enter
Autocomplete: Ctrl-Space
Zoom: Ctrl +/-, Ctrl-Wheel
Builtin Modules: bpy, bpy.data, bpy.ops, bpy.props, bpy.types, bpy.context, bpy.utils, bgl, blf, mathutils
Convenience Imports: from mathutils import *; from math import *
Convenience Variables: C = bpy.context, D = bpy.data

```
>>> |
bpy.ops.transform.rotate(value=0.199818, orient_axis='X', orient_type='GLOBAL', orient_matrix=((1, 0, 0), (0, 1, 0), (0, 0, 1)), orient_matrix_type='GLOBAL', constraint_axis=(True, False, False), mirror=True, use_proportional_edit=False, proportional_edit_falloff='SMOOTH', proportional_size=1, use_proportional_connected=False, use_proportional_projected=False)
bpy.ops.transform.translate(value=(0.0108899, -0.00426816, -0.00950741), orient_type='GLOBAL', orient_matrix=((1, 0, 0), (0, 1, 0), (0, 0, 1)), orient_matrix_type='GLOBAL', mirror=True, use_proportional_edit=False, proportional_edit_falloff='SMOOTH', proportional_size=1, use_proportional_connected=False, use_proportional_projected=False)
```

Text: Internal

Scroller Set Selection Scroller Call Menu

88
89
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92
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94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113 code_s1 = "#vec4(1,1,1,"+string_join_array([min(scale[0:3])])+"")
code = name+"(("+code_r+code_t+)" "+code_s+", col_required)+"+code_s1
code_full = "d = smin(d, " + code + ", 0.01);"
print(code_full)
114
115
116
117
118
119 if __name__ == "__main__":
120
121 print("===== Get Transform =====")
122
123 for obj in bpy.data.objects:
124 if obj.name in ["Camera", "Light"]:
125 continue
126 if not obj.visible_get():
127 continue
128 get_transform_code(obj)
129
130 print(end='\n')
131

2022/01/13 Model bird eggs.

Nest | mapEggBrokenS2 | Verts:831,202 | Faces:1,495,230 | Tris:1,663,634 | Objects:1/41 | Mem: 708.0 MB | v2.80.75

User Perspective
(0) Collection | Plane
Rendering Done

2022/01/14 Test rendering in Blender Cycles.

I'm a little surprised (yet worried) that the model appears nicer when without glass. When rendered outside glass, it look cartoon style yet has light and occlusion. It appears odd when combined with the realism of the refraction of glass.



I may need to talk to my teacher about whether I can do them without glass. If I don't do glass, I may explore different materials and lighting.

Even though I don't think I finished modeling this one yet, my plan for tomorrow is to start modeling the second one, or, the hermit crab one.

Playback ▾ Keying ▾ View Marker

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Collection | Plane | Verts:831,210 | Faces:1,495,235 | Tris:1,663,644 | Objects:0/44 | Mem: 1.1 GB | v2.80.75

File Edit Selection View Go Run Terminal Help

sdf_boat.gsl - AV14M-ISP - Visual Studio Code

EXPLORER

OPEN EDITORS

GROUP 1

- preview.gsls U
- sdf_bird.gsls modeling...
- sdf_boat.gsls modeling...**
- export_linear_transform.py 1

GROUP 2

- Static GLSL Preview

AV14M-ISP

- .ref
- blender
- export_linear_transform...
- get-object-transform.bl...
- mapLiriopeGroupTest01...
- mapSceneBN01.blend
- mapSceneBN01.blend1

gls2cpp

- gls2cpp.py
- glsLmath.h
- README.md
- ui_pt.glass.cpp
- ui.cpp

images

modeling

- bird-nest
- common.gsls
- preview.gsls
- sdf_baby.gsls
- sdf_bERRIES.gsls
- sdf_bIRD.gsls
- sdf_liriope.gsls
- sdf_nest.gsls
- sdf.gsls
- paper-boat
- common.gsls
- preview.gsls
- sdf_boat.gsls**
- preliminary
- dragonfly_1.glass.gsls

