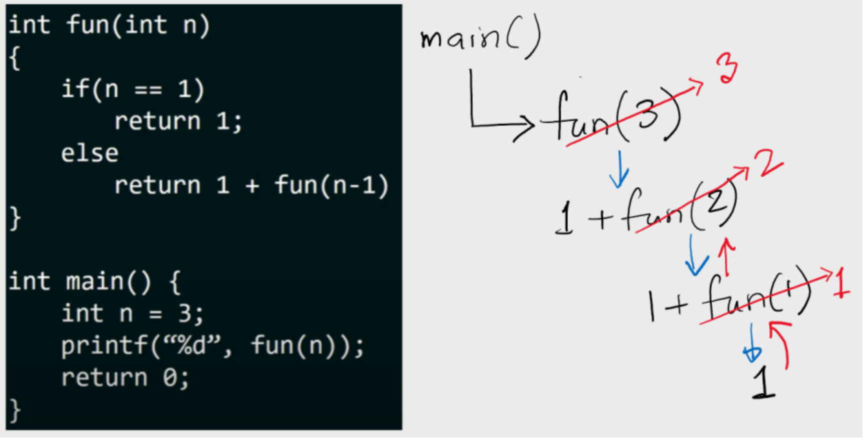
Simulation of a recursive function:



```
int fun(int n)
{
    if(n == 1)
        return 1;
    else
        return 1 + fun(n-1)
}

int main() {
    int n = 3;
    printf("%d", fun(n));
    return 0;
}
```

Figure 1: https://youtu.be/kepBmgvWNDw

How to write Recursive Functions

https://youtu.be/ggk7HbcnLG8

1. Divide the problem into smaller subproblem
2. Specify the base condition to stop the recursion

Divide the problem into smaller subproblem

Fact (1) = 1
Fact (2) = 2. 1 = 2. Fact (1)
Fact (3) = 3. 2. 1 = 3. Fact (2)
Fact (4) = 4. 3. 2. 1 = 4. Fact (3)
…
Fact (n) = n. Fact(n-1)

Specify the base condition to stop the recursion

The base case returns a value without making any subsequent recursive calls. For example: Fact (1) = 1

In summary:

```
Function rec:                       Function Fact(n):
    if base condition:                  if n==1 then
    …                                       return 1
    else                                else
    … recursive formula                     return n*Fact(n-1)
```

Why Stack Overflow error occurs in recursion?

If the base case is not reached or not defined, then the stack overflow problem may arise. In the following code, `Fact(5)` or `Fact(1)` will cause stack overflow.

```
Function Fact(n):
    if n==10 then
        return 10
    else
        return n*Fact(n-1)
```

Practice problems:

Instructions:

1. Do not adopt unfair means. **10 marks will be deducted from the final marks for adopting unfair means.**
2. No more than 40% marks for uncompilable codes.

1. Write a recursive implementation of the factorial function.
   Recall that $n! = 1 \times 2 \times ... \times n$, with the special case that $0! = 1$.
2. Write a recursive program to print the nth Fibonacci number.
3. Write a recursive program to calculate the power of x (x^y), where y is a non-negative integer.
4. Write a recursive program to count the number of digits of an integer.
5. Write a recursive program to find the sum of digits of an integer.
6. Write a recursive program to find the sum of the elements of an array of size n.
7. Write a recursive program to find the products of the elements of an array of size n.
8. Write a recursive program to find the maximum of the elements of an array of size n.
9. Write a recursive program to find the minimum of the elements of an array of size n
10. Write a recursive program to find the average of the elements of an array of size n
11. Write a recursive program to count/print the odd/even numbers of an array of n integers
12. Write a recursive program to print an array of size n in reverse order
13. Write a recursive program to print the even numbers in a given range.

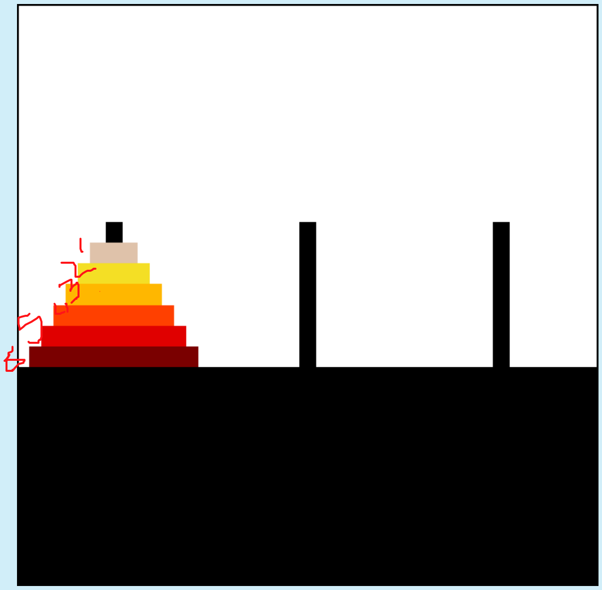
Sample input	Sample output
3 10	4 6 8 10

14. Write a recursive program to check if a given string is a palindrome or not.
15. Write a recursive program to find the maximum of a 2d array.
16. Write a recursive program to count the prime numbers of a given 2d array.

17. Find the sum of the following series up to nth position.
    (a) $1 + 2 + 3 + \cdots$
    (b) $1^2 + 2^2 + 3^2 + \cdots$
    (c) $1 * 3 + 2 * 5 + 3 * 7 + 4 * 9 + \cdots$
    (d) $2 * 3 + 4 * 5 + 8 * 7 + 16 * 9 + \cdots$
    (e) $2 * 3 * 4 + 4 * 5 * 3 + 8 * 7 * 2 + 16 * 9 * 1 + \cdots$

18. Write a recursive program to find the GCD of x and y where x, y are positive integers. (Hint: use Euclid's algorithm. Two ways to solve this.)
19. Write a recursive program to find the LCM of x and y where x, y are positive integers. (Two ways to solve this)

20. Write a recursive program to solve the Tower of Hanoi problem for n disks.



Sample input	Sample output
4	Move disk 1 from A to B Move disk 2 from A to C Move disk 1 from B to C Move disk 3 from A to B Move disk 1 from C to A Move disk 2 from C to B Move disk 1 from A to B Move disk 4 from A to C Move disk 1 from B to C Move disk 2 from B to A Move disk 1 from C to A Move disk 3 from B to C Move disk 1 from A to B Move disk 2 from A to C Move disk 1 from B to C

21. Write a recursive implementation of binary search in a sorted array.
22. Given a set of parentheses check if they are balanced or not using a recursive function.

23. Write a recursive program to print all subsets of a set of n elements.
24. Write a recursive program to print all subsequence of a string.

25. DFS
26. In-order, preorder, postorder
27. Print path from node to the root of a binary tree