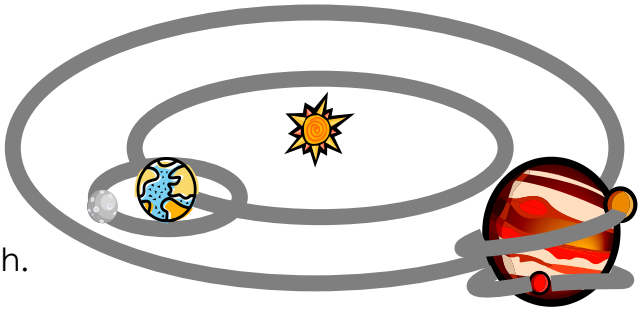
CS 418: Interactive Computer Graphics Fall 2015
In-class Worksheet 3

Viewing and Hierarchical Modeling

1. Modeling a (part of) a Solar System

Fix the following code so that it correctly models the Earth and Moon positions. You can insert Push/Pop commands and rearrange any lines of code you wish.



```
PushMatrix
Scale(7917,7917,7917)          // Set Earth diameter
Translate (AU,0,0)             // AU = distance from Earth to Sun
Rotate 360*days/365,(0,1,0)    // Rotation around sun
Scale (2159,2519,2519)         // Set moon diameter
Rotate 360*days/27,(0,1,0)     //  Moon rotation around Earth
Translate 238856,0,0           // Earth to moon distance
DrawMoon
DrawEarth
PopMatrix
```

```
PushMatrix
Rotate 360*days/365,(0,1,0)    // Rotation around sun
Translate (AU,0,0)             // AU = distance from Earth to Sun
PushMatrix
Rotate 360*days/27,(0,1,0)     //  Moon rotation around Earth
Translate 238856,0,0           // Earth to moon distance
Scale (2159,2519,2519)         // Set moon diameter
DrawMoon
PopMatrix
Scale(7917,7917,7917)          // Set Earth diameter
DrawEarth
PopMatrix
```

2. **Memory Layout of Matrices in WebGL**
   Suppose we have the following transformation matrix:

$$\begin{bmatrix} a & b & c & t_x \\ d & e & f & t_y \\ g & h & i & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   Write down the column-major layout of the matrix in memory:

   adg0beh0cfi0$t_x t_y t_z$1

   Write down the row-major layout of the matrix in memory:

   abc$t_x$def$t_y$ghit_z0001

   Our vertex shaders have typically transformed vertex positions using a line of code like this:

```
gl_Position = uMVMatrix*vec4(aVertexPosition, 1.0);
```

   Suppose in your JavaScript code your matrices are laid out in row-major instead of column-major order. How could you change the vertex shader code to accommodate that? Just alter the one line.

```
gl_Position = transpose(uMVMatrix)*vec4(aVertexPosition, 1.0);
```

3. **View Transformation**
   What viewing transformation matrix is produced by having the eyepoint at (1,0,0) with the lookat point at (4,0,0) and an up vector of <0,1,0>?

$w = \langle -1,0,0 \rangle$
$u = \langle 0,0,1 \rangle$
$v = \langle 0,1,0 \rangle$
$e = \langle 1,0,0 \rangle$

$$\begin{bmatrix} u & v & w & e \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$