

Texturing in GLSL

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Textures.pptx mjb – December 22, 2023

2D Texturing

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Vertex shader:

```
#version 330 compatibility
out vec2 vST;
```

void main()

```
{
    vST = gl_MultiTexCoord0.st;
    gl_Position = gl_ModelViewProjectionMatrix * gl_Vertex;
}
```

Rasterizer

Fragment shader:

```
#version 330 compatibility
in vec2 vST;
uniform sampler2D uTexUnit;
```

void main()

```
{
    vec3 newcolor = texture( uTexUnit, vST ).rgb;
    gl_FragColor = vec4( newcolor, 1. );
}
```

On Macs, this function should be called **texture2D**

Both-named functions return a vec4: rgba

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2D Texturing in the OpenGL API

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Fragment shader:

```
#version 330 compatibility
in vec2 vST;
uniform sampler2D uTexUnit;
```

void main()

```
{
    vec3 newcolor = texture( uTexUnit, vST ).rgb;
    gl_FragColor = vec4( newcolor, 1. );
}
```

GGLuint TexName; // a global

```
...
glGenTextures( 1, &TexName ); // in InitGraphics()
int num, numt;
unsigned char *texture = BmpToTexture( "filename.bmp", &num, &numt );
glBindTexture( GL_TEXTURE_2D, TexName );
glTexParameteri( GL_TEXTURE_2D, GL_TEXTURE_WRAP_S, GL_REPEAT );
glTexParameteri( GL_TEXTURE_2D, GL_TEXTURE_WRAP_T, GL_REPEAT );
glTexParameteri( GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_LINEAR );
glTexParameteri( GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER, GL_LINEAR );
glTexImage2D( GL_TEXTURE_2D, 0, 3, num, numt, 0, GL_RGB, GL_UNSIGNED_BYTE, texture );
...
Pattern.Use( ); // in Display():
glActiveTexture( GL_TEXTURE6 ); // use texture unit 6
glBindTexture( GL_TEXTURE_2D, TexName );
Pattern.SetUniformVariable( "uTexUnit", 6 );
```

2D Texturing in glman

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Fragment shader:

```
#version 330 compatibility
in vec2 vST;
uniform sampler2D uTexUnit;
```

void main()

```
{
    vec3 newcolor = texture( uTexUnit, vST ).rgb;
    gl_FragColor = vec4( newcolor, 1. );
}
```

Texture2D 6 worldtex.bmp

```
...
Vertex pattern.vert
Fragment pattern.frag
Program World uTexUnit 6
```

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The OsuSphere Has Sensible s,t Coordinates Assigned

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The GLUT Teapot Doesn't

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What if You Want to Use Two Textures in One Shader?

C++ Program:

```
// In Display():
Pattern.Use();
glActiveTexture(GL_TEXTURE5);
glBindTexture(GL_TEXTURE_2D, TexName0);

glActiveTexture(GL_TEXTURE6);
glBindTexture(GL_TEXTURE_2D, TexName1);

Pattern.SetUniformVariable("uTexUnit0", 5);
Pattern.SetUniformVariable("uTexUnit1", 6);

<< draw something >
Pattern.UnUse();
```

Fragment shader:

```
#version 330 compatibility
in vec2 vST;
uniform sampler2D uTexUnit0;
uniform sampler2D uTexUnit1;

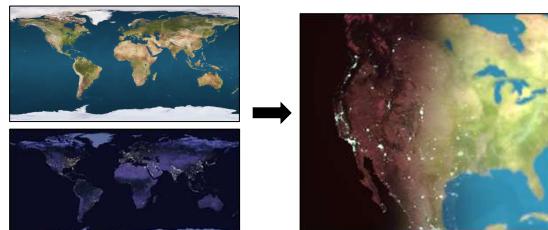
void main()
{
    vec3 newColor0 = texture( uTexUnit0, vST );
    vec3 newColor1 = texture( uTexUnit1, vST );
    gl_FragColor = ...
}
```

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Why Might You Want to Use Two Textures in One Shader?

Once the RGBs have been read from a texture, they are just numbers. You can do any arithmetic you want with the texture RGBs, other colors, lighting, etc. Here is an example of blending two textures at once:



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Using Two Textures in One Shader, I

```
#version 330 compatibility

uniform float uBlend;
uniform float uSunLng;
uniform sampler2D uTexUnitDay, uTexUnitNight;

in float vLightIntensity;
in vec2 vST;

const float OFFSETS = 0.0;           // how much the images are off horizontally

void main()
{
    float suning = uSunLng; // -180. to +180.
    float suningp = suning - 180.;
    if( suningp < -180. ) suningp += 360.; // -180. to +180.

    vec2 nightST = vST;
    vec2 dayST = vST;
    dayST.s += OFFSETS;
    if( dayST.s < 0. ) dayST.s += 1.;
```

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Using Two Textures in One Shader, II

```
float earthng = 360. * ( dayST.s - 0.5 );           // -180. to +180.

float delta0 = earthng - suning;
if( delta0 < -180. ) delta0 += 360.0;
if( delta0 > 180. ) delta0 -= 360.0;

float delta1 = earthng - suningp;
if( delta1 < -180. ) delta1 += 360.0;
if( delta1 > 180. ) delta1 -= 360.0;
float delta = delta0;
if( abs(delta1) < abs(delta0) )
    delta = -delta1;

vec3 rgbd = texture( uTexUnitDay, dayST.rgb );
vec3 rgbn = texture( uTexUnitNight, nightST.rgb );

float t = smoothstep( uBlend, uBlend, delta );
vec3 newcolor = mix( rgbd, rgbn, t );
gl_FragColor = vec4( vLightIntensity * newcolor, 1. );
```

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Shaders Can Combine More than Two Textures

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Just assign each texture a different texture unit

