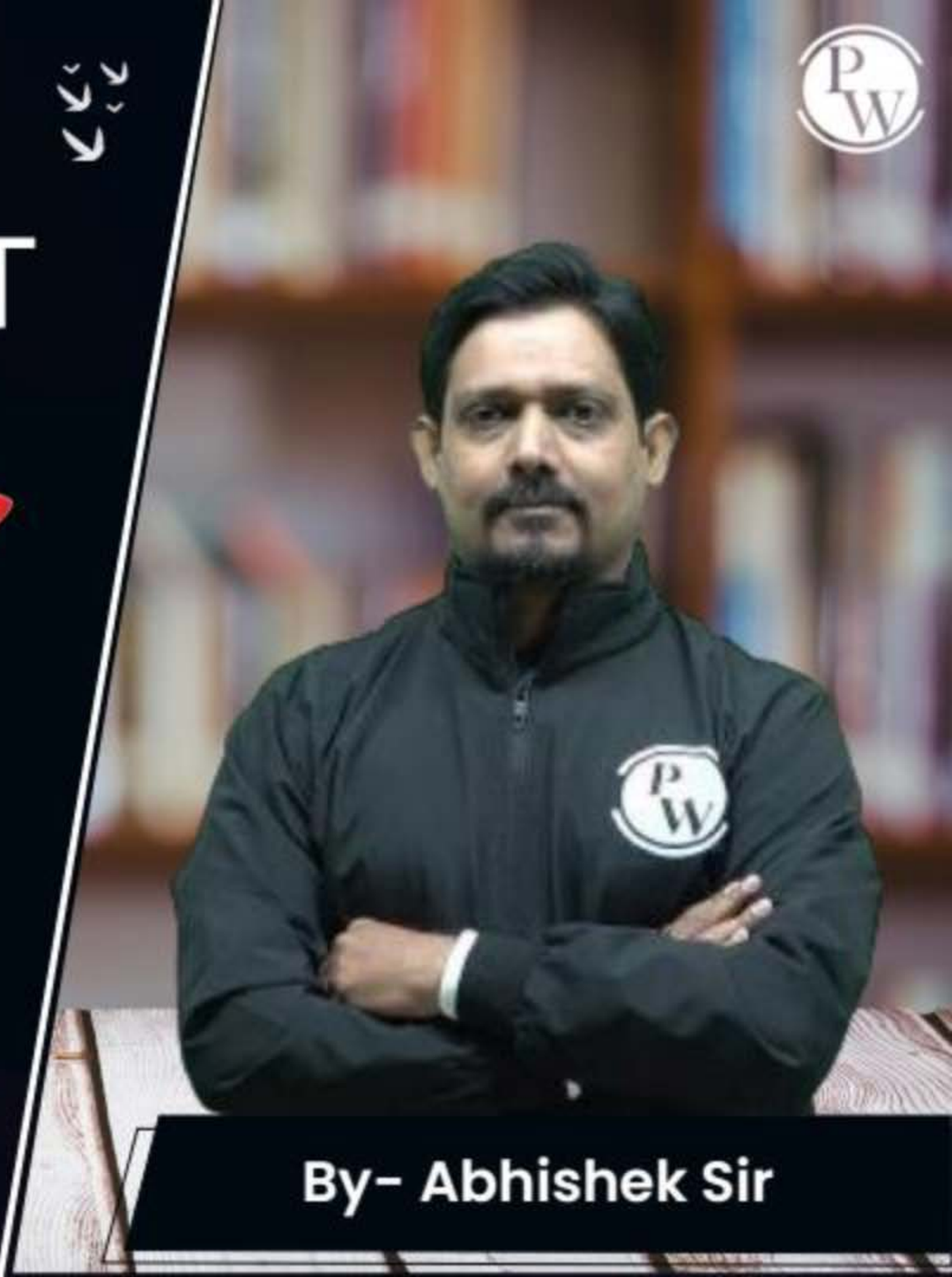
Computer Science & IT

C Programming

Control Flow Statement

Lecture No. 02



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Recap of Previous Lecture

- Topic — if else
- Topic — Switch
- Topic
- Topic
- Topic

Slide

Topics to be Covered

- Topic — for Loop
- Topic
- Topic
- Topic
- Topic

Slide

For loop: Syntax

```
for ( ①exp1 ; ②exp2 ; ③exp3 ) : {
        stmts, ④
      }
```

