Assignment 6
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Problem Set 9

Problem Set 9-1:

Write a function M-file called par_res that takes as input two resistor values (say R1 and R2), and outputs the equivalent resistance, say R_eq, if the two resistors are in parallel.

Main Script

```
% Program Name: par_res_TEST.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This program prompts the user to enter two values and produce
and produce equivalent resistance.

clear, clc
format short, format compact

r1 = input('Enter value for R1: ');
r2 = input('Enter value for R2: ');

req = par_res(r1,r2);

fprintf('%d || %d = %d?\n', r1, r2, req)
```

Function Script

```
% Program Name: par_res.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This function will calculate the parallel resistance of two
resistor values.

function[req] = par_res(r1, r2)

req = (r1 .* r2) ./ (r1 + r2);

end
```

Results

```
Enter value for R1: 3
Enter value for R2: 6
3 || 6 = 2Ω
```

Problem Set 9-2:

Write a function M-file called circle_area that takes as input the radius of the circle, say radius; and yields as output the area of the circle, say area.

Main Script

```
% Program Name: circle_area_TEST.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This program prompts the user to enter a value for radius and
produce the area.

clear, clc
format short, format compact

r = input('Enter value for radius: ');

area = circle_area(r);

fprintf('The area of a circle with radius %d is %5.2f\n', r, area)
```

Function Script

```
% Program Name: circle_area.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This function will calculate the area of a circle given a
radius.

function[area] = circle_area(r)

area = pi .* r^2;
end
```

Results

```
Enter value for radius: 5
The area of a circle with radius 5 is 78.54
```

Problem Set 9-3:

Write a function M-file called triangles that:
-takes as input 3 sides (say a, b and c) of a triangle;
-yields the perimeter, say p, and area, say A (using Heron's formula given below) of the triangle as output.

Perimeter: p = a + b + c;
Heron's formula for Area: A = sqrt(s(s-a)(s-b)(s-c)), where s = p/2, the semi-perimeter.

Use the command window to check that your code works for a 3-4-5 right triangle and a 5-12-13 right triangle. (Use A = 1/2bh in your check for the area.) Note that the check does not have to be part of the function M-file.

Main Script

```
% Program Name: triangles_TEST.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This program prompts the user to enter three values and output
the perimeter and area of a triangle.

clear, clc
format short, format compact

a = input('Enter value for side a: ');
b = input('Enter value for side b: ');
c = input('Enter value for side c: ');

[per,area] = triangles(a,b,c);

fprintf('The perimeter of a triangle with sides %d, %d, %d equals %d.\n', a,
b, c, per)
fprintf('The area of a triangle with sides %d, %d, %d equals %d.\n',
a,b,c,area)
```

Function Script

```
% Program Name: triangles.m
% Author: Juan Silva Last Modified: Mar. 13, 2018
% Description: This function will calculate the perimeter and area of a
triangle.

function[per, area] = triangles(a, b, c)

per = a + b + c;

s = per / 2;
area = sqrt(s * (s - a) * (s - b) * (s - c));
end
```

Results

```
Enter value for side a: 3
Enter value for side b: 4
Enter value for side c: 5
The perimeter of a triangle with sides 3, 4, 5 equals 12.
The area of a triangle with sides 3, 4, 5 equals 6.
>> 0.5 * 3 * 4
ans =
     6
Enter value for side a: 5
Enter value for side b: 12
Enter value for side c: 13
The perimeter of a triangle with sides 5, 12, 13 equals 30.
The area of a triangle with sides 5, 12, 13 equals 30.
>> 0.5 * 5 * 12
ans =
    30
```

Problem Set 9-4:

From physics, the capacitance (in F) between 2 parallel plates, filled with a dielectric material of relative permittivity e, can be approximated by the equation: C ?e0eA/d, where A is the area of the plates (in sq. m), d is the distance (in m) between the plates, and e0is the electric constant, 8.854×10?12F/m.

a. Write a function M-file to find the capacitance between two rectangular parallel plates,

- with inputs: the length and width of the plates (both in m), the permittivity of the dielectric material separating the plates, and the distance between the plates (in m); and
- with output: the capacitance between the two plates (in F)

b. After debugging your code, use your program to find: the capacitance between parallel rectangular plates of length 3 mm and width 4 mm, separated by distance d = 0.2 mm, if the relative permittivity of the material between the plates is 2.5. (Be careful with the units.)