OUTLINE

TIMELINE

preview.gsls sdf_boat.gsls export_linear_transform.py

17 MS (2-2115)

Static GLSL Preview

11 vec3 mast = vec3(0.025, 0.0, 1.4);
12 vec3 mid = vec3(0.015, 0.55, 0.25);
13 vec3 port_bow = vec3(1.0, 0.0, 0.0);
14 vec3 keel = vec3(0.0, 0.3, 0.0);
15 vec3 port = vec3(0.0, 1.1-0.0*sign(p.y), 0.75);
16 vec3 bow = vec3(2.1, 0.0, 1.25) + sign(p.x)*vec3(0.2,0.0,0.2);
17 float tri1 = sdTriangle(a, port_bow, mid, mast);
18 float tri2 = sdTriangle(a, port_bow, bow, port);
19 float tri3 = sdTriangle(a, port_bow, port, keel);
20 vec4 boat = vec4(0.95,0.9,0.85, min(tri1,min(tri2,tri3))-0.03);
// sand
21 float sign1 = dot(cross(mid-port_bow, mast-port_bow), q-port_bow);
22 float sign2 = dot(cross(bow-port_bow, port-port_bow), q-port_bow);
23 float sign3 = dot(cross(port-port_bow, keel-port_bow), q-port_bow);
24 float sand_d = min(tri1, min(tri2, tri3)) * -sign(min(sign1, min(sign2, sign3)));
25 float noise_lf = 0.02*GradientNoise2D(4.0*p.xy);
26 float noise_hf = 0.004*GradientNoise2D(18.0*p.xy);
27 float sand_face = p.z + 0.1*cos(2.0*p.x)-0.02*p.x-0.08 + noise_lf+noise_hf;
28 vec4 sand = vec4(1,0,0, max(sand_d,sand_face)+0.01);
29 if (col_required) {
30 sand.xyz = vec3(0.7,0.65,0.5)-20.0*vec3(0.95,0.85,0.55)*noise_hf;
31 sand.xyz = vec3(1.1,1.0,0.9)*pow(sand.xyz,vec3(0.6));
32 }
// return
33 vec4 res = smin(boat, sand, 0.05);
34 res = mix(res, bound+boundw, smoothstep(0.,1.,(bound.w+boundw.w)/boundw.w)); // smooth clipping
35 return res;

PROBLEMS 1 OUTPUT DEBUG CONSOLE TERMINAL

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try <code>Get-ChildItem</code> from PowerShell. <https://aka.ms/powershell>

PS D:\Coding\github\AV14M-ISP>

2022/01/15 Start working on the second composition as planned.

I “borrowed” the frame of the paper boat from a CC0-licensed Shadertoy ([link](#)). I folded a physical model of a paper boat as reference, but I considered how it will interact with the coral trees and the creatures.

Ln 19, Col 54 Spaces: 4 UTF-8 CRLF GLSL ⚙

File Edit Selection View Go Run Terminal Help

sdf_trees.gsl - AVI4M-ISP - Visual Studio Code

EXPLORER

OPEN EDITORS

- preview.gsl M
- sdf_bird.gsl M
- sdf_boat.gsl M
- sdf_trees.gsl U

AVI4M-ISP

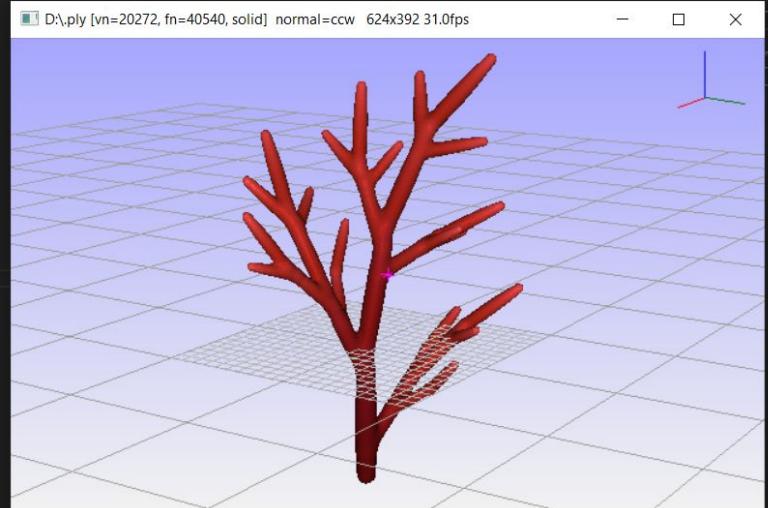
- C glslmath.h M
- README.md
- ui_pt_glass.cpp
- ui.cpp
- images
- modeling
- bird-nest
- common.glsl
- preview.gsl
- sdf_baby.gsl
- sdf_bERRIES.gsl
- sdf_bIRD.gsl
- sdf_lIROPE.gsl
- sdf_nEST.gsl
- sdf_gLSS.gsl
- paper-boat
- common.gslsl A
- preview.gsl M
- sdf_boat.gsl M
- sdf_trees.gsl U

