Question 1

a)

Uniform A global variable that cannot be changed by the shaders, and is dependent upon the geometric primitive in use.

Attribute A global variable that cannot be changed by the shader, which is dependent upon the current vertex, and therefore is only available within the vertex shader.

Varying A variable that stores data that has been interpolated, so can vary pixel by pixel. The vertex shader is able to modify this, however the fragment shader is not.

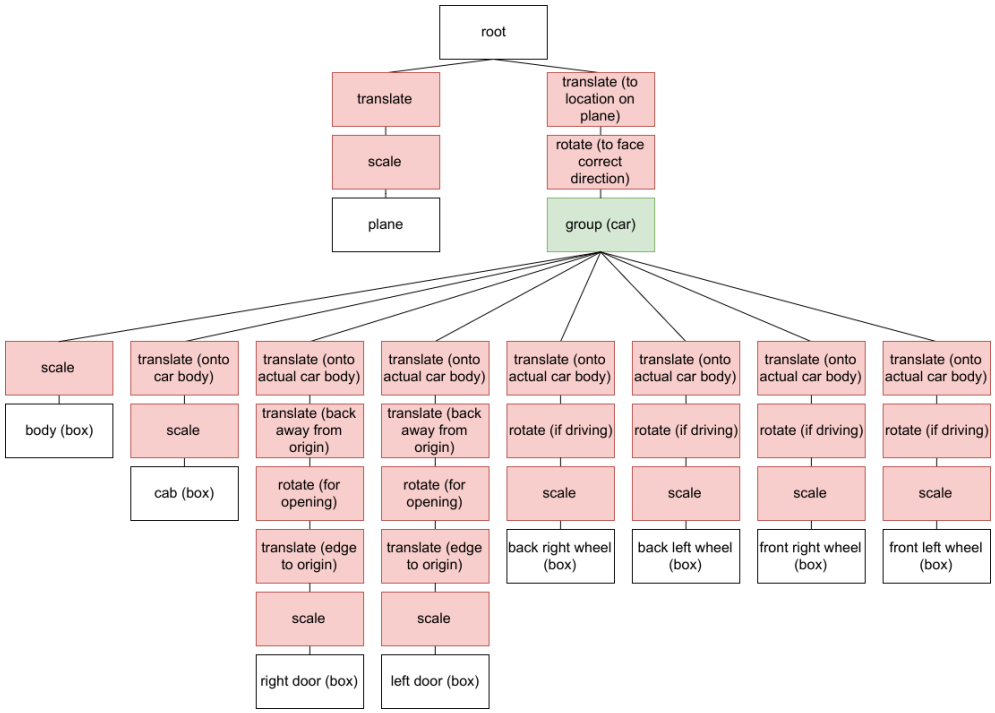
b)

```
var polygonVerticesAndColours = new Float32Array([
     0.0,  1.0,  -4.0,  0.4,  1.0,  0.5,
    -0.5, -1.0,  -4.0,  0.4,  0.7,  0.4,
     0.5, -1.0,  -4.0,  0.5,  0.4,  0.5,
     0.0,  1.0,  -2.0,  1.0,  1.0,  0.4,
    -0.5, -1.0,  -2.0,  0.3,  1.0,  0.5,
     0.5, -1.0,  -2.0,  1.0,  0.4,  0.4
]);
var n = 6; // 6 vertices in this polygon

// Create a buffer object
var vertexColorbuffer = gl.createBuffer();
if (!vertexColorbuffer) {
  console.log('Failed to create the buffer object');
  return -1;
}

// Write the vertex information and enable it
gl.bindBuffer(gl.ARRAY_BUFFER, vertexColorbuffer);
gl.bufferData(gl.ARRAY_BUFFER, polygonVerticesAndColours, gl.
    STATIC_DRAW);

var FSIZE = verticesColors.BYTES_PER_ELEMENT;

// Assign the buffer object to a_Position and enable the
    assignment
var a_Position = gl.getAttribLocation(gl.program, 'a_Position
    ');
if(a_Position < 0) {
```

```
27    console.log('Failed to get the storage location of
          a_Position');
28    return -1;
29  }
30
31  gl.vertexAttribPointer(a_Position, 3, gl.FLOAT, false, FSIZE
        * 6, 0);
32  gl.enableVertexAttribArray(a_Position);
33
34  // Assign the buffer object to a_Color and enable the
        assignment
35  var a_Color = gl.getAttribLocation(gl.program, 'a_Color');
36  if(a_Color < 0) {
37    console.log('Failed to get the storage location of a_Color'
          );
38    return -1;
39  }
40  gl.vertexAttribPointer(a_Color, 3, gl.FLOAT, false, FSIZE *
        6, FSIZE * 3);
41  gl.enableVertexAttribArray(a_Color);
```

Colour and vertices in same array

c)



d)

```
1     m.setRotate(angle, 0.0, 1.0, 0.0);
2     m.translate(1.0, 3.0, -5.0);
3     drawBox(m);
```

Explaining the meaning

i.

The above code block ensures that the matrix m is rotated around the y axis by *angle* degrees from 0, regardless of current rotation before this code block, and then is translated by $+1.0$in the x axis, $+3.0$ in the y axis, -5.0 in the z axis, relative to where m was before this code block. The matrix is then drawn.

ii.

In this case, replacing *setRotate* by *rotate* will *not* give the same result. *setRotate* is done before 'chain-able' transformations, however *rotate* is not, and so with *rotate* it would be 'chained' with $transform$, which would mean that the transform is actually carried out first, as the 'chain-able' commands are carried out in reverse order. Additionally, if the matrix already had some rotation applied, *setRotate* overwrites this, but *rotate* adds to it.

In this case, the matrix would be transformed away from it's current position, and then rotated, still about the origin. If we assume it started centered about $(0, 0, 0)$, it would be moved to $(1.0, 3.0, -5.0)$, and then rotated about the origin, around the y axis, causing it to move in a big circle, as opposed to turning 'on the spot'.

Question 2

The included files `tqvj24.html` and `tqvj24.js` are my code for this question.