



Introduction to Computer Graphics with WebGL

Ed Angel

Professor Emeritus of Computer Science
Founding Director, Arts, Research,
Technology and Science Laboratory
University of New Mexico



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Video 1.3

- **Example: Draw a triangle**
 - Each application consists of (at least) two files
 - HTML file and a JavaScript file
- **HTML**
 - describes page
 - includes utilities
 - includes shaders
- **JavaScript**
 - contains the graphics



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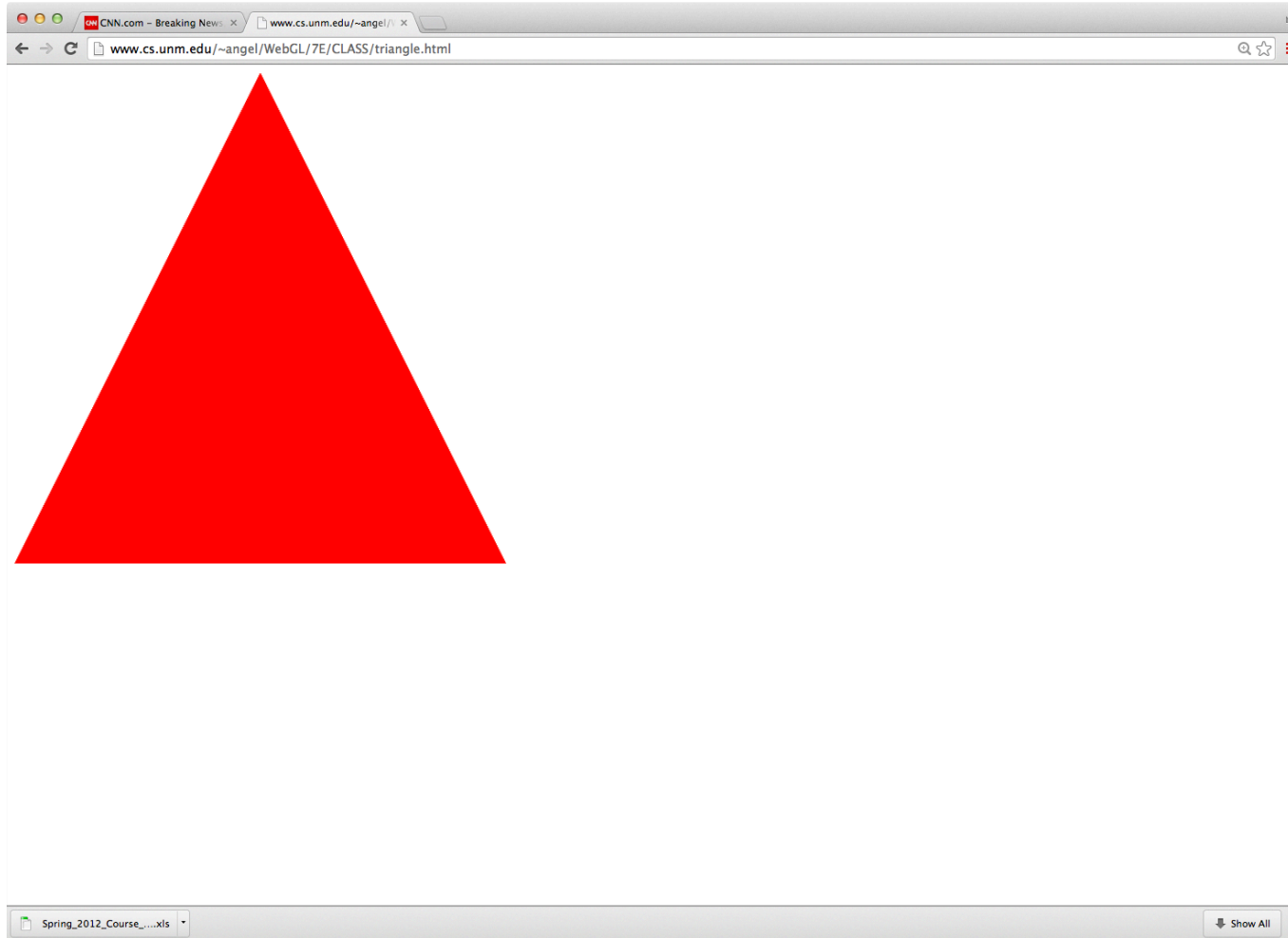
Coding in WebGL

- Can run WebGL on any recent browser
 - Chrome
 - Firefox
 - Safari
 - IE
- Code written in JavaScript
- JS runs within browser
 - Use local resources



