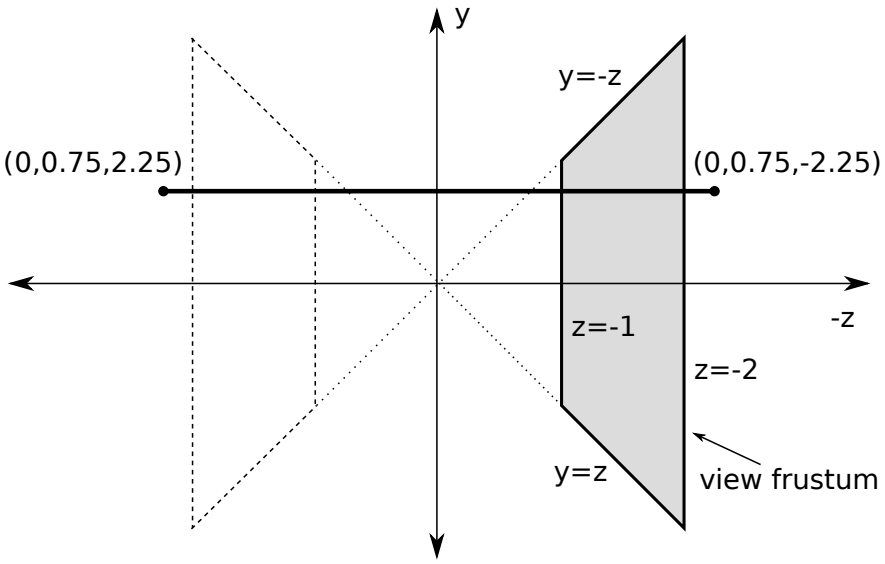
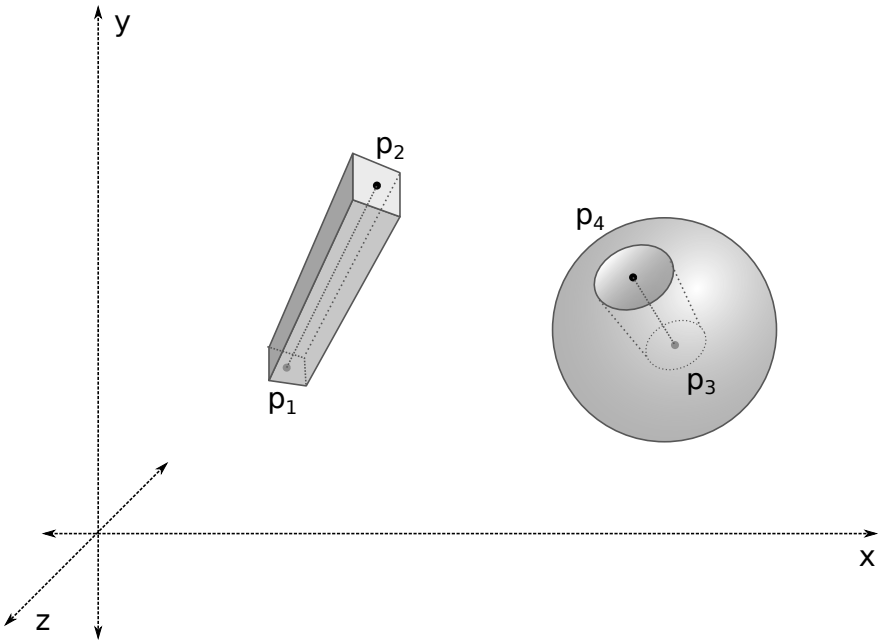
CS354 Sample Midterm Examination Fall 2015

Each problem is worth 20 points.

1. You are working in a **left-handed** coordinate system. Give a set of three 4×4 homogeneous transformation matrices which will perform counterclockwise rotations of angle θ about each of the three principal axes as seen from an observer in the positive coordinate space looking at the origin in each case.



2. Consider the simple model with only a single line segment and the viewing volume in *clipping coordinates* as shown in cross section from the point of view of an observer on the positive x axis. Suppose that you *do not clip* the line segment before you project it. You project each point on the line to the window using the perspective projection, and then display it in a viewport whose boundaries are $xmin = ymin = 0$ and $xmax = ymax = 0.5$ on a screen with coordinates ranging from (0,0) to (511,511). Sketch the viewport, labelling the coordinates of any visible endpoint of the line segment and any intersection of the line segment with the viewport boundaries.



3. You are trying to fit the square peg into the round hole in the sphere as shown. Ignoring the fact that if these objects were solid the peg may not fit into the hole, you want to make p_1 coincide with p_3 and the line segment p_1p_2 coincide with segment p_3p_4. Give a sequence of basic right-handed transformations expressed in terms of matrices with formulas in terms of the coordinates of p_1, p_2, p_3 and p_4 for all entries in the matrices which will accomplish the goal.

4. Assume that the OpenGL ModelView matrix is set to the identity matrix and that the OpenGL Projection matrix is the transformation matrix given below, and consider the points below whose coordinates will be used as parameters in OpenGL drawing commands.

Points	Transformation Matrix
$P_1 = (0.7, -0.3, 0.5)$	1 0 0 0
$P_2 = (-0.7, 0.8, 1.5)$	0 1 0 0
$P_3 = (-1.05, 1.2, 2.25)$	0 0 0 1
	0 0 -1 0

(a) Give the values of the z coordinates of the points in clipping coordinates (before the perspective division).

(b) Now project the points from clipping coordinates into NDC space by perspective division. Give the resulting NDC coordinates for the points.

(c) Assuming all points are opaque, tell which are visible and why or why not.