WebGL Workshop

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Software Engineer

C#, C++, VB, MySQL, .NET, Linq, blah, blah, blah, blah

Desktop developer – no web ☹

OpenGL ☺

not shaders ☹

JavaScript, PHP, CSS, HTML ☺

Next workshop: Lighting and shadows (probably)

Thursday, January 23rd 2014

Merry Christmas

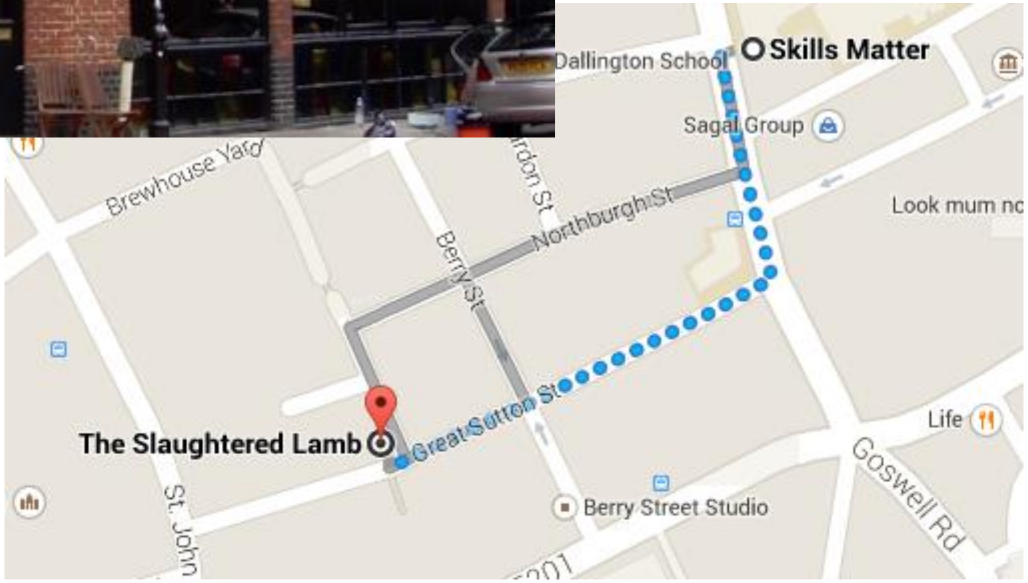
WebGL Workshop

Files and slides at

https://c9.io/carlbateman/webgl-workshop-02/workspace/index.html

WebGL Workshop

After Workshop Drinkies @ The Slaughtered Lamb



HTML Template - Self-explanatory?

```
<html>
  <title> </title>
  <head>
  <style>
    body {background-color:#b0c4de;}
    canvas {background-color:#c4deb0;}
  </style>
```

Simple styling to differentiate body and canvas

```
  <script id="vertex" type="x-shader">
  </script>
  <script id="fragment" type="x-shader">
  </script>
```

Fragment and vertex shader

```
  <script type="text/javascript">
    function init() {  }
  </script>
```

JavaScript code

```
  </head>
  <body onload="init()">
```

```
  <canvas id="glCanvas" width="500" height="500">
```

`<canvas>` element to hold WebGL context

```
 </body>
</html>
```

Hello Triangle 1 - Shaders

Vertex position

```
<script id="vertex" type="x-shader">
  attribute vec2 aVertexPosition;

  void main() {
    gl_Position = vec4(aVertexPosition, 0.0, 1.0);
  }
</script>
```

Fragment (pixel) colour

```
<script id="fragment" type="x-shader">
  precision highp float;
  uniform vec4 uColor;

  void main() {
    gl_FragColor = uColor;
  }
</script>
```

Hello Triangle 2 – get and clear context

```
var shaderProgram;
var cubeVertexPositionBuffer;
```

Global variables

```
function initWebGL() {
  canvas = document.getElementById(“myCanvas");
```

Get glCanvas element

```
  var names = ["webgl", "experimental-webgl",
"webkit-3d", "moz-webgl"];
  for (var i = 0; i < names.length; ++i)  {
    try {
      gl = canvas.getContext(names[i]);
    }
    catch (e) { }
    if (gl) break;
  }
```

