CMSC427 Fall 2017
Hw 4 – Transformations and vectors

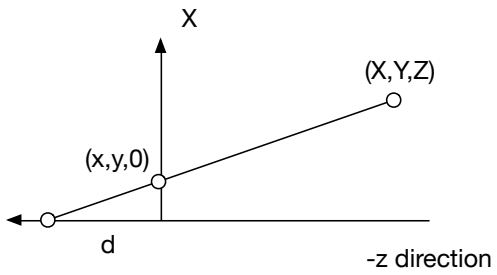
Due by start of class Tuesday, Oct. 3rd
Submit on Canvas

1. Using the barn from the PowerPoint presentation on polygonal meshes, sketch what the data structure must look like following the tetrahedron example from the same presentation. Eg, you need to explain the components: vertices, edges, faces. List all the vertices, and all the normals (assume the roof is at 45 degrees), but to keep this from being too tedious, you only need to do two faces: the face with five sides in the plane and normal n6, and the roof face with four sides and normal n2. For the vertices assume the barn is 1 unit wide, 1 unit tall to the roof, and 2 units long. The funky vertices are those on the barn's roof ridge, the funky normals are those for the roof faces.

2. Compute the camera matrix given these input values. You can check with printCamera, BTW. Show your work by giving the calculation at each step, and then the final matrix.
at = (1,1,1) lookAt = (0,0,0) up = <0,1,0>

3. If an object like Hill's barn is centered at the origin, and like the barn is flat on the (x,z) plane, then give the values of at, LookAt and up that would give you a front view (down the x axis), side view (down the z), and top view (down the y).

4. Using similar triangle arguments, give the perspective equations for x and y when the image plane is at z=0, the camera position (the focal point) is at d, the camera is looking out the negative z axis, and the point is at (X,Y,Z). Once you have the equations, then put them into homogenous matrix that gives (x,y,0) = M * (X,Y,Z).



5. Give 2D homogeneous matrices to scale a 2D point P by s=3, to translate a point to the position (3,-4), and then show how you'd use those two matrices to scale an object centered at P about its center. Set up the sequence of matrices as an equation (eg, like P' = M1*M2*P), and then just this once, show the single matrix that results from multiplying these out.

6. What is distance of the point (7,8) from the line defined by P0=(0,0) and v=<2,3>? Show the formula you use.

7. In class we constructed the parametric form for a cylinder with P(u,v) = < rcos u, hv, rsin u>. That the basic form for a surface of revolution. If we want to revolve a parabola around the y axis, given its parametric form in (x,y) as we had earlier in class, what would be the parametric form for the parametric surface of revolution? Assume the parabola is simply $y = x^2$.