Introduction to Computer Graphics with WebGL

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Programming with WebGL
Part 1: Background

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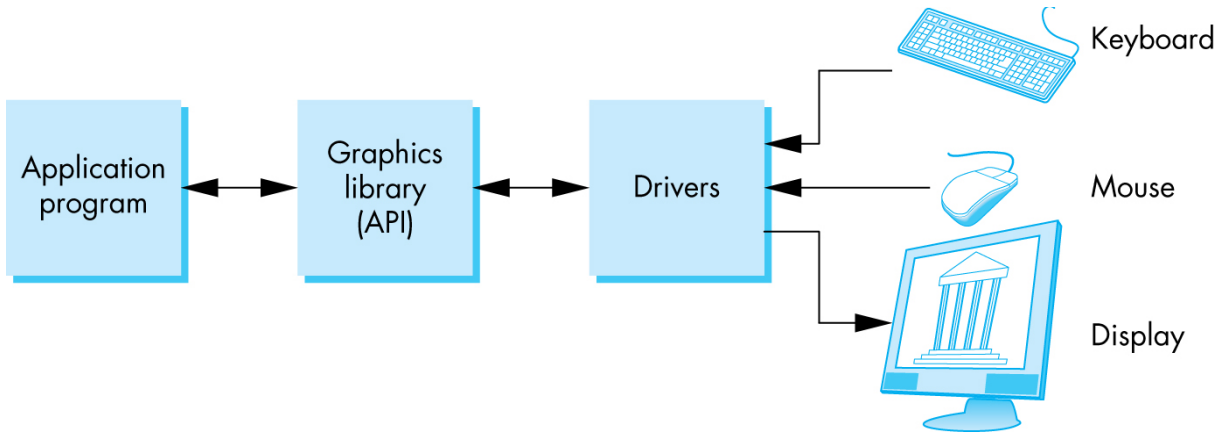
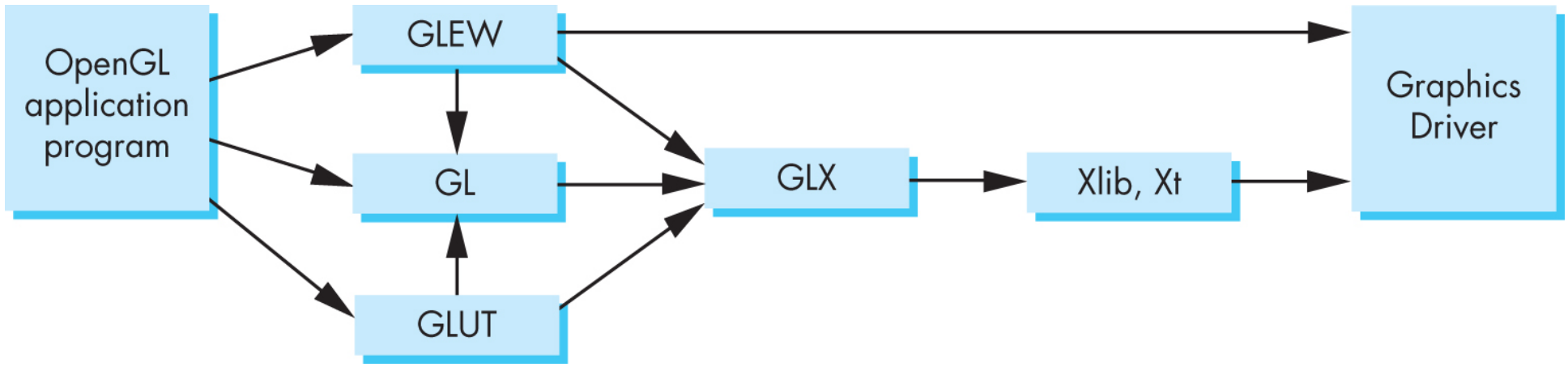
OpenGL Architecture

