

Homework 6

Create a single MATLAB script with each problem below as a separate section (hint: %%).

1. Create a new script
2. Create a comment section at the top with your name, date, HW#, class, etc.
3. The first script commands should erase all the workspace data, command window output, and close all figures.
4. Create separate sections (%%) for each problem

Problem 1 (20 pts)

Create a 3×5 matrix. Perform each of the following two ways: using built-in functions, and also using loops (with **if** statements if necessary):

- Find the maximum value in each column.
- Find the maximum value in each row.
- Find the maximum value in the entire matrix.

Problem 2 (20 pts)

A student borrows \$10,000 to buy a used car. Interest on her loan is compounded at the rate of 2% per month while the outstanding balance of the loan is more than \$5000, and at 1% per month otherwise. She pays back \$300 every month, except for the last month, when the repayment must be less than \$300. She pays at the end of the month, *after* the interest on the balance has been compounded. The first repayment is made 1 month after the loan is paid out. Write a program which displays a monthly statement of the balance (after the monthly payment has been made), the final payment, and the month of the final payment.

Problem 3 (20 pts)

The power series for $\sin(x)$ is given by

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$$

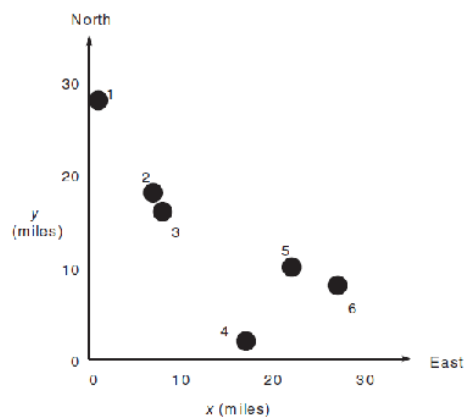
The script on the next slide will compute this power series for a given value of x . What causes the loop to terminate?

How accurate is the series for $x = \frac{\pi}{2}$? How many terms were needed?

Problem 4 (20 pts)

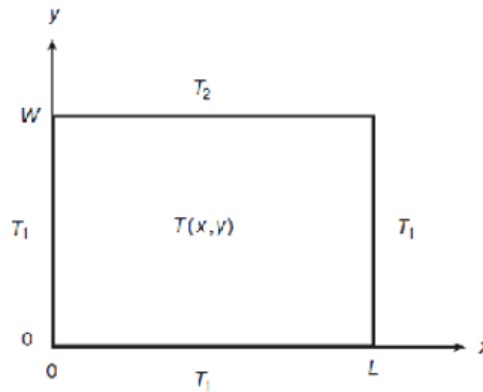
A company wants to locate a distribution center that will serve six of its major customers in a 30x30 mi area. The locations of the customers relative to the southwest corner of the area are given in the following table in terms of (x, y) coordinates (the x direction is east; the y direction is north). Also given is the volume in tons per week that must be delivered from the distribution center to each customer. Then weekly delivery cost c_i for customer i depends on the volume V_i and the distance d_i from the distribution center. For simplicity we will assume that this distance is the straight-line distance. (This assumes that the road network is dense.) The weekly cost is given by $c_i = 0.5d_iV_i$, $i = 1, \dots, 6$. Find the location of the distribution center (to the nearest mile) that minimizes the total weekly cost to service all six customers.

Customer	x location (mi)	y location (mi)	Volume (tons/week)
1	1	28	3
2	7	18	7
3	8	16	4
4	17	2	5
5	22	10	2
6	27	8	6



Problem 5 (20 pts)

Many applications require us to know the temperature distribution in an object. For example, this information is important for controlling the material properties, such as hardness, when cooling an object formed from molten metal. In a heat-transfer course, the following description of the temperature distribution in a rectangular metal plate is often derived.



The temperature is held constant at T_1 on three sides and at T_2 on the fourth side. The temperature as a function of the xy coordinates shown is given by

