Assignment A9, Matlab Lab, CS100J Fall 2003

Due 5 December, by midnight

This assignment is designed only to get you to practice using Matlab and to learn its basic operations. It is not terribly long, and you should be able to do most of it during your last lab. It counts as a lab, and it also counts as an assignment: it will be graded, and the grade will be count toward your final weighted total.

Submit on the CMS a file named a9.m that contains: (1) as a comment, your name and your netid (2) the answers to the questions below. Most of the answers are one- or two-line matlab expressions, statements, or functions. When answering a question, first get it working correctly in the Command-line window. When it works properly, copy it to file a9.m If an answer is not a matlab expression, statement, or function, then make the answer a Matlab comment.

1 Matrix Operations

1. Write assignment statements that assign these two matrices to A and B:

$$\mathbf{A} = \begin{pmatrix} 1 & 2 & 5 \\ 5 & 2 & 1 \end{pmatrix}$$

$$\mathbf{B} = \begin{pmatrix} 10 & 20 \\ 30 & 40 \\ 50 & 60 \end{pmatrix}$$

2. Type an expression to catenate B's columns to A's rows, resulting in the following matrix:

$$\mathbf{D} = \begin{pmatrix} 1 & 2 & 5 \\ 5 & 2 & 1 \\ 10 & 30 & 50 \\ 20 & 40 & 60 \end{pmatrix}$$

3. Type an expression to catenate B's rows to A's columns resulting in the following matrix:

$$\mathbf{D^t} = \begin{pmatrix} 1 & 5 & 10 & 20 \\ 2 & 2 & 30 & 40 \\ 5 & 1 & 50 & 60 \end{pmatrix}$$

4. Try calculating $A + B$ and explain what happens.

5. The previous expression doesn't work due to dimensions mismatch, now do the following. (Remember that A^t is the transpose of A, which is found by interchanging rows and columns.)

   (a) Calculate the following two matrices : $C_1 = A^t + B$ and $C_2 = A + B^t$.

   (b) Write a one-line expression that checks whether $C_1 == C_2^t$; This expression should return 1 if the equality holds and 0 otherwise. (Hint: use functions *find* and *isempty*).

6. Type an expression that results in a $4X5$ matrix all of whose elements are zeros (don't type the elements one by one !)

7. Type an expression that results in a $3X4$ matrix all of whose elements are equal to 5. (don't type the elements one by one !)

8. Type an expression that creates a vector (one-dimensional array) whose elements are the odd numbers in the range 1..23.

9. Type a one-line expression (don't type the elements one by one) that results in the following matrix:

$$\mathbf{D_1} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

10. Write an expression that results in a matrix each element of which is the square of the corresponding element from matrix D_1 in (10), i.e.

$$\mathbf{D_2} = \begin{pmatrix} 1 & 4 & 9 \\ 16 & 25 & 36 \\ 49 & 64 & 81 \end{pmatrix}$$

11. Write a one-line statement that prints the following sum:
    $3 + 6 + 9 + 12 + 15 + \ldots + 300$
    Hint: Use the sum function.

12. Define the following two arrays:

    (a) $v1 = \ (1, 3, 5, \ldots, 31)$

    (b) $v2 = \ (2, 4, 6, \ldots, 32)$

    Write an expression that will calculate the following sum based on $v1$ and $v2$:
    $\frac{1}{1*2} + \frac{1}{3*4} + \frac{1}{5*6} + , \ldots, \frac{1}{31*32}$

13. Given are two series:

    (a) $a_0 = \ 1, \quad a_n = 2 * n - 1$

    (b) $b_0 = \ a_0, \quad b_n = b_{n-1} + a_n$

Write a one-line expression that prints the first 10 elements of the series b_n, i.e. $b_0, b_1, \ldots, b_9$
Hint: Use function cumsum.

2 Functions and Plots

1. Write a function (it should not use loops) whose parameter is a matrix with an odd number of rows and that yields the matrix reflected over its horizontal symmetric axis. The input matrix has at least 3 rows. For example, for the argument matrix:

$$\mathbf{D_{in}} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

the function returns this matrix:

$$\mathbf{D_{out}} = \begin{pmatrix} 7 & 8 & 9 \\ 4 & 5 & 6 \\ 1 & 2 & 3 \end{pmatrix}$$

Hint 1: Use function *size* to determine the number of lines. $[num_{rows}] = size(D_{in}, 1)$.
Hint 2: If you think that you need an integer division (though you really don't need one) use matlab function *floor*.

2. Plot the sin function over the range $[-2 \times \pi, \ldots, +2 \times \pi]$. The step size should be 0.1. Your expression should be a one-line expression. You can use the matlab constant pi.