preview.gsl M sdf_bird.gsl M sdf_boat.gsl M sdf_trees.gsl U

```
1 #include "common.glsl"
2
3
4 vec4 mapTreeBranch(vec3 p, bool col_required) {
5     float th = 0.05 + 0.02*(4.*p.z*(1.0-p.z)) - 0.02*p.z;
6     return vec4(mix(vec3(0.7,0.15,0.1), vec3(0.95,0.3,0.3), pow(max(p.z,0.),2.0)),
7                 sdSegment(p,vec3(0,0,0),vec3(0,0,1.0))-th);
}
8
9
10 vec4 mapTree01(vec3 p, bool col_required) {
11     vec3 q = p+vec3(0,0,1);
12     const int nbranch = 3;
13     const int depth = 4;
14     int stk_b[depth];
15     mat4 stk_t[depth];
16     int stkptr = 0;
17     stk_b[stkptr] = -1, stk_t[stkptr] = mat4(1.0), stkptr++;
18     vec4 tree = mapTreeBranch(q, col_required) * vec4(0.55,0.3,0.5,1.);
19     while (stkptr >= 0) {
20         do { stkptr--; } while (stkptr>=0 && stk_b[stkptr]>=nbranch-1);
21         if (stkptr<0) break;
22         stk_b[stkptr] += 1;
23         for (stkptr++; stkptr<depth; stkptr++) {
24             mat4 transform;
25             float t = exp(-float(stkptr-1));
26             if (stk_b[stkptr-1] == 0) { // bottom branch
27                 transform = mat4(1.6*rotz(0.6*PI)*roty(mix(0.2,0.3,1.0-t)*PI)*rotx(0.1*PI));
28                 transform[3] = transform*vec4(-vec3(0,0,mix(0.2,0.8,1.0-t)), 1);
29             }
30         }
31     }
32 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

D:\ply [vn=20272, fn=40540, solid] normal=ccw 624x392 31.0fps



2022/01/16 Modeling coral trees. More imagination than observation.

I iterated through all branches of the tree, which takes a lot of time to compile as GLSL and freezes the IDE. I “translate” them to C++ and use marching cube to export PLY models for preview.

I need coral trees with four different styles as planned in my sketchbook.
I finished two by the end of the day.

Microsoft Visual Studio Debug Console

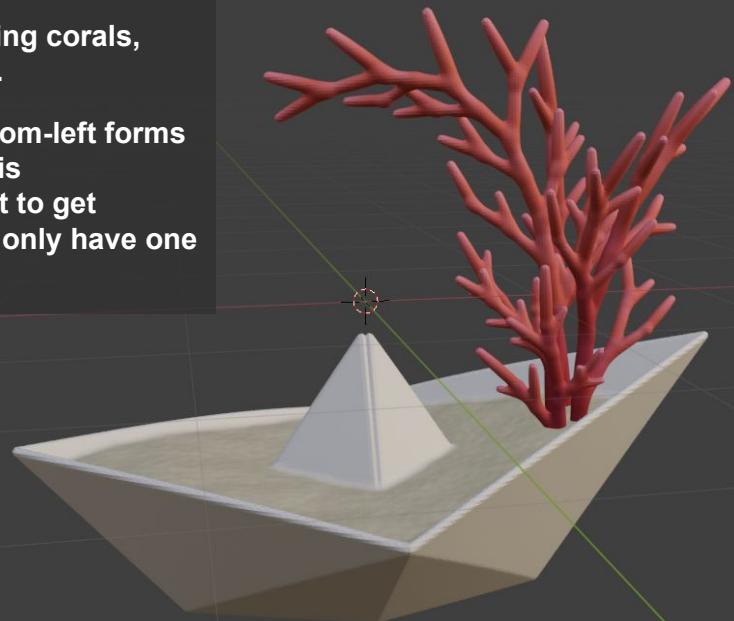
```
32 32 32 8 epsilon=2e-05
sample octree root - 864.5 ms
subdivide octree layer 1/3 - 41.5 ms
subdivide octree layer 2/3 - 162.8 ms
subdivide octree layer 3/3 - 631.3 ms
1732.5ms, 98927 evaluations
40564 triangles => 20272 vertices, 40540 faces
256.5ms coloring
D:\Coding\Github\Release\Graphics.exe (process 17000) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

User Perspective
(0) Corals | Cube

**2022/01/17 Finish modeling corals,
layout shown in Blender.**

**The branches in the bottom-left forms
a regular pattern, which is
coincidental. I decide not to get
bothered by it because I only have one
week until the deadline.**



Global

Scene Collection

Collection Area Camera Cube Plane Corals mapCoralTree01 mapCoralTree02 mapCoralTree03 mapCoralTree04 Cube Cube

Transform

Location X	0m
Y	0m
Z	0m
Rotation X	0°
Y	0°
Z	0°
Scale X	1.000
Y	1.000
Z	1.000

Rotation Mode XYZ Euler

Playback Keying View Marker 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 Start: 1 End: 250

Select Box Select Rotate View Object Context Menu Corals | Cube | Verts:120,607 | Faces:241,202 | Tris:241,202 | Objects:0/5 | Mem: 160.7 MB | v2.80.75

File Edit Selection View Go Run Terminal Help sdf_crab.glsi - AVI4M-ISP - Visual Studio Code

