EE322 Fall 2012: Lesson 3/PS03: Solutions

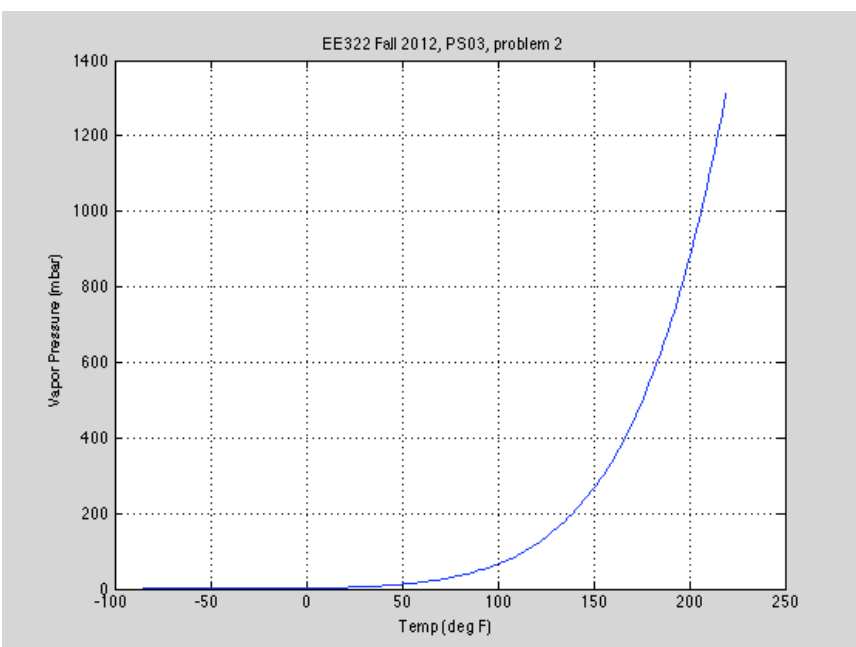
Use your Introduction to MATLAB book to perform the following:

1. If x = [1 2 3], what is x.^2? What is e^x? What is x^x ? Why won't MATLAB let you calculate x^2?

```
x=[1 2 3]
x.^2          % [1 4 9]
exp(x)        % [2.7183    7.3891   20.0855]
x.^x          % [1 4 27]
x^2           % error: trying to multiply a 1x3 vector by a 1x3 vector
              %  so the dimensions are not correct
```

2. Based on Example 3.1, generate a plot of saturation vapor pressure (y-axis) vs temperatures (x-axis) for temperatures from -85° F to + 220°F in 2°F increments.

```
% problem 2
TF=-85:2:220;  % temp in deg F
TK=(TF+459.6)/1.8;  % temp in deg K
Delta_H=2.45e6;     % latent heat of vaporization
R_air = 461;        % ideal gas constant for air
Vapor_Pressure=6.11*exp((Delta_H/R_air)*(1/273-1./TK));
figure(1)
plot(TF,Vapor_Pressure),xlabel('Temp (deg F)')
ylabel('Vapor Pressure (mbar)'),grid on
title('EE322 Fall 2012, PS03, problem 2')
```



3. Find the maximum and minimum value of $f(t) = 3 \sin(2\pi 110t) \cos(2\pi 11t) + 0.25$ over the time interval from 0 to 0.5 sec. When creating the time vector, use a step size of 1 μsec.

```
t=0:1e-6:0.5;
f=3*sin(2*pi*110*t).*cos(2*pi*11*t)+0.25;
max(f)  % ans: max value 3.2134
min(f)  % ans: min value -2.6514
```

4. Determine how many integer values there are if you start counting at -1105 and stop counting before you get to +713, when you only count every 17th integer. Create a vector and use the length function to determine your answer.

```
n=-1105:17:713;
length(n)  % ans: 107 integers
```

5. Generate 2000 uniformly distributed random numbers between 0.0 and 1.0. What is the average (mean) value of these numbers? The standard deviation? (see the section on uniform random numbers).

```
x=rand(2000,1);
mean(x)     % ans: 0.4994 - these values will change every time you use rand
std(x)      % ans: 0.2844
```

6. Generate 2000 Gaussian distributed random numbers with a mean value of -2.75 and a standard deviation of 10.35. Using MATLAB's *mean* and *std* (standard deviation) function, determine the average (mean) value of the random numbers that MATLAB generated. Determine the standard deviation. How closely did the actual mean and standard deviation get to the desired mean and standard deviation? Note: if you're not careful in how you use the *randn* function, you will create a matrix of 2000x2000 values (4 million), and it will cause your computer to balk. Hint: *randn* generates Gaussian values with a mean of 0 and a standard deviation of 1. See the top of page 82 to learn how to adjust the generated mean and standard deviation of a set of Gaussian values.

```
x=randn(2000,1)*10.35;  % these values could range from –inf to +inf
x=x-2.75;            % the mean value will be approximately -2.75
mean(x)     % ans: -2.3715 -will change every time you use randn
std(x)      % ans: 10.3570
```

7. Enter the following command into MATLAB to create a variable called x:

```
x = eye(5)
```

Now describe what the following commands create, in terms of x:

```
y1 = x(:)
y2 = x(1:3,1:2)
y3 = sum(x)
y4 = x(:,5)
y5 = fliplr(x)
y6 = sum(x(:))
```

```
y1=x(:);          % makes y1 one long vector of values in x
y2=x(1:3,1:2);    % takes rows 1-3 and columns 1-2 of x to make y2
y3=sum(x);        % finds the sum of each column of x
y4=x(:,5);        % y4 is all rows of x in the 5th column
y5=fliplr(x);     % flips each row of x left-to-right
y6=sum(x(:));     % finds the overall sum of values of x
```

