CS & IT ENGINEERING

Programming in C

Functions and Storage Classes

Lec-05

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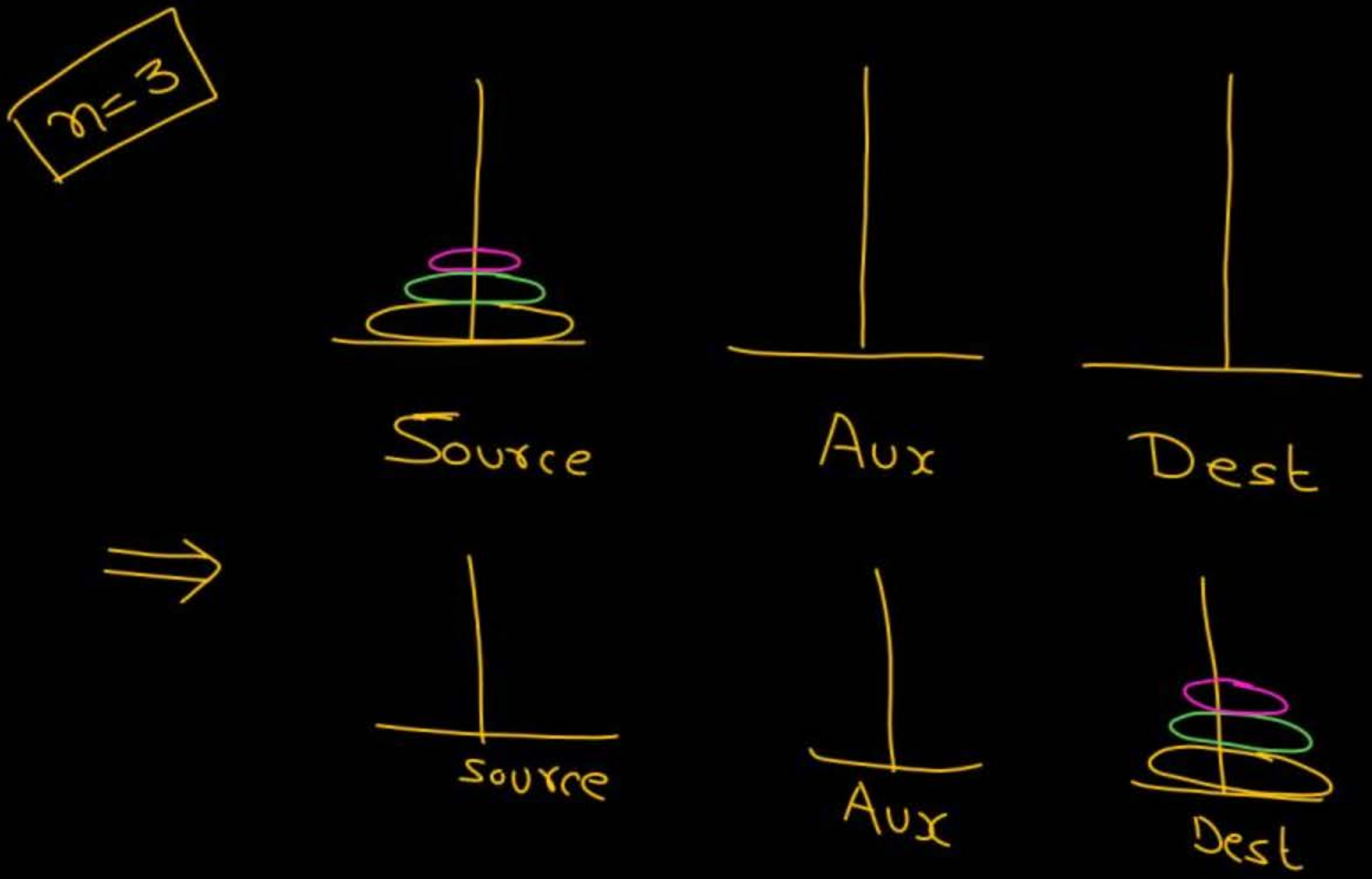
TOPICS TO BE COVERED

