ENGR 121 – Exam 1 Practice Problems **Spring 2008**

All problems are from previous first exams. Note this is not a complete exam. Also consult class problems, quizzes, and homework.

1. Order of operations: In the blanks below each operator, number the order in which the operations occur.

x = 8 + 8 * 5 ^ (4 / 3) + 12

4 3 2 1 5

2. Matrix Addressing: Write down **the array produced by each expression** listed below. You cannot use MATLAB to solve this problem. You must do this calculation by hand.

$$A = \begin{bmatrix} 6 & -2 & 2 & 6 \\ 4 & 1 & -3 & -2 \\ 7 & 1 & 8 & 2 \\ 5 & 9 & 2 & 7 \\ 4 & 7 & 3 & 4 \\ 8 & 9 & 4 & 7 \end{bmatrix}$$

a. A(5, 4)

4

b. A(2:3, 2:4)

1 -3 -2
1 8 2

c. Transpose of answer in b above, i.e., A(2:3, 2:4)**'**

1 1
-3 8
-2 2

d. A(1:2 , 2:3) **.*** A(5:6 , 2:3)

-2 2 7 3 = -14 6
1 -3 9 4 9 -12

e. Write down the single expression to produce the ARRAY containing the numbers as indicated in the boxed region of the above matrix. The resultant array is also shown below:

6 -2 2
4 1 -3
9 2 7
7 3 4
9 4 7

[A(1:2,1:3);A(4:6,2:4)]

3. Matrix calculations: Perform the following operations in MATLAB. Any calculations required are to be **element-by-element calculations**.

a. Create the following matrices in Matlab

$$M1=\begin{bmatrix}2 & 3 & 4\\ 4 & 6 & 8\end{bmatrix} \qquad M2=\begin{bmatrix}-2 & 4 & 2\\ 4 & -3 & 1\end{bmatrix} \qquad M3=\begin{bmatrix}5 & 3 & 0\\ 1 & -2 & -1\end{bmatrix}$$

b. $(M1)(M2)$

c. $\dfrac{4}{M3}-M1$

d. Determine the maximum value in the quantity (*M2 – M3*)

e. Determine the summation of all the values in *M3*

Solution:

```
>> M1=[2 3 4;4 6 8]; M2=[-2 4 2;4 -3 1]; M3=[5 3 0;1 -2 -1];
>> M1.*M2 % part b

ans =

    -4    12     8
    16   -18     8

>> 4./M3-M1 % part c
Warning: Divide by zero.

ans =

   -1.2000   -1.6667       Inf
         0   -8.0000  -12.0000

>> max(max(M2-M3)) % part d

ans =

     3

>> sum(sum(M3)) % part e

ans =

     6
```

4. Script with interactive input: Write a MATLAB script that will ***interactively*** ask the user for two input values (an x and a y). The script should then calculate the value of the 1) arctangent of y/x and 2) the value of $\frac{x+y}{xy}$.
   a. Printout your script. Please use simple comments including the name of the script, your name and the problem number. Full comments are not required for this problem.
   b. Printout your MATLAB command session where you run the script with the values x = 3 & y = 6. If your script works include only the successful run. If it does not work include your best attempt with error message.

a.) Script File

```
% program q7
% S. Scott Moor
% 121 Exam 1 practice, question 4.

x = input('What is the x-value: ');
y = input('What is the y-value: ');

disp('1) Angle in radians')
A = atan(y/x)

disp('2) Calculation')
B = (x + y) /(x *y)
```

b.) Execution:

```
>> q7
What is the x-value: 3
What is the y-value: 6
1) Angle in radians
A =
   1.1071
2) Calculation
B =
   0.5000
>>
```

3. Function Problem: The equations for the surface area for a right circular cone of radius r and height, h are given below. See figure 1.

$$Total\ Surface\ Area = \pi r^2 + \pi rl$$

$$where \quad l = \sqrt{r^2 + h^2}$$

Write a function that will calculate and return to the workspace the surface area, and the value of *l* given r and h.

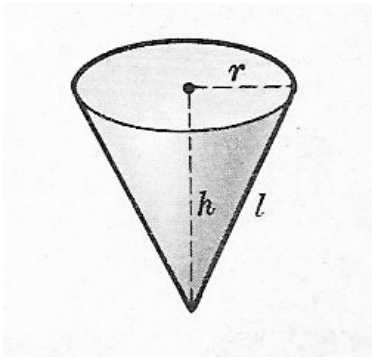

Figure 1: The dimensions of a right circular cone from: M.R. Spiegel, *Mathematical Handbook*, Schaum's Outlines Series, McGraw Hill, 1968.

1. Problem Goal (brief):

Calculate the surface area and the surface distance from base to peak for a right circular cone given the radius and height perpendicular to the base.

2. Inputs: (full name, variable to be used, units)

Variable Name	Description	Units or Values	Input Source*
r	radius	length	Command line
h	height	length	Command line

3. Outputs: (full name, variable to be used, units)

Variable Name	Description	Units or Values	Output type*
A	Area	length squared	Command line
L	surface distance	length	Command line

4. Hand Calculation and Program Steps

Test Calculation

$r = 2 \qquad h = 1.5$

$L = \sqrt{2^2 + 1.5^2} = 2.5$

$A = \pi(2^2 + 2(2.5)) = 28.2743$

Steps

1. Calculate length

$$l = \sqrt{r^2 + h^2}$$

2. Calculate Area

$$Surface\ Area = \pi r^2 + \pi rl$$

5. Program (Code)

```
function [A,L] = cone1(r,h)
% S. Scott Moor     September 2007
% This function will calculate the volume, surface area and surface
% distance from the base circumference to the tip of the cone for a
% right circular cone.
%
% function [A,L] = cone1(r,h)
%
% Input:  r = radius of the cone base (length units)
%         h = height of the cone (same length units)
% Outputs:  A = area (length units squared)
%           L = edge length (length units)

% Calculate the edge length
L = sqrt(r.^2 + h.^2);

% Calculate the surface area
A = pi*(r.^2 + r.*L);
```

6. Test against Hand Calculation

```
> [Area, L]=cone1(2, 1.5)
Area =
  28.2743
L =
   2.5000
```

7. NA

8. Calculation on broader set of values and with vector input

```
>> [Area, L]=cone1([1,2,1,2], [1.5,1.5,2,2])
Area =
   8.8052   28.2743   10.1664   30.3379
L =
   1.8028    2.5000    2.2361    2.8284
```

These results follow the pattern expected – the output values increase with increasing input dimensions. In addition radius has a bigger impact than height changes as expected.