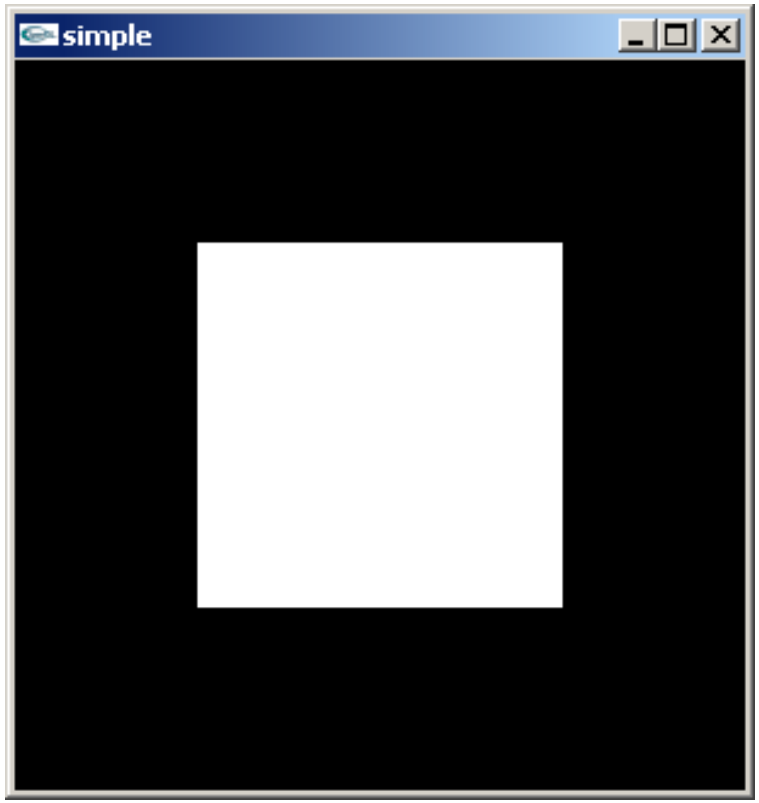


Software Organization



A OpenGL Simple Program

Generate a square on a solid background



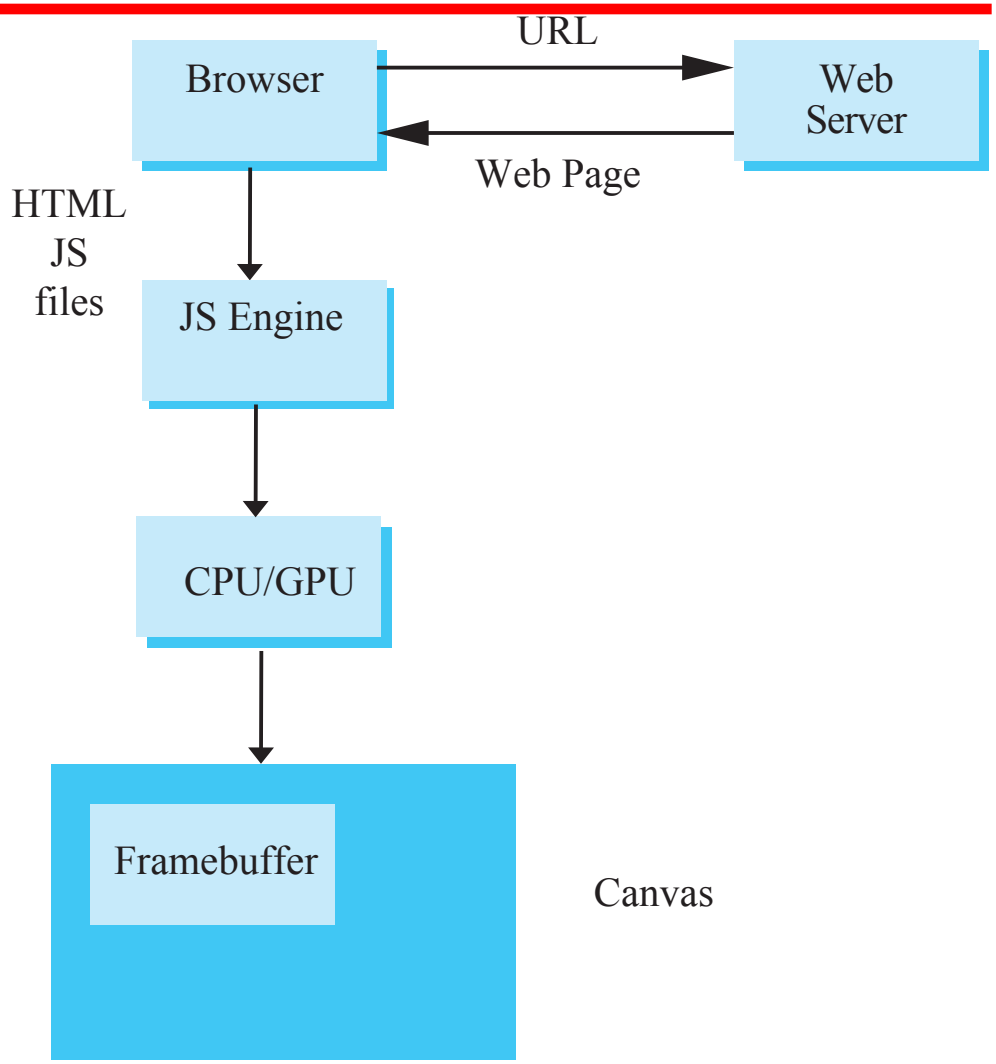
It used to be easy

```
#include <GL/glut.h>
void mydisplay(){
      glClear(GL_COLOR_BUFFER_BIT);
      glBegin(GL_QUAD;
            glVertex2f(-0.5, -0.5);
            glVertex2f(-0,5, 0,5);
            glVertex2f(0.5, 0.5);
            glVertex2f(0.5, -0.5);
      glEnd()
}
int main(int argc, char** argv){
      glutCreateWindow("simple");
      glutDisplayFunc(mydisplay);
      glutMainLoop();
}
```

What happened?

- Most OpenGL functions deprecated
  - immediate vs retained mode
  - make use of GPU
- Makes heavy use of state variable default values that no longer exist
  - Viewing
  - Colors
  - Window parameters
- However, processing loop is the same