- Recursion

Tower of Hanoi

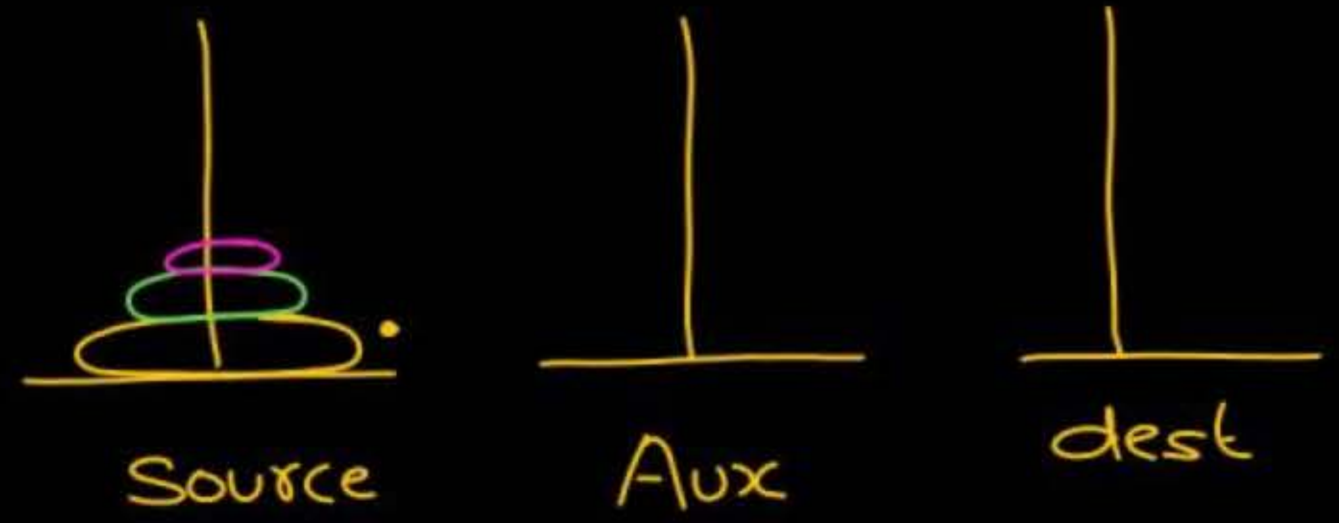


n disks
↳ distinct size

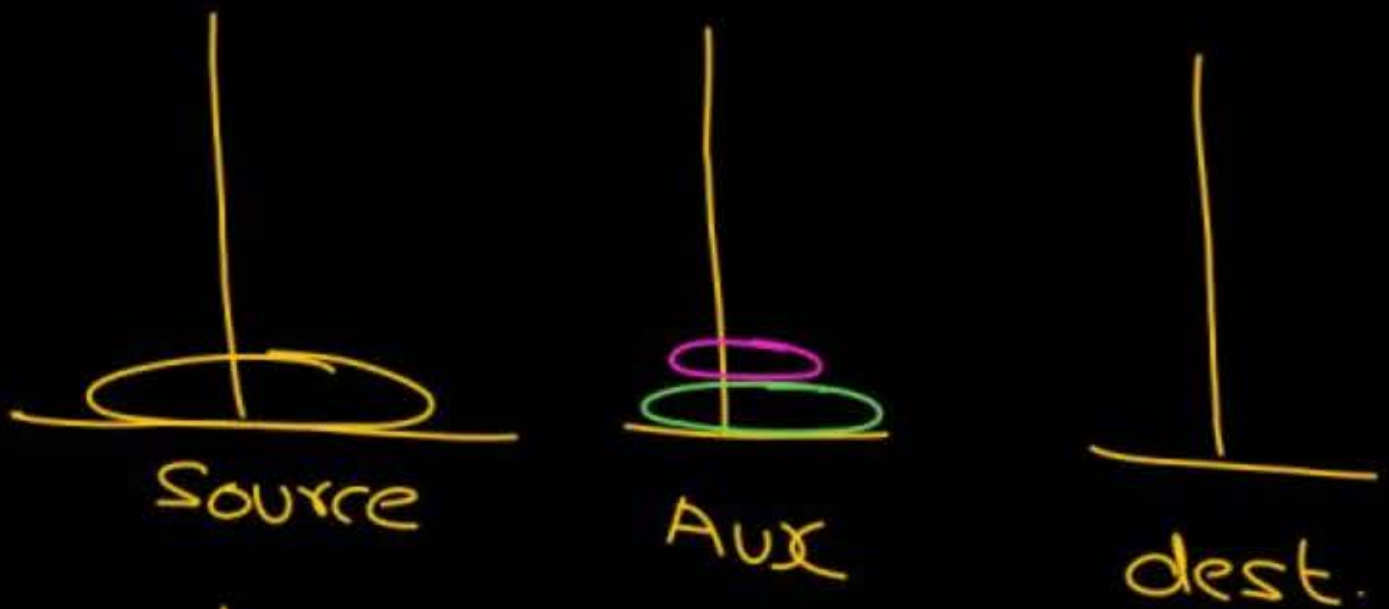
① we can only put a smaller size disk above large size

② we can move exactly one disk at a time

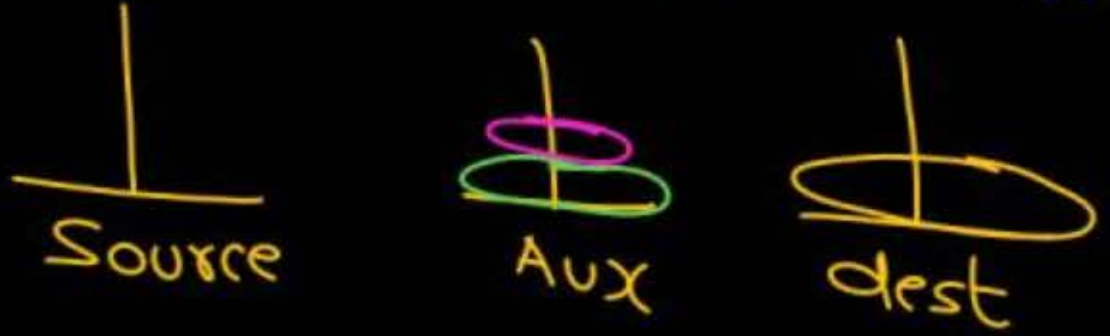
1.



