ASSIGNMENT 4: FUNCTIONS
Note: Good programming practices to write functions.
  a. **Always design reusable functions.**
  b. **Make function declarations global.**
  c. **Avoid displaying results into the functions i.e. return the results from functions.**
  d. **Avoid accepting inputs from user into the function i.e. pass them as arguments.**
  e. **Avoid use of global variables. Avoid void functions.**
  f. **Before using any of the pre-defined function (library functions) read its prototype from help documents.**

A. ITERATION
1. Write a function to calculate factorial of a given number.
2. Write a function to indicate whether given number is prime or not.
3. Write a function to check whether given year is leap year or not.
4. Write a function to calculate power x^y.
5. Write a function to calculate gcd of given nos.
6. Write a function to check whether given character is
    a. Uppercase
    b. Lowercase
    c. Alphabet
    d. Digit
    e. Alphanumeric
    f. Hex Digit
7. Write a function to return a character representing hex value for numbers between 0 to 15;
8. Write a function to return a number between 0 to 15 corresponding to hex character 0-9, A-F.
9. Write a function to Calculate value of golden ratio ϕ using Fibonacci series.
10. Write a function to convert a HEX number to BCD number.
11. Write a function to convert a BCD number to HEX number.
12. Write a function to implement four function calculator. Function would take operands and operator as arguments and returns result.
13. In above program, division may fail if denominator is zero. Use global variable as an error flag to avoid this problem.
14. Write a function to count number of '1' bits into a given number.
15. Write a function to display given number in binary format using bitwise operators.
16. Write a function to check whether a given byte has even parity.
17. Write a function to check whether given character is alphabet or not. If it is alphabet, perform bitwise XOR operation with value 32 and return the value. Observe the result.
18. Write a function to swap two numbers using XOR operation.
19. Write a function to return a number having reverse bit order of given number.
20. Write a function to accept date from user and return the date in form of a short integer and vice versa.
        Use first 5 bits for day. Next 4 bits for month and Last 7 bits to store (year – 1900).
    Example:
```
Input: 19 1 1969
Return Value: 39109
The bit pattern of the 39109 is
10011 0001 1000101
----- ---- -------
  19    1     69
```

Following functions have void return type.
21. Write a function to print a given character for a given number of times.
22. Write a function to print given number of terms of Fibonacci series.
23. Write a function to print arithmetic series, which takes 3 arguments as start, end and difference.

B. ITERATION (Nested function calls)
1. Write a function to calculate Binomial coefficient.
2. Write a function to print Pascal triangle of given number of rows.
3. Write a function to find out number of days in given month and year.
4. Write a function to Calculate day of week for given date.
5. Write a function to display
   a. Prime numbers between given range.
   b. Twin Prime numbers between given range.
   c. Fibonacci prime numbers between given range.

6. Write a function to Calculate values using Taylor series
   a. $e^x = x + \frac{1}{2!} \times x^2 + \frac{1}{3!} \times x^3 + \frac{1}{4!} \times x^4 \ldots = \sum_{n=0}^{\infty} \frac{1}{(2n)!} \times x^{(2n)} \quad for -\infty < x < \infty$
   b. $\sin(x) = x - \frac{1}{3!} \times x^3 + \frac{1}{5!} \times x^5 - \frac{1}{7!} \times x^7 \ldots = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!} \times x^{(2n+1)} \, for -\infty < x < \infty$
   c. $\cos(x) = x - \frac{1}{2!} \times x^2 + \frac{1}{4!} \times x^4 - \frac{1}{6!} \times x^6 \ldots = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!} \times x^{(2n)} \quad for -\infty < x < \infty$

7. Calculate value of pi using following Formula
   a. Machin's Formula
   $$\frac{\pi}{4} = 4 \times \tan^{-1}\left(\frac{1}{5}\right) - \tan^{-1}\left(\frac{1}{239}\right)$$

   b. Euler's Formula
   $$\frac{\pi}{4} = 4 \times \tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right)$$