Context name can differ depending on browser

Store possible context names in array then try each

Can become very complicated

Context covers entire canvas

WebGL methods / functions, constants, etc. accessed through context i.e. “`gl.`” (by convention

```
  gl.viewportWidth = canvas.width;
  gl.viewportHeight = canvas.height;
```

Save viewport dimensions

Hello Triangle 3 – build shaders

```
var v = document.getElementById("vertex").
firstChild.nodeValue;
var f = document.getElementById("fragment").
firstChild.nodeValue;
```

```
var vs = gl.createShader(gl.VERTEX_SHADER);
gl.shaderSource(vs, v);
gl.compileShader(vs);
```

```
var fs = gl.createShader(gl.FRAGMENT_SHADER);
gl.shaderSource(fs, f);
gl.compileShader(fs);
```

```
program = gl.createProgram();
gl.attachShader(program, vs);
gl.attachShader(program, fs);
gl.linkProgram(program);
```

Hello Triangle 4 – check shaders

```
if (!gl.getShaderParameter(vs, gl.COMPILE_STATUS))
  console.log(gl.getShaderInfoLog(vs));
```

Check status

```
if (!gl.getShaderParameter(fs, gl.COMPILE_STATUS))
  console.log(gl.getShaderInfoLog(fs));
```

```
