

Mathematics 308 — Homework 4 — due Friday, November 1

1. (a) Find **by hand calculation** the matrix describing the transformation from user to page coordinates at each line in this PS programs (several matrices):

```
%!
```

```
100 100 translate
72 36 scale
32 rotate
[1 1 0 1 0 0] concat
```

(b) Construct procedures `Translate`, `Scale`, `Rotate`, `Concat` that effect the corresponding coordinate changes and simultaneously display by `==` the current user-to-page matrix. Show how it works on the code above, in order to check your hand calculation.

(c) Write a PostScript program that displays on separate pages the figure which in user coordinates is the unit square with diagonal $(0, 0)$ – $(1, 1)$, after each of the changes above.

2. Write down the equation in user coordinates of the line whose equation in page coordinates is $2x + y = 200$, after each of the coordinate transformations in question #1. Verify that your equation is correct by drawing in PostScript that line on separate pages, in the different user coordinate systems.

3. Construct a procedure `projective` with one argument, an array of four 2D points (x, y) , that returns a 3×3 projective matrix moving these four points into $(0, 0)$, $(1, 0)$, $(0, 1)$, and $(1, 1)$. Show how this works by drawing at least two examples of what my image manipulation program does: draws the initial four points on one page in a rectangle, along with a square grid, underneath it in medium gray, then draws the transform of this image by the matrix on the next page.