

Introduction to MATLAB

Practice Problem Solutions

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1 Basics

1.1 Find 3 different ways to create the vector $x = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$.

```
>> x = (1:3)';  
>> x = [1 2 3]';  
>> x = [1;2;3];  
>> x = [1  
        2  
        3];
```

1.2 Let $x = [1\ 2\ 3\ 4\ 5\ 6\ 7\ 8]^T$ and $y = [171\ 53]$.

(a) Find $A = xy$.

```
>> x = (1:8)';  
>> y = [171 53];  
>> A = x*y
```

A =

171	53
342	106
513	159
684	212
855	265
1026	318
1197	371
1368	424

- | | |
|--|--------------|
| (b) What are the dimensions of A ? | 8×2 |
| (c) Does A have an inverse? | NO |
| (d) What is the size of $A^T A$? | 2×2 |
| (e) What is the size of AA^T ? | 8×8 |
| (f) Do $A^T A$ and AA^T have inverses? | YES |
-

2 Programming in MATLAB

- 2.1 Write a function which takes inputs x , a , b , c , where x is a vector and a , b , c are scalars, and returns the values of

$$f(x) = ax^2 + bx + c$$

and

$$f'(x) = 2ax + b.$$

```
function [f,fp] = ffp(x,a,b,c)
```

```
f = a*x.^2+b*x+c;
```

```
fp = 2*a*x+b;
```

- 2.2 Write a script that calls the previous function for 3 different sets of parameters a , b , c , over the range $-1 \leq x \leq 1$.

```
x = linspace(-1,1,101);
```

```
[f1,fp1] = ffp(x,1,0,0);
```

```
[f2,fp2] = ffp(x,1,4,4);
```

```
[f3,fp3] = ffp(x,0,3,1);
```

3 MATLAB Functions

- 3.1 Create a 300 element column vector where the even entries are 2 and the odd entries are 1.

```
>> x = ones(300,1);
```

```
>> x(2:2:300) = 2;
```

3.2 Create a 7×7 identity matrix and then change the 4th column to

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{bmatrix}.$$

```
>> M = eye(7);  
>> M(:,4) = (1:7)';  
>> M
```

M =

```
1    0    0    1    0    0    0  
0    1    0    2    0    0    0  
0    0    1    3    0    0    0  
0    0    0    4    0    0    0  
0    0    0    5    1    0    0  
0    0    0    6    0    1    0  
0    0    0    7    0    0    1
```

3.3 Let $A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$.

(a) Find A^{-1} .

```
>> A = [1 0 1; 1 1 0; 0 1 1];  
>> Ainv = inv(A)
```

Ainv =

```
0.5000    0.5000   -0.5000  
-0.5000    0.5000    0.5000  
0.5000   -0.5000    0.5000
```

(b) Find $A^{-1}A$ and AA^{-1} .

```
>> A*Ainv
```

```
ans =
```

```
     1     0     0
     0     1     0
     0     0     1
```

```
>> Ainv*A
```

```
ans =
```

```
     1     0     0
     0     1     0
     0     0     1
```

3.4 Write a function which defines the ODE

$$y'' = -y$$

```
function dy = f(t,y)
M = [ 0 1
      -1 0];
dy = M*y;
```

3.5 Write a script to solve the following IVP for times $0 \leq t \leq 2\pi$.

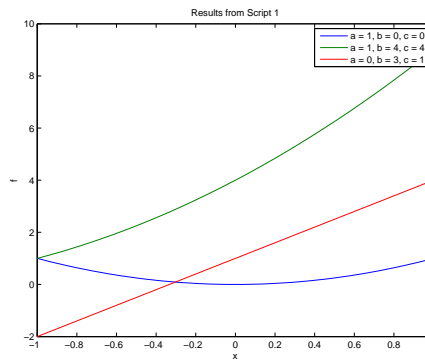
$$\begin{aligned}y'' &= -y \\ y(0) &= 0 \\ y'(0) &= 1\end{aligned}$$

```
[t,y] = ode45(@f,[0 2*pi],[0;1])
```

4 Other Useful Stuff

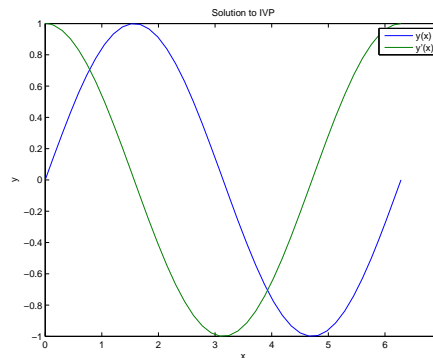
4.1 Plot the results from (2.2). Be sure to include a title, axis labels, and a legend.

```
>> plot(t,y(:,1),t,y(:,2))
>> plot(x,f1,x,f2,x,f3)
>> title('Results from Script 1')
>> xlabel('x')
>> ylabel('f')
>> legend('a = 1, b = 0, c = 0', 'a = 1, b = 4, c = 4', 'a = 0, b = 3, c = 1')
```



4.2 Plot the results from (3.5). Be sure to include a title, axis labels, and a legend.

```
>> plot(t,y(:,1),t,y(:,2))
>> title('Solution to IVP')
>> xlabel('x')
>> ylabel('y')
>> legend('y(x)', 'y''(x)')
```



4.3 Save all variables currently in memory.

```
>> save mydata
```

4.4 Clear all variables currently in memory.

```
>> clear
```

4.5 Load the variables from the file you just saved.

```
>> load mydata
```