Computer Assignment 2

1. A Fibonacci sequence is given as

$$1, 1, 2, 3, 5, 8, 13, 21, \cdots \tag{1}$$

where every term (except first two) is the sum of the two preceding terms. The terms of a Fibonacci sequence are called Fibonacci numbers.

The nth term in the Fibonacci sequence is given by Binet's formula:

$$F_n = \frac{\phi^n - (-\phi)^{-n}}{\sqrt{5}}, \quad \phi = \frac{1+\sqrt{5}}{2} \tag{2}$$

Here, ϕ is called the 'Golden ratio'. Using Binet's Formula, write a function which calculates the nth term of the Fibonacci sequence for a given value of n. Calculate F_{15}.

2. Consider again the Fibonacci sequence (1). MATLAB's fibonacci function is a handy way to find Fibonacci numbers. For example, fibonacci(7)=13 which means the 7th Fibonacci number is 13. Use fibonacci function to write a function which calculates the ratio $\frac{F_n}{F_{n-1}}$ for a given value of n. What happens when n gets large?

3. The general equation of a circle is given by

$$x^2 + y^2 + 2gx + 2fy + c = 0 \tag{3}$$

where g, f and c are constants. The radius r of circle is given by the formula:

$$r = \sqrt{g^2 + f^2 - c} \tag{4}$$

Write a function which takes the values of $g = 3$, $f = 4$ and $c = -11$ as inputs to output the following statement: 'Radius of this circle is 6'. Make sure you create a subfunction to calculate the radius r. [**Hint:** Use sprintf function and use %d instead of %s].

4. The integral function in MATLAB calculates an integral numerically. For example integral(fun,min,max) numerically calculates the definite integral of the integrand 'fun' from lower limit 'min' to upper limit 'max'. To define the integrand function you can use a function handle.

   Write a function which calculates the following integral for given positive integers m and n. Make sure you use format bank for output display.

   $$\int_{-\pi}^{\pi} sin(mx)sin(nx)dx \tag{5}$$

   Consider the cases $m = n$ and $m \neq n$. What do you observe? [**Hint:** Use element-wise multiplication .* to multiply the sine functions.]

5. The xor function xor(A,B) in MATLAB performs a logical-exclusive OR of expressions A and B. xor(A,B) is only true when exactly one of A and B is true. Write a function which uses for-loops, if-statements and xor to create a square matrix of size n of following pattern:

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix}$$

6. Use while loop and if-statement to write a script file which on running displays all square numbers between given natural numbers a and b ($a \neq b$) of your choice. If there are no square numbers between a and b, you should get the output 'There are no square numbers'. Verify with your code that there are no square numbers between 900 and 950.

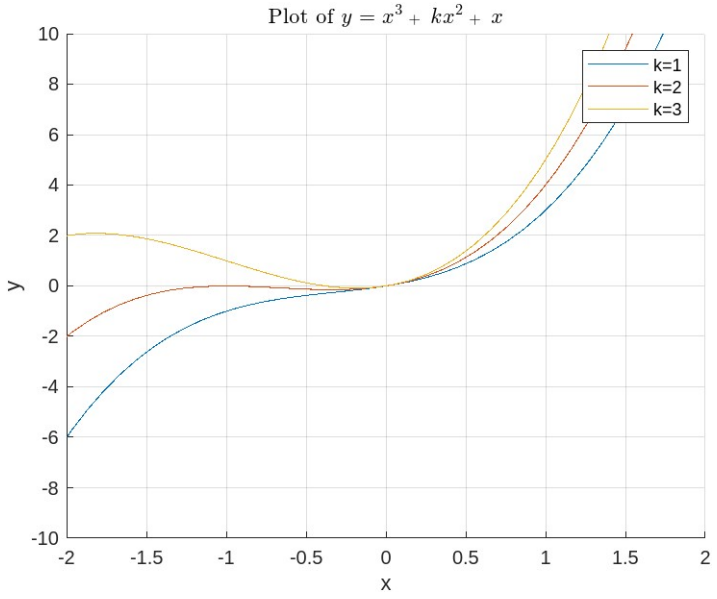
7. The general form of a geometric progression (G.P.) is given as

$$a, ar, ar^2, ar^3, \cdots, ar^n, \cdots$$

Here, a and r are non-zero real numbers and $n \in \mathbb{N}$. Write a recursive function which takes the values of a, r and n and calculates the sum of first n terms of the geometric progression. Using your function, find the sum for $a = 1$, $r = 0.5$ and $n = 5$.

8. Compute $(2^{56} + 5) - 2^{56}$ in the command window. What do you get? Explain your answer.

9. Write a script file which generates the plot shown below. Attach your plot.
(**Hint:** You may use a for-loop.)



10. Write a script file which plots the first 10 Fibonacci numbers as points (n, F_n) where F_n is the nth Fibonacci number. Attach your plot. (**Hint:** Use a for-loop.)