if (!gl.getProgramParameter(program, gl.LINK_STATUS))
  console.log(gl.getProgramInfoLog(program));
```

```
 gl.useProgram(shaderProgram);
```

```
 shaderProgram.uColor =
gl.getUniformLocation(shaderProgram, "uColor");
  gl.uniform4fv(shaderProgram.uColor, [0.0, 1.0, 0.0,
1.0]);
```

Get position of uniform “uColor”

```
 shaderProgram.aVertexPosition =
gl.getAttribLocation(shaderProgram, "aVertexPosition");
```

Get position of attribute “aVertexPosition”

```
gl.enableVertexAttribArray(shaderProgram.
aVertexPosition);
```

Enable vertex array

Hello Triangle 5 – define geometry

```
function initGeometry() {
```

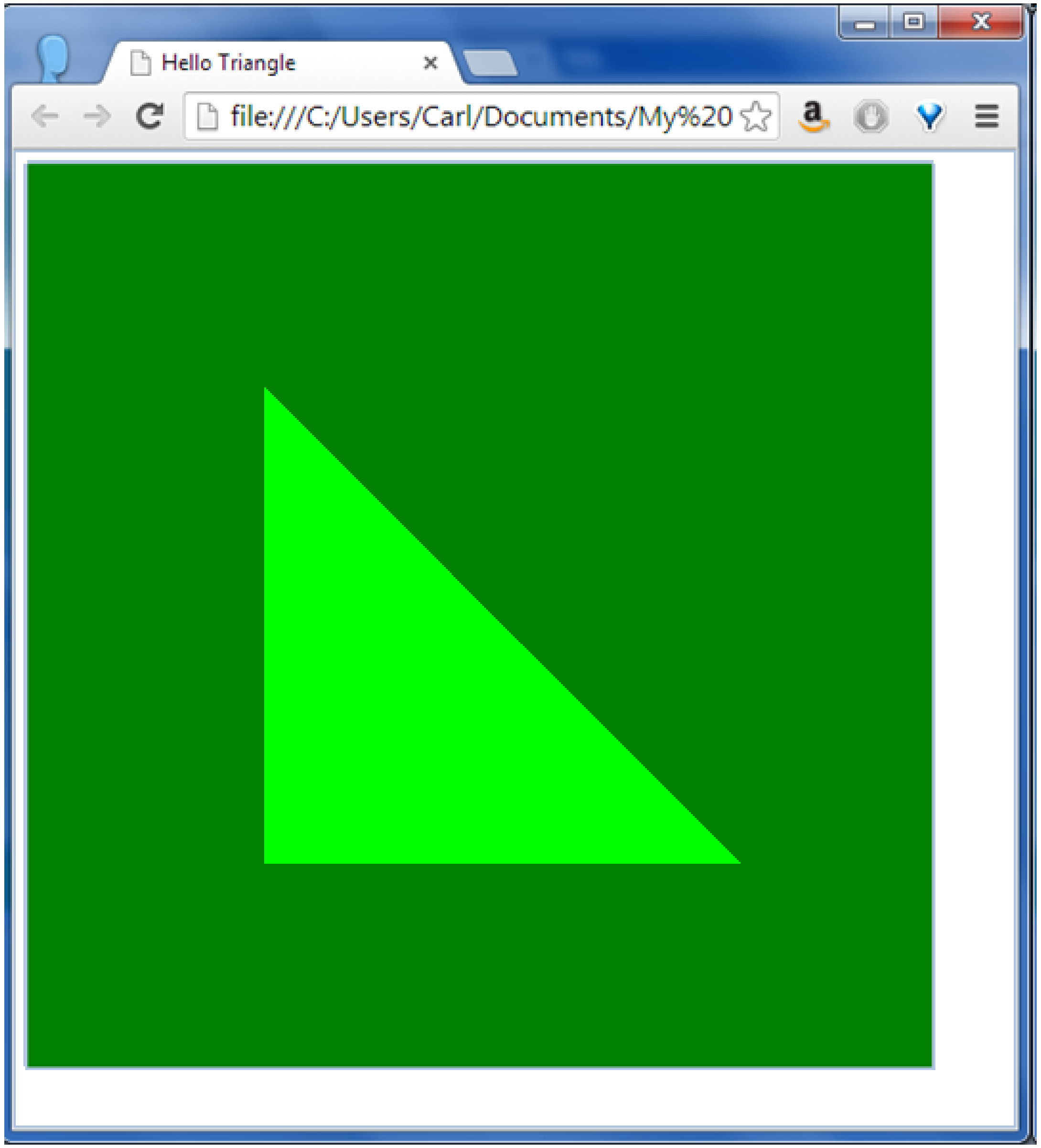
`var vertices = new Float32Array([-0.5, 0.5, 0.5, -0.5, -0.5, -0.5]);`	Define vertices
`cubeVertexPositionBuffer = gl.createBuffer();` `gl.bindBuffer(gl.ARRAY_BUFFER, cubeVertexPositionBuffer);` `gl.bufferData(gl.ARRAY_BUFFER, vertices, gl.STATIC_DRAW);`	Create buffer and bind data
`cubeVertexPositionBuffer.itemSize = 2;` `cubeVertexPositionBuffer.numItems = vertices.length / cubeVertexPositionBuffer.itemSize;`	Itemsize: ordinates in vertex

