

Drexel University
Office of the Dean of the College of Engineering
ENGR 232 – Dynamic Engineering Systems

Week 8 – Pre Lab

MATLAB Primer

Finding eigenvalues and eigenvectors in MATLAB

1. Using eig() function
2. The form of the matrices and the diagonals holding the eigenvalues, columns holding eigenvectors
3. Solutions to differential equation example

```
%% ENGR 232 Week 8 - Recitation

% Matlab Primer
%% Eigenvalues and Eigenvectors in MATLAB
clear; clc; close all;
% Define matrix

A = [0 1;-3 -4];
[v,d] = eig(A)

% v- eigenvectors as columns
% d - diagonal matrix of eigenvalues
lam_1 = d(1,1)
lam_2 = d(2,2)

v1 = v(:,1)
v2 = v(:,2)
% Note: Eigenvectors correspond to eigenvalues along columns
%% Expressing eigenvectors as whole numbers (if possible) v1
= v1/min(v1)
v2 = v2/min(v2)

%% Differential equations solutions %
y''+3y'+11y = 0,    y(0) =1, y'(0) = 2
clear; clc;
A = [0 1;-11 -3];
[v,d] = eig(A);
lam_1 = d(1,1);
lam_2 = d(2,2);
v1 = v(:,1);
v2 = v(:,2);
v1 = v1/min(v1);
v2 = v2/min(v2);

%% Now we have the eigenvalues and eigenvectors, we know:
% x(t) = c1 e^r1t v1 + c2 e^r2t v2 % Check
notes: we can solve for c1 and c2:

C = inv([v1 v2])*[1;2];
c1 = C(1);
c2 = C(2);
```

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%% Want to plot solution:

time = 0:0.01:4;
x = c1*exp(lam_1*time).*v1(1) + c2*exp(lam_2*time).*v2(1);
x_p = c1*exp(lam_1*time).*v1(2) + c2*exp(lam_2*time).*v2(2);

plot(time,x)
hold on
plot(time,x_p,'g')

grid on
legend('y(t)', 'dy/dt')
```

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%% What happens when we only have 1 eigenvector?
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B = [-2 1; 0 -2];
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[v,d] = eig(B)
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% We get the same eigenvectors - not good. We need linearly %
independent vectors.
% Use Jordan function:
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[v,d] = jordan(B)
```

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% The second vector is the generalized eigenvector.
```