EXPLORER OPEN EDITORS GROUP 1 preview.glsi M sdf_coraltrees.glsi sdf_crab.glsi common.glsi M export_linear_transform.py GROUP 2 Static GLSL Preview AVI4M-ISP sdf_berries.glsi sdf_bird.glsi sdf_liriope.glsi sdf_nest.glsi sdf.glsi paper-boat common.glsi preview.glsi sdf_boat.glsi sdf_coraltrees.glsi sdf_crab.glsi U preliminary dragonfly_1_glass.glsi dragonfly_1_sdf.glsi flower_01_glass.glsi flower_01_sdf.glsi flower_02_sdf.glsi flower_03_sdf.glsi fruit_01_sdf.glsi fruit_02_sdf.glsi fungi_1_sdf.glsi group_01_glass.glsi group_01_sdf.glsi leaf_01_sdf.glsi README.md root_01_config.glsi > models > octree > octree_buffer OUTLINE TIMELINE

```

56     vec4 seg4 = vec4(1,0,0, seg4_d);
57     return smin(smin(seg0, seg1, 0.05), smin(seg2, seg3, 0.01), 0.01), seg4, 0.01) - vec4(0,0,0,0
58 }
59
60 vec4 mapCrabbBody(vec3 p, bool col_required) {
61     vec3 q = roty(0.1*PI)*p; q.y=0.2*log(2.0*cosh(q.y/0.2));
62     float body_d = sdLnNormEllipsoid(q, vec3(0.8,0.5,0.38)+0.02*cos(4.0*q.x), min(2.0+exp(-q.x),8.0));
63     body_d = smin(body_d, length(q-vec3(0,0.1,0.2))-0.2, 0.4);
64     body_d = smin(body_d, sdSegment(q, vec3(0.0,0.1,0.1), vec3(0.7,0.18,0.1))-0.1, 0.3);
65     vec4 body = vec4(1,0,0, body_d);
66     q = p; q.y = -length(vec2(q.y,0.05));
67     q = rotx(0.1*PI)*rotz(0.1*PI)*roty(0.1*PI)*(q-vec3(-0.1,-0.5,-0.2));
68     vec4 legs = mapCrabLeg(q, vec3(0.8,0,-0.1), vec3(0.7,-0.1,-0.7), vec3(0.3,-0.2,-1.1), vec3(-0.3,-0
69     q = p; q.y = -length(vec2(q.y,0.05));
70     q = rotx(0.05*PI)*rotz(0.05*PI)*roty(0.2*PI)*(q-vec3(0.0,-0.3,-0.2));
71     legs = cmin(legs, mapCrabLeg(q, 0.95, vec3(0.8,0,-0.1), vec3(0.7,-0.1,-0.7), vec3(0.4,-0.2,-1.2), v
72     return smin(body, legs, 0.1);
73 }
74
75 vec4 mapCrab(vec3 p, bool col_required) {
76     vec3 q = rotx(0.5*PI)*rotz(PI)*roty(-0.05*PI)*rotx(0.08*PI)*(p-vec3(-0.2,0,-0.2));
77     vec4 shell = mapCrabShell(q, col_required);
78     q = p;

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Delta compression using up to 8 threads
 Compressing objects: 100% (7/7), done.
 Writing objects: 100% (7/7), 2.33 KiB | 159.00 KiB/s, done.
 Total 7 (delta 3), reused 0 (delta 0)

2022/01/18 Model the hermit crab, still incomplete.

The shell is modified from a model I made previously, which is based on the logarithmic spiral.

PS D:\Coding\Github\AVI4M-ISP>

Windows PowerShell
 Copyright (C) Microsoft Corporation. All rights reserved.

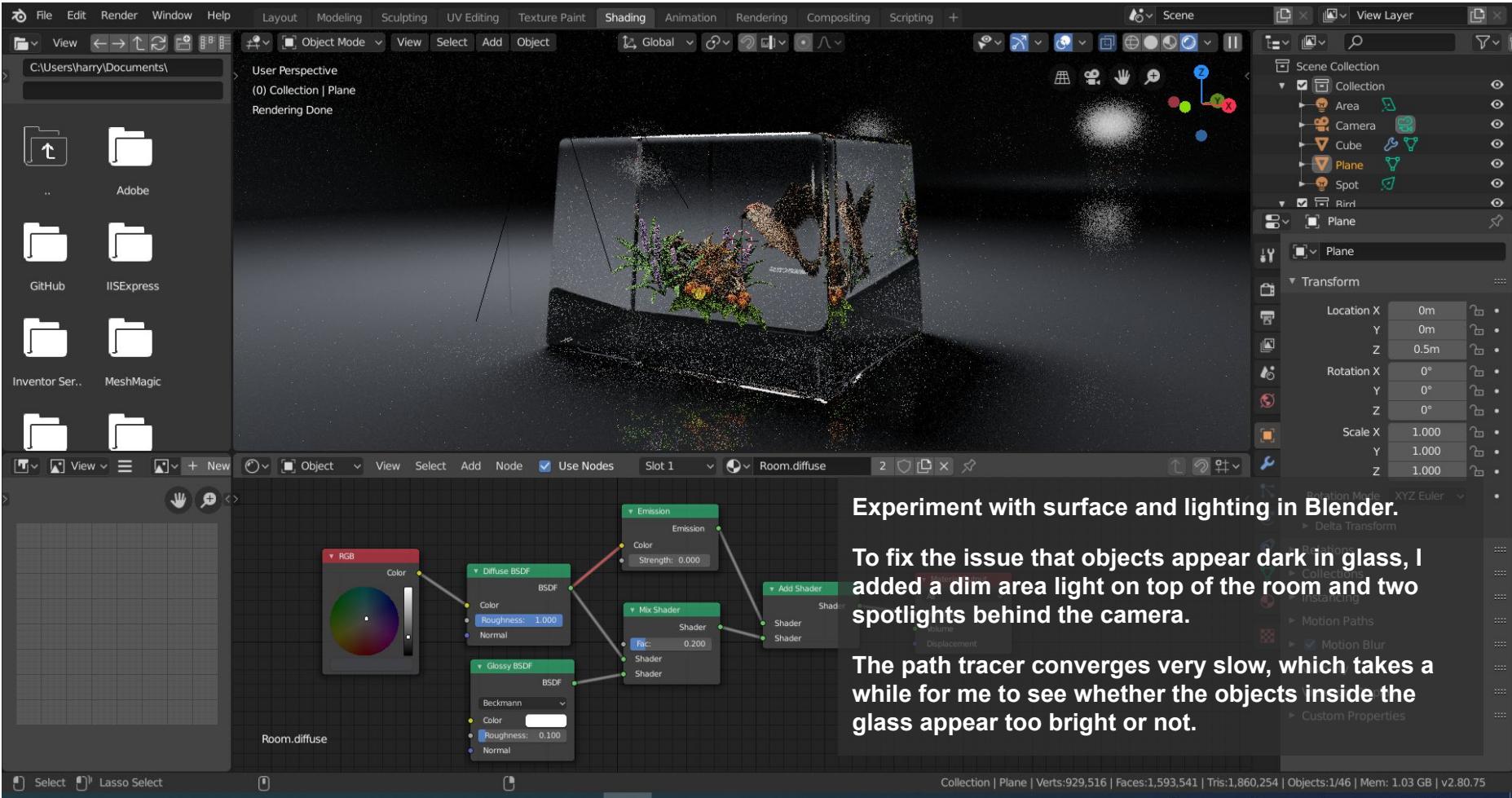
Try the new cross-platform PowerShell <https://aka.ms/pscore6>

PS D:\Coding\Github\AVI4M-ISP>

Static GLSL Preview 34 MS (2.3146)

