ELEN 50 Lab 1: Vectors and Matrices MATLAB Lab Report

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Matrix Multiplication

Create 2 x 2 matrices A and B are as follows:

```
>> A=[2,1;3,2]
A =
     2     1
     3     2
>> B=[3,1;2,2]
B =
     3     1
     2     2
```

Print A' and B', the transposes of these two matrices

```
>> A'
ans =
     2     3
     1     2
>> B'
ans =
     3     2
     1     2
```

Compute the following 4 matrix products and print them. Are any the same? Which ones?

```
>> A1=A*B
A1 =
     8     4
    13     7
>> A2=B*A
A2 =
     9     5
    10     6
>> A3=(A'*B')'
A3 =
     9     5
    10     6
>> A4=(B'*A')'
A4 =
     8     4
    13     7
```

The products $A * B$ is the same as $(B' * A')'$, and $B * A$ is the same as $(A' * B')'$

Matrix Inverses

Use "inv" to compute the following matrix inverses.

```
>> A1 = inv(A*B)
A1 =
    1.7500   -1.0000
   -3.2500    2.0000
>> A2 = inv(A) * inv(B)
A2 =
    1.5000   -1.2500
   -2.5000    2.2500
>> A3 = inv(B*A)
A3 =
    1.5000   -1.2500
   -2.5000    2.2500
>> A4 = inv(B) * inv(A)
A4 =
    1.7500   -1.0000
   -3.2500    2.0000
```

The two matrices $A1$ and $A4$ are the same, as are $A2$ and $A3$.

Multiply A1(A*B) and also multiply (A*B)*A1. What are the two products?*

```
>> A1*(A*B)
ans =
     1     0
     0     1
>> (A*B)*A1
ans =
    1.0000   -0.0000
    0.0000    1.0000
```

These two matrices both result in the identity matrix.

Solving Circuits with MATLAB

*The result of a KVL/KCL analysis of a circuit is the set of simultaneous equations: [set of equations]. To solve this 3x3 system of equations we invert the coefficients matrix C and multiply it by the source matrix S. Invert the matrix C and solve the system for the voltage matrix V. Then verify that the result is correct by multiplying C*V and compare the result with S.*

```
>> C=[1,0,1;3,3,4;2,2,3]
C =
     1     0     1
     3     3     4
     2     2     3
>> S=[10;12;5]
S =
    10
    12
     5
>> V=inv(C)*S
V =
   19.0000
   -3.0000
   -9.0000
>> C*V
ans =
   10.0000
   12.0000
    5.0000
```

At the end, we calculated $C * V$ and found that it resulted back to the original S column vector.

More About Matrix Inverses

Find the inverse of the matrix D shown below: D = [2,4;1,2].
a. Is there an inverse of D ?
b. If the answer is 'NO' then why not?

```
>> inv(D)
Warning: Matrix is singular to working precision.
ans =
   Inf   Inf
   Inf   Inf
```

The matrix is singular. This means that the determinant is 0, which is a result of the variables not being independent variables.

Products of Time Functions

*Given the following functions, p(t) = 5cos (2*pi*3*t) and v(t) = 5*exp(-0.5*t). plot p(t) and v(t) from t = 0 to t=10 using time steps of 0.01.*

```
>> t=0.01*[0:1000];
>> p=5*cos(2*pi*3*t)
p =
  Columns 1 through 6
    5.0000    4.9114    4.6489    4.2216    3.6448    2.9389
  Columns 7 through 12
   ....
>> v=5*exp(-0.5*t)
v =
  Columns 1 through 6
    5.0000    4.9751    4.9502    4.9256    4.9010    4.8765
  Columns 7 through 12
   ....
>> plot(t,p,t,v)
```