$$T(x, y) = (T_2 - T_1)w(x, y) + T_1$$

where

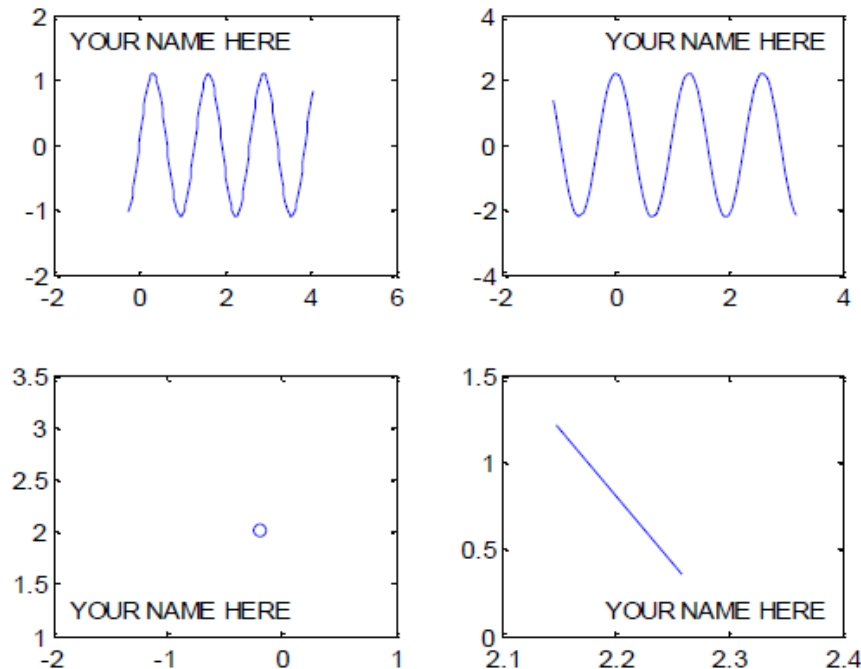
$$w(x, y) = \frac{2}{\pi} \sum_{n \text{ odd}} \frac{2}{n} \sin\left(\frac{n\pi x}{L}\right) \frac{\sinh(n\pi y/L)}{\sinh(n\pi W/L)}$$

Use the following data: $T_1 = 70^\circ\text{F}$, $T_2 = 200^\circ\text{F}$, and $W=L=2\text{ft}$.

- The terms in the preceding series become smaller in magnitude as n increases. Write a program to verify this fact for $n=1, \dots, 19$ for the center of the plate ($x=y=1$)
- Using $x=y=1$, write a program to determine how many terms are required in the series to produce a temperature calculation that is accurate to within 1 percent. (That is, for what value of n will the addition of the next term in the series produce a change in T of less than 1 percent?) Use your physical insight to determine whether this answer gives the correct temperature at the center of the plate.
- Modify the program from part b to compute the temperatures in the plate; use a spacing of 0.2 for both x and y .

Bonus question (20 pts)

Place your name in the right corner as shown in the figure. For this assignment, the code for the plots are given and you are expected to create a user defined function that places your name in the corner of any plot.



```
%%  
% This MATLAB script tests a user-defined function that places a name  
% on randomly sized plots.  
  
%% Generate randomized data to plot  
clear all;clc;  
  
% x data  
xmin = (-10) + (10-(-10)).*rand; %Generate random number between -10  
and 10  
xrange = 2 + (5-2).*rand; %Generate random number between 2 and 5  
xmax = xmin + xrange;  
numPts = 150; %Number of data points  
x = linspace(xmin,xmax,numPts);  
x2 = x-0.2*xrange;  
  
% y data  
Amp = 0.5 + (2-0.5).*rand; %Generate random amplitude between 0.5 and 2  
Freq = 0.5 + (1.5-0.5).*rand; %Generate random freq between 0.5 and 1.5  
y = Amp*sin(2*pi*Freq*x);  
y2 = 2*Amp*cos(2*pi*Freq*x2);  
  
%% Plot data and test your function  
r = 2; %number of subplot rows  
c = 2; %number of subplot columns  
  
subplot(r,c,1)  
plot(x,y)  
%*****  
%TYPE THE NAME OF YOUR FUNCTION HERE TO PUT YOUR NAME IN THE UPPER LEFT  
%*****
```

```

subplot(r,c,2)
plot(x2,y2)
%*****
%TYPE THE NAME OF YOUR FUNCTION HERE TO PUT YOUR NAME IN THE UPPER
RIGHT
%*****

subplot(r,c,3)
plot(-5*rand,3*rand,'o')
%*****
%TYPE THE NAME OF YOUR FUNCTION HERE TO PUT YOUR NAME IN THE LOWER LEFT
%*****

subplot(r,c,4)
plot([5*rand 5*rand],[2*rand,6*rand])
%*****
%TYPE THE NAME OF YOUR FUNCTION HERE TO PUT YOUR NAME IN THE LOWER
RIGHT
%*****

```

Turn in the following:

1. A Word (.doc, .docx) document created using the MATLAB publish feature to publish your script.
2. Your .m script file(s) (these are separate files from the document above). Make sure you use plenty of comments. Before submitting, rename all *.m files to have a .txt extension. For example, rename MyHW6.m to MyHW6.txt before submitting. Submit all files electronically on Blackboard. See syllabus for late assignment policy.

Late submissions will receive a 10% deduction!

No submissions will be accepted after one day!