①

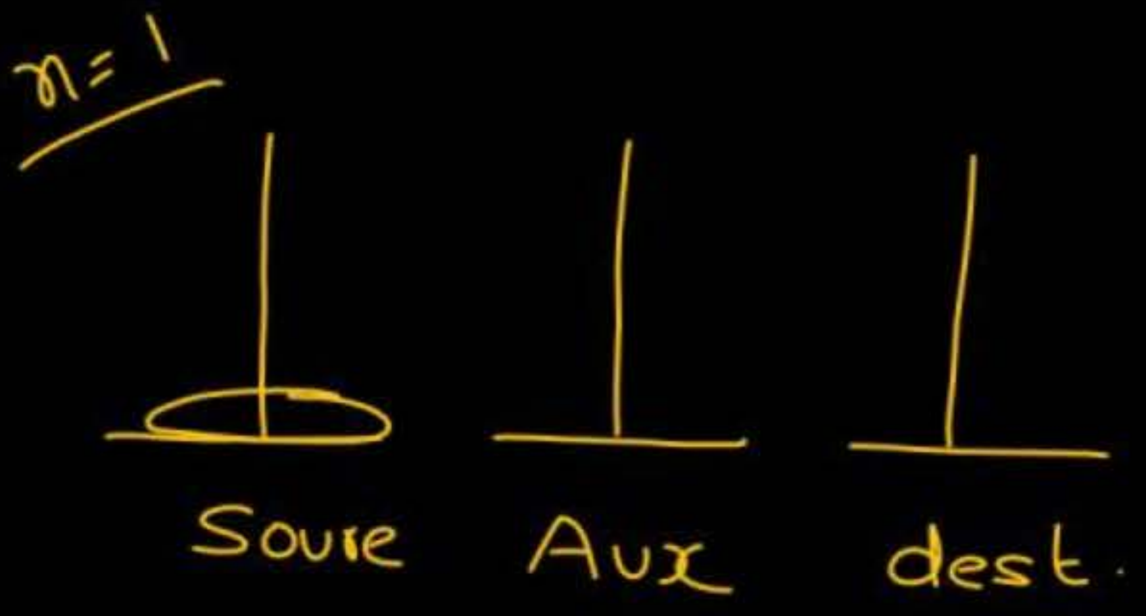


②

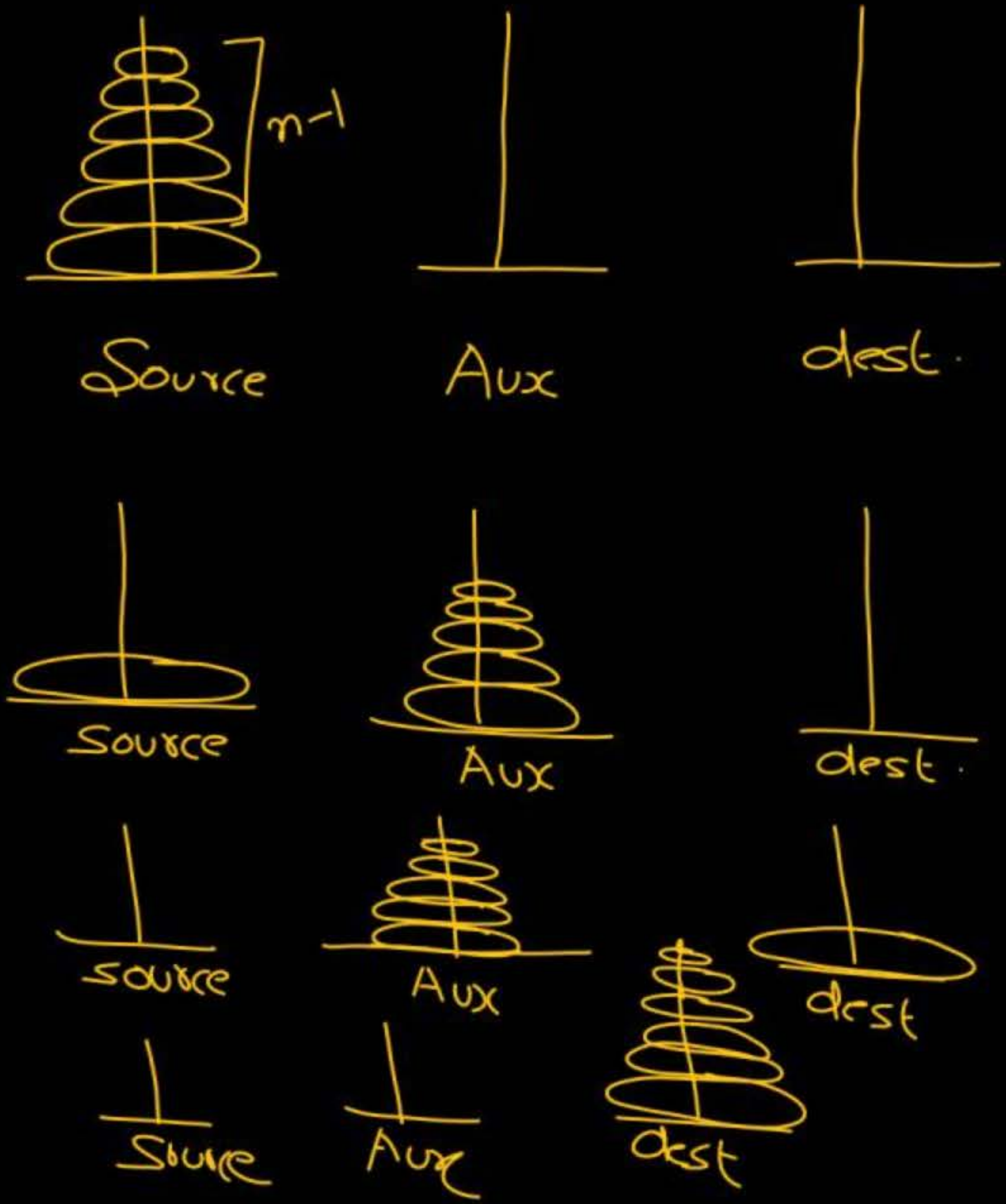


```
void TOH ( 3, Source, dest, Aux )
{

   ① TOH(2 ,Source,Aux, dest);
   ② Move Source → dest
   ③ TOH(2, Aux, dest, Source)

}
```

```
if ( n==  )
  {
Move  Source → dest.
   return;
  }
else {

          n  is  large
          rec.  is needed ⇒

   }
```