Hello Triangle 6 – connect to GPU and draw

`function draw() {`
`  gl.vertexAttribPointer(shaderProgram.aVertexPosition, cubeVertexPositionBuffer.itemSize, gl.FLOAT, false, 0, 0);`
	Set pointer to vertices

`  gl.clearColor(0, 0.5, 0, 1);`	Clear background to pale blue
`  gl.clear(gl.COLOR_BUFFER_BIT);`	Enable colour clearing
`  gl.drawArrays(gl.TRIANGLES, 0, cubeVertexPositionBuffer.numItems);`	Draw array

Hello Triangle - result



Steps

Triangle → 3D Square

3D Square → Coloured Cube

Coloured Cube → Rotated Cube

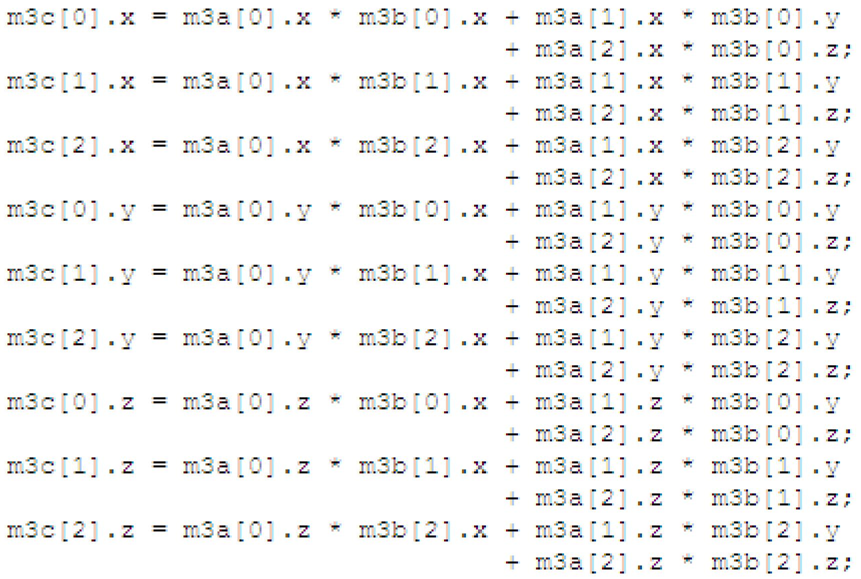
Rotated Cube → Rotatable Cube

Rotatable Cube → Dice

Steps

Triangle → 3D Square

- Note: included libraries

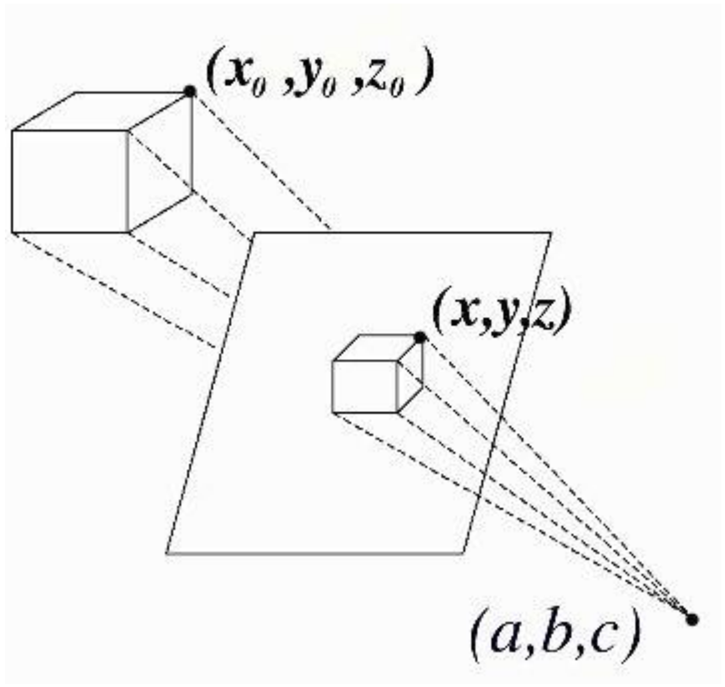


```
m3c[0].x = m3a[0].x * m3b[0].x + m3a[1].x * m3b[0].y
                               + m3a[2].x * m3b[0].z;
m3c[1].x = m3a[0].x * m3b[1].x + m3a[1].x * m3b[1].y
                               + m3a[2].x * m3b[1].z;
m3c[2].x = m3a[0].x * m3b[2].x + m3a[1].x * m3b[2].y
                               + m3a[2].x * m3b[2].z;
m3c[0].y = m3a[0].y * m3b[0].x + m3a[1].y * m3b[0].y
                               + m3a[2].y * m3b[0].z;
m3c[1].y = m3a[0].y * m3b[1].x + m3a[1].y * m3b[1].y
                               + m3a[2].y * m3b[1].z;
m3c[2].y = m3a[0].y * m3b[2].x + m3a[1].y * m3b[2].y
                               + m3a[2].y * m3b[2].z;
m3c[0].z = m3a[0].z * m3b[0].x + m3a[1].z * m3b[0].y
                               + m3a[2].z * m3b[0].z;
m3c[1].z = m3a[0].z * m3b[1].x + m3a[1].z * m3b[1].y
                               + m3a[2].z * m3b[1].z;
m3c[2].z = m3a[0].z * m3b[2].x + m3a[1].z * m3b[2].y
                               + m3a[2].z * m3b[2].z;
```

