E7 Midterm Exam 2

NAME: ______________________________
SID: ______________________________
SECTION: 1 or 2 (please circle your discussion section)
LAB:

| #11: TuTh 8-10 | #12: TuTh 10-12 | #13: TuTh 12-2 | #14: TuTh 2-4 |
| #15: TuTh 4-6 | #16: MW 8-10 | #17: MW 10-12 | #18: MW 2-4 |
| #19: MW 4-6 | #20: TuTh 10-12* | #21: MW 3-5* | #22: TuTh 4-6* |

(please circle your lab section) * in Wheeler

<table>
<thead>
<tr>
<th>Problem</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td></td>
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<tr>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Carefully read and follow these instructions:

1. Write your name on the top right corner of each page.
2. Start answering the exam only when instructed to do so.
3. Record your answers only in the spaces provided.
4. You may not ask questions during the exam.
5. You may not leave the exam room before the exam ends.
6. You may not use any electronic devices.
7. You may use two 8.5×11 sheet (4 sides) of handwritten notes.
8. Count the number of pages before the start of the exam. There should be 8 pages.
1. Consider the following MATLAB script:

```matlab
A = {'125' '22' '24'};
G = {89, 92, 93};
G{1,2} = 91;
% G{1,3} = 94;
Data = struct('Name', {'Nick', 'Ben', 'Ericka'}, 'Grade', G, 'Age', A);
classtype = class(Data);
[dim1, dim2] = size(Data);
C = [Data.Age];
D = [Data.Grade];
E = Data(1).Name;
F = A(1,1);
```

Fill out the following table (ignore cells with n/a) according to the variables in the workspace after the script has been executed:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Class</th>
<th>Size</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example1</td>
<td>Cell</td>
<td>1x1</td>
<td>{'usetheforceluke'}</td>
</tr>
<tr>
<td>Example2</td>
<td>Double</td>
<td>1x2</td>
<td>[4 7]</td>
</tr>
<tr>
<td>Data</td>
<td>Double</td>
<td>1x2</td>
<td>n/a</td>
</tr>
<tr>
<td>classtype</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tmp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dim2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. How do you allocate $4/9$ of the figure window to a single plot as pictured below, using subplot?

Answer:
3. For the histogram shown in the following figure calculate the probability density for the 4th bin from the left (centered at 9).

Answer:
4. Two temperature sensors are located near Napa measuring temperature at specific times. Location of the sensors (latitude and longitude) and their measured data are listed in the following table

<table>
<thead>
<tr>
<th>Gauge</th>
<th>Location</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napa-1</td>
<td>[38, -122]</td>
<td>25, 29, 28, 29, 19, 18, 17</td>
</tr>
<tr>
<td>Napa-2</td>
<td>[38.22, -122.18]</td>
<td>27, 30, 29, 22, 22, 16, 17</td>
</tr>
</tbody>
</table>

(a) Create a structure called myData based on the above table using one line of code.
   **Answer:**

(b) Create a new structure myDataSplit by modifying the myData structure you built in part a. The new structure should have four fields: Gauge, Lat, Long, and Temperature. The Lat should be the first element of the arrays in the Location column, while the Long should be the second element of the array in Location.
   **Answer:**

(c) Write matlab code that calculates the mean and standard deviation of the data in the Temperature field of myDataSplit. Assign mean to a new field called meanTemp and assign the standard deviation to a new field called stdDevTemp.
   **Answer:**

(d) Complete the following code to create the following plot of Temperature of Napa-1 (x-axis) vs. the Temperature of Napa-2 (y-axis) using the above data

![Plot of Temperature of Napa-1 vs. Napa-2](image)
Answer:

```
figure(1)
% Plot the Data
handle = plot(______________________________)
% Label the axes with a font size of 16
% Set tick marks for the axes from 16 to 30 in increments of 2
set(______________________________)
% Set font size for the axes to 14
```

5. Pacific Gas and Electric Company (in brief PG&E) is in charge of providing natural gas and electricity to the most of the northern California. We will focus on the electricity bill for the office of Mr. Smith in San Francisco.

PG&E has three rates for electricity. Each month, electricity usage up to 30 kWh\(^1\) is called tier 1 with the rate T1, from 30 kWh to 50 kWh is called tier 2 with the rate T2, and anything beyond 50 kWh is called tier 3 and is charged with the rate T3. Mr Smith is interested to know what the rates T1, T2 and T3 are.

In August, Mr. Smith used 62 kWh, and received a bill of $9. In September, Mr. Smith used 48 kWh and received a bill of $6.3 and in October he used 102 kWh and received a bill of $17.

(a) With this information, can Mr. Smith find a solution for the rates T1, T2 and T3? in other words, does any solution exist for this problem? why? (You do not need to write a matlab code for this part, but instead use linear algebra as discussed in class to answer this question.)

**Answer:**

(b) If a solution exist for this problem, is this solution unique? why?

**Answer:**

(c) Write a Matlab code to help Mr. Smith calculate PG&E rates T1, T2 and T3. Include comments that show what each line does.

**Answer:**

\(^1\)kWh is an acronym for Kilowatt hour and is a unit for the electric energy
6. In computability theory, the Ackermann function, named after Wilhelm Ackermann (1896–1962) is defined as follows

\[ A(m, n) = \begin{cases} 
  n + 1, & \text{if } m = 0 \\
  A(m - 1, 1), & \text{if } m > 0 \text{ and } n = 0 \\
  A(m - 1, A(m, n - 1)), & \text{if } m > 0 \text{ and } n > 0 
\end{cases} \]

(a) Write a recursive function in Matlab that calculates \( A(m, n) \) for any given non-negative integers \( m \) and \( n \).

Answer:

(b) Calculate \( A(2,1) \) and provide the final answer.

Answer: