CE300 SUMMER PRACTICE I 2009-2010 Summer

MATLAB Assignment (Interactive Computation, 2D Plots & Programming Basics)

Due: 06.07.2010, Monday

Attention: You are expected to submit your solutions in MS Word format. Save your file named with your student ID. For instance, if your student ID is 1234567, your file name should be '1234567.doc'. If you can convert your document to Adobe PDF format, that will also be appreciated. Please submit your files electronically to the address ce300summer@gmail.com.

1. Write down the MATLAB expressions that will correctly compute the following and report the results.
   a) $y = 7 + 4x^{0.58} \qquad x = 20$
   b) $\frac{27^2}{4} + \frac{319^{4/5}}{5} + 60(14)^{-3}$
   c) $e^{-2.1^3} + 3.47\ln(14) + \sqrt[4]{287}$
   d) $\cos\left(\frac{4.12\pi}{6}\right)^2$
   e) $5\tan\left(3\sin^{-1}\left(\frac{13}{5}\right)\right)$

2. The ideal gas law relates the pressure P, volume V, absolute temperature T, and amount of gas n. The law is PV=nRT/V where R is the gas constant.
   An engineer must design a large natural gas storage tank to be expandable to maintain the pressure constant at 2.2 atmospheres. In December when the temperature is 4°F (-15°C), the volume of gas in the tank is 807 m³. What will the volume of the same quantity of gas be in July when the temperature is 88°F (31°C)? (Hint: Use the fact that n, R, and P are constant in this problem. Note also that K =°C + 273.2.)
   Show all your steps when evaluating the above problem in MATLAB and report your results.

3. Consider the following arrays.

A=

1	4	2
2	4	100
7	9	7
3	π	42

B=ln(**A**)

Write MATLAB expressions to do the following and report the results.

a) Select just the second row of **B**.
b) Evaluate the sum of the second row of **B**.
c) Multiply the second column of **B** and the first column of **A**.
d) Evaluate the maximum value in the vector resulting from element-by-element multiplication of the second column of **B** with the first column of **A**.
e) Evaluate the sum of the first row of **A** divided element-by-element by the first three elements of the third column of **B**.

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4. Plot columns 2 and 3 of the following matrix A versus column 1 in the same plot (Show column 2 with a red solid line with the actual values indicated with stars and column 3 with a black dashed line with the actual values indicated with circles. Don't forget to put legend, title and x & y axis labels.) The data in column 1 is time (seconds). The data in columns 2 and 3 is force (newtons). Put your name as a text into the plot figure and show all your expressions in MATLAB.

A=

0	-8	6
5	-4	3
10	-1	1
15	1	0
20	2	-1

5. Write a script file that accepts a numerical value x from 0 to 100 as input and computes and displays the corresponding letter grade given by the following table.

Letter Grade	Grade points
A	$x \geq 90$
B	$80 \leq x < 90$
C	$70 \leq x < 80$
D	$60 \leq x < 70$
F	$x < 60$

The program should also display an error message if x falls outside the given range.

6. π can be approximated by computing the sum

$$\pi \approx 4\sum_{k=0}^{m} \frac{(-1)^k}{2k+1}$$

a) The more terms you keep in the summation, the more accurate your answer will be. (In fact, the series converges to π as m goes to infinity) In order to verify this fact, employ this summation formula to approximate π using the first 10, 100, 1000 and 10000 terms in the series, respectively. For each of these numbers, compute the error of approximation by the following formula:

$$\varepsilon = \left| \frac{x_{true} - x_{approximate}}{x_{true}} \right| \times 100$$

Plot the error as a function of the number of terms used in the sum in log-log scale. (Hint: The true value of π is stored in `pi` in MATLAB.)

b) How many terms are required to ensure that the error ε falls below 1×10^{-6}? What is the number of accurate digits in your approximate value in this case? (Hint: Accurate digits are those which are exactly the same as the digits in the true value. E.g. Given that the exact value is 3.14159265358979, the approximate value 3.14175321072912 is accurate to 4 digits. In order to display numbers with more digits, you may write on the command window "`format long`".)

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