Lab 3 - Transformation Matrices and Their Usage
Due (via Bitbucket and hard copy) Tuesday, 22 September 2015
50 points

Lab Goals

- Rework your Lab 1 submission using the `translate()`, `rotate()`, and `scale()` functions
- Answer some questions related to transformation matrices

Assignment Details

Now that we have been using Processing for a few more classes, you should be a bit more familiar with its functionality and with the wide variety of sketches you can create. In this lab, you will revisit your submission from Lab 1, updating it with the transformation functions built into Processing and adding classes (if you haven’t already).

Additionally, the second component of the lab asks you to provide the transformation matrices necessary to perform a variety of actions.

Lab 1 Update (30 points)

Since you were assigned Lab 1 several weeks ago, we have introduced a few new capabilities of the Processing language and development environment, including:

- Classes
- Arrays and `ArrayLists`
- Transformation matrices and the `translate()`, `rotate()`, and `scale()` functions
- The `pushMatrix()` and `popMatrix()` coordinate system state manipulators

For the first component of this lab, you should update your scene from Lab 1 to make use of these additional features. In particular, your updated submission should include:

- At least one class, but preferably more
- All shapes drawn at (0, 0), using transformations to move the coordinate system
- At least one use of each of the `translate()`, `rotate()`, and `scale()` functions

If you are already sick of your Lab 1 submission, you are certainly welcome to create a new scene of your choice, so long as you adhere to the requirements listed above.
Transformation Matrices (20 points)

For four points each, please give transformation matrix (or matrices) that will perform each of the requested operations. If multiple transformation matrices are required, your submission can either provide the single matrix that results from multiplying them all together, or can list each of the matrices separately (but in the correct order).

1. Move a 2D rectangle to the right 60 pixels and down 30 pixels.
2. Rotate a 50x42 2D rectangle initially located with a center at (45, 18) by $3\pi/4$ radians and repositioning its center at (-20, 50).
3. Scale a 75x30 2D rectangle initially located with a top-left corner at (10, -6) by 0.5 in the x-dimension and 1.75 in the y-dimension and repositioning its center at (17, 21).
4. Rotate a 3D cube initially located with a center at (5, 15, 10) by $\pi/4$ radians in the XZ-plane, then by 215 degrees in the YZ-plane, finally moving its center back into the original position.
5. Rotate a 3D cube initially located with a center at (50, 20, 18) by $5\pi/6$ radians about the vector (1, -3, 2), then moving the cube back into its original position.

Submission Details

For this assignment, please submit the following items which you have followed while completing this lab in paper form. Also, please upload these same items to your cs382f2015-<your user name> repository. Your submission should include the following:

1. The commented source code for your reworked Lab 1 submission
2. The answers to the transformation matrix questions from the second section
3. An Assignment Information Sheet

Additional Group Requirements

You are welcome to submit this assignment on your own, or in a group with one other person. In cases of groups, I would prefer one experienced programmer and one inexperienced programmer in the group, but this is not an absolute requirement. Additionally, each group need only submit one paper copy of their work, but each member of the group should push all items to their own repositories.

Finally, each group must create a short document (0.5-1 pages) detailing the work breakdown of the group members: who worked on which components, which lines of code belong to each group member, etc. Comments in the code will help here too.