264210-1600x1030-quirky-hermit-crab-names.jpg - Wi... File Print E-mail Burn Open

Ln 75, Col 1 Spaces: 4 DLF-8 CRLF GLSL



Experiment with surface and lighting in Blender.

To fix the issue that objects appear dark in glass, I added a dim area light on top of the room and two spotlights behind the camera.

The path tracer converges very slow, which takes a while for me to see whether the objects inside the glass appear too bright or not.

File Edit Selection View Go Run Terminal Help Static GLSL Preview - AVI4M-ISP - Visual Studio Code

File Edit View Project Build Debug Team Tools Harry Chen HC

Graphics - Micr... Quick Launch (Ctrl+Q)

Test Analyze Window Help

preview.gls sdf_coralreets.gls sdf_crab.gls common.gls ... Static GLSL Preview 17 MS (5.49074)

2022/01/19 Finish modeling the hermit crab.

I'm not sure if a real hermit crab can stretch its claw like that because I didn't find any picture of a hermit crab doing that. I intended to make it holding a chip with a NVidia logo on it.

I feel the color of the shell is still off.

D:\.ply [vn=145631, fn=291278, surface] normal=ccw 624x354 8.6fps

PROBLEMS

On br Change (use

PS D:\ [master Date: 1 fil PS D:\ Enumer Counti Delta Compre Writin Total remote To https://github.com/harry755758/AVI4M-ISP.git ddc6b6a..639f746 master -> master PS D:\Coding\Github\AVI4M-ISP

File Edit View Project Build Debug Team Tools Harry Chen HC

Graphics - Micr... Quick Launch (Ctrl+Q)

Test Analyze Window Help

Release

Solution Explorer

Microsoft Visual Studio Debug Console

32 32 32 8 epsilon=2e-05 sample octree root - 72.2 ms subdivide octree layer 1/3 - 52.8 ms subdivide octree layer 2/3 - 231.3 ms subdivide octree layer 3/3 - 1109.6 ms 1707.1ms, 479447 evaluations 291576 triangles => 145631 vertices, 291278 faces 438.5ms coloring

D:\Coding\Github\Release\Graphics.exe (process 13176) exited with code 0. To automatically close the console when debugging stops, enable Tools->Options->Debugging. Press any key to close this window . . .

1168 [] 1169 template<typename vec> 1170 vec refract(vec I, vec N, float eta) { 1171 : float k = 1.0f - eta * eta * (1.0f - dot(N, I) + sq

File Print E-mail Burn Open

01-hermit-crabs-minden_00512417_16x9.webp - Wind...

File Edit View Project Build Debug Team Tools Harry Chen HC

common.gls1

paper-boat\preview.gls1

preview.gls1

sdf_crab.gls1

common.gls1

INS

Python 3.9.1 64-bit 0 0 Graphics master

User Perspective
(0) Corals | mapCrab

2022/01/21 Layout the scene, with minor changes/fixes in the eyes and the legs of the crab.

Global Viewport Transform

Scene Outliner

Microsoft Visual Studio Debug Console

