CMSC 491G/691G

Computer Graphics for Games

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Shader Design Strategies

- Learn and adapt from RenderMan
  - Noise
  - Layers
- Multiple Passes
- *Baked* computation

Using GLSL (OSG)

- Load Shaders

```
vs = new osg::Shader(osg::Shader::VERTEX, string);
fs = new osg::Shader(osg::Shader::FRAGMENT);
fs->loadShaderSourceFromFile(filename);
```

- Create Program

```
prog = new osg::Program;
prog->addShader(vs); prog->addShader(fs);
```

- Attach to Node

```
ss = model->getOrCreateStateSet();
ss->setAttributeAndModes(prog, osg::StateAttribute::ON);
```

Uniform Parameters (OSG)

- Create Uniform

```
u = new osg::Uniform(name, value);
```

- Attach to Node

```
ss = model->getOrCreateStateSet();
ss->addUniform(u);
```

- OK to add uniforms you don’t use
- Built-in (by osgUtil::SceneView)
  - osg_FrameNumber, osg_FrameTime, osg_DeltaFrameTime, osg_SimulationTime, osg_DeltaSimulationTime, osg_ViewMatrix, osg_ViewMatrixInverse

Using GLSL (OpenGL)

- Create shader object

  ```
  S = glCreateShader(GL_VERTEX_SHADER)
  S = glCreateShaderObjectARB(GL_VERTEX_SHADER_ARB)
  ```

  - Vertex or Fragment
- Load shader into object

  ```
  glShaderSource(S, n, shaderArray, lenArray)
  glShaderSourceARB(S, n, shaderArray, lenArray)
  ```

  - Array of strings
- Compile object

  ```
  glCompileShader(S)
  glCompileShaderARB(S)
  ```

Loading Shaders (OpenGL)

- `glShaderSource(S, n, shaderArray, lenArray)`
  - One string containing entire mmap'd file
  - Strings as #includes
    - Varying variables between vertex and fragment
  - Strings as lines
    - Null-terminated if lenArray is Null or length=-1

Using GLSL (OpenGL)

- Create program object

```
P = glCreateProgram()
P = glCreateProgramObjectARB()
```

- Attach all shader objects

```
glAttachShader(P, S)
glAttachObjectARB(P, S)
```

  - Vertex, Fragment or both

- Link together

```
glLinkProgram(P)
glLinkProgramARB(P)
```

- Use

```
glUseProgramObject(P)
glUseProgramObjectARB(P)
```

Using Parameters (OpenGL)

- Where is my attributes/uniforms parameter?

```
i=glGetAttribLocation(P,”myAttrib”)
i=glGetUniformLocation(P,”myAttrib”)
```

- Set them

```
glVertexAttrib1f(i,value)
glVertexAttribPointer(i,…)
glUniform1f(i,value)
```

Low-level Code (OpenGL)

- Load shader

```
glProgramStringARB(GL_VERTEX_PROGRAM_ARB,
    GL_PROGRAM_FORMAT_ASCII_ARB, length, shader)
```

