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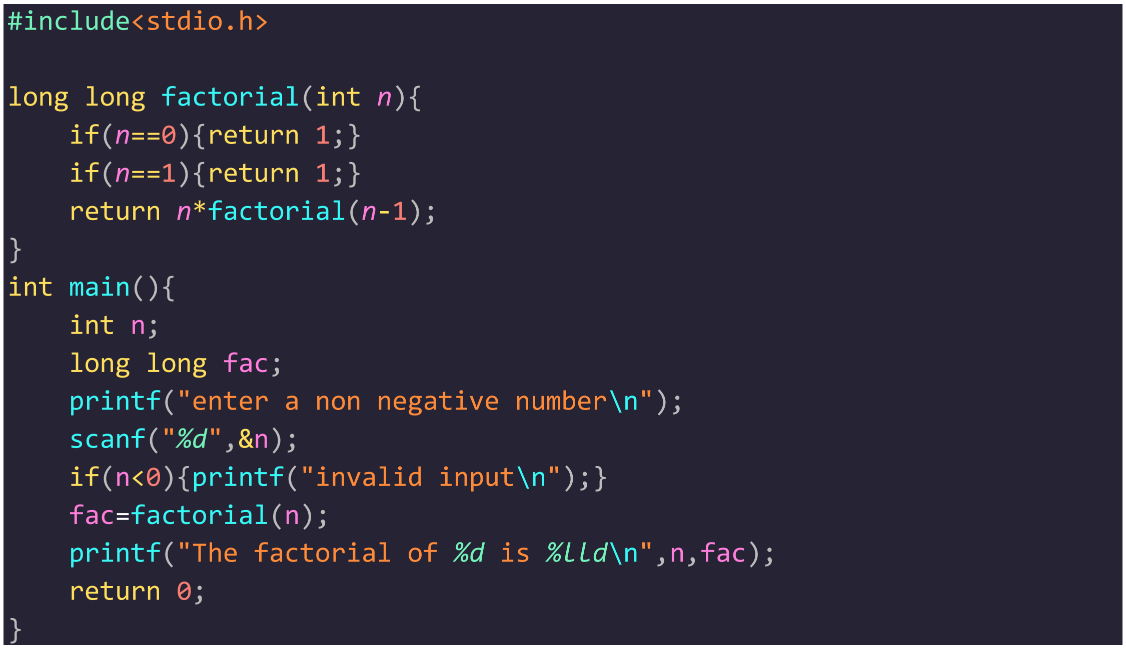
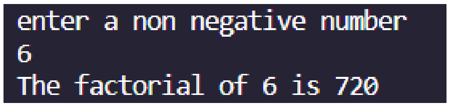
Experiment No.	4

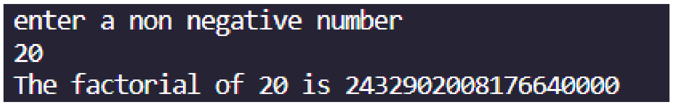
AIM:	Apply the concept of recursion to solve a given problem.
Program 1	
PROBLEM STATEMENT :	Write a recursive function to find the factorial of a number and test it.
ALGORITHM:	Algorithm for main() Step 1: START Step 2: Read an integer n from input. Step 3: fac=factorial(n) Step 4: print the value of fac. Step 5: END Algorithm for factorial(int n) Step 1: if n>1, return n*factorial(n-1) Step 2: if n equals 1 or 0, return 1
PROGRAM:	

```
#include<stdio.h>

long long factorial(int n){
    if(n==0){return 1;}
    if(n==1){return 1;}
    return n*factorial(n-1);
}
int main(){
    int n;
    long long fac;
    printf("enter a non negative number\n");
    scanf("%d",&n);
    if(n<0){printf("invalid input\n");}
    fac=factorial(n);
    printf("The factorial of %d is %lld\n",n,fac);
    return 0;
}
```

RESULT:



```
enter a non negative number
6
The factorial of 6 is 720
```



```
enter a non negative number
20
The factorial of 20 is 2432902008176640000
```