```
32 32 32 8 epsilon=2e-05
sample octree root - 164.4 ms
subdivide octree layer 1/3 - 381.0 ms
subdivide octree layer 2/3 - 1884.6 ms
subdivide octree layer 3/3 - 6776.5 ms
9314.6ms, 387738 evaluations
247216 triangles => 123501 vertices, 247026 faces
2911.6ms coloring

D:\Coding\GitHub\Release\Graphics.exe (process 10260) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

C:\WINDOWS\system32\cmd.exe

```
.glsl.cpp
pause
)
Open GLSL source: modeling/paper-boat/preview.glsl
Open GLSL source: modeling/paper-boat/sdf.glsl
Open GLSL source: modeling/paper-boat/common.glsl
Open GLSL source: modeling/paper-boat/sdf_boat.glsl
Open GLSL source: modeling/paper-boat/common.glsl
Open GLSL source: modeling/paper-boat/sdf_coraltree.glsl
Open GLSL source: modeling/paper-boat/common.glsl
Open GLSL source: modeling/paper-boat/sdf_crab.glsl
Open GLSL source: modeling/paper-boat/common.glsl
Write C++ source to: .glsl.cpp
Press any key to continue . . .
```

Transform

Location X: -0.83m

Instancing
Motion Paths
 Motion Blur
Visibility
Viewport Display

Playback View Keying Marker

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Start: 1 End: 250

Corals | mapCrab | Verts:269,723 | Faces:539,446 | Tris:539,446 | Objects:0/6 | Mem: 310.1 MB | v2.80.75

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

User Perspective
(0) Corals | mapChip

Add the chip with an NVidia logo.

The image shows a 3D rendering in Blender's User Perspective mode. A crab with a large, textured shell is positioned on a small, light-colored boat. To the right of the crab is a large, branching red coral structure. A green rectangular object, which appears to be a map or a logo, is placed on top of the boat. This green object features the classic green and white Nvidia logo. The background is a simple gray gradient.

Scene View Layer

Object Mode View Select Add Object

Global

View Layer

Corals

Plane

Corals

mapChip

mapCoralTree01

mapCoralTree02

mapCoralTree03

mapCoralTree04

mapCrab

Boat

mapChip Material.PLY

Material.PLY

Mat 9 Data

Preview Surface

Surface Add Shader

Shader None

Shader Glossy BSDF Multiscatter GGX

Color Gamma

Roughness 0.864

Normal Default

Volume

Displacement

Displacement Default

Settings

Viewport Display

Playback Keying View Marker

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Start: 1 End: 250

Corals | mapChip | Verts:313,721 | Faces:627,438 | Tris:627,438 | Objects:0/7 | Mem: 344.1 MB | v2.80.75

preview.gls sdf_crab.gls sdf_fish.gls sdf.gls glsl2cpp.py common.gls

```

9      float lateral_line_d = exp(-sqrt(40.0*lateral_line))*exp(-sqrt(1.5*(p.x+0.5)));
10     vec4 body = vec4(0.85,0.65,0.7, sdEllipsoid(p, vec1(1.3, vec2(0.35*(0.8+0.15*tanh(p.x)),0.5*(0.9+0.1*tanh(p.x)))*rad));
11     if (col_required)
12         body.xyz = mix(body.xyz,
13             mix(vec3(0.95,0.5,0.4),
14                 smoothstep(0.1,1.0,p.x+1.5)),
15             smoothstep(0.1,1.0,p.x+1.5));
16     else
17         body.xyz = mix(body.xyz,
18             mix(vec3(0.95,0.5,0.4),
19                 smoothstep(0.1,1.0,p.x+1.5)),
20             smoothstep(0.1,1.0,p.x+1.5));
21     vec4 gill = vec4(0.65,0.35,0.15, sdEllipsoid(q, vec3(0.3+0.04*cos(8.0*q.z),0.1,0.35)));
22     body = smin(body, gill, 0.05);
23     q = rotz(0.1*PI)*(vec3(p.x,abs(p.y),p.z)-vec3(0.9,0.13,0.1));
24     vec3 eyes = vec4(1.0,0, length(q)-0.13);
25     if (col_required) eyes.xyz = mix(vec3(0.1,0.05,0.1), vec3(0.55,0.3,0.45), clamp(40.0*(length(q.xz)-0.05)+0.5,0.,1.));
26     body = smin(body, eyes, 0.02);
27     q = roty(0.05*PI)*(p-vec3(-0.2,0,0.4)); q.z += 0.3*q.x*q.x*q.x;
28     float spines = exp(sin(80.0*atan(p.z+0.5,p.x-1.0)));
29     vec4 fin_dorsal = vec4(1.0,0, sdEllipsoid(q,
30         vec3(0.8,max(0.08*exp(-2.0*q.z),0.01),max(0.2+0.1*exp(-cos(4.0*q.x))+0.05*q.x,0.01))-0.005*spines));
31     if (col_required) fin_dorsal.xyz = pow(vec3(0.9,0.75,0.15),vec3(1.0+0.2*spines));
32     body = smin(body, fin_dorsal, 0.05);
33     q = roty(-0.05*PI)*(p-vec3(-1.4,0,0.0)); q.z = length(vec2(q.z,0.15));
34     q = roty(-0.2*PI)*(q-vec3(-0.0,0,0.2));
35     cninac = sin(csin(25.0*atan(p.z+0.1*x1,0.11))+length(vec2(p.z+0.1*x1,0.0,1)));

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

(use "git reset HEAD <file>..." to unstage)

