Announcements

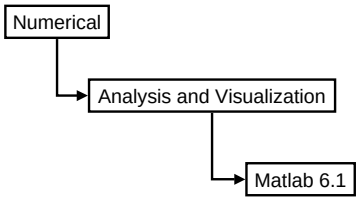
- Class mailing list: send email to Hyoungjune Yi: aster@cs.umd.edu
- Homework at the end of class.
- Text is on reserve in the CS library.
- Powerpoint should be available by 10am class day.

Matlab tutorial and Linear Algebra Review

- Today's goals:
- Learn enough matlab to get started.
- Review some basics of Linear Algebra
- Essential for geometry of points and lines.
- But also, all math is linear algebra.
- (ok slight exaggeration).
- Many slides today adapted from Octavia Camps, Penn State.

Starting Matlab

- For PCs, Matlab should be a program.
- For Sun's:



Help

- help
- help command

Eg., help plus

- Help on toolbar
- demo
- Tutorial: http://amath.colorado.edu/scico/tutorials/matlab/

Matlab interpreter

- Many common functions: see help ops

Vectors

- Ordered set of numbers: (1,2,3,4)
- Example: (*x*,*y*,*z*) coordinates of pt in space.

$$v = (x_1, x_{2,\ldots,} x_n)$$

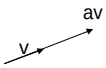
$$\|v\| = \sqrt{\sum_{i=1}^{n} x_i^2}$$

If $\|v\| = 1$, v is a unit vector

Indexing into vectors

Vector Addition

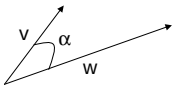
Scalar Product



Operations on vectors

- sum
- max, min, mean, sort, …
- Pointwise: .^

Inner (dot) Product



The inner product is a SCALAR!

Matrices

Sum:

A and B must have the same dimensions

Matrices

Product:

A and B must have compatible dimensions

Identity Matrix:

$$I = \begin{pmatrix} 1 & 0 & \ddots & 0 \\ 0 & 1 & \ddots & 0 \\ \ddots & \ddots & \ddots & \ddots \\ 0 & 0 & \ddots & 1 \end{pmatrix} \quad IA = AI = A$$

Matrices

Transpose:

If A is symmetric

Matrices

Determinant: A must be square

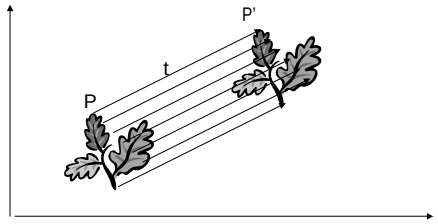
Matrices

Inverse: A must be square

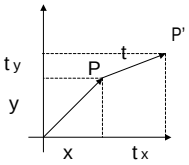
Indexing into matrices

Euclidean transformations

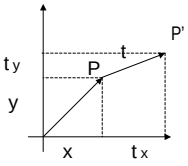
2D Translation

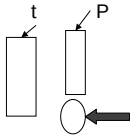


2D Translation Equation

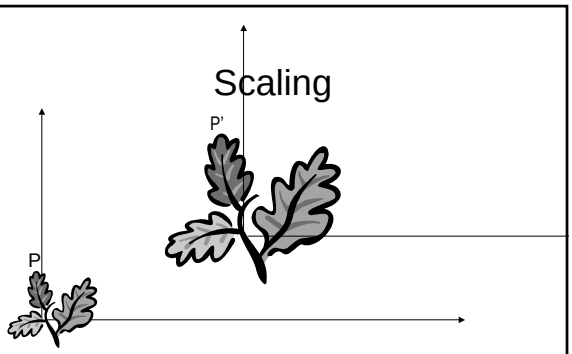


2D Translation using Matrices

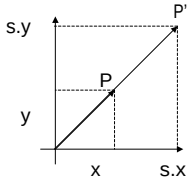




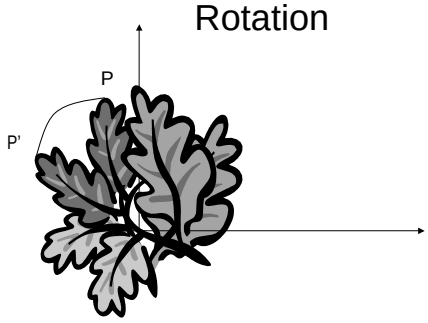
Scaling



Scaling Equation

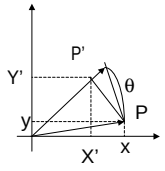


Rotation



Rotation Equations

Counter-clockwise rotation by an angle θ



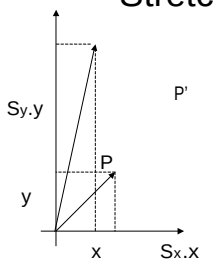
Degrees of Freedom

R is 2x2 ⟹ 4 elements

BUT! There is only 1 degree of freedom: θ

The 4 elements must satisfy the following constraints:

Stretching Equation



Stretching = tilting and projecting (with weak perspective)

Linear Transformation

Affine Transformation

Files

Functions

- Format: function o = test(x,y)
- Name function and file the same.
- Only first function in file is visible outside the file.

Images

Debugging

- Add print statements to function by leaving off ;
- keyboard
- debug and breakpoint

Conclusions

- Quick tour of matlab, you should teach yourself the rest. We'll give hints in problem sets.
- Linear algebra allows geometric manipulation of points.
- Learn to love SVD.