AMath 584, Autumn 2023

Assignment 1.

Due Thu, Oct. 5, 11:59 p.m.
Reading: Lectures 1-2 in the text.

1. p. 9, Exercise 1.1. Check your result using Matlab by entering a 4×4 matrix B, applying the required operations to B and then checking if the result is equal to the product of the eight matrices you wrote down in part (a) and the product ABC of the three matrices you wrote down in (b). Turn in a listing of your output showing that the matrices that are supposed to be equal really are.

2. **For this problem, you will turn in a .m file of your code. (It is ok if you turn in more than one such file if needed).** This exercise will help you construct and execute a Matlab function, and get accustomed with some of the plotting commands. Let $\mathcal{P}_s$ be a parallelogram in the first quadrant produced by applying a horizontal shear to the unit square $S = [0, 1]^2$. In other words, if (x, y) are points in S, then a corresponding point in $\mathcal{P}_s$ is given by $x' = x + sy, y' = y$.

   (A) Write a matlab function called `tilt(s)` that takes as input the shear factor s. As output, the function should produce a linear transformation (a 2 by 2 matrix we will call L) that maps the unit square $S = [0, 1]^2$ to the parallelogram $\mathcal{P}_s$.

   (B) Let $s = 1/6$. The following code produces some points in the unit square and shows how to plot them nicely:

```
figure(1)
 t = linspace(0, 1, 20);  %t is 20 equally spaced points from 0 to 1
[x, y] = meshgrid(t,t); % form a grid of (x,y) pairs on [0, 1]^2
x = x(:);
y = y(:);
plot(x, y, '.k', 'markersize', 15) % plots pairs of points,
 % uses dot markers,  k = black color, size 15 markers
```

   Write an executable .m program that does the following: (i) Opens Figure 1 and plots the grid of points from the code above in Figure 1. Label the plot 'Square points'. (ii) calls `tilt` function, gets the transformation matrix L, and (iii) Opens Figure 2 and plots the transformed points $L \begin{pmatrix} x \\ y \end{pmatrix}$ in Figure 2. Label the plot 'Tilted points'.

   Note on MATLAB functions: Check out pg. 35 at this website (links to the MATLAB guide mentioned in the syllabus) for a discussion of MATLAB functions vs. scripts. This guide can also help with the basics for plotting, matrix vector operations, etc.

3. pp. 15-16, Exercises 2.1, 2.2, and 2.6. In exercise 2.6, assume that u and v are nonzero m-vectors.