Main Script

```
% Program Name: capacitance_TEST.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This program prompts the user to enter four values and will
output the capacitance.

clear, clc
format short, format compact

l = input('Enter length of the plate (in m): ');
w = input('Enter width of the plate (in m): ');
d = input('Enter distance between both plates (in m): ');
p = input('Enter permativity: ');

cap = capacitance(l,w,d,p);

fprintf('\nThe capacitance of a plate with %.3fm length', l)
fprintf(' and %.3fm width with distance %.4fm and %.2f permitivity is
%dF.\n',w,d,p,cap)
```

Function Script

```
% Program Name: capacitance.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This function will calculate the capacitance between two
parallel plates.

function[cap] = capacitance(l,w,d,p)

e = 8.854e-12;

a  = (l * w);
cap = (a * e * p) / d;

end
```

Results

```
Enter length of the plate (in m): 0.003
Enter width of the plate (in m): 0.004
Enter distance between both plates (in m): 0.0002
Enter permativity: 2.5

The capacitance of a plate with 0.003m length and 0.004m width with distance
0.0002m and 2.50 permitivity is 1.328100e-12F.
```

Problem Set 9-5:

Legend: When the inventor of the game of chess showed the game to his king, the king offered him whatever prize he desired. The inventor said: I won't be greedy. Just give me one grain of rice for the first square, two grains for the second square, four grains for the third square, etc., doubling the number of grains for each square, up to the last square on the board. Write a MATLAB M-file called chess_board to determine how many grains of rice the inventor would receive, in total.

Main Script

```
% Program Name: chess_board_TEST.m
% Author: Juan Silva Last Modified: Feb. 26, 2018
% Description: This program prompts the user to enter a values to solve the
Chess problem. This is a geometric series so it takes in three values to set
up the series.

clear, clc
format short, format compact

a = input('Enter first term (a): ');
r = input('Enter common term (r): ');
n = input('Enter # of terms (N): ');

A = [a r n];
s = GeoSolver(A);

fprintf('The sum of the geometric series equals %d.\n', s)
```

Function Script

```
% Program Name: chess_board.m
% Author: Juan Silva Last Modified: Feb. 26, 2018
% Description: This function will solve the geometric series.

function s = GeoSolver(array)

a = array(1);
r = array(2);
n = array(3);
s = (a - a*r^n) / (1-r);

end
```

Results

```
Enter first term (a): 1
Enter common term (r): 2
Enter # of terms (N): 64
The sum of the geometric series equals 1.844674e+19.
```

Problem Set 10

Problem Set 10-1:

Compute the following Maclaurin Series Equation by hand for six terms.

$$\cos(x) = \sum_{k=0}^{N} (-1)^k \frac{X^{2k}}{(2k)!}$$

$$\cos(x) = (-1)^0 \frac{x^{2*0}}{(2*0)!} + (-1)^1 \frac{x^{2*1}}{(2*1)!} + (-1)^2 \frac{x^{2*2}}{(2*2)!} + (-1)^3 \frac{x^{2*3}}{(2*3)!} + (-1)^4 \frac{x^{2*4}}{(2*4)!} + (-1)^5 \frac{x^{2*5}}{(2*5)!}$$

$$\cos(x) = 1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \frac{x^8}{40320} - \frac{x^{10}}{36288000}$$

Write a function M-file called CosSeries that takes as its inputs, x and N and has output given by the sum in the N-term Maclaurin Series approximation for Cos(x). Hint: try a "for loop": for k = 0:N, and set: "format long" in your code. You may use the MATLAB built-in function factorial().

Check your code by finding the 2-terms, 4-terms, and 6-terms Maclaurin Series approximations every 30 degrees for Cos(x) where 0?x?360?. Display a Table using fprintf() function. See canvas for additional instructions regarding formatting.

Modify your code so that it uses a default value of N = 3, if the user does not specify a value for N. (Hint: Use the function nargin). To demonstrate that your code works:-Evaluate the function with x = p/4 and N = 3;-Evaluate the function with x = p/4, and no input for N. See canvas for additional instructions regarding formatting.

Main Script

```
% Program Name: SeriesCos_TEST.m
% Author: Juan Silva Last Modified: Mar. 12, 2018
% Description: This program prompts the user to enter two values and produce
and produce equivalent resistance.
```

```
clear, clc, close
format long

% Part 2
x = (pi/180) .* [0 : 30 : 360];     %matrix from 0 - 360°
Term2 = SeriesCos(x,2);
Term4 = SeriesCos(x,4);
Term6 = SeriesCos(x,6);

A = [rad2deg(x);x;Term2;Term4;Term6];

fprintf('Theta\t\tcos(x)\t\t2 Terms\t\t\t4 Terms\t\t6 Terms\n');
fprintf('%3.f°\t\t %7.3f\t\t%7.3f\t\t%7.3f\t\t%7.3f\t\t\n', A);

% Part 3
x = pi/4;
n = 3;

TermN = SeriesCos(x);
Term3 = SeriesCos(x,n);

B = [rad2deg(x);TermN;Term3];

fprintf('\nTheta\t\t? Terms\t\t 3 Terms\n');
fprintf('%3.f°\t\t%6.3f\t\t%6.3f\n', B);
```

Function Script

```
% Program Name: SeriesCos.m
% Author: Juan Silva Last Modified: Mar. 12, 2018
% Description: This function will calculate the Maclaurin series for cos(x)
where x is between 0 to 360 degrees.

function sum = SeriesCos(x, n)

sum = 0;

if nargin < 2
  n = 3;
end

for k = 0:n
   sum = sum + (-1).^k * (x.^(2*k) / factorial(2*k));
end

end
```