order of execution

① ← Initialization only one time

② ④ ③ → updation occurs after complete execution of block

② ④ ③

exp1 : initialization / function call

exp2 : Conditional expression / expression / function call

exp3 : update / Increment / Decrement / function call

Slide

For loop: Syntax

Different range of numbers

LB UB

```
for(i =1;i<=10;i++)

    printf("Name");
```

UB LB

```
for( i=10; i>=1; i--)
    printf("Name");
```

if LB <= UB i+1, i--

No of time loop runs :- UB - LB + 1

Slide

For loop: Syntax

Different range of numbers

```
for(i =11; i<=21; i++)
    printf("Name");
```

No of time printf executed:

21 - 11 + 1 = 11 times

Slide

For loop: Syntax

Different range of numbers

```
for(i =100; i>=1; i--)
    printf("Name");
```

100 - 1 + 1 = 100 times

For loop: Syntax

All Three Parts are mandatory ?

```
int i=1;
for( ; i<=10; i++)
    printf("Name");
```

No error

10 times

For loop: Syntax

All Three Parts are mandatory ?

```
int i;
for( i=1; ; i++)
    printf("Name");
```

Not an Error

If No condition is present then

equal to condition always TRUE

→ Infinite loop

Slide

For loop: Syntax

All Three Parts are mandatory ?

```
int i;
for( i=1;i<=10 ;)
     printf("Name");
```

i<=10

1<=10 TRUE

1<=10 TRUE

⋮

Infinite Loop

Slide

```
char i;
for (i=100; i; i++)
    printf("Name");
```

overflow

Not infinite

100
101
:
255

156 times

256 ← end

For loop: Syntax

All Three Parts are mandatory ?

Infinite loop

```
int i;
for( ; ;)
    printf("Name");
```

Slide

For loop

```
int i;
for( i=1;i<=10 ;i+=3)
     printf("Name");
```

$$\left\lceil \frac{10-1+1}{3} \right\rceil = \lceil \frac{10}{3} \rceil = 4$$

1 <= 10 ✓

4 <= 10 ✓

7 <= 10 ✓

10 <= 10 ✓

Slide

For loop

```
int i;
for( i=LB;i<=UB ;i+=k)
     printf("Name");
LB<=UB
```

No of iteration

$$\left\lceil \frac{UB - LB + 1}{K} \right\rceil$$

Slide

For loop

```
int i;
for( i=2;i<=n ;i*=2)
     printf("Name");
```

$\lfloor \log_2 n \rfloor$

$n - 2^6 \text{ —— } 2^7 - 1$

6

Slide

For loop

$\lfloor \log_2 n \rfloor + 1$

```
int i;
for( i=1;i<=n ;i*=2)
     printf("Name");
```

2^0

For loop

```
int i;
for( i=n;i>=2 ;i/=2)
     printf("Name");
```

$\lfloor \log_2 n \rfloor$

For loop

```
int i;
for( i=n;i>=1 ;i/=2)
     printf("Name");
```

$\lfloor \log_2 n \rfloor + 1$

```
for (i = n; i >= 3; i/=3)
    printf("Name")
```

$\lfloor \log_3 n \rfloor$

Slide

Nested For loop

```
for (i = 1;i<=n; i++)
     for(j=1;j<=n;j++)
        printf("Name");
```