Move source → dest



```
void TOH(n, Soure,dest,Aux)
{
    if(     ){

    }

    else{
① TOH(n-1, Source,Aux,dest);
②   Move Source → dest.
③ TOH(n-1, Aux,dest,Source);
    }
```

$$a^b \Rightarrow a \times a^{b-1}$$

```
int    Pow(int a, int b)
        {
            if( )
            {

            }
            else {

            return    a × $\underline{\boxed{a^{b-1}}}$

        }
```

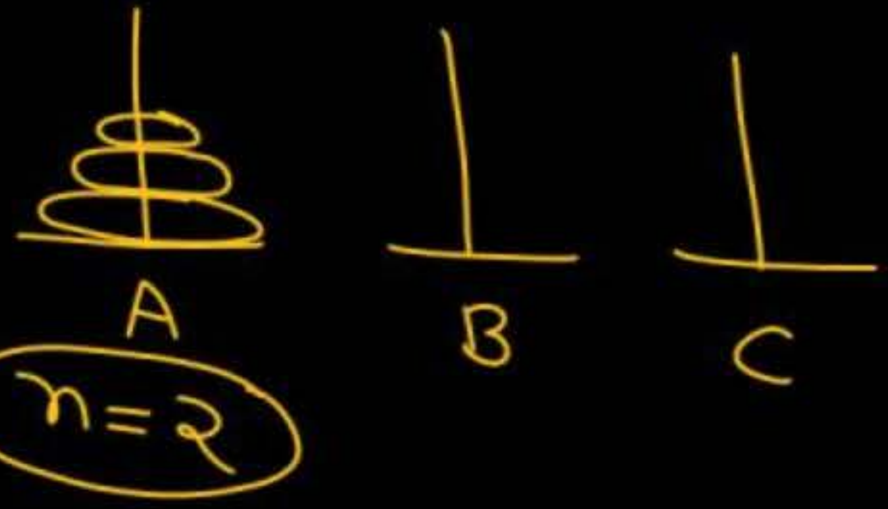
a^b

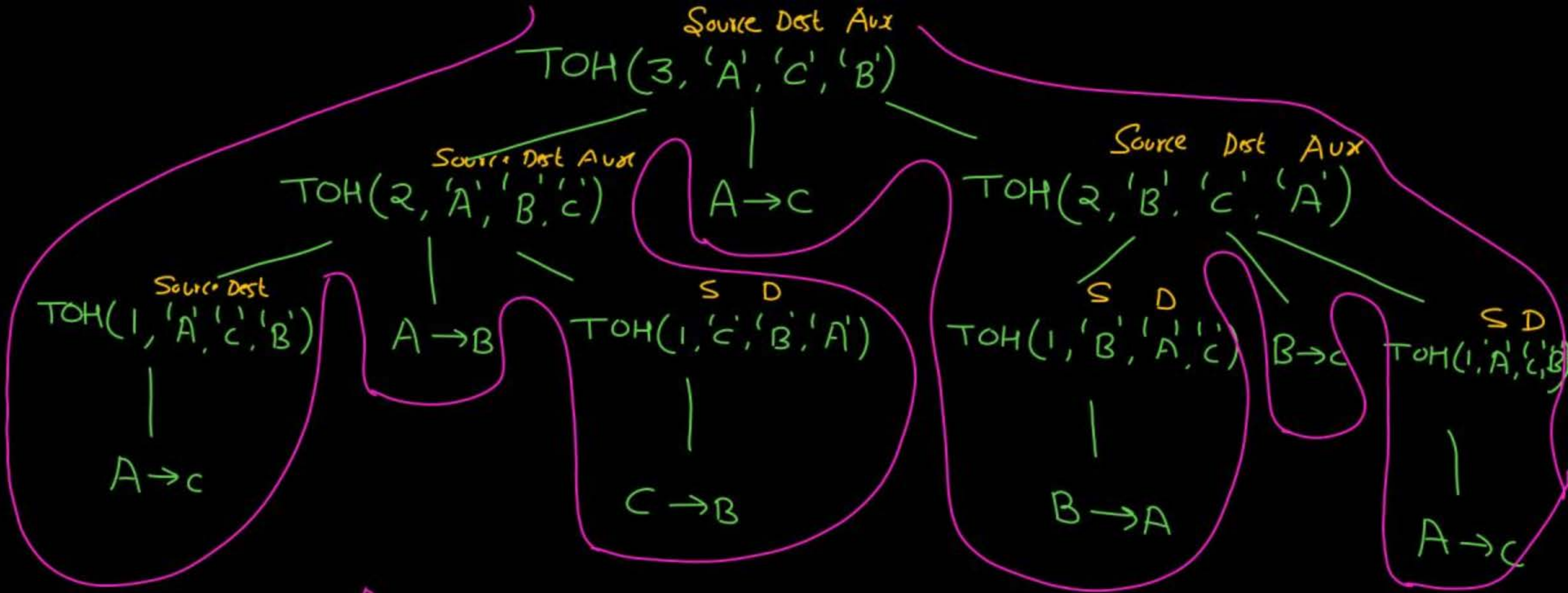
$\boxed{a^{b-1}}$

recursion

```
void TOH(int n, char Source,char dest,char Aux)
    {
      if(n==1){
          printf("%c → %c",source,dest);
          return;
            }
      else {
        {  TOH(n-1, Source,Aux,dest);
3step   {   printf("%c → %c",Source,dest);
        {   TOH(n-1,Aux,dest,Source);
          }
    }
```

```
void main(){
      int n;
printf("______");
scanf("%d",&n);

TOH(n,'A','C','B');
      }
```