Results

Theta	cos(x)	2 Terms	4 Terms	6 Terms
0°	0.000	1.000	1.000	1.000
30°	0.524	0.866	0.866	0.866
60°	1.047	0.502	0.500	0.500
90°	1.571	0.020	0.000	0.000
120°	2.094	-0.392	-0.500	-0.500
150°	2.618	-0.470	-0.862	-0.866
180°	3.142	0.124	-0.976	-1.000
210°	3.665	1.802	-0.757	-0.865
240°	4.189	5.055	-0.097	-0.495
270°	4.712	10.444	1.266	0.028
300°	5.236	18.609	4.001	0.620
330°	5.760	30.265	9.598	1.310
360°	6.283	46.200	20.988	2.465

Theta	? Terms	3 Terms
45°	0.707	0.707

Problem Set 10-2:

- Write a function M-file called BigEnuf.
- Takes scalar or vector inputs x.
- Outputs the magnitude of the scalar (or the magnitude of each scalar in the vector input) only if all of the entries have magnitude of at least 3.
- Outputs a message: "Sorry this number (or some of these numbers) are too small." if at least one of the numbers has magnitude less than 3.
- Verify that your code works for inputs: -8, 3, [-8 0 2 7], and [-6 5 7 -9].

Main Script

```
% Program Name: BigEnuf_TEST.m
% Author: Juan Silva Last Modified: Mar. 12, 2018
% Description: This program prompts the user to enter that takes scalar or
vector inputs and outputs the magnitude of the input.

clear, clc
format short, format compact

a = -8;
b = 3;
c = [-8 0 2 7];
d = [-6 5 7 -9];
```

```
tmp1 = BigEnuf(a);
tmp2 = BigEnuf(b);
tmp3 = BigEnuf(c);
tmp4 = BigEnuf(d);
```

Function Script

```
% Program Name: par_res.m
% Author: Juan Silva Last Modified: Feb. 28, 2018
% Description: This function will calculate the magnitude of a constant or
vector value. The program will return an error if any of the numbers listed
have a magnitude less than three.

function mag = BigEnuf(x)

mag = abs(x);

if any(abs(x) < 3)
    disp('Sorry this number (or some of these numbers)are too small.')
else
    disp(mag);

end
```

Results

```
     8
     3
Sorry this number (or some of these numbers) are too small.
     6     5     7     9
```

Problem Set 10-3:

-Write a function (called Compute) that has two outputs, and three inputs.
-The inputs will be the radius of a sphere or the three sides of a triangle.
-If the user requests no outputs, the output will be the message "No outputs requested".
-If the user requests just one output and supplies just one input, the output will be the volume of the sphere. V = (4/3) pr3
-If the user requests two outputs and supplies just one input, the outputs will be both the volume of the sphere and the surface area of the sphere. A = 4 pr2
-If the user requests just one output and supplies three inputs, the output will be the perimeter of the triangle. C = s1 + s2 + s3
Anything else, the output will be the message "Error: Something went wrong".

Main Script

```
% Program Name: Compute_TEST.m
% Author: Juan Silva Last Modified: Mar. 14, 2018
% Description: This program prompts the user to enter inputs and outputs.
Based on the number of inputs and outputs, it will produce different results.

clear, clc
format short, format compact
```

```
%no outputs
Compute(1,2,3);
%one output, one input
x = Compute(5);
%two outputs, one input
[x,y] = Compute(3);
%one output, three inputs
x = Compute(1,2,3);

%two inputs, two outputs
[x,y] = Compute(3,4);
%one output, two inputs
[x] = Compute(3,4);
```

Function Script

```
% Program Name: Compute.m
% Author: Juan Silva Last Modified: Mar. 14, 2018
% Description: This function will calculate the volume and surface area of a
sphere given one input and two outputs. It will calculate the perimeter of a
triangle given three inputs and one output. If no output is given, print a
message. Otherwise, all other cases will print out an error.

function [o1,o2] = Compute(i1,i2,i3)

if nargout == 0
    disp('No output requested.')
    return
elseif nargout == 1 && nargin == 1
        o1 = (4/3) * pi .* i1^3;
        fprintf("The volume of a sphere with radius %d is %.3f\n", i1, o1);
elseif nargout == 2 && nargin == 1
        o1 = (4/3) * pi .* i1^3;
        o2 = 4 * pi * i1^2;
        fprintf("The volume of a sphere with radius %d is %.3f\n", i1, o1);
        fprintf("The surface area of a sphere with radius %d is %.3f\n", i1,
o2);
elseif nargout == 1 && nargin == 3
        o1 = i1 + i2 + i3;
        fprintf("The perimeter of a triangle with sides %d, %d, %d is %d.\n",
i1, i2, i3, o1);
else
    o1 = '';
    o2 = '';
    disp('Error. Something went wrong.')
end
end
```

Results

```
No output requested.
The volume of a sphere with radius 5 is 523.599
The volume of a sphere with radius 3 is 113.097
The surface area of a sphere with radius 3 is 113.097
The perimeter of a triangle with sides 1, 2, 3 is 6.
Error. Something went wrong.
Error. Something went wrong.
```