

# Introduction to MATLAB

## Practice Problems

May 13, 2008

### 1 Basics

- 1.1. Find 3 different ways to create the vector  $x = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ .
- 1.2. Let  $x = [1\ 2\ 3\ 4\ 5\ 6\ 7\ 8]^\top$  and  $y = [90\ 100]$ .
- (a) Find  $A = xy$  and  $A^\top$ .
  - (b) What are the dimensions of  $A$  and  $A^\top$ ?

### 2 Programming

- 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

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

- 2.2. Write a script that calls the previous function for 3 different sets of parameters  $a$ ,  $b$ ,  $c$ , over the range  $-1 \leq x \leq 1$ .
- 2.3. Create a function m-file to calculate  $f = b \sin(x)$  for  $x \in [-2\pi, 2\pi]$  with the stepsize= 0.01 where the input is  $b$  and the output is  $f$ . Run the program for  $b = 2, 3, 5$ .
- 2.4. Write a function that creates the Fibonacci Sequence up to  $N$  numbers, where  $N$  is the input. Try different approaches with the 'for' loop and 'while' loop. Test your function for  $N = 5, 10$ . The Fibonacci sequence is defines by

$$F(n) = \begin{cases} 0 & \text{if } n = 0; \\ 1 & \text{if } n = 1; \\ F(n-1) + F(n-2) & \text{if } n > 1. \end{cases}$$

### 3 Numerical Functions

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

3.2. Create a  $7 \times 7$  identity matrix and then change the 4<sup>th</sup> column to  $[1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7]^\top$ .

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

(a) Find  $A^{-1}$ .

(b) Solve the linear system  $Ax = b$  for vector  $x$ .

3.4. Write a script and all the necessary functions to solve the IVP for  $0 \leq t \leq 2\pi$ .

$$\begin{cases} y''(t) = -y(t) \\ y(0) = 0 \\ y'(0) = 1 \end{cases}$$

3.5. Use *fminsearch* to find a minimizer of  $x^2$ . Verify your result with the apparent solution  $x = 0$ .

3.6. Use *fminsearch* to find a minimizer of  $f(x) = \sin(\pi x_1) \sin(\pi x_2)$ ,  $x = [x_1, x_2]^\top$ . Try different initial guesses  $\begin{cases} x_1 = -1/4 \\ x_2 = 1/4 \end{cases}$  and  $\begin{cases} x_1 = 1/4 \\ x_2 = -1/4 \end{cases}$ .

### 4 Inputs and Outputs

4.1. Plot the results ( $y$  and  $y'$ ) of 3.4 in one figure. Include a title, axis labels, and a legend.

4.2. Save all variables currently in memory into a mat-file, then clear them all.

4.3. Reload the variables you just saved.