```

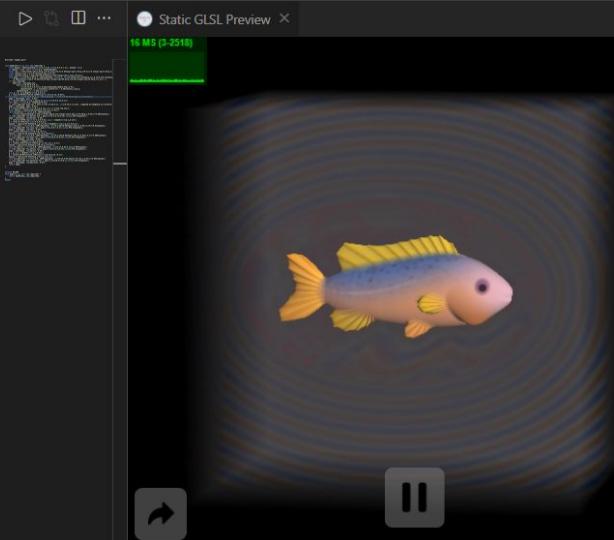
modified: modeling/paper-boat/preview.gls
new file: modeling/paper-boat/sdf_fish.gls

```

```

PS D:\Coding\Github\AVI4M-ISP> git commit -m "model a fish"
[master d458be4] model a fish
2 files changed, 64 insertions(+), 1 deletion(-)
create mode 100644 modeling/paper-boat/sdf_fish.gls
PS D:\Coding\Github\AVI4M-ISP> git push origin master
Enumerating objects: 10, done.
Counting objects: 100% (10/10), done.
Delta compression using up to 8 threads
Compressing objects: 100% (6/6), done.
Writing objects: 100% (6/6), 1.62 KiB | 103.00 KiB/s, done.
Total 6 (delta 3), reused 0 (delta 0)
remote: Resolving deltas: 100% (3/3), completed with 3 local objects.
To https://github.com/harry7557558/AVI4M-ISP.git
  14e0bd1..d458be4 master -> master
PS D:\Coding\Github\AVI4M-ISP>

```



File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

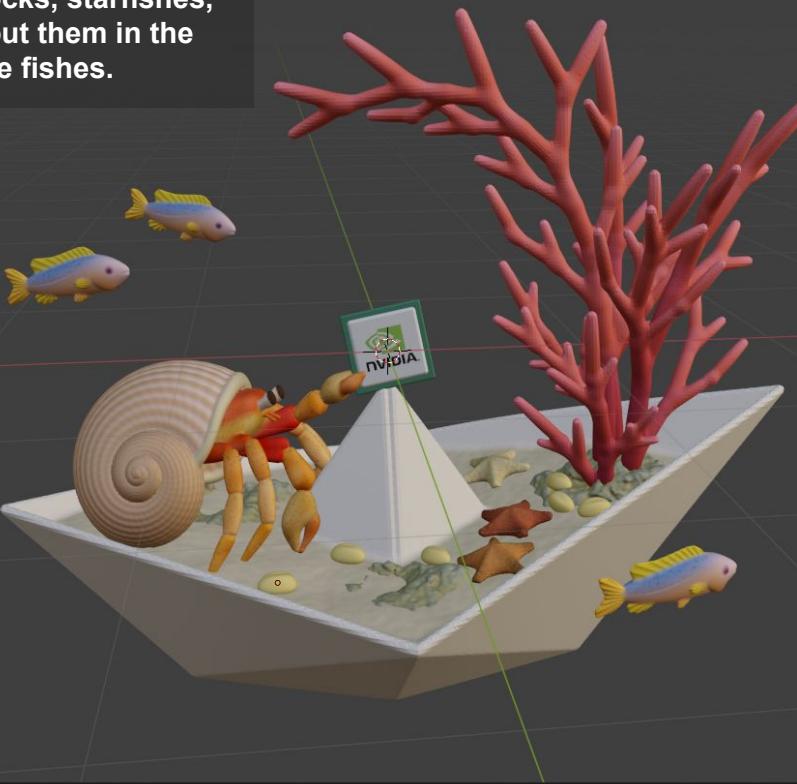
Object Mode View Select Add Object

Global

Scene

View Layer

2022/01/23 Model rocks, starfishes, and seashells. Layout them in the scene along with the fishes.



mapSeashell.001
mapSeashell.002
mapSeashell.003
mapSeashell.004
mapSeashell.005
mapSeashell.006
mapStarfish01
mapStarfish02
mapStarfish02.001
mapStarfish03

Material.PLY
Mat 24
Preview
Surface
Shader None
Shader Glossy BSDF
Multiscatter GGX
Color Gamma
Roughness 0.864
Normal Default
Volume
Displacement
Displacement Default
Settings
Viewport Display

Playback Keying View Marker 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Box Select

Rotate View

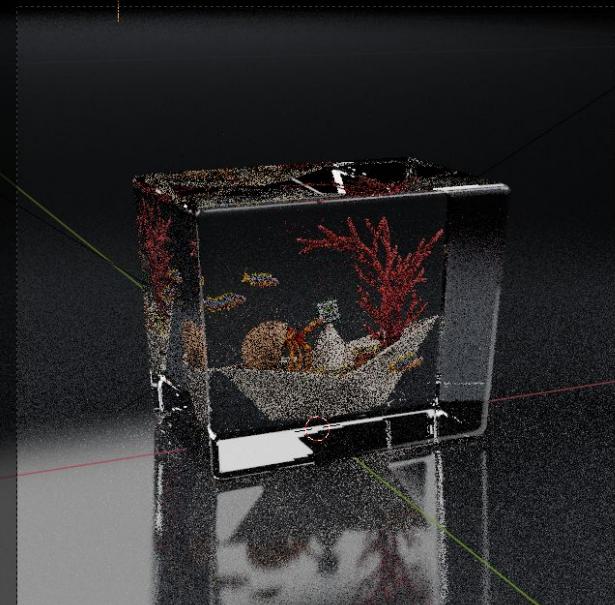
Object Context Menu

Saved "mapScenePB01.blend"

Scene Collection | mapSeashell.006 | Verts:534,227 | Faces:1,068,382 | Tris:1,068,382 | Objects:0/24 | Mem:

[File](#) [Edit](#) [Render](#) [Window](#) [Help](#)[Layout](#) [Modeling](#) [Sculpting](#) [UV Editing](#) [Texture Paint](#) [Shading](#) [Animation](#) [Rendering](#) [Compositing](#) [Scripting](#) +[Object Mode](#) [View](#) [Select](#) [Add](#) [Object](#)[Global](#) [Loc](#) [Rot](#) [Scale](#) [Transform](#)

2022/01/24 Setup the scene in Blender. I made the glass smaller at the bottom to accompany with the shape of the paper boat, which works with the graphics card that appears “geeky”. I considered the positions and angles of lights and camera to make the subject stand out while there isn't a strong reflection on the glass.

Camera Perspective
(0) Collection | Area
Path Tracing Sample 32/128

