Octave/Matlab/Scilab Exercises

(NOTE: // is the comment symbol for Scilab, for others, use %)

Part A: Basic operations & arithmetic calculations

1. Create variables x = 2.5, y = -2e-3, z = %pi, then calculate x+y,x-y,x*y,x/y,x+z,x*z,y-z,y/z
2. Evaluate ln $[s^2 - 2s\cos\left(\frac{\pi}{5}\right) + 1]$, where
   a. s = 0.5 b. s = 0.95 c. s = 1
3. Given below the two numbers for variable x and y,
   x = 2 + 3*j* y = 1 - *j*
   Obtain the absolute value for x*y and x/y.
4. Determine the resulting calculations if : a= 2.3, b = -2.3, c = π/2, x = 2/ π, y = √3
   a. $a^2 + bc + x$ b. sin(c) + y/c c. (a + c) / (x + y)
   d. 1 / (cos(c) + ln(x)) e. $(a + c)^3 / b$
5. Try out the following
   a. How do you find $\sin^{-1}(0.5)$?
   b. If x = 0.5, is $\sin(\sin^{-1}(x)) - x$ equals to zero?
   c. If $\theta = \pi/3$, is $\sin^{-1}(\sin(\theta)) - \theta$ equals to zero? What about when $\theta = 5\pi/11$?

Part B : Array, Vector and Matrix Operation Exercise

1. Create the vector 'M' containing 0,1,2,3,4,5,6,7,8,9, then
   a. Display the array value of 'M'
   b. Show only the value when at M_6
   c. Show only the values of M_6~M_8
   d. Y is a variable which contains the values of M_6~M_8 + 3. Display the new array value of M
   e. Create another vector 'N' containing 9,8,7,6,5,4,3,2,1,0, then calculate M+N.
2. Generate the vector values of X for a given table below :

X	0	0.5	1	1.3	1.6	2	2.3	2.6	3	3.3	3.6	4	4.3	4.6	5	6	8	13	18
Y																			

when the function of x is a) Y = ½X – 3, b) $Y = 4e^{\frac{2}{3}X} + 2$, c) $Y = 3X^2 + 2X + 6$,
d) Y = sin(X), e) Y = sin(X) cos(X)

3. Display the follwing matrix :

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

Then write the commands to
   a. Display only the values in the second column
   b. Display only the values in the third row
   c. Display only the value on the last column of the last row
   d. Display only the value on the second column of the third row
4. Use the : (colon) operator to create the following sequences:
a) 1,2,3,,…,10 b) 10,9,8,…,1 c) 2,4,6,…,20 d) 0.1,0.2,…,1.0 e) 4,3.5,3,…,0.5
5. Create the following matrices and vectors:

$$\mathbf{A} = \begin{bmatrix} 5 & 3 & 1 \\ 3 & 4 & 2 \\ 1 & 2 & 3 \end{bmatrix}; \mathbf{B} = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}; \mathbf{C} = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{bmatrix}; \mathbf{x} = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}; \mathbf{y} = [3 \; -1 \; 2]$$

A) Calculate a) **AB** b) $\mathbf{AC}^T$ c) **CB** d) **Ax** e) $\mathbf{Ay}^T$ f) **Cx** g) **yB** h) **xy** i) **yx**
B) Create a new square matrix **D** by adding **y** to be the third row of **C**.

C) Solve **Az** = **x** and **Bw** = $\mathbf{y}^T$ using the \ operator.
D) Is it possible to calculate a) **BC** b) **Ay** c) **xx** d) **A**+**C** ?
E) Write the command to add the first row of **A** times (-3/5) to the second row of **A**.
F) Write the command to add the first row of **A** times (-1/5) to the third row of **A**.

Part C : Basic Plotting

1. Plot graphs using the following commands: (For Scilab, use %pi instead of pi and xgrid(1) instead of grid on.)

```
> x = linspace(0,4*pi,200);
> plot(x,sin(x));
> plot(x,sin(x).^2,'r--');
> plot(x,cos(x/2),'g-.');
```

```
> y = linspace(0,4*pi,200).';
> plot(y,[sin(y) sin(y).^2 cos(y/2)]);
> grid on; %add "black" grid
```

2. Plot graph of $e^{-x}\sin x$, x = [0,10].
3. Plot graph of $\sin x/x$, x = [-5,5].

Part D : Program Control & Programming

1. Create functions using the following codes:

```
function y=test(x)
    if x > 0 then
        y = 3;
    elseif x < 0 then
        y = 1;
    else
        y = 2;
    end
```

```
function y=test2(x, n)
% x:vector
%n: number of elements
    y = x(1);
    for k = 2:n
        y = y + x(k);
    end
```

```
function [Min, Max]=test3(x, n)
    Min = x(1); Max = x(1);
    for k=2:n
        if Max < x(k) then
            Max = x(k);
        elseif Min > x(k) then
            Min = x(k)
        end
    end
```

and observe how they work.
(Note: In Scilab, one needs to add `endfunction` at the end of each function, and use // for specifying comments.)
2. Modify codes in 1. to create a function that receives a vector and returns the sum, maximum, minimum.
3. Write a program to evaluate a function f(x,y) for any two user-specified values x and y. The function f(x,y) is defined as follows

$$f(x,y) = \begin{cases} x + y & x \geq 0 \text{ and } y \geq 0 \\ x + y^2 & x \geq 0 \text{ and } y < 0 \\ x^2 + y & x < 0 \text{ and } y \geq 0 \\ x^2 + y^2 & x < 0 \text{ and } y < 0 \end{cases}$$

4. Create a function f(x) = $x^2 - 2x - 2$. Test your function to see if it does what you expect.
5. Repeat 4. using simple function definition (anonymous functions in Octave/Matlab, "deff" command in Scilab)
6. Run the following script: (For Scilab, use %pi instead of pi)

```
m = 1:100;
n = m.^2;
y = cos(n*pi/1e4);
plot(m, y);
```

7. Write a function using the following code:

```
function y = MyTaylorExp(x, n)
% x: input value, n : number of terms
y = 1+x; m = 1; xx = x;
for k = 2:n
    xx = xx * x;
    m = m * k ;
    y = y + xx/m;
end
```

Then modify the code to write a function for calculating sin(x) or cos(x) using Taylor's series.