Graphics and Multimedia

OpenGL
Brief background and introduction

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OpenGL

What is OpenGL?

- Sometimes called a language, actually an Application Programming Interface (API).
- Initially released in 1992.
- Specification is controlled by OpenGL Architecture Review Board (ARB)

OpenGL

- OpenGL APIs
- Languages
  - – C, C++, C#
  - – FORTRAN
  - – Java
  - – Perl
  - – Python
  - – Ada
- We will use OpenGL's python API

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GLU: OpenGL Utility

- Higher Level and Convenience Functions

– Projections

– Creating texture maps

- Collections of calls for convenience
- Standard with all OpenGL implementations

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GLUT: GL Utility Toolkit

- Provides access to OS and Window System
  - Open windows and setting size and capabilities
  - Register and triggers callbacks
  - Keyboard and mouse interaction
  - Elementary fonts
- Not part of OpenGL, but provides a portable abstraction of the OS
  - FreeGLUT
  - OpenGLUT
- Alternatives: SDL, Qt, ...

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OpenGL Naming Convention

- Most functions created by name mangling
- Constants are GL_SOMETHING
- Variable types are GLsomething

- Functions

– glDoSomething Example: glClear()
– glutDoSomething ……. glutMainLoop()
– gluDoSomething ……. gluPerspective()

- Constants

GLUT_SOMETHING
GLU_SOMETHING
GL_SOMETHING

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OpenGL Naming Convention

- glDoSomethingXy() – DoSomething is the name of the function

– X is 2 or 3 or 4 for the dimension

– y is for the the variable type

For instance:

glVertex2f(0.0, 0.5)

glVertex3i(0 , 0 , 1)

glVertex2d(20.5, 50.13)

GlColor3ub(255, 255, 0)

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DATA TYPES NAMING

Variable types are GLsomething

- GLbyte (signed char) 8 bit
- GLshort (signed short) 16 bit
- GLint (signed int) 32 bit
- GLubyte (unsigned char) 8 bit
- GLushort (unsigned short) 16 bit
- GLuint (unsigned int) 32 bit
- GLfloat (float) 32 bit
- GLdouble (double) 64 bit

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Types of Objects

- glBegin(type)

– GL_POINTS points

– GL_LINES lines between pairs of points

– GL_LINE_STRIP series of line segments

– GL_LINE_LOOP closed GL_LINE_STRIP

– GL_POLYGON simple polygon

– GL_TRIANGLES triangles between triples of points

– GL_TRIANGLE_STRIP series of triangles

– GL_TRIANGLE_FAN fan of triangles

- Set coordinates with glVertex
- glEnd()

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Color

- Default is RGB color
  - R,G,B 0-1 or integer range
    - glColor3f(1.0 , 0.0 .0.0)
    - glColor3b(127 , 0 , 0);
    - glColor3ub(255 , 0 , 0);
    - glColor3fv(rgbarray); #((255, 0, 21.3))
- Color can also contain transparency (alpha)
  - glColor4f(1.0 , 0.0 . 0.0 , 0.5);
  - Default alpha=1 (opaque)

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Event Driven Programming

- Don't call us, we'll call you

– register callbacks corresponding to events

– similar to interrupt driven programs

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Simple Callback function example:

```
def someAction(x, y, someCallback):
  x = x + y
  y = y -1
  return someCallback(x, y)

def calcSum(x, y):
  return x + y

someAction(4, 13, calcSum)
```

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- Display

– glutDisplayFunc() Draw the scene
– glutReshapeFunc() Window resized
– glutIdleFunc() Nothing more scheduled

- User input

– glutKeyboardFunc() Key pressed
– glutSpecialFunc() Special key pressed
– glutMouseFunc() Mouse button
– glutMotionFunc() Mouse motion
etc

Registering Callbacks

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Keyboard Inputs

- special(int key,int x,int y)

– Cursor keys GLUT_KEY_LEFT, GLUT_KEY_UP, ...

– Function keys GLUT_KEY_Fx

– Basically anything not an ASCII key

- keyboard(char ch,int x,int y)

– Regular keystrokes

- (x,y) is the mouse position in pixels

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Hello world Python OpenGL example:

```
from OpenGL.GL import *
from OpenGL.GLU import *
from OpenGL.GLUT import *
#import sys
glutInit(sys.argv)
glutInitDisplayMode(GLUT_RGB|GLUT_SINGLE)
glutInitWindowSize(400, 400)
glutCreateWindow("Hello, World")
glutMainLoop()
```

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predefined objects drawing examples in python OpenGL:

```
#import …
# A polygon drawing callback function
def polygon():
    glClear(GL_COLOR_BUFFER_BIT)
    glBegin(GL_POLYGON)
    glVertex2f(0.0,0.5)
    glVertex2f(0.5,-0.5)
    glVertex2f(-0.5,-0.5)
    glEnd()
    glFlush()
```

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predefined objects drawing examples in python OpenGL:

```
glutInit(sys.argv)
glutInitDisplayMode(GLUT_RGB|GLUT_SINGLE)
glutInitWindowSize(400, 400)
glutCreateWindow("Polygon")
glutDisplayFunc(polygon)
glutMainLoop()
```