A→C

A→B

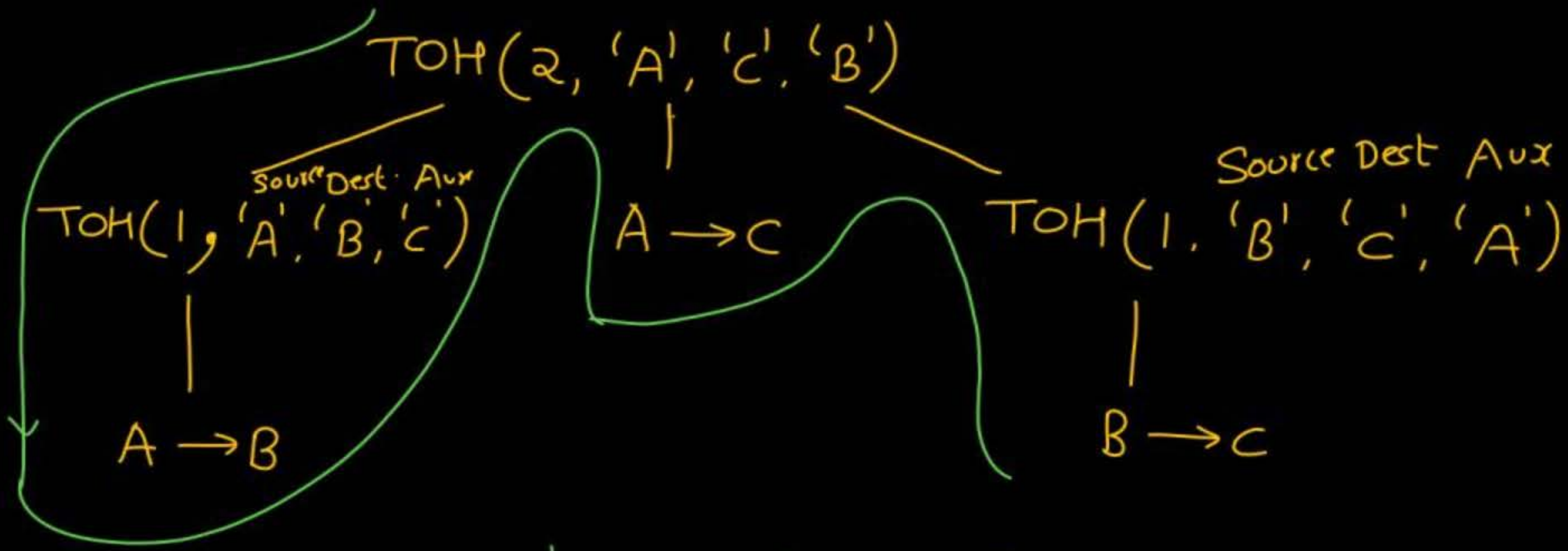
C→B

A→C

B→A

B→C

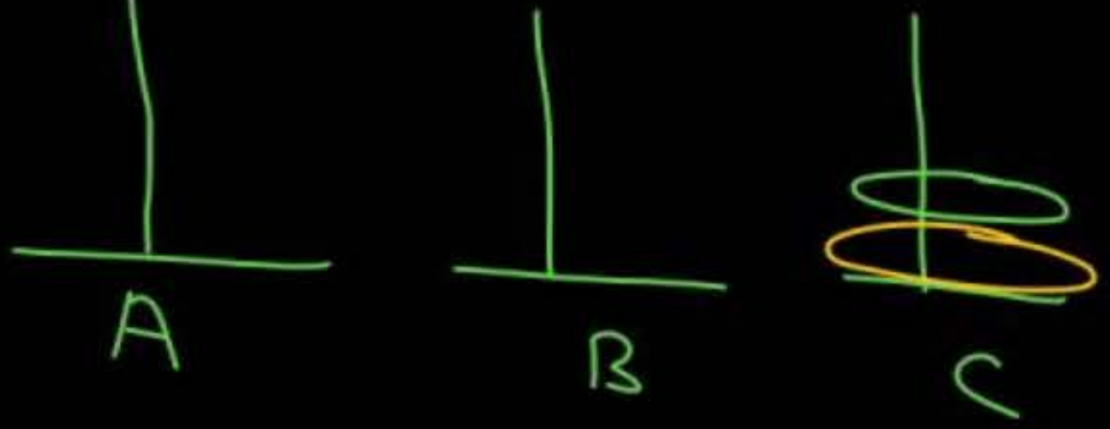
A→C


TOH(2, 'A', 'C', 'B')
Source Dest Aux
TOH(1, 'A', 'B', 'C')
A → C
Source Dest Aux
TOH(1, 'B', 'C', 'A')
A → B
B → C

A → B

A → C

B → C


A
B
C

Fibonacci Series

0, 1, 1, 2, 3, 5, 8, . . .