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Example: triangle.html





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Example Code

```
<!DOCTYPE html>
<html>
<head>
<script id="vertex-shader" type="x-shader/x-vertex">
attribute vec4 vPosition;
void main(){
    gl_Position = vPosition;
}
</script>
<script id="fragment-shader" type="x-shader/x-fragment">
precision mediump float;
void main(){
    gl_FragColor = vec4( 1.0, 0.0, 0.0, 1.0 );
}
</script>
```



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HTML File (cont)

```
<script type="text/javascript" src="../Common/webgl-utils.js"></script>
<script type="text/javascript" src="../Common/initShaders.js"></script>
<script type="text/javascript" src="../Common/MV.js"></script>
<script type="text/javascript" src="triangle.js"></script>
</head>
<body>
<canvas id="gl-canvas" width="512" height="512">
Oops ... your browser doesn't support the HTML5 canvas element
</canvas>
</body>
</html>
```



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JS File

```
var gl;
var points;

window.onload = function init(){
    var canvas = document.getElementById( "gl-canvas" );
    gl = WebGLUtils.setupWebGL( canvas );
    if ( !gl ) { alert( "WebGL isn't available" );
    }

    // Three Vertices

    var vertices = [
        vec2( -1, -1 ),
        vec2( 0, 1 ),
        vec2( 1, -1 )
    ];
```

]; Angel and Shreiner: Interactive Computer Graphics 7E © Addison-Wesley 2015



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JS File (cont)

```
// Configure WebGL
```

```
//
```

```
gl.viewport( 0, 0, canvas.width, canvas.height );
```

```
gl.clearColor( 1.0, 1.0, 1.0, 1.0 );
```

```
// Load shaders and initialize attribute buffers
```

```
var program = initShaders( gl, "vertex-shader", "fragment-shader" );
```

```
gl.useProgram( program );
```

```
// Load the data into the GPU
```

```
var bufferId = gl.createBuffer();
```

```
gl.bindBuffer( gl.ARRAY_BUFFER, bufferId );
```

```
gl.bufferData( gl.ARRAY_BUFFER, flatten(vertices), gl.STATIC_DRAW );
```




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JS File (cont)

```
// Associate our shader variables with our data buffer
```

```
var vPosition = gl.getAttribLocation( program, "vPosition" );  
gl.vertexAttribPointer( vPosition, 2, gl.FLOAT, false, 0, 0 );  
gl.enableVertexAttribArray( vPosition );  
render();  
};
```

```
function render() {  
    gl.clear( gl.COLOR_BUFFER_BIT );  
    gl.drawArrays( gl.TRIANGLES, 0, 3 );  
}
```



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Exercise

-
- Run triangle.html from the class website
 - Load the triangle.html and triangle.js to your computer and run them from there
 - Edit the two files to change the color and display more than one triangle



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JavaScript Notes

- JavaScript (JS) is the language of the Web
 - All browsers will execute JS code
 - JavaScript is an interpreted object-oriented language
- References
 - Flanagan, JavaScript: The Definitive Guide, O' Reilly
 - Crockford, JavaScript, The Good Parts, O' Reilly
 - Many Web tutorials



JS Notes

- Is JS slow?
 - JS engines in browsers are getting much faster
 - Not a key issues for graphics since once we get the data to the GPU it doesn't matter how we got the data there
- JS is a (too) big language
 - We don't need to use it all
 - Choose parts we want to use
 - Don't try to make your code look like C or Java



JS Notes

- Very few native types:
 - numbers
 - strings
 - booleans
- Only one numerical type: 32 bit float
 - `var x = 1;`
 - `var x = 1.0; // same`
 - potential issue in loops
 - two operators for equality `==` and `===`
- Dynamic typing



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Scoping

- Different from other languages
- Function scope
- variables are *hoisted* within a function
 - can use a variable before it is declared
- Note functions are first class objects in JS



JS Arrays

- JS arrays are objects
 - inherit methods
 - `var a = [1, 2, 3];`
 - is not the same as in C++ or Java
 - `a.length // 3`
 - `a.push(4); // length now 4`
 - `a.pop(); // 4`
 - avoids use of many loops and indexing
 - Problem for WebGL which expects C-style arrays



Typed Arrays

JS has typed arrays that are like C arrays

```
var a = new Float32Array(3)
```

```
var b = new Uint8Array(3)
```

Generally, we prefer to work with standard JS arrays and convert to typed arrays only when we need to send data to the GPU with the `flatten` function in `MV.js`



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A Minimalist Approach

- We will use only core JS and HTML
 - no extras or variants
- No additional packages
 - CSS
 - JQuery
- Focus on graphics
 - examples may lack beauty
- You are welcome to use other variants as long as I can run them from your URL