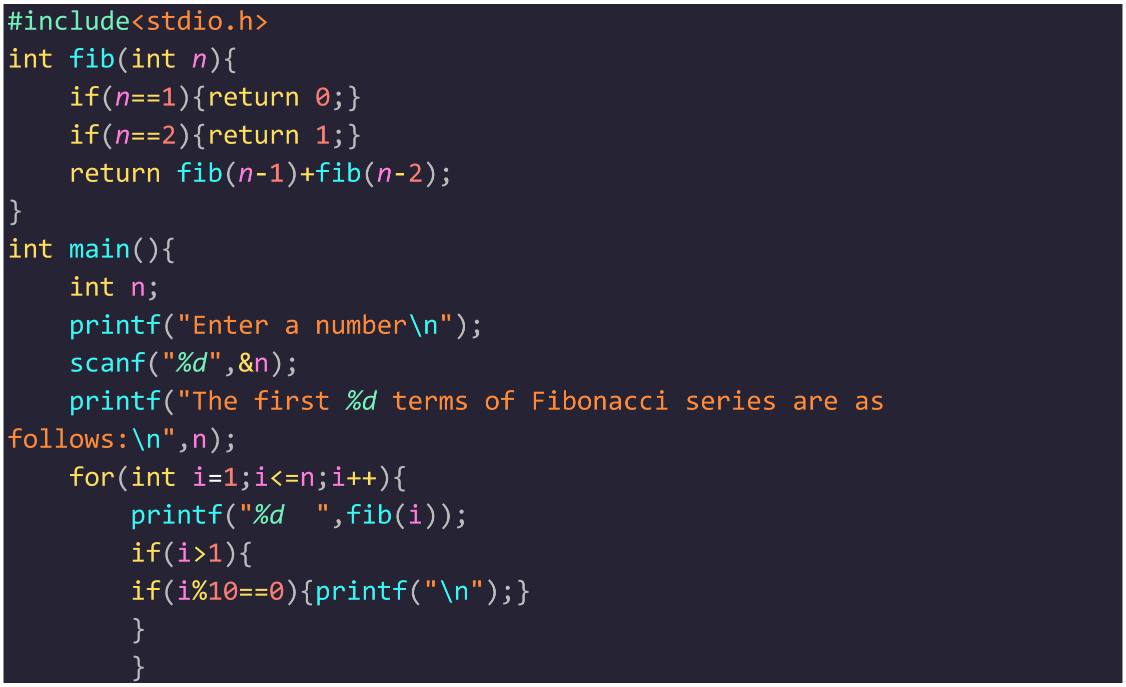
Program 2

PROBLEM STATEMENT : Write a recursive function which returns the nth term of the fibonacci series. Call it from main() to find the 1st n numbers of the fibonacci series.

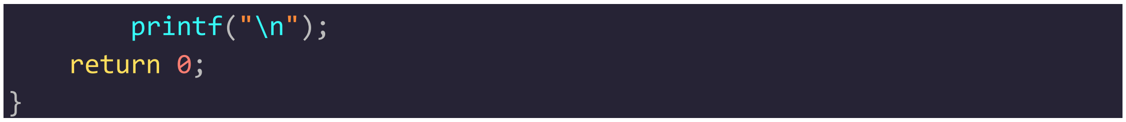
ALGORITHM:

```
Algorithm for main()
Step 1: START
Step 2: Read a number n from input
Step 3: Initialize i=1
Step 4: Print value of fib(i)
Step 5: Increment i
Step 6: If i<=n, return to step 4
Step 6: END

Algorithm for function fib(int n)
Step 1: if n>2, return fib(n-1)+fib(n-2)
Step 2: if n equals 2, return 1
Step 3: if n equals 1, return 0
```

PROGRAM:

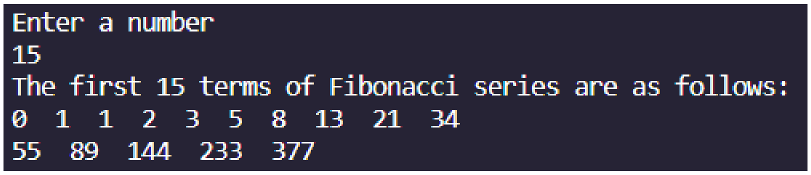


```
#include<stdio.h>
int fib(int n){
    if(n==1){return 0;}
    if(n==2){return 1;}
    return fib(n-1)+fib(n-2);
}
int main(){
    int n;
    printf("Enter a number\n");
    scanf("%d",&n);
    printf("The first %d terms of Fibonacci series are as 
follows:\n",n);
    for(int i=1;i<=n;i++){
        printf("%d  ",fib(i));
        if(i>1){
        if(i%10==0){printf("\n");}
        }
        }
```



```
        printf("\n");
    return 0;
}
```

RESULT:



```
Enter a number
15
The first 15 terms of Fibonacci series are as follows:
0  1  1  2  3  5  8  13  21  34
55  89  144  233  377
```

Program 3

PROBLEM STATEMENT:

Given a number n, print following a pattern without using any loop.

Example:

Input: n = 16

Output: 16, 11, 6, 1, -4, 1, 6, 11, 16

Input: n = 10

Output: 10, 5, 0, 5, 10

ALGORITHM:

Algorithm for main()

Step 1: START

Step 2: Read a number n.

Step 3: execute patternrev(n)

Step 4: execute pattern(n)

Step 5: END

Algorithm for function patternrev(int n)

Step 1: print n

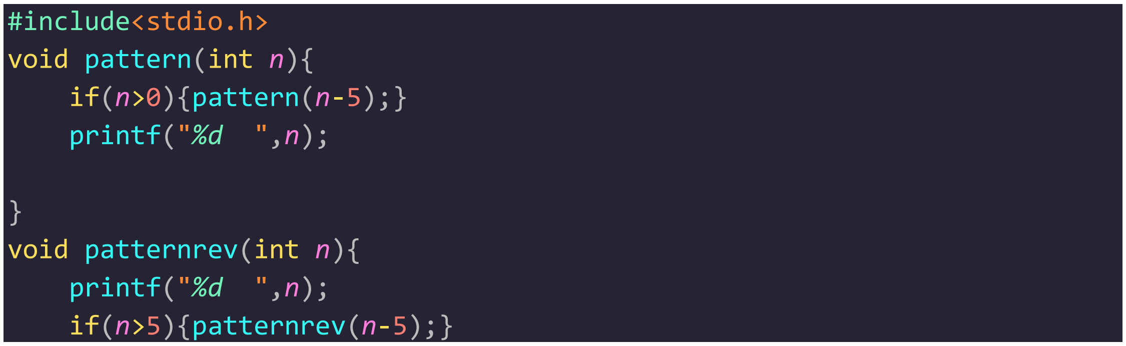
Step 2: if n>5, execute pattern(n-5)

Algorithm for function pattern(int n)

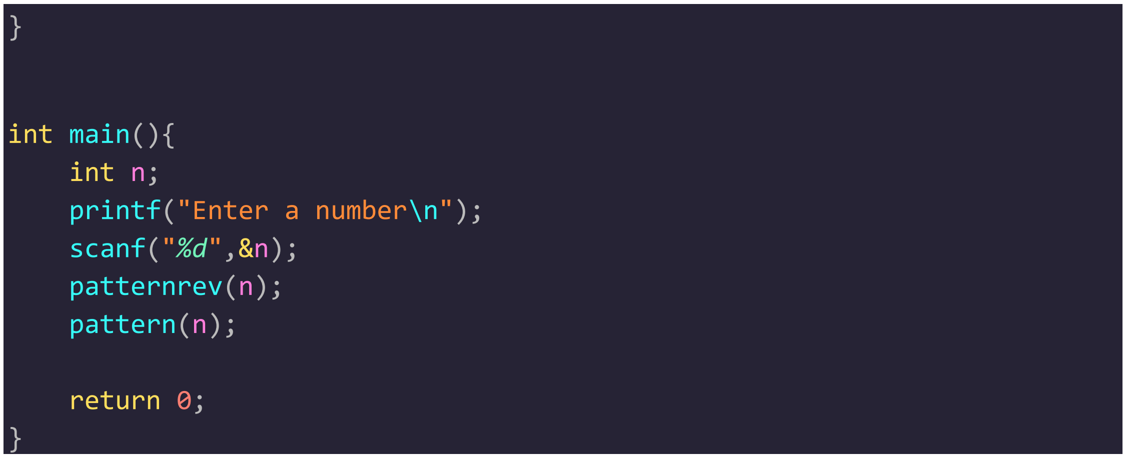
Step 1: if n>0, execute pattern(n-5)