$$\boxed{1, 1, 2, 3, 5, . . .}$$

$$\begin{array}{ccccc} n & & n-1 & & n-2 \\ 3^{rd} & \Rightarrow & 2^{nd} & + & 1^{st} \end{array}$$

$$Fib(n) = Fib(n-1) + Fib(n-2)$$

$$Fib(1) = 1$$

$$Fib(2) = 1$$

Q.1

```
void f(int n)
  {
     if(n<=0)
     return;
     printf("%d",n);
     f(n-1);
  }
```

What is the output of f(5)

Q.2

```
void f(int n)
  {
     if(n<=0)
     return;
     f(n-1);
     printf("%d",n);
  }
```

What is the output of f(5)

Q.3

```
void f(int n)
  {
     if(n<=0)
     return;
     f(n-1);
     printf("%d",n);
     f(n-1);
  }
```

What is the output of f(4)

Q.4

```
int f(int n)
  {
     if(n<=1)
     return n;
     return f(n/2) + f(n/2) + 1;
  }
```

What is the output of f(5)

Q.5

```
int f(int n)
  {
     if(n<=1)
     return n;
     return f(n/2) + n/2 ;
  }
```

What is the output of f(12)

Q.6

```
int f(int n)
  {
    if(n<=1)
    return n;
    if(n%2)
    return f(n/2) + n;
    return f(n/3) + n;
  }
```

output of f(22) ?

Q.7

Consider the code :

```
/* Assume that n>=0 */
void fun(int n)
  {
      if(n==0)
      return 0;
      fun(n/2);
      printf("%d",n%2);
  }
```

output of f(11)?

Q.8

Consider the following C program :

```
void foo(int n , int sum) {
    int k=0,j=0;
    if(n==0)
    return;
    k=n%10;
    j=n/10;
    sum=sum + k;
    foo(j,sum);
    printf("%d",k);
}
void main(){
int a=2018,sum=0;
foo(a,sum);
printf("%d",sum);
}
```

Output?

A. 8, 4, 0, 2, 14

B. 8,4,0,2,0

C. 2,0,4,8,14

D. 2,0,4,8,0

Q.9

```
void main()
{
    static int var=5;
    printf("%d",var--);
    if(var)
    main();
}
```

Q.10

```
void main()
 {
    static int i =5;
    if(--i)
      {
        main();
        printf("%d",i);
     }
 }
```

Q.11

predict the output

```
int fun(int x)
  {
    if(x%2==0)
    return fun(fun(x-1));
  else
    return(x++);
  }
int main()
  {
    printf("%d",f(12));
    getchar();
    return 0;
  }
```

A. 10

B. 11

C. 12

D. None of these

Q.12

```
int fun(int a,int b)
  {
    if(b==0)
    return 0;
    if(b%2==0)        Even
    return fun(a+a,b/2);
    return fun(a+a,b/2) + a;   ← odd
  }

int main()
  {
    printf("%d",fun(4,3));
    getchar();
    return 0;
  }
```

[✓ A. 12]

B. 81

C. 64

D. 8

a b 12

fun(4,3)

a b 8

fun(8,1)+4

0

fun(16,0)+8

Q.13

Consider the following C function :

```
int f(int n)
{
  static int r=0;
  if(n<=0)
  return 1;
  if(n<3)
  {
    r=n;
    return f(n-2) + 2;
  }
  return f(n-1) + r;
}
```

what is the value of f(5)

A. 5

B. 7

C. 9

D. 18

Q.14 Consider the following recursive C function

```
unsigned int foo(unsigned int n, unsigned int r)
 {
   if(n>0)
   return (n%r) + foo(n/r , r);
else
   return 0;
 }
```

2 15

output of foo(513,2)

A. 9

B. 8

C. 5

[✓ D.] 2

Q.15

Which of the following statements is/are valid?

A. return a+b;

B. return a,b,c; ⇒ return a ;

C. return (a,b,c);

[✓ D.] All of them

return c ;

(10, 12, 14)

Eval / reject

(exp1, exp2, exp3)

Priority

```
int a ;
a = 10, 20, 30 ;

a = 10 ;
20 ;
30 ;
```

Q.16

```
int fun(int x)
 {
   if(x>3)
   return fun(x-4) + fun(x-1) + 1;
   return 1;
 }
```

Find the value returned by fun(12)

