Laboratory Assignment #1

1. Lab assignments in general

There will be at least two lab assignments during the rest of the quarter. They can be done over the Internet with a web browser. You may use (a) the PIC/Math Lab, BH 2817, (b) the Natural Sciences Learning Center (NSLC) lab in Young Hall South, or (c) off-campus equipment, such as your own. For (a) and (b), you already have accounts; follow instructions in the labs to log in. For any, use Netscape or MS Internet Explorer and make sure Java is enabled.

The lab assignments are graded pass-fail, so you can either do the bare minimum or do more, depending on how much time you have to spend on them. If you do well on labs, I'll make a note of that so I can mention it if you need a recommendation in the future.

Each lab assignment has a target due date. However, you may submit it earlier or later. Each day early counts for "one credit". Each day late counts "one debit". At the end of the quarter credits minus debits should be ≥ 0. All work must be submitted by the last day of classes. Weekends count for credits but not for debits.

For handing in your work, follow instructions with each assignment.

2. This assignment

Target due date: Monday, May 18.

Purpose: Experiments with linear transformations and eigenvectors

How to hand in: Simply email your answers to `tst115a1` in the form of regular email.

2.1 Linear transformations

Go to the Math 115A/1 home page `http://www.math.ucla.edu/~baker/115a.1.98s/` and click on the Linear Transformation Lab. After a wait you should get a bar that says "Linear Program". (If you don't, then probably Java is not enabled on your computer; in your browser, find "preferences", probably under the Edit menu, and under that find "enable Java".)

Click on "Linear Program." You should get a window showing a linear transformation somewhat in the style of the "house" handout. In fact, one option *is* the house. Depending on the number of pixels (dots) on your computer screen, the whole picture may or may not fit on the screen without your needing to "scroll" left-right and/or up-down.

Look for these features and answer the questions.

- There are some buttons to choose different things to draw in the domain (the left side). What do they do, and what do the images look like? (For the first two, try "dragging" any vectors in the domain–moving the cursor while holding the mouse button down.)
- There are some ways of changing the linear transformation shown. You can drag the images of the standard basis vectors or you can type in the matrix. You can also pick one of the menu items. See if you can imitate the transformations from the "house" handout, especially #8, and report your degree of success.
- What do the center buttons do?
- Choosing the grid in the domain, describe what happens as you make the transition from a nonsingular matrix to a singular matrix (by dragging the images of the standard basis vectors to change the transformation).

2.2 Eigenvalues

Back up in your browser to the class home page and click on the Eigenvector Lab. Once you get it going, it has two phases: First you choose the linear transformation exactly as you did above, and then you click on the tab "Find Eigen". (On some computers the tab seems not to work–in that case just say so.)

Start with the example matrix already shown. The vectors in the image and domain are both shown together. The goal is to drag $\mathbf{v}$ so that $T(\mathbf{v})$ is along the same line as $\mathbf{v}$. (Sometimes you may find that the picture takes some time to catch up with your dragging.) If you are successful, when you let go you will see a whole line representing an "eigenspace", meaning all possible eigenvectors along the same line as the one you chose. Now find a second eigenvector somewhere else.

For at least three different matrices, find all the eigenvectors you can and describe what happens. Your examples should include

(a) Another matrix somewhat like the preset example,

(b) a shear, and

(c) a rotation.

Email your answers.