Steps

Triangle → 3D Square

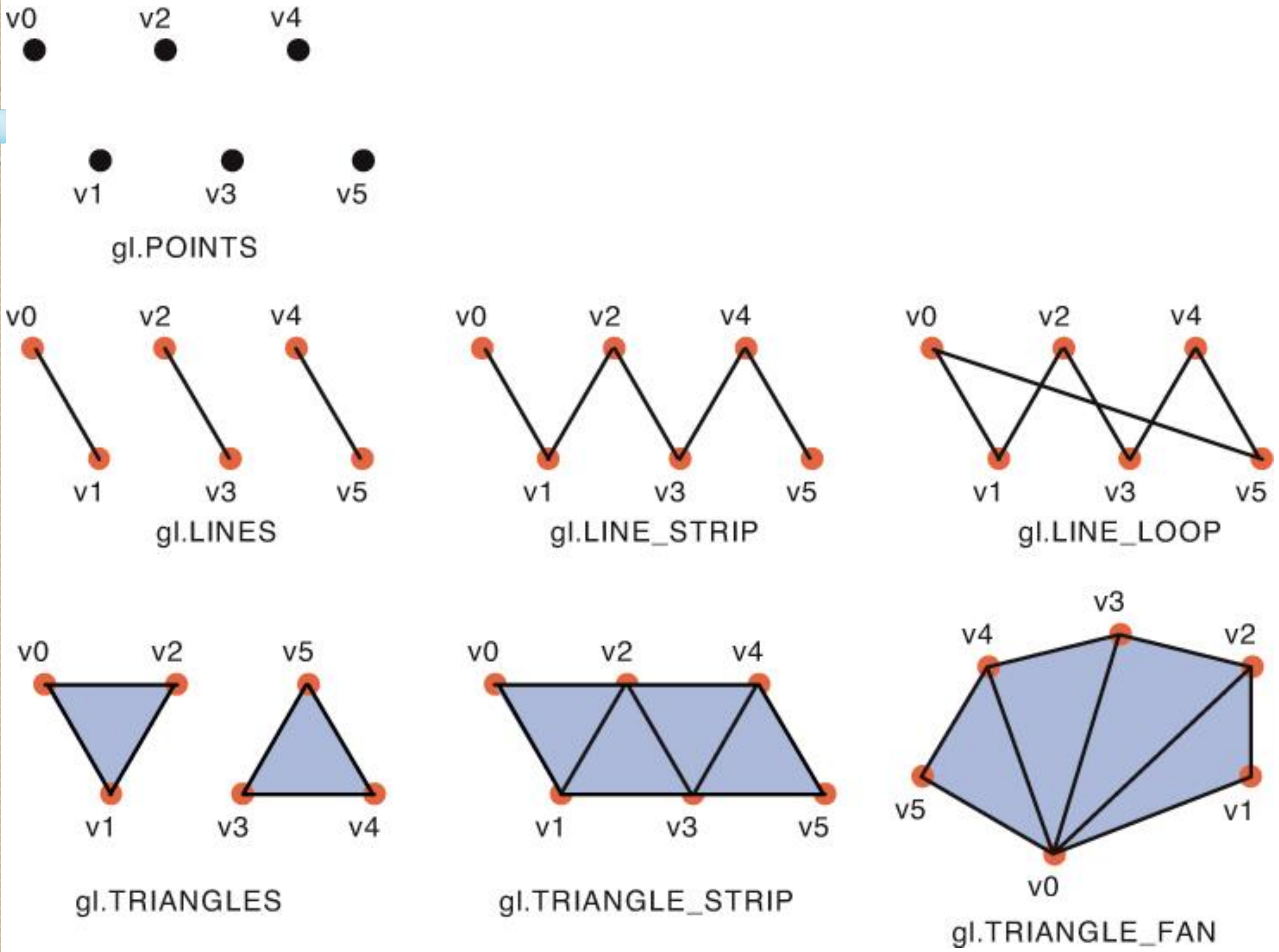
- Add perspective projection and model matrices