Q.17

Predict output of following program

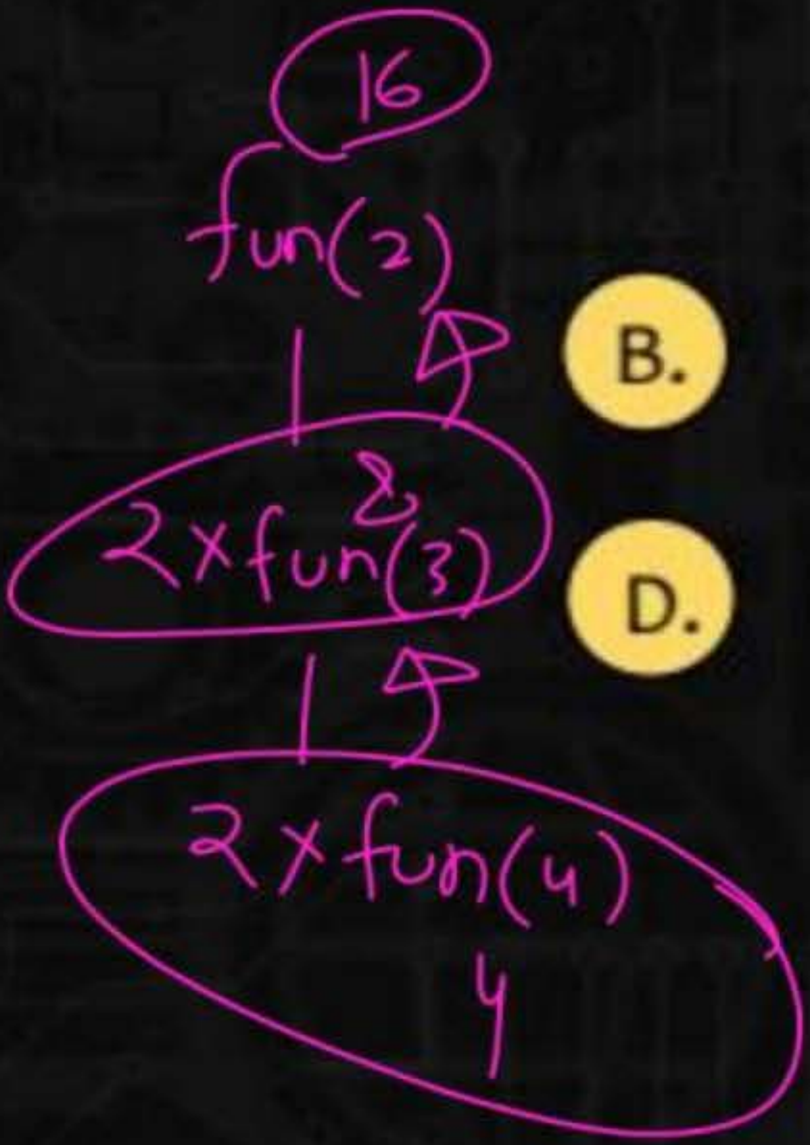
```
#include <stdio.h>
int fun(int n)
 {
   if (n == 4)
   return n;
   else return 2*fun(n+1);
 }
int main()
 {
   printf("%d ", fun(2));
   return 0;
 }
```

A. 4

B. 8

[✓ C.] 16

D. error



Q.18 Consider the following recursive function fun(x, y). What is the value of fun(4, 3)

```
int fun(int x, int y)
{
    if (x == 0)
    return y;
    return fun(x - 1, x + y);
}
```

[✓ A.] 13

B. 12

C. 9

D. 10

$fun(\overset{x}{4},\overset{y}{3})$

$fun(\overset{x}{3},\overset{y}{7})$

$fun(2, 10)$

$fun(1, 12)$

$fun(0, 13)$

$\Rrightarrow \boxed{13}$

Q.19 What does the following function do?

```
int fun(int x, int y)
{
  if (y == 0)  return 0;
  return (x + fun(x, y-1));
}
```

A. x + y

B. x + x * y

[✓ C. x * y]

D. pow(x, y)

example

Q.20

What does fun2() do in general?

fun → $x \times y$

```
int fun(int x, int y)
{
   if (y == 0)  return 0;
   return (x + fun(x, y-1));
}
```

A. x * y

B. x + x * y

[✓ C.] pow(x, y)

D. pow(y, x)

```
int fun2(int a, int b)
{
   if (b == 0) return 1;
   return fun(a, fun2(a, b-1));
}
```

$$\text{fun2}(a,b) = a \times \text{fun2}(a,b-1)$$

$$\Downarrow$$

$$a \times a \times \text{fun2}(a,b-2)$$

$$\Rightarrow \boxed{a^b} = a^2 \times \text{fun2}(a,b-2)$$

Q.21

Output of following program?

```
#include<stdio.h>
void print(int n){
   if (n > 4000)
   return;
   printf("%d ", n); ✓
   print(2*n);
   printf("%d ", n); ✓
}
int main()
{
   print(1000);
   ~~getchar();~~
   return 0;
}
```

~~A.~~ 1000 2000 4000

[✓ B.] 1000 2000 4000 4000 2000 1000

~~C.~~ 1000 2000 4000 2000 1000

D. 1000 2000 2000 1000

Q.22

What does the following function do?

```
int fun(unsigned int n)
{
   if (n == 0 || n == 1)
     return n;

   if (n%3 != 0)
     return 0;
   return fun(n/3);
}
```

fun(6)

= fun(2)

⇒ 0

fun(1) → 1

fun(0) → 0

6%3!=0

0!=0

$\boxed{3^x = 0}$

~~x = 0~~

fun(6) ⇒ 0

fun(7) ⇒ 0

fun(6) = 0

fun(7) = 0

2%3!=0

2!=0

⇒ 7%3!=0

1!=0

A. It returns 1 when n is a multiple of 3, otherwise returns 0

[✓ B.] It returns 1 when n is a power of 3, otherwise returns 0

C. It returns 0 when n is a multiple of 3, otherwise returns 1

D. It returns 0 when n is a power of 3, otherwise returns 1

Q.23 Predict the output of following program

```
#include <stdio.h>
int f(int n)
{
   if(n <= 1)
      return 1;
   if(n%2 == 0)
      return f(n/2);
   return f(n/2) + f(n/2+1);
}
 int main()
{
   printf("%d", f(11));
   return 0;
}
```

