WEEK-END ASSIGNMENT-04
Top-Down Design with Functions
Operating Systems Workshop (CSE 3541)

Problem Statement:

Demonstrate the top-down design method of problem solving and emphasize the role of modular programming using functions.

Assignment Objectives:

To learn about functions and how to use them to write programs with separate modules.

Instruction to Students (If any):

Students are required to write his/her own program by avoiding any kind of copy from any sources. Additionally, They must be able to realise the outcome of that question in relevant to systems programming. You may use additional pages on requirement.

Programming/ Output Based Questions:

1. Describe the problem input(s), output(s) and write the algorithm for a program that computes the circle's area and circumference. Also write a function prototype to compute the same using radius as input to the function and return type **void**.

   Input, Output, Algorithm and Function Prototype ▼

2. During execution of the following program segment, how many lines of star marks will be displayed?

```c
void nonsense(void){
  printf("*****\n");
  printf("* *\n");
  printf("*****\n");
}
int main(void){
 nonsense();
 nonsense();
 nonsense();
 return (0);
}
```

   Output

3. Consider the following C program;   **[GATE 2004]**

```c
int main(void){
 int x,y,m,n;
 scanf("%d%d",&x,&y);
 /* Assume x > 0 and y > 0  */
 m = x; n = y;
 while(m!=n){
   if(m>n)
       m=m-n;
   else
       n=n-m;
 }
 printf("%d",n);
}
```

The program computes

(a) x + y using repeated subtraction

(b) x mod y using repeated subtraction

(c) the greatest common divisor of x and y

(d) the least common multiple of x and y

Output▼

4. What does the following algorithm approximate? (Assume $m > 1, e > 0$).   **[GATE 2004]**

The program computes

```c
x = m; y = 1;
while (x - y > e){
   x = (x + y) / 2;
   y = m/x;
}
printf("%d",x);
```

(a) $log\ m$ (c) $m^{\frac{1}{2}}$

(b) m^2 (d) $m^{\frac{1}{3}}$

Output▼

5. Consider the following two functions.   **[GATE 2017]**

Find the output when **fun1(15)** is called;

```c
void fun1(int n)
{
   if(n==0)
       return;
   printf("%d",n);
   fun2(n-2);
   printf("%d",n);
}
```

```c
void fun2(int n)
{
   if(n==0)
       return;
   printf("%d",n);
   fun1(++n);
   printf("%d",n);
}
```

Output▼

(a) 53423122222445

(b) 53423120112233

(c) 53423122132435

(d) 53423120213243

6. The output of executing the following C program is;   **GATE**

```c
int total(int v){
 int count=0;
 while(v){
  count +=v&1;
  v>>=1;
 }
 return count;
}
```

```c
int main(){
int x=0,i=5;
for( ; i>0; i--){
   x=x+total(i);
}
printf("%d\n",x);
return 0;
}
```

Output▼

How many times the function call, **total()**, is called?

7. Consider the following C function;

```c
int fun(n){
 int i,j;
 for(i=1;i<=n;i++){
    for(j=1;j<n;j++){
       printf("%d %d\n",i,j);
    }
 }
 return 1;
}
```

Output▼

Determine the number of times the **printf()** will be executed if **n=5**.

8. Write a program that prompts the user for the two legs of a right triangle and makes use of the **pow** and **sqrt** functions and the Pythagorean theorem to compute the length of the hypotenuse.

Space for Program and output ▼

9. Write the prototype for a function called **script** that has three input parameters. The first parameter will be the number of spaces to display at the beginning of a line. The second parameter will be the character to display after the spaces, and the third parameter will be the number of times to display the second parameter on the same line and return type of the function is of integer.

Function Prototype/ Declaration/ Signature ▼

10. In a particular jurisdiction, taxi fares consist of a base fare of $4.00, plus $0.25 for every 140 meters traveled. Write a function that takes the distance traveled (in kilometers) as its only parameter and returns the total fare as its only result. Write a main program that demonstrates the function.
    Hint: Taxi fares change over time. Use constants to represent the base fare and the variable portion of the fare so that the program can be updated easily when the rates increase.