Change vec2 to vec3

Change assignment to gl_Position

WebGL Primitives

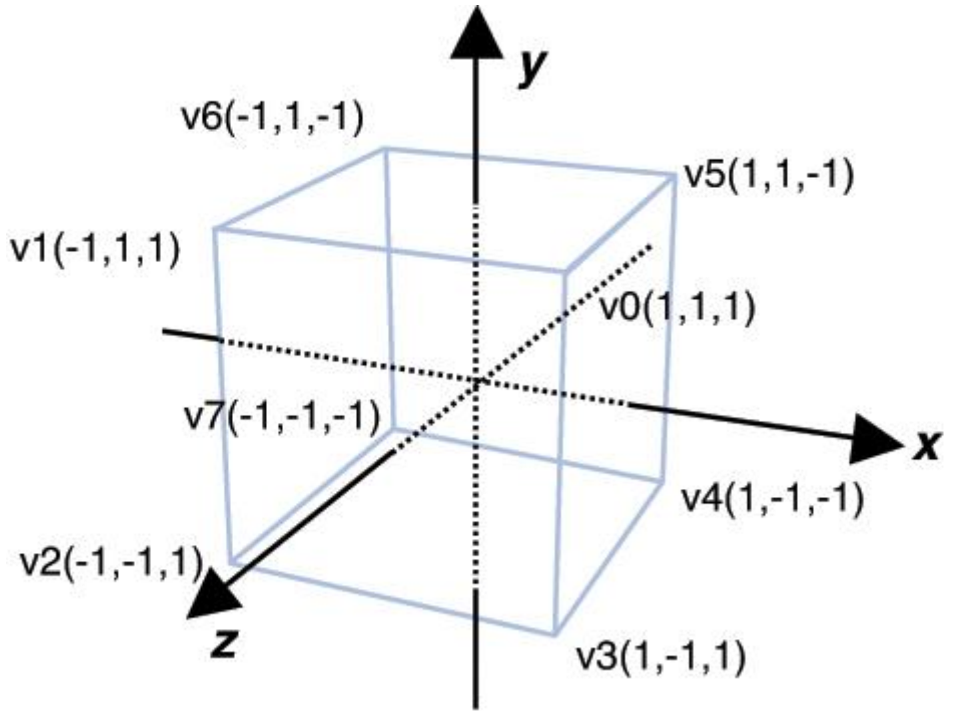


Steps

3D Square → Coloured Cube (1)

- Define vertices

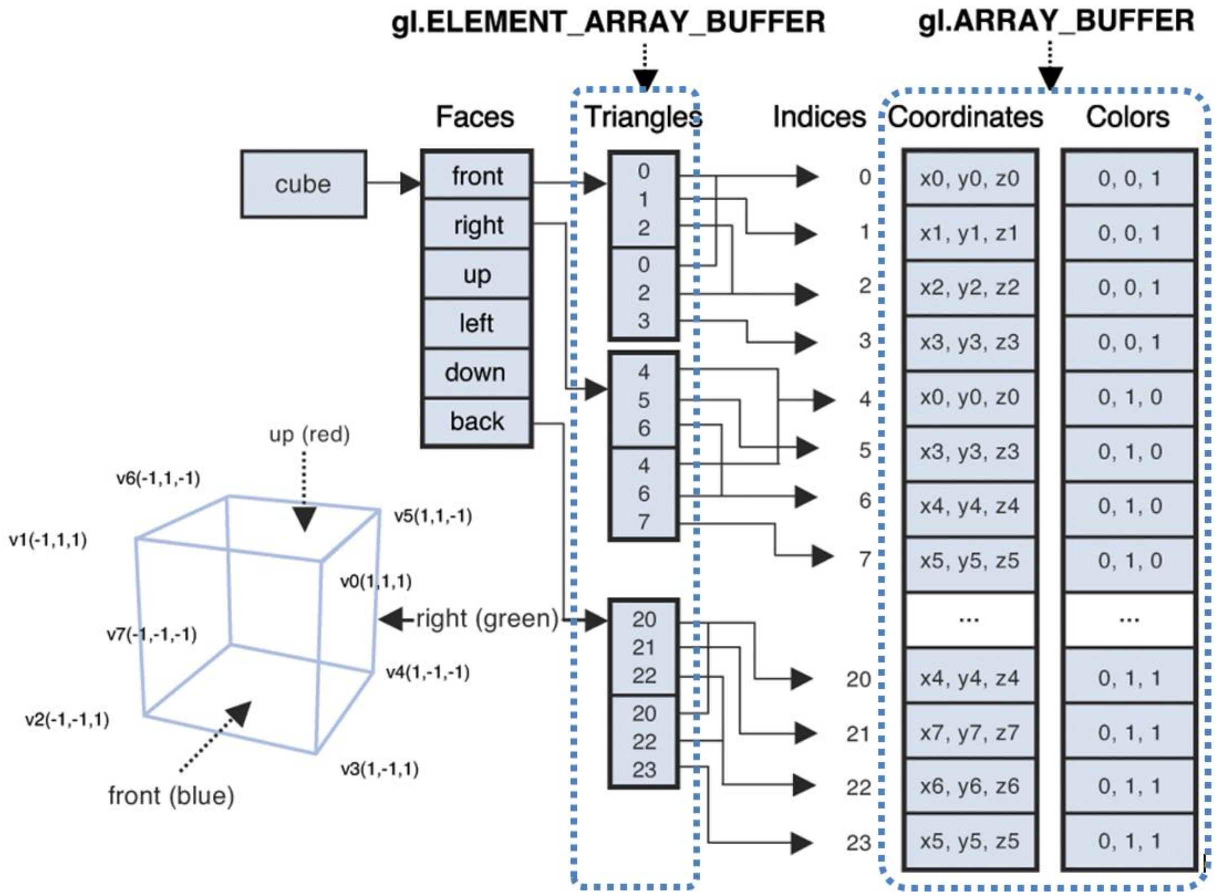
Define face colours (and for each vertex)