A. Stack Overflow

B. 3

C. 4

D. 5

Q.24

Consider the following C function:

```
int f(int n)
{
  ~~static int i = 1;~~
  if (n >= 5)
    return n;
1.  n = n+i;
2.  i++;
3.  return f(n);
4. }
```

i
~~3~~ 4
~~1~~ ~~2~~

The value returned by f(1) is

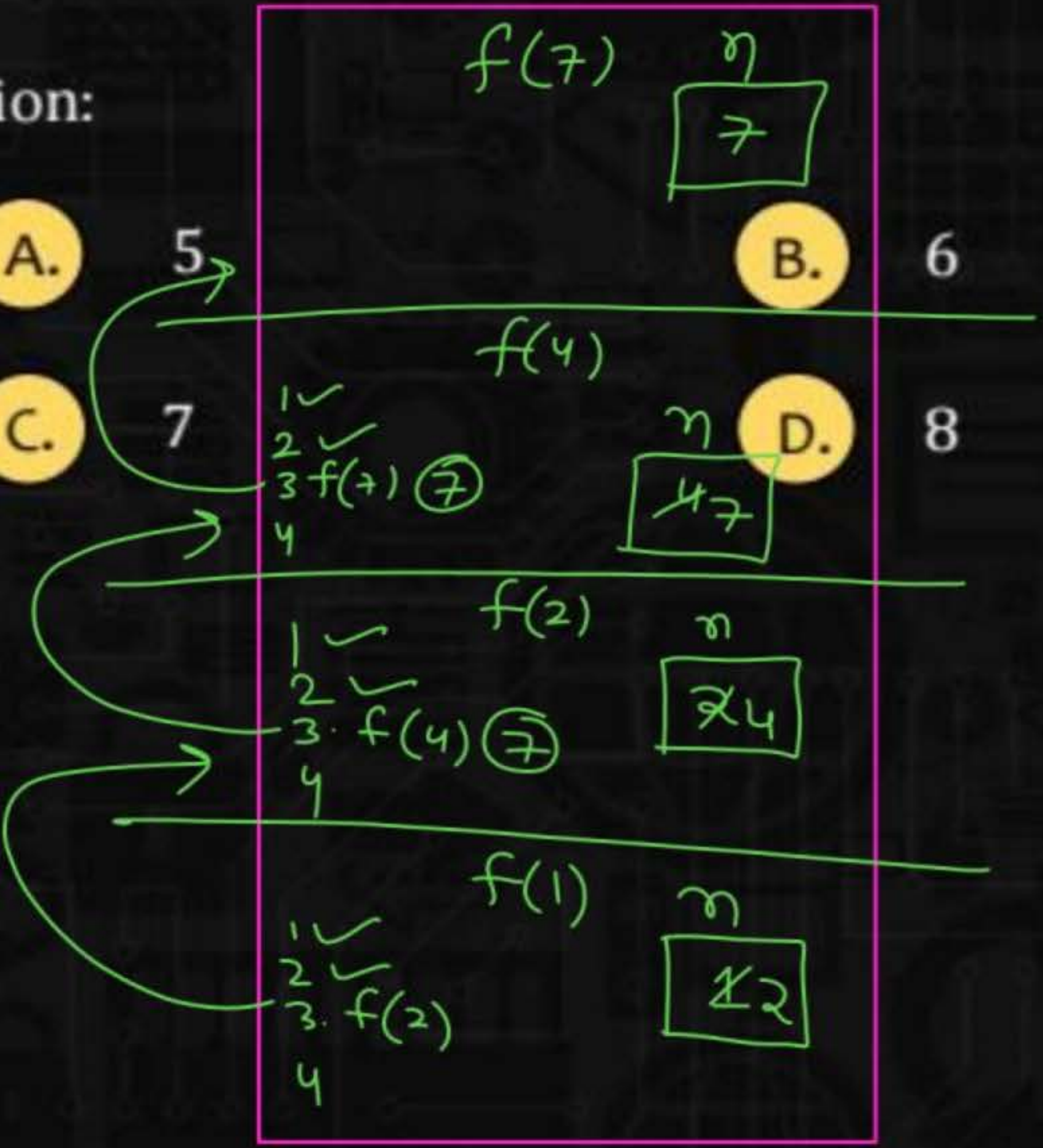
7

A. 5

B. 6

C. 7

D. 8



Q.25

Consider the following C function.

```
int fun (int n)
{
  int x=1, k;
  if (n==1) return x;
  for (k=1; k<n; ++k)
  x = x + fun(k) * fun(n – k);
  return x;
}
```

The return value of fun(5) is ________.

Respected

A. 0

B. 26

C. 51

HW

D. 71

Rec + static variable ✓

Rec + loop ✓

Q.26 Consider the following recursive C function. If get(6) function is being called in main() then how many times will the get() function be invoked before returning to the main()?

```
void get (int n)
{
  if (n < 1) return;
  get(n-1);
  get(n-3);
  printf("%d", n);
}
```

A. 15

[✓ B.] 25

C. 35

D. 45

Q.27 What will be the output of the following C program?

```
void count(int n)
{
    static int d = 1;
    printf("%d ", n);
    printf("%d ", d);
    d++;
    if(n > 1) count(n-1);
    printf("%d ", d);
}
int main()
{
    count(3);
}
```

A. 3 1 2 2 1 3 4 4 4

B. 3 1 2 1 1 1 2 2 2

C. 3 1 2 2 1 3 4

D. 3 1 2 1 1 1 2

H.W

Q.28

What will be the output of the C program?

```
#include<stdio.h>
int main()
 {
   function();
   return 0;
 }
void function()
 {
   printf("Function in C is awesome");
 }
```

A. Function in C is awesome

B. no output

C. Runtime error

D. Compilation error

Q.29 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
  main();
  return 0;
}
```

A. Runtime error

B. Compilation error

C. 0

D. None of these

THANK YOU GW SOLDIERS !