No of terms

Series

$i=1 \longrightarrow j=1 \text{ to } n \longrightarrow n$

$+$

$i=2 \longrightarrow j=1 \text{ to } n \longrightarrow n$

$+$

$i=3 \longrightarrow j=1 \text{ to } n \longrightarrow n$

$+$

$\vdots$

$+$

$i=n \longrightarrow j=1 \text{ to } n \longrightarrow n$

Value of each term

No. of times Loop runs

n terms

$n+n+n+n+\cdots+n$

$n \cdot n = n^2$

Slide

Nested For loop

$n-3+1 = n-2$

```
for (i = 1;i<=n; i++)
      for(j=i;j<=n;j++)
            printf("Name");
```

$i=1 \quad j=1 \text{ to } n \quad - \quad n$

$+$

$i=2 \quad j=2 \text{ to } n \quad - \quad n-1$

$+$

$i=3 \quad j=3 \text{ to } n \quad - \quad n-2$

$+$

$\vdots$

$+$

$i=n \quad - j=n \text{ to } n \quad - \quad 1$

No of loop runs

$$1+2+3+\ldots+n$$

$$\frac{n(n+1)}{2}$$

Slide

Nested For loop

Algorithmic → Analysis

```
for (i = 1;i<=n; i++)
      for(j=1;j<=i;j++)
            printf("Name");
```

$$\sum_{i=1}^{n} \boxed{\sum_{j=1}^{i} 1}$$

$i - 1 + 1 = i$

$$\sum_{i=1}^{n} i$$

$$1 + 2 + 3 + 4 + \cdots + n = \frac{n(n+1)}{2}$$

Slide

For loop

12 23 34 45

```
#include <stdio.h>
int main(){
    int i;
    for(i=1;i<=4;printf("%d\t",i)){
        printf("%d", i);
        i++;
    }
    return 0;
}
```

i++

i=1 1<=4 1, 2

i=2 2<=4 2 3

i=3 3<=4 3 4

i=4 4<=4 4 5

Output the program is

A. 12 23 34 45

B. 11 22 33 44

C. 21 32 43 54

D. error

Slide

For loop

What is the output of the program

```
#include<stdio.h>
int main(){
    int i,sum=0;
      for (i=1; i<=200;i+=2){
            sum= sum+i;
      }
      printf("%d",sum);
      return 0 ;
}
```

(A) 100
(B) 5050
(C) 10100
(D) 10000

$\frac{n}{2}(a+l)$

$1 <= 200$ 1
$3 <= 200$ 1+3
$5 <= 200$ 1+3+5

$\frac{100}{2}[199+1]$

$\frac{100}{2} \times 200$

100 1+99×2
1+198
=199

$199 <= 200$ 1+3+5

1+3+5+ ... 199

Slide

For loop

```
#include<stdio.h>
int main(){
int i,j=1,sum=0;
      for (i=1; i<=10;i++){
            sum= sum+j*j*j;
            j=j+1;
      }
      printf("%d",sum);
      return 0 ;
}
```

(A) 3025
(B) 55
(C) 0100
(D) 10000

$$\text{Sum} = 0+1^3+2^3+3^3+\cdots+10^3 \qquad \left(\frac{n(n+1)}{2}\right)^2$$

$$\left(\frac{10\times 11}{2}\right)^2 = 55\times 55$$

$$= 3025$$

Slide

Question

Consider the following C statements

```
P:    for (i = 0; i < 8; i+ = 3) {printf ("*");}
Q:    for (i = 4; i > 0; i- = 2) {printf ("*");}
R:    for (i = 0; i <= 9; i+ = 3) {printf ("*");}
S:    for (i = 0; i < 7; i + +) {if (i%3 == 0) printf ("*");}
```

Which one of the following is a TRUE statement?