Step 2: print n

PROGRAM:

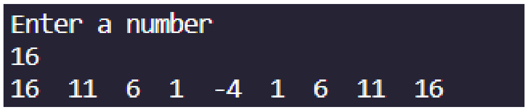


```
#include<stdio.h>
void pattern(int n){
    if(n>0){pattern(n-5);}
    printf("%d  ",n);

}
void patternrev(int n){
    printf("%d  ",n);
    if(n>5){patternrev(n-5);}
```

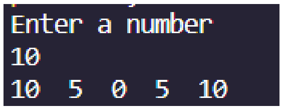


```
}


int main(){
    int n;
    printf("Enter a number\n");
    scanf("%d",&n);
    patternrev(n);
    pattern(n);

    return 0;
}
```

RESULT:



```
Enter a number
16
16  11  6  1  -4  1  6  11  16
```



```
Enter a number
10
10  5  0  5  10
```

Program 4

PROBLEM STATEMENT:

Ackerman's function is defined by:

A(m,n) =n+1 if m=0

=A(m-1,1) if m≠0 and n=0

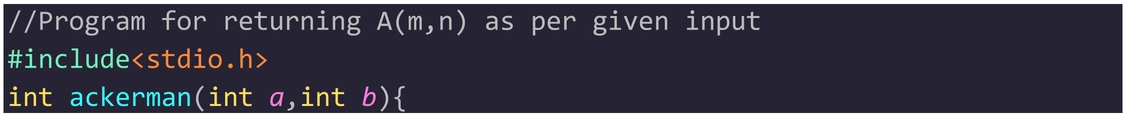
=A (m-1 , A(m,n-1)) if m≠0 and n≠0

Write a function which given m and n returns A(m,n).