Execution in Browser



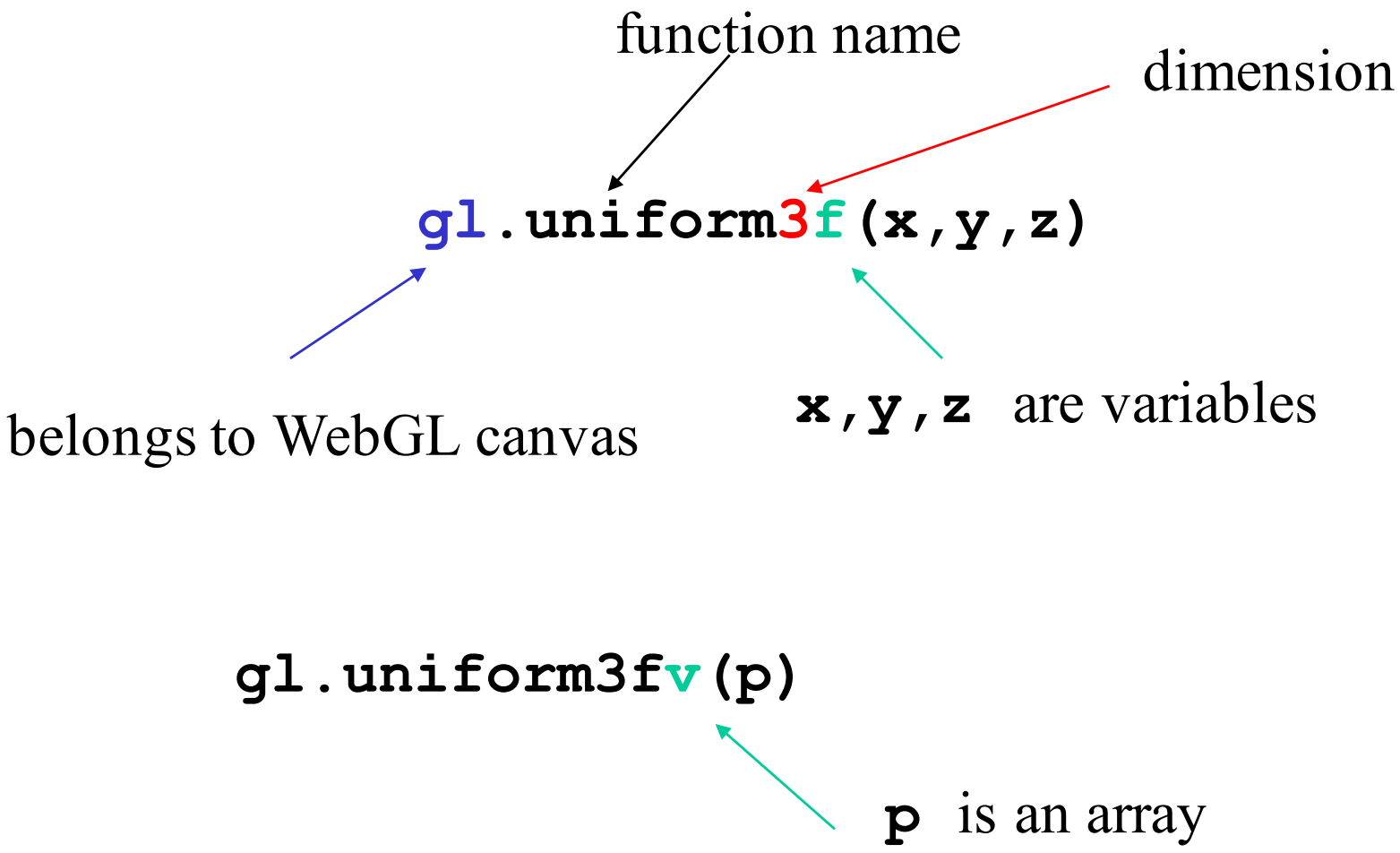
Event Loop

- Remember that the sample program specifies a render function which is a *event listener* or *callback* function
  - Every program should have a render callback
  - For a static application we need only execute the render function once
  - In a dynamic application, the render function can call itself recursively but each redrawing of the display must be triggered by an event

Lack of Object Orientation

- All versions of OpenGL are not object oriented so that there are multiple functions for a given logical function
- Example: sending values to shaders
  - **`gl.uniform3f`**
  - **`gl.uniform2i`**
  - **`gl.uniform3dv`**
- Underlying storage mode is the same

WebGL function format



WebGL constants

- Most constants are defined in the canvas object
  - In desktop OpenGL, they were in #include files such as **`gl.h`**
- Examples
  - **`desktop OpenGL`**
    - **`glEnable(GL_DEPTH_TEST);`**
  - **`WebGL`**
    - **`gl.enable(gl.DEPTH_TEST)`**
  - **`gl.clear(gl.COLOR_BUFFER_BIT)`**

WebGL and GLSL

- WebGL requires shaders and is based less on a state machine model than a data flow model
- Most state variables, attributes and related pre 3.1 OpenGL functions have been deprecated
- Action happens in shaders
- Job of application is to get data to GPU

GLSL

- OpenGL Shading Language
- C-like with
  - Matrix and vector types (2, 3, 4 dimensional)
  - Overloaded operators
  - C++ like constructors
- Similar to Nvidia's Cg and Microsoft HLSL
- Code sent to shaders as source code
- WebGL functions compile, link and get information to shaders