

1. Read the handout on Display Lists
2. Transformation applied to points (This is an **object transformation** problem)
 - a. Write out the following 4x4 matrices and label each with the following names:
T0: Translate in x by 4 and in y by 3
R: Rotate about the z axis by 45 degrees
T1: Translate in x by -4 and in y by -3
S: Scale in x by a factor of 2 and y by a factor of 4 (z is unchanged)
 - b. Assume you have an object you want to rotate by 45 degrees around a z-axis centered at (4, 3, 0). Using the symbols T0, R, and T1, show the correct order of composition of these matrices to perform the desired rotation.
 - c. Find the composite matrix M by multiply out your answer from question 1.b.
 - d. Apply the transformation matrix M to the 3D point $P=(7, 5, 7)$ to find the transformed point Q by multiply it out.
3. **Coordinate Transformation**
 - a. Assume you have an object you want to rotate by 45 degrees around a z-axis centered at (4, 3, 0). How should the coordinate system be transformed? Compute the Current Transformation (CT) matrix as a result of the coordinate transformations.
 - b. For a 3D point $P'=(4, 3, 4)$ in the transformed coordinate system, what is the coordinates of this point in the original coordinate system?
<you may use numpy on ranger (use python2.6) or other software for the matrix computations>
4. Write a program to apply OpenGL transformation functions to draw the figure (a) shown below. Each twisted star should be drawn based on the vertex definition of one branch of the star, as shown in figure (b). Attach your program and a screen shot of the program output.

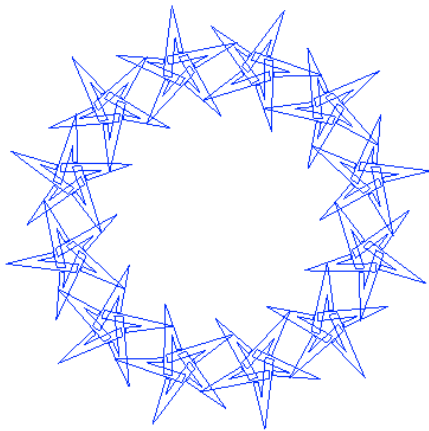


Figure (a)



Figure (b)