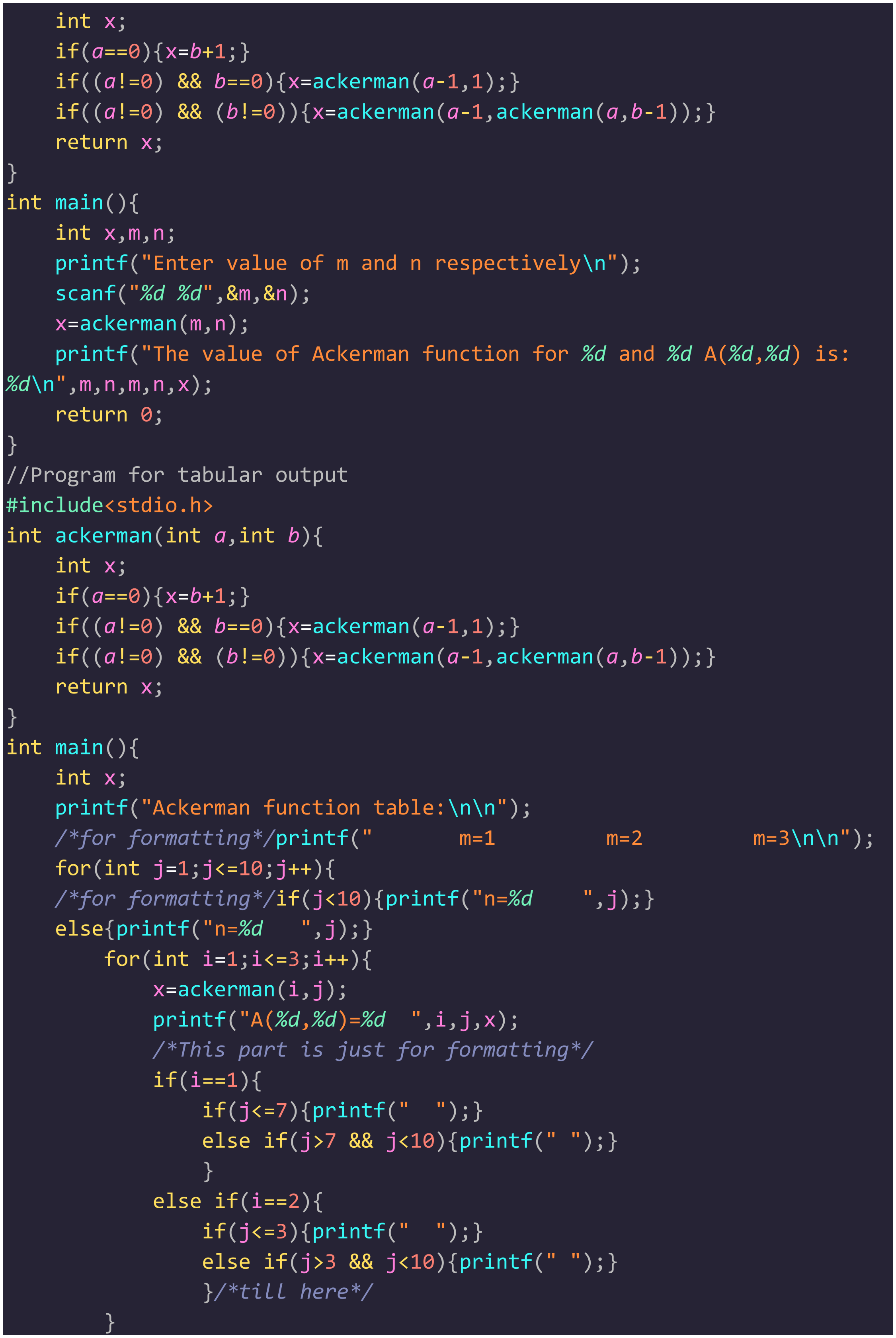
ALGORITHM:

```
Algorithm for main()
Step 1: START
Step 2: Read value of m and n from input.
Step 3: x=ackerman(m,n)
Step 4: Print value of x.
Step 5: END

Algorithm for int ackerman(int a, int b)
Step 1: if  a equals 0, return b+1
Step 2: if a does not equal 0 and b equals 0, return ackerman(a-1,1)
Step 3: if both a and b do not equal 0, return ackerman(a-1,ackerman(a,b-1))
```

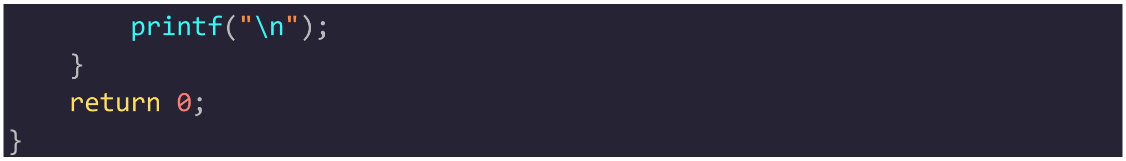
PROGRAM:



```
//Program for returning A(m,n) as per given input
#include<stdio.h>
int ackerman(int a,int b){
```