X	0.5m
Y	2m
Z	1m
X	0°
Y	-0°
Z	0°
X	0.500
Y	0.500
Z	0.500

de XYZ Euler

- Instancing
- Motion Paths
- Visibility
- Viewport Display
- Custom Properties

► Resize

[Playback](#) [Keying](#) [View](#) [Marker](#)[0](#) [◀](#) [◀](#) [▶](#) [▶](#) [200](#)0 [Start:](#) 1 [End:](#) 250[Select](#) [Box Select](#)[Rotate View](#)[Object Context Menu](#)



Test rendering in Blender at 2560x2560, 256 spp with AI denoising. It took about 40 minutes to render. Looks nicer on a monitor that has a higher contrast.

The light and reflection of the glass on the plane works out pretty well. The objects inside are illuminated by carefully-considered lighting instead of hacky glowing like I did in the mentor artist study. It is still off compared to the photographs of Paul's work but I'm quite satisfied with it.

I feel it is kind of sad that I spent a lot of time trying to render them interactively in WebGL but ended up using Blender. I was too ambitious in the first place. I'm not sure what my art teacher would say but at least this saves me a lot of time.

User Preferences
(0) Collection | mapLiropeLeaves3

I came out with the idea of placing a “keep off grass” sign behind the bird nest to demonstrate human and nature. I modeled the sign and layout it in Blender.

Object Mode View Select Add Object Global

Layout Modeling UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Camera Cube Plane Spot Bird Nest Berries.001 Berries.002 Liropes.001 Liropes.002

mapLiropeLeaves3 Material.PLY Mat 45 Data Preview Surface Surface Add Shader None Glossy BSDF Multiscatter GGX Color Bright/Contrast Roughness 0.864 Normal Default Volume Displacement Displacement Default Settings Viewport Display

Start: 1 End: 250

Playback Keying View Marker

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Box Select Rotate View Object Context Menu

Collection | mapLiropeLeaves3 | Verts:923,156 | Faces:1,679,158 | Tris:1,847,562 | Objects:0/47 | Mem: 569.1 MB | v2.80.75



2022/01/25 I left my computer render it overnight and went to sleep last night because it was late. This is the finished rendering I check this morning.

This image appears to have a higher contrast compared to the paper boat one. I feel the stick of the sign is too high that looks strange, but I try not to be bothered by it.

I'm thinking about creating one more rendering for each image, if I have time. The entire project is due end of this day and I need to work on my artist's statement.