  - Vertex or fragment
  - Single string (vs. array)
- Enable

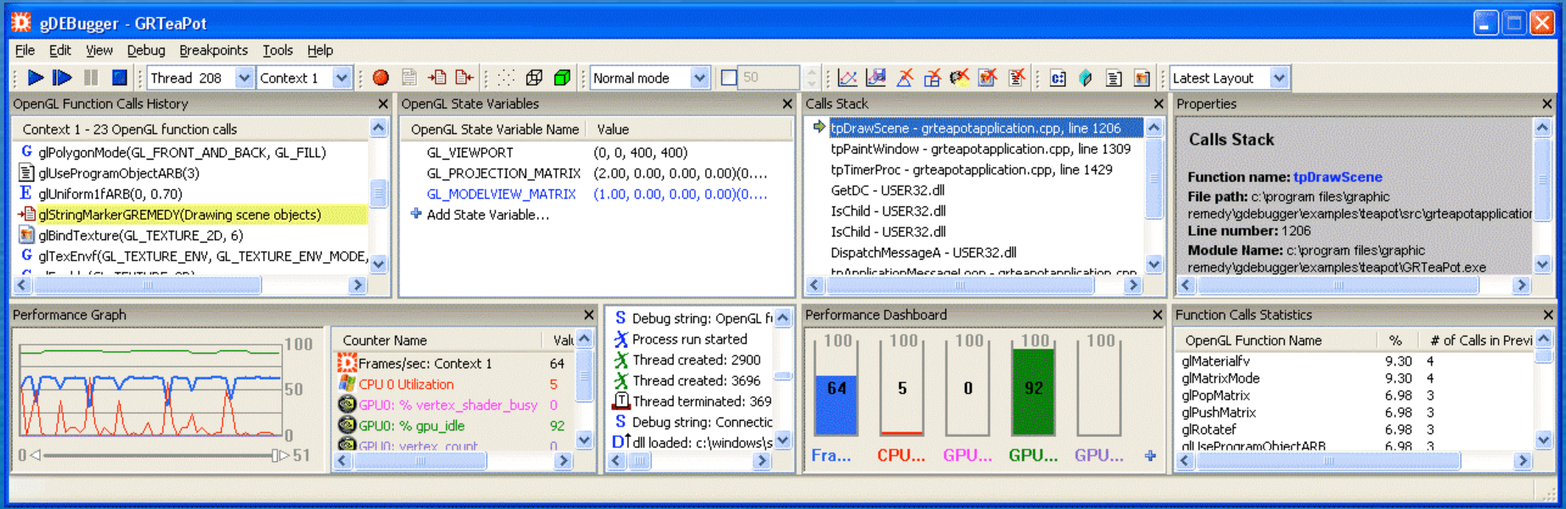
```
glEnable(GL_VERTEX_PROGRAM_ARB)
```

Useful Tools

- Shader debugger
  - Immediate updates
  - Choose model/texture
  - Tweak parameters
  - Examine/dump frames
- Several available
  - Not hard to build
- OpenGL debugger
  - Trace of calls made
  - Examine resources
  - Breakpoints/actions
  - Graph performance
- A couple of choices

Debuggers

- Provide graphic pipeline information needed to find bugs and to optimize application performance
  - gDEBugger (Linux / Windows; ATI / NVIDIA; OpenGL)
  - NVPerfKit (Windows; NVIDIA; OpenGL / Direct3D)
  - Apple OpenGL Profiler (Mac; ATI / NVIDIA; OpenGL)



```
Context 1 - 23 OpenGL function calls
G glPolygonMode(GL_FRONT_AND_BACK, GL_FILL)
  glUseProgramObjectARB(3)
E glUniform1fARB(0, 0.70)
  glStringMarkerGREMEDY(Drawing scene objects)
  glBindTexture(GL_TEXTURE_2D, 6)
G glTexEnvf(GL_TEXTURE_ENV, GL_TEXTURE_ENV_MODE,
```

OpenGL State Variable Name	Value
GL_VIEWPORT	(0, 0, 400, 400)
GL_PROJECTION_MATRIX	(2.00, 0.00, 0.00, 0.00)(0.…
GL_MODELVIEW_MATRIX	(1.00, 0.00, 0.00, 0.00)(0.…
Add State Variable…	

```
tpDrawScene - grteapotapplication.cpp, line 1206
tpPaintWindow - grteapotapplication.cpp, line 1309
tpTimerProc - grteapotapplication.cpp, line 1429
GetDC - USER32.dll
IsChild - USER32.dll
IsChild - USER32.dll
DispatchMessageA - USER32.dll
```

Calls Stack

Function name: tpDrawScene
File path: c:\program files\graphic remedy\gdebugger\examples\teapot\src\grteapotapplicatior
Line number: 1206
Module Name: c:\program files\graphic remedy\gdebugger\examples\teapot\GRTeaPot.exe

Counter Name	Valı
Frames/sec: Context 1	64
CPU 0 Utilization	5
GPU0: % vertex_shader_busy	0
GPU0: % gpu_idle	92

```
S Debug string: OpenGL fı
  Process run started
  Thread created: 2900
  Thread created: 3696
  Thread terminated: 369
S Debug string: Connectic
  dll loaded: c:\windows\s
```

64	5	0	92	

OpenGL Function Name	%	# of Calls in Previ
glMaterialfv	9.30	4
glMatrixMode	9.30	4
glPopMatrix	6.98	3
glPushMatrix	6.98	3
glRotatef	6.98	3