Space for Program	**Output ▼**

11. Create a function named **nextPrime** that finds and returns the first prime number larger than some integer, **n**. The value of **n** will be passed to the function as its only parameter. The main function in the program that reads an integer from the user and displays the first prime number larger than the entered value. Additionally, your program must specify the function prototype and identify the actual argument(s) and formal parameters.

Space for Program	Output ▼

12. Write a program that allows the user to convert a number from one base to another. Your program should support bases between 2 and 16 for both the input number and the result number. If the user chooses a base outside of this range then an appropriate error message should be displayed and the program should exit. Divide your program into several functions, including a function that converts from an arbitrary base to base 10, a function that converts from base 10 to an arbitrary base, and a main program that reads the bases and input number from the user.

Space for Program   **Output ▼**

Space for Program   **Output ▼**

13. Write a program that calculates the speed of sound (a) in air of a given temperature T ($°F$). Formula to compute the speed in ft/sec:

$$a = 1086\sqrt{\frac{5T + 297}{247}}$$

Be sure your program does not lose the fractional part of the quotient in the formula shown. As part of your solution, write and call a function that displays instructions to the program user.

Space for Program	Output ▼

14. After studying the population growth of Gotham City in the last decade of the 20th century, we have modeled Gotham's population function as

$$P(t) = 52.966 + 2.184t$$

where t is years after 1990, and P is population in thousands. Thus, $P(0)$ represents the population in 1990, which was 52.966 thousand people. Write a program that defines a function named population that predicts Gotham's population in the year provided as an input argument. Write a program that calls the function and interacts with the user as follows:

```
Enter a year after 1990> 2015
Predicted Gotham City population for 2010 (in thousands): 107.566
```

Space for Program	Output ▼

Space for Program

Output ▼

15. Positions on a chess board are identified by a two digit number from 11 to 88. The unit place digit identifies the column, while the 10th place digit identifies the row, as shown below:

Valid position

43

Row- 4
Column-3

Row Position: 1 t0 8

Column Positions: 1 to 8
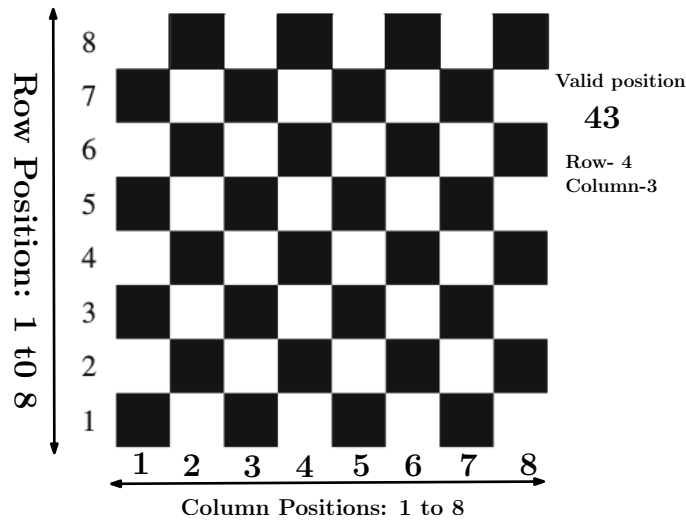
Write a program that reads a position (i.e. 2 digit number) from the user. Write a use-defined function to check whether 2 digit position is a valid cell or not as per the function protoype **int flag=IsvalidPosition (int);**. If the position is valid, use an if statement to determine if the column begins with a black square or a white square then report the color of the square in that row. For example, if the user enters **11** then your program should report that the square is black. If the user enters **34** then your program should report that the square is white.

Space for Program	**Output ▼**

Space for Program   **Output ▼**