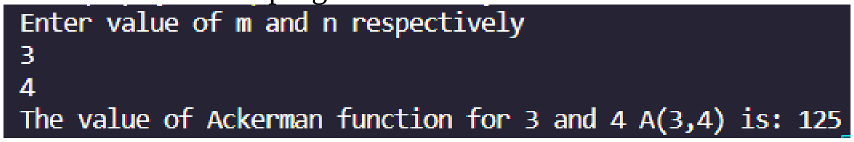


```
    int x;
    if(a==0){x=b+1;}
    if((a!=0) && b==0){x=ackerman(a-1,1);}
    if((a!=0) && (b!=0)){x=ackerman(a-1,ackerman(a,b-1));}
    return x;
}
int main(){
    int x,m,n;
    printf("Enter value of m and n respectively\n");
    scanf("%d %d",&m,&n);
    x=ackerman(m,n);
    printf("The value of Ackerman function for %d and %d A(%d,%d) is: 
%d\n",m,n,m,n,x);
    return 0;
}
//Program for tabular output
#include<stdio.h>
int ackerman(int a,int b){
    int x;
    if(a==0){x=b+1;}
    if((a!=0) && b==0){x=ackerman(a-1,1);}
    if((a!=0) && (b!=0)){x=ackerman(a-1,ackerman(a,b-1));}
    return x;
}
int main(){
    int x;
    printf("Ackerman function table:\n\n");
    /*for formatting*/printf("       m=1         m=2         m=3\n\n");
    for(int j=1;j<=10;j++){
    /*for formatting*/if(j<10){printf("n=%d    ",j);}
    else{printf("n=%d   ",j);}
        for(int i=1;i<=3;i++){
            x=ackerman(i,j);
            printf("A(%d,%d)=%d  ",i,j,x);
            /*This part is just for formatting*/
            if(i==1){
                if(j<=7){printf("  ");}
                else if(j>7 && j<10){printf(" ");}
                }
            else if(i==2){
                if(j<=3){printf("  ");}
                else if(j>3 && j<10){printf(" ");}
                }/*till here*/
        }
```



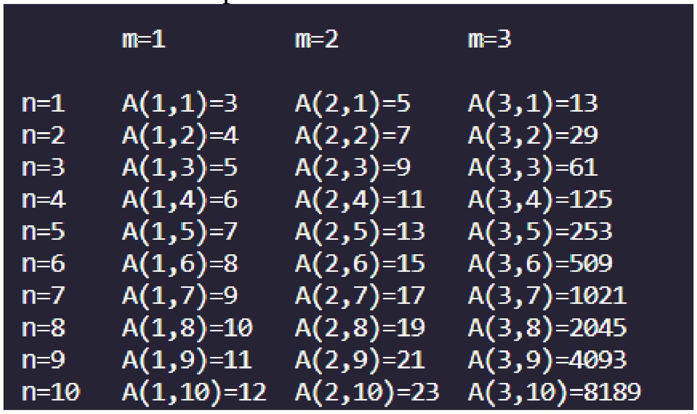
```
        printf("\n");
    }
    return 0;
}
```

RESULT: For basic program



```
Enter value of m and n respectively
3
4
The value of Ackerman function for 3 and 4 A(3,4) is: 125
```

For tabulated output



```
       m=1         m=2         m=3

n=1    A(1,1)=3    A(2,1)=5    A(3,1)=13
n=2    A(1,2)=4    A(2,2)=7    A(3,2)=29
n=3    A(1,3)=5    A(2,3)=9    A(3,3)=61
n=4    A(1,4)=6    A(2,4)=11   A(3,4)=125
n=5    A(1,5)=7    A(2,5)=13   A(3,5)=253
n=6    A(1,6)=8    A(2,6)=15   A(3,6)=509
n=7    A(1,7)=9    A(2,7)=17   A(3,7)=1021
n=8    A(1,8)=10   A(2,8)=19   A(3,8)=2045
n=9    A(1,9)=11   A(2,9)=21   A(3,9)=4093
n=10   A(1,10)=12  A(2,10)=23  A(3,10)=8189
```

CONCLUSION: We studied the method of recursion for solving certain problems, and that it can act as a substitute to control structures even in problems that do not necessarily need it.