FINAL EXAM – CS 151L  
Spring 2015  
Due: Wednesday, May 6, 2015 at 5:00 PM (all M-files must be emailed to TAs by this time)

PLEASE READ BEFORE STARTING THE EXAM!!!  
This is a final exam which means that there is no working with other students in class or getting help from anyone on how to code. However, you may ask questions on the wording or understanding of the problems to either me or the TAs. Any cheating on any of the problems will result in a failing grade in the course. All programs are due on time and there will be no exam programs accepted after the deadline (no exceptions) – 5:00 PM, 5/6/15.

REQUIRED NAMING CONVENTION  
For this exam, use the naming convention as given:
- Problem 1 should be called cs151sp15exam31.m,  
- Problem 2 called cs151sp15exam32.m,  
- Problem 3 called cs151sp15exam33.m,  
- Problem 4 called cs151sp15exam34a.m and cs151sp15exam34.m,  
- Problem 5 called cs151sp15exam35.m,  
- Problem 6 called cs151sp15exam36.m and  
- Problem 7 called cs151sp15exam37.m.

1. Given the magnitude M of an earthquake on the Richter scale:  
   \[ M = \frac{2}{3} \log_{10} \left( \frac{E}{E_0} \right), \]  
   where \( E \) is the energy released by the earthquake, and \( E_0 = 10^{4.4} \) Joules (energy of a small reference earthquake) and also noting that \( E = E_0 \cdot 10^{\frac{3M}{2}} \), create a MATLAB program that determines how many times more energy is released from an earthquake that registers 6.9 on the Richter scale than an earthquake that registers 6.1. To do this, create a single matrix with the two Richter scale values, determine the energy created by each one and divide the energy of the 6.9 by the energy of the 6.1. Print out the value to only two decimal places. (13 points)

2. Create a program that calculates the sum of the infinite series:  
   \[ \sum_{n=1}^{\text{value}} \frac{(-1)^n x^{2n}}{(2n)!}. \]  
   For this program, ask the user to enter \( x \) in radians, then create an outer for loop that calculates the sum when \( \text{value} \) is 2, 4, 6 and 10. Inside this outer loop, use another for loop to create a row vector matrix of terms that can be added (outside the loop) to determine the summation (similar to an example done in class and the program assignment – the loop values should start at 1 and end on the value of the outer loop). After calculating the terms in the inner loop, find the summation of the matrix (NOTE: you will need to add 1 to the summation to get the correct result – takes into account when \( n=0 \)) and display the result to 6 decimal places. Also, display the result of the \( \cos(x) \) each time to compare it to your calculated values. You can use the \texttt{factorial} function to calculate the denominator of the summation. NOTE: For this problem, you do not have to use a loop within a loop as long as you calculate 4 different answers; one for each of the values 2, 4, 6 and 10. (14 points)

Make sure that your programs are correctly named so the TAs can check your work!  
NOTE: No working together with others to solve problems and no late submissions accepted.
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6. Electrical power is often modeled as $P = I^2 R$ where $P$ is the power in watts, $I$ is the current in amps and $R$ is the resistance in ohms. Consider the following data which will be modeled as first-order and second-order equations with the polyfit and polyval functions (you should have new current values defined from 0 to 600 - incremented by 10 - and should determine the power values using the polyval function). You will need to plot the data (original should only be points and curve fitting should be different colors) with the current on the horizontal axis and the power on the vertical axis. (12 points)

<table>
<thead>
<tr>
<th>Power, watts</th>
<th>Current, amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>55,000</td>
<td>100</td>
</tr>
<tr>
<td>210,000</td>
<td>200</td>
</tr>
<tr>
<td>430,000</td>
<td>300</td>
</tr>
<tr>
<td>790,000</td>
<td>400</td>
</tr>
<tr>
<td>1,250,000</td>
<td>500</td>
</tr>
</tbody>
</table>

7. Given an electrical circuit which consists of resistor and voltage sources, determine the current flows ($i_1$, $i_2$, $i_3$, $i_4$ and $i_5$). Use the following values for the voltage and resistor sources:

- $V_1 = 38$ volts, $V_2 = 20$ Volts, $V_3 = 24$ Volts
- $R_1 = 15$ Ohms, $R_2 = 18$ Ohms, $R_3 = 10$ Ohms, $R_4 = 9$ Ohms, $R_5 = 5$ Ohms, $R_6 = 14$ Ohms, $R_7 = 8$ Ohms, $R_8 = 13$ Ohms, $R_9 = 5$ Ohms and $R_{10} = 2$ Ohms

And, use the following equations to determine the 5 current values:

- $R_9(i_5 - i_4) + R_8(i_5 - i_3) + R_3(i_5 - i_1) + R_{10}(i_5) = -V_3$
- $R_1(i_1) + R_2(i_1 - i_3) + R_3(i_1 - i_5) = V_1$
- $R_4(i_2) + R_6(i_2 - i_4) + R_5(i_2 - i_3) = -V_1$
- $R_2(i_3 - i_1) + R_5(i_3 - i_2) + R_7(i_3 - i_4) + R_8(i_3 - i_5) = 0$
- $R_6(i_4 - i_2) + R_7(i_4 - i_3) + R_9(i_4 - i_5) = V_2$

You must solve this problem using at least one method from reduced row echelon form, the backslash operator, or the inverse AND using all of the symbolic functions, sym (to create the original equations), subs (to substitute the given voltage and resistance values) and solve (to determine the currents). Print out the values as doubles and be sure to distinguish the value of each current in your program. (15 pts)

Make sure that your programs are correctly named so the TAs can check your work!

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