Steps

3D Square → Coloured Cube (2)

- Define face colours (and for each vertex)

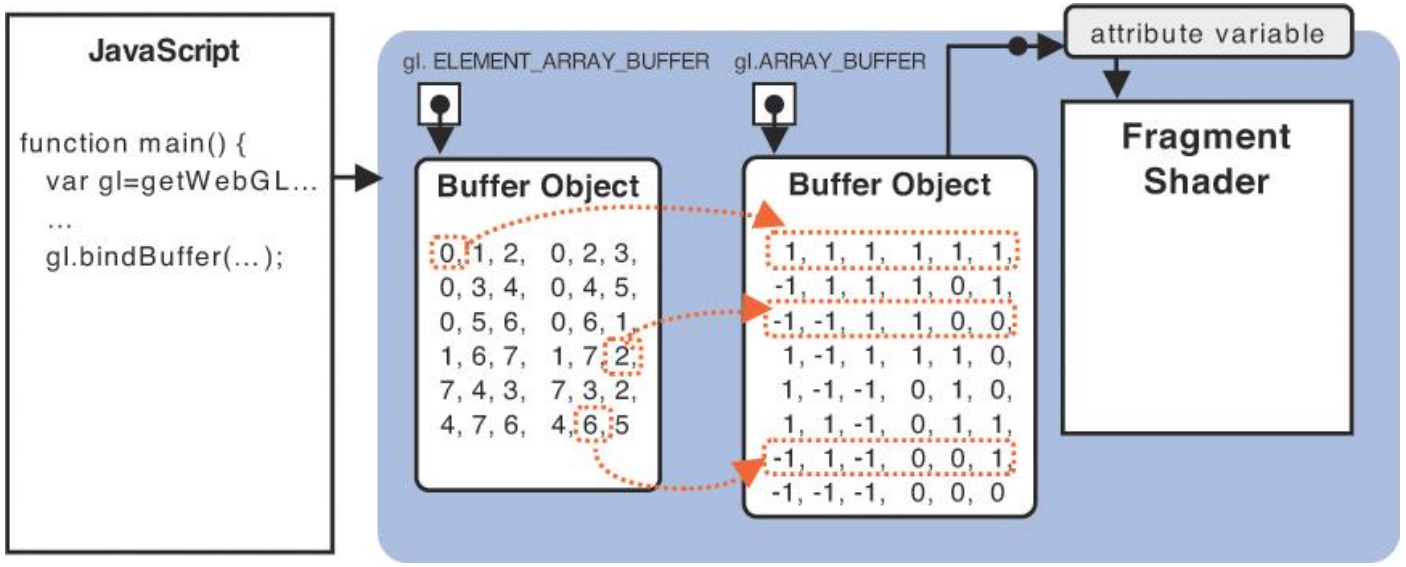


Steps

3D Square → Coloured Cube (3)

- Create and bind the buffers and data

Bind buffers and set attribute pointers to draw



Steps

Coloured Cube → Rotated Cube

- Add a transformation matrix

  Rotation

  Position

  Scale

  Sheer

Steps

Rotated Cube → Rotatable Cube

- Add mouse event handlers
  - Track current and previous mouse position while dragging
  - Difference => velocity
  - Update cube orientation
  - If not dragging reduce velocity

Steps

Rotatable Cube → Dice ???

WebGL Workshop

References:

WebGL Programming Guide

Mozilla Developer Centre

https://developer.mozilla.org/en-US/docs/Web/WebGL

Learning WebGL blog

http://learningwebgl.com/blog/

Get started with WebGL: draw a square

http://www.creativebloq.com/javascript/get-started-webgl-draw-square-7112981

Cheat sheets