   Where series for $\tan^{-1}(x)$ is

   $$\tan^{-1}(x) = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \frac{x^9}{9} \ldots = \frac{(-1)^n x^{(2n+1)}}{(2n+1)} \quad for -1 < x < 1$$

   Compare results with value of π (M_PI defined in *math.h*)

8. The reverse and add function starts with a number, reverses its digits, and adds the reverse to the original. If the sum is not a palindrome (meaning it does not give the same number read from left to right and right to left), we repeat this procedure until it does. For example, if we start with 195 as the initial number, we get 9,339 as the resulting palindrome after the fourth addition:

Example:

195	786	1,473	5,214
+	+	+	+
591	687	3,741	4,125
——	—— —	———	———
786	1,473	5,214	9,339

9. When sum of the digits of a number is equal to sum of the digits of the prime factors of the same number, it is called as Smith's number. Write a program to accept a number and check whether the number is Smith's number or not. (example : 4937775)

$$4937775 = 3 \cdot 5 \cdot 5 \cdot 65837$$

$$4 + 9 + 3 + 7 + 7 + 7 + 5 = 42,$$
$$3 + 5 + 5 + 6 + 5 + 8 + 3 + 7 = 42.$$

C. STATIC VARIABLE
1. Write a function to return next term of Fibonacci series with each call to the function.
2. Write a function to return pseudo random number.

D. RECURSION
1. Write a function to calculate factorial of a given number using recursion.
2. Write a function to calculate power using recursion.
3. Write a function to calculate GCD of given numbers using recursion.
4. Write a function to print given number of terms of Fibonacci series.
5. Write a function to calculate n^{th} term of the Fibonacci series using recursion. Write another function to print given number of terms of Fibonacci series.
6. Write a function to print a given number in binary format.
7. Write a function to print a given number in hexadecimal format, without using %x format specifier.
8. Write a function to accept a no and base. print a given number in given base.
9. Write a function to print amount in words.

E. POINTERS
1. Write a function to calculate area and perimeter of a rectangle in a single function.
2. Write a function to swap two numbers.
3. Write a function to implement four function calculator. The return value indicates the error (either invalid operation or divide by zero). The result is returned via out-parameter.
4. Write a function to calculate daytime for given sunrise and sunset.

F. SELF – STUDY (IMPORTANT)
1. Read the prototypes of the library functions from the help documents.
   a. printf()
   b. scanf()
   c. sqrt()
   d. getchar()
   e. rand()
   f. getchar()

G. Print following patterns

(a)

```
1
1       2
1       2       3
1       2       3       4
1       2       3       4       5
```

(b)

```
5
5       4
5       4       3
5       4       3       2
5       4       3       2       1
```

(c)

```
1       2       3       4       5
1       2       3       4
1       2       3
1       2
1
```

(d)

```
5       4       3       2       1
5       4       3       2
5       4       3
5       4
5
```

(e)

```
1       2       3       4       5
2       3       4       5
3       4       5
4       5
5
```

(f)

```
5       4       3       2       1
4       3       2       1
3       2       1
2       1
1
```

(g)

```
1       3       5       7       9
2       4       6       8
3       5       7
4       6
5
```

(h)

```
5       4       3       2       1
16      8       4       2
27      9       3
16      4
5
```

(i)

```
1       2       4       8       16
16      8       4       2
2       4       8
8       4
4
```

(j)

```
1       1       2       3       5
8       13      21      34
55      89      144
233     377
610
```

(k)

1	4	9	16	25
36	49	64	81	
100	121	144		
169	196			
225				

(l)

2	3	5	7	9
11	13	17	19	
23	29	31		
37	43			
47				

(m)

					F					
				E	F	E				
		C	D	E	F	E	D	C		
A	B	C	D	E	F	E	D	C	B	A
		C	D	E	F	E	D	C		
				E	F	E				
					F					

ASSIGNMENT 4 FUNCTIONS ☺

- Write a function to calculate hamming code for given byte. Write another function to return data from given hamming code.