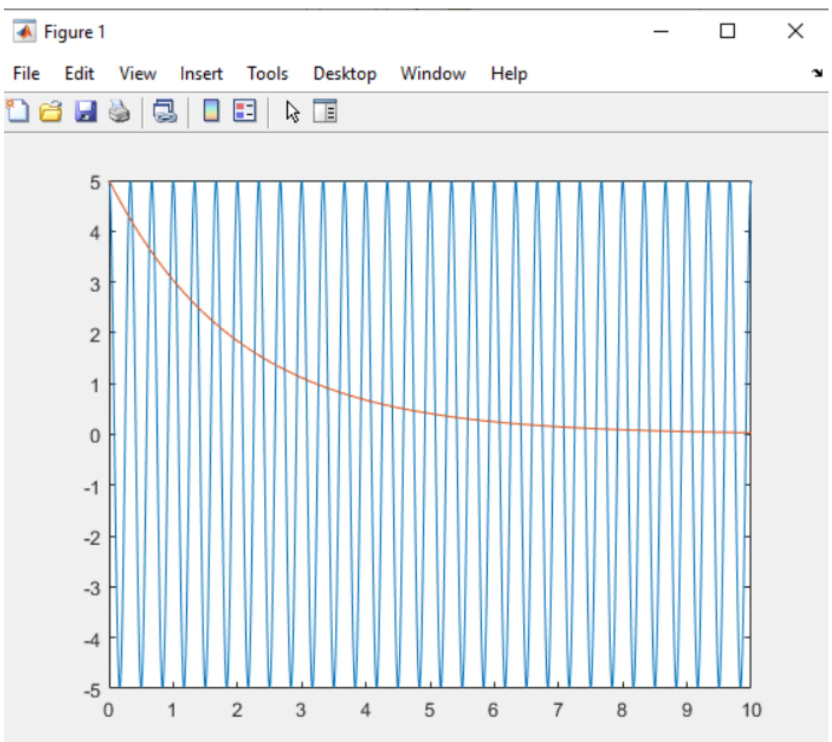

Figure 1: Graph of p(t) (blue) and v(t) (red) from t = 0 to 10

*Create the point by point product function $b(t) = p(t)v(t)$ using b=p.*v and plot it. Note that the .* operation multiplies the two vectors point by point rather than computing a matrix product.*

```
>> b = p.*v
b =
  Columns 1 through 6
   25.0000    24.4347    23.0131    20.7939    17.8634    14.3318
  Columns 7 through 12
   ....
>> plot(t,b)
```

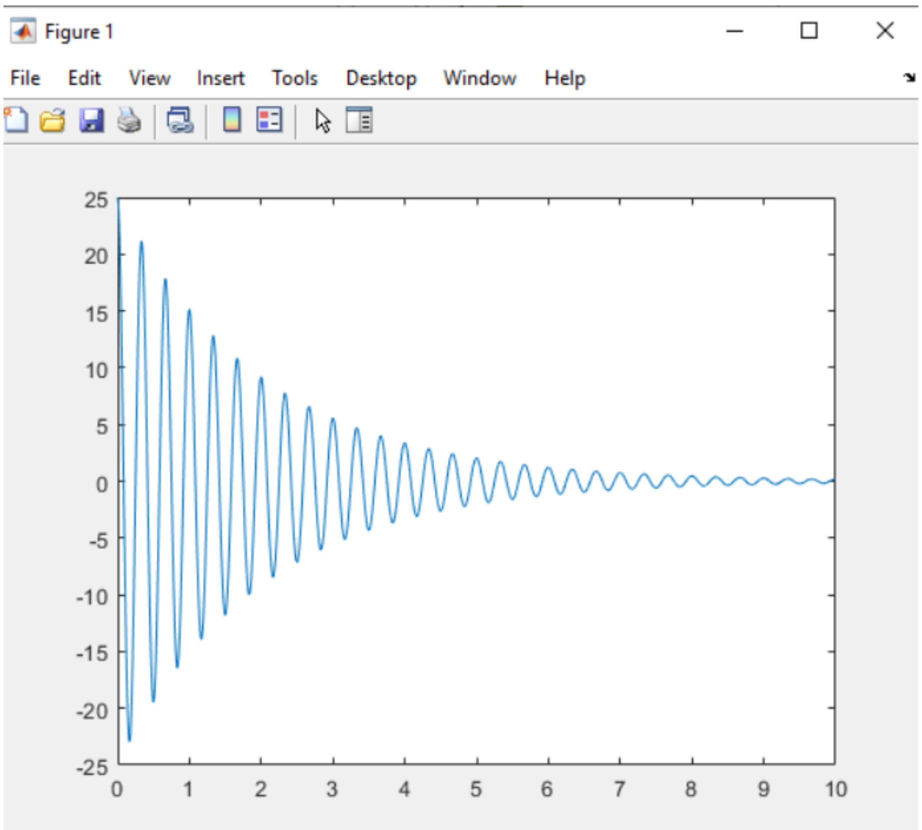

Figure 2: Graph of p(t)*v(t) (vector mult.) from t = 0 to 10