8. Type the following commands:

```
z = peaks;
figure(1),surf(z)
```

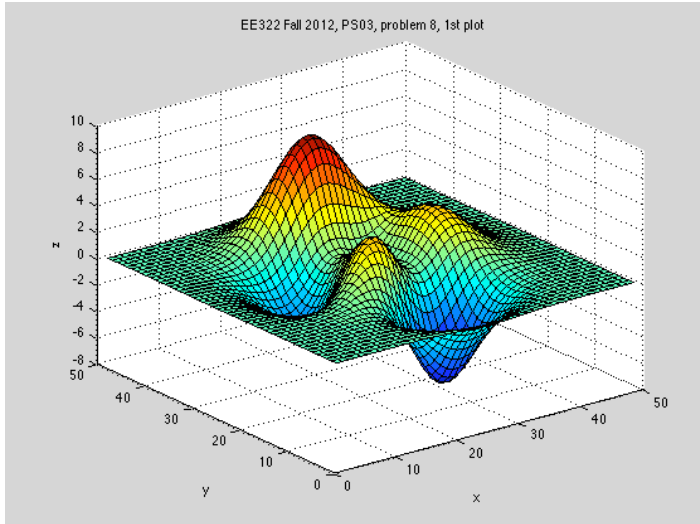
The function *peaks* is a built-in MATLAB function that creates an interesting matrix of values, and surf is a way to view matrices of values as 3d surface plots.

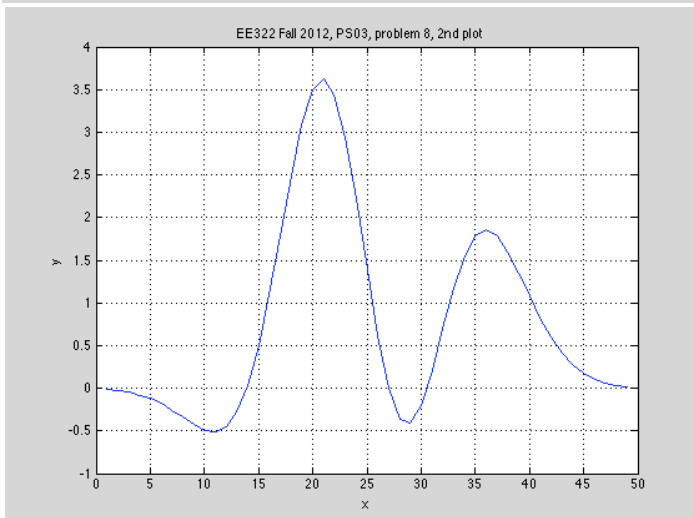
What are the dimensions (size) of z?

Use the colon command to extract the 19th row from matrix z, and plot it.

What is the minimum and maximum value of the 19th row of z?

```
z=peaks;
figure(2),surf(z),title('EE322 Fall 2012, PS03, problem 8, 1st plot');
,xlabel('x'),ylabel('y'),zlabel('z')
size(z)   % ans: 49 rows, 49 cols
x=z(19,:); % extract 19th row from z, call it x
figure(3),plot(x),xlabel('x'),ylabel('y'),grid on
title('EE322 Fall 2012, PS03, problem 8, 2nd plot');
min(x)      % ans: -0.5096
max(x)      % ans: 3.6265
```





9. What is 1/0? What is 1/∞? What is ∞/∞? What is 0/0? What is NaN?

```
1/0      % = inf
1/inf    % = 0
inf/inf  % = NaN
0/0      % = NaN
```

NaN = "Not a number", which is an undefined value

10. Chapter 3, problem 8.

```
t=0:2:100;
h=2.13*t.^2 - .0013*t.^4 + .000034*t.^4.751;
table = [t' h']

table =

   1.0e+03 *

         0         0
    0.0020    0.0085
```

```
    0.0040    0.0338
    0.0060    0.0752
    0.0080    0.1317
    0.0100    0.2019
    0.0120    0.2843
    0.0140    0.3770
    0.0160    0.4780
    0.0180    0.5849
    0.0200    0.6956
    0.0220    0.8075
    0.0240    0.9183
    0.0260    1.0253
    0.0280    1.1261
    0.0300    1.2182
    0.0320    1.2993
    0.0340    1.3670
    0.0360    1.4193
    0.0380    1.4541
    0.0400    1.4695
    0.0420    1.4641
    0.0440    1.4365
    0.0460    1.3856
    0.0480    1.3107
    0.0500    1.2113
    0.0520    1.0874
    0.0540    0.9392
    0.0560    0.7674
    0.0580    0.5733
    0.0600    0.3584
    0.0620    0.1248
    0.0640   -0.1249
    0.0660   -0.3875
    0.0680   -0.6593
    0.0700   -0.9361
    0.0720   -1.2129
    0.0740   -1.4842
    0.0760   -1.7439
    0.0780   -1.9849
    0.0800   -2.1998
    0.0820   -2.3802
    0.0840   -2.5171
    0.0860   -2.6005
    0.0880   -2.6198
    0.0900   -2.5636
    0.0920   -2.4194
    0.0940   -2.1742
    0.0960   -1.8138
    0.0980   -1.3231
    0.1000   -0.6863

% problem 9
[hmax maxindex]=max(h);  % hmax = max height, maxindex=index of max height
hmax % max height: 1469.5 (units of height not provided)

% problem 10
tmax=t(maxindex) % time of max height: 40 sec
```