(A) P, Q, R and S give the same output

(B) P and S give the same output

(C) Q and R give the same output

(D) P, Q and S give the same output

0, 3, 6

$\lceil \frac{7-0+1}{3} \rceil = 3$

$\lceil \frac{4-1+1}{2} \rceil = 2$

$\lceil \frac{9-0+1}{3} \rceil = 4$

0, 3, 6, 9

0 %3 = 0 ✓

1

2

3 %3 = 0 ✓

4

5

6 %3 = 0 ✓

Slide

Question

$\lfloor \log_3 70 \rfloor$ $j=3; j<=70; j*=3$

Consider the following program segment

```
#include <stdio.h>
int main() {
    int i,j;
    int count=0;
    for(i =1;i<=10;i++){
        for(j=2;j<=70;j*=3){
            count++;
    }
    }
    printf("%d", count);
     return 0 ;
}
```

output of the program is

(A) 60 (B) 40 (C) 350 (D) 70

10

i=1 — 4

i=2 — 4

i=10 - 4

2<=70 —

6<=70 —

18<=70 —

54<=70 — (4)

Slide

Question

Consider the following code

```
int P = 0;
for(i= 1; i < 3n; i++) {
      for(j = 1, j<=n-3; j++){
            P = P+1;
      }
}
printf( "%d", P);
```

outer loop $(3n-1)$

$(n-3)$

$(3n-1)(n-3)$

$3n^2 - 9n - n + 3$

$3n^2 - 10n + 3$

What is the output printed by the above code in terms of n?

$(A) 3n^2 - 10n + 3$ (C) $3n^2 + 10n - 3$

(B) $3n^2 - 9n$ (D) $3n^2 + 9n$

Question

Consider the following code

```
int P = 0;
for(i= 1; i < 2n; i++) {
        for(j = 1, j<=n; j++){
                if(j < i) P = P+1;
        }
}
printf( "%d", P);
```

What is the output printed by the above code in terms of n?

(A) $\frac{4n^2 - n}{2}$

(C) $\frac{n^2 - 4n}{2}$

(B) $\frac{3n^2 - 3n}{2}$

(D) $\frac{n^2 - 3n}{2}$

$1+2+3+\cdots(n-1)$

$\frac{n(n-1)}{2}$

$\frac{n(n-1)}{2} + n(n-1)$

$3n^2 - 3n/2$

i=1 j=1 to n — 0

i=2 j=1 to n — 1 j=1<i

i=3 j=1 to n — 2 j=1,2<i

:

i=n j=1 to n n-1 j=1,2 ..n-1<i

i=n+1 j=1 to n n

i=n+2 j=1 to n n

:

i=2n-1 j=1 to n n

$n(n-1)$

Question

$2^{64}-1$ ← Max

30% Maths + Aptitude + ...

Consider the following C code. Assume that unsigned long int type length is 64 bits.

```
unsigned long int fun(unsigned long int n){
unsigned long int i,   j = 0,   sum = 0;
for    (i = n;   i > 1;    i = i/2)
      j++;
for{ ;    j > 1;    j = j/2)
          sum++;
return(sum);
}
```

i >= 2

j >= 2

$j = \lfloor \log_2 2^{40} \rfloor =$

$j = 40$

$\lfloor \log_2 40 \rfloor = [5]$

The value returned when we call fun with the input 2^{40} is

(A) 4 (B) 5 (C) 6 (D) 40

Slide

X ← dividend

Y ← divisor

7 ← Remainder

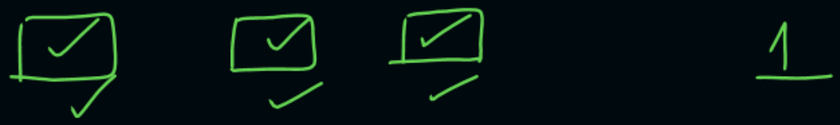
3

r = X

7 - 3 = 4 ✓ r >= Y

4 - 3 = 1 r

1 >= 3



1

2 mins Summary

Topic

for Loop

Topic

for (i=LB; i<=UB; i+=k)

$$\left\lceil \frac{UB-LB+1}{k} \right\rceil$$

Topic

for (i=2; i<=n; i*=2)

