

MTBI New Student Computer Lab

Linear Algebra with Maple & Matlab

The objective of this lab is to familiarize you with the linear algebra packages/commands in both Maple and Matlab. Carefully read every problem and make sure you understand it.

General:

Besides the usual set of useful Maple commands, we now have some specifically used for linear algebra. Among these are: `evalm`, `eigenvects`, `eigenvals`, `jacobian`, `matrix`, `trace`, `vector`, `minor`, `multiply`, `transpose`, `inverse`, `row`, `col`, `minor`. There are comparable commands in Matlab (see Example 2).

Before using any of the linear algebra commands, you must load the linear algebra package. See the 2nd line of example 1 below.

Example 1: Maple

```
restart;
with(linalg):
eq1:=matrix(2,2,[a,b, c, d]);
eq2:=inverse(eq1);
eq3:=(multiply(eq1,eq2));
eq4:=simplify(eq3);
eq5:=subs(a=3,b=1,c=4,d=1,evalm(eq1));
eq6:=inverse(eq5);
eq7:=charpoly(eq5,lambda);
eq8:=solve(eq7,lambda);
eq9:=eigenvals(eq5);
eq10:=eigenvects(eq5);
eq11:=eq10[1][3];
eq11a:=eq10[1][3][1];
eq11b:=eq10[2][3][1];
eq12:= matrix(2,2,[eq11a,eq11b]);
eq12a:=transpose(eq12);
eq13:=multiply(inverse(eq12a),eq5,eq12a);
eq13a:=simplify(evalm(eq13));
```

Example 2: Matlab

```
A=[1 3 5;1 7 9;1 2 3]
B=inv(A)
det(A)
A'
x=[8 17 30]
x=[8; 17; 30]
A*x
x'*A
```

```

b=[0; 1; 3]
y=A\b           %this is the solution of Ay=b
lambda=eig(A)
[v,d]=eig(A)
v*d*inv(v)
A=[A;2 4 6; 8 10 12]
A(:,4)=[1;2;3;4;5]
A(:,4)
A(4,:)
A(2:4,3)

```

Now do Exercises 1,2, 3 using both Matlab and Maple. Compare the answers you obtain using each program.

Exercise 1: Consider the following matrices:

$$A = \begin{pmatrix} \frac{-7}{8} & \frac{3}{8} \\ \frac{-1}{8} & \frac{-3}{8} \end{pmatrix}, \quad B = \begin{pmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{5} & \frac{4}{5} \end{pmatrix}$$

Give the eigenvalues and eigenvectors of each. Find a matrix S such that $A = SAS^{-1}$, where Λ is a diagonal matrix containing the eigenvalues of A . Suppose that A and B are maps from R^2 to R^2 . What are the fixed points of each system? That is, what vectors x, y satisfies $Ax = x$ and $By = y$. Can you think of a computationally efficient way to calculate B^{100} . (You will need to use `evalm(A^2)` in Maple to square A). Give a linear algebra explanation for the qualitative difference between the A^{100} and B^{100} .

Pseudocode answer:

-Use the commands eig, inv, etc.

Exercise 2: Consider the matrix

$$A = \begin{pmatrix} -\rho & \rho & 0 \\ r - z & -1 & -x \\ y & x & -b \end{pmatrix}$$

where $y = \sqrt{rb - b}$, $x = -\sqrt{rb - b}$, $z = r - 1$. Substitute $b = 8/3$, $\rho = 10$, $r = 28$ and calculate the eigenvectors and eigenvalues. For Maple only, calculate the characteristic equation leaving r as a parameter (i.e., don't substitute $r = 28$). For what values of r will we have more than one real root?

Exercise 3: Using Maple, verify the identity

$$(A B)^{-1} = B^{-1}A^{-1}$$

for the general 2-by-2 case. Using both Matlab and Maple, verify the identity above and the comparable one for transposes using the matrices from exercise 1.