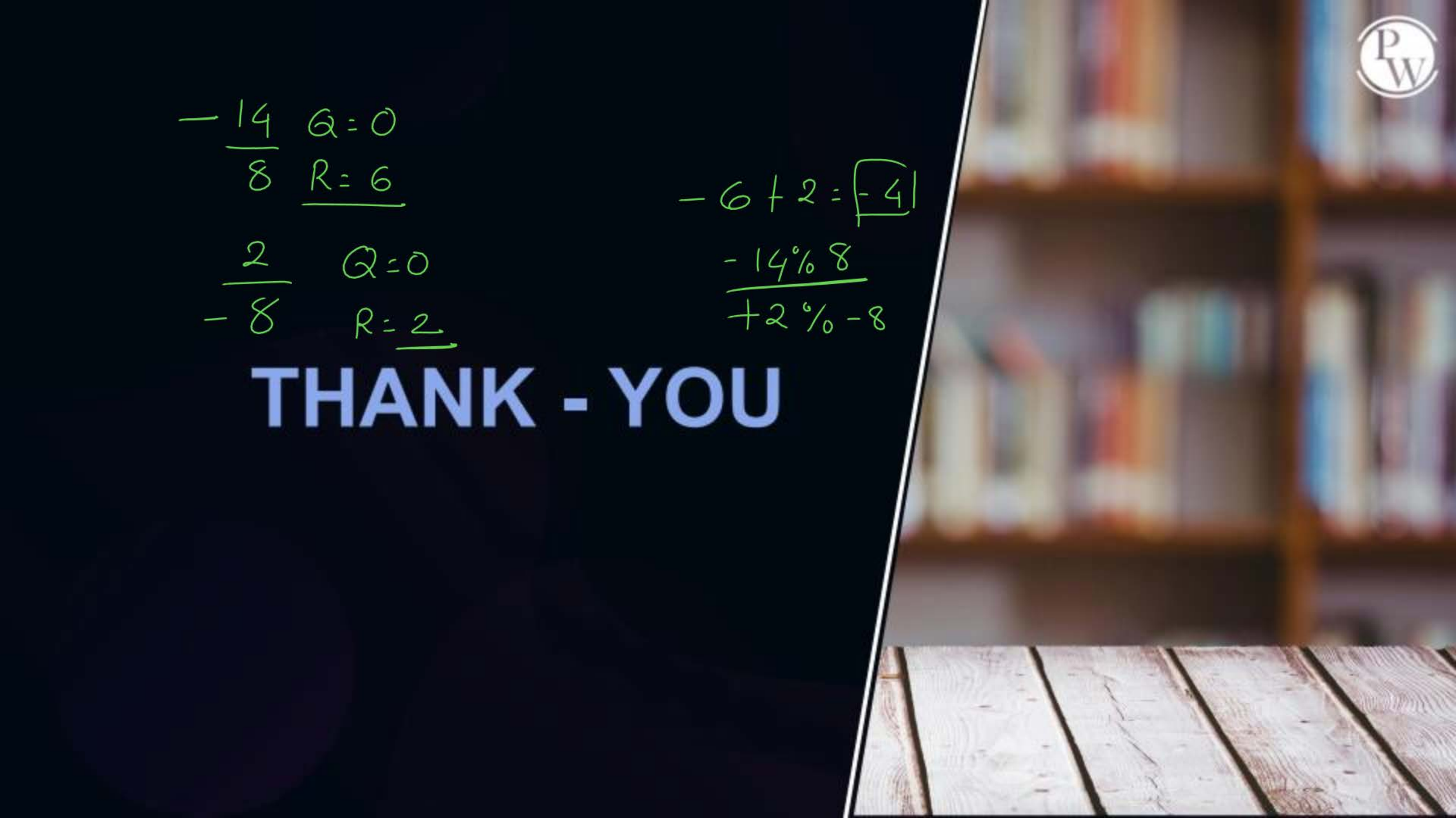
Topic

for (i=n ; i>=2; i/=2)

$$\lfloor \log_2 n \rfloor$$

Topic

Slide


-14 Q=0
8 R=6
2 Q=0
-8 R=2
-6+2=-4
-14%8
+2%-8
THANK - YOU