Computer Science & IT

C programming

Control Flow Statement

Lecture No. 04

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Recap of Previous Lecture

Topic — Switch

Topic — for loop

Topic — Infinite loop / char

Topic

Topic

Slide

Topics to be Covered

Topic — for Loop   Mathematical way (Nested for loop)
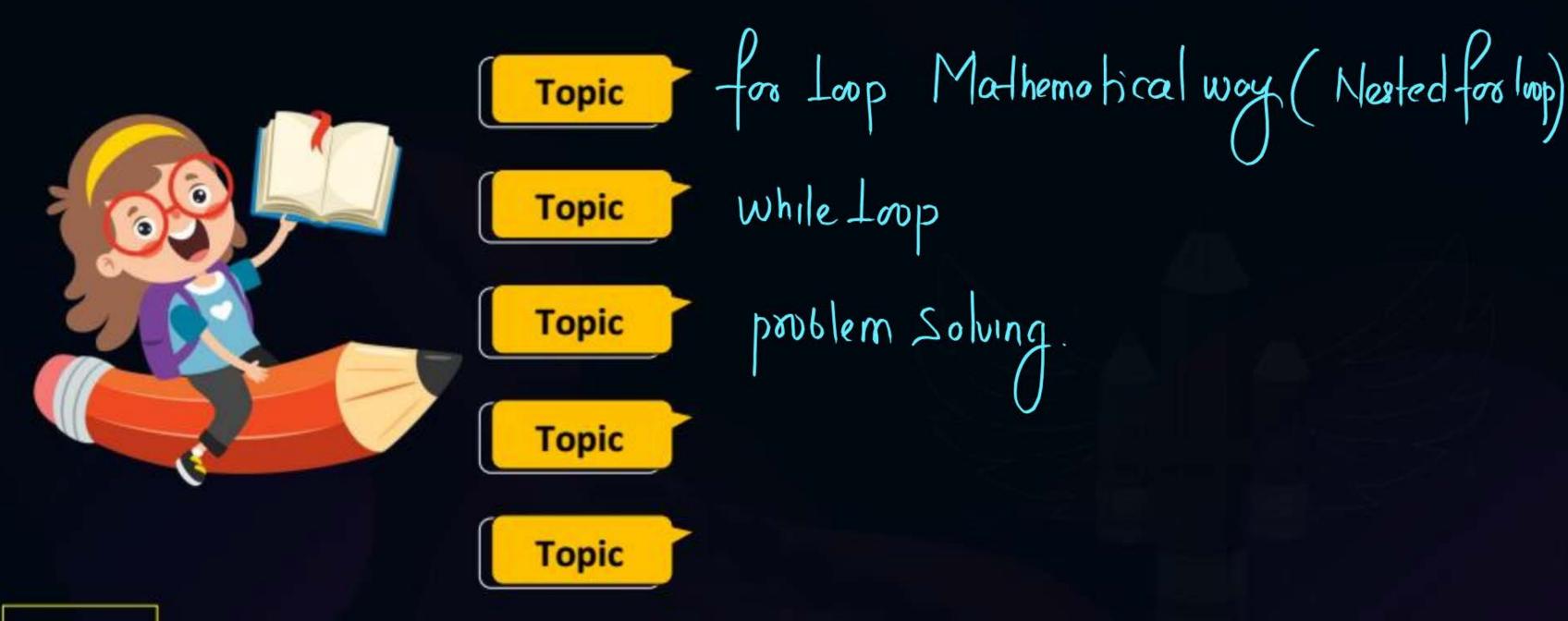
Topic — while Loop

Topic — problem Solving.

Topic

Topic

For loop

- Decrement loop
- Other than ++ (i+2) formula
- Multiplication
- Nested for loop
- While loop
  - Flow chart
  - For loop equivalent to while loop

-

(1) int i;

$$\text{for } (i = \underline{10}; \ i >= \underline{1}; \ i--)$$

UB

stmt

LB

$10 - 1 + 1 = \underline{10}$

$i = 10 \qquad 10 >= 1$

$\longrightarrow UB - LB + 1$

Decrement for loop

For loop

int i;

for (i=1 ; i<=4 ; printf("%d", i)) {

③

① — printf("%d", i); ←

② i++;

}

| 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |

i=1
1<=4
i=2

i=2
2<=4
i=3

i=3
3<=4
i=4

i=4
4<=4
i=5

i=5
5<=4

```
int i;
for (i=1; i<=10; i=i+2)
    stmt;
```

Even No

Expression ①
function call

```
int i;
for (i=1; i<=16; i=i+2)
    stmt;
```

①	i=1	i<=10	i=i+2 1+2
②	i=3	3<=10	i=5
③	i=5	5<=10	i=7
④	i=7	7<=10	i=9
⑤	i=9	9<=10	i=11
	i=11	11<=10	loop terminate

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int i;

for (i = 1; i <= 10; i = i+2)$^{\text{K}}$ $\underline{1}$

     stmt;

int i;

for (i = 1; i <= 16; i = i+2)

     stmt;

①	i = 1	1 <= 16
②	i = 3	3 <= 16
③	i = 5	5 <= 16
④	i = 7	7 <= 16
⑤	i = 9	9 <= 16
⑥	i = 11	11 <= 16
⑦	i = 13	13 <= 16
⑧	i = 15	15 <= 16

i = 3 (next to row ①)

i = 17   17 <= 16 Terminate

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int i

for $(i=1; i<=n; i=i+2)$ → n is Even No

$\quad$ stmt;

No. of times loop execute

$\dfrac{n}{2}$ times

$$\text{int } i;$$

$$\text{for } (i=1; i<=n; i=i+2)$$

$$\text{stmt};$$

n is odd

$\left\lceil \dfrac{n}{2} \right\rceil$ Ceiling function

floor function

$$\left\lceil \frac{5}{2} \right\rceil = \left\lceil 2.5 \right\rceil = 3$$

$$\left\lceil \frac{7}{2} \right\rceil = \left\lceil 3.5 \right\rceil = 4$$

Next greater integer value

No. of times loop execute $\left\lceil \dfrac{n}{2} \right\rceil$

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$$\text{for} \ (i=1; \ i<=n; \ i=i+2) \ = \ \left\lceil \frac{n}{2} \right\rceil$$
$$\text{stmt;}$$

Even or
__odd__

The number of times loop executed is

```c
#include<stdio.h>
int main(){
    int i,count=0;
    for (i=1; i<=100; ){
        printf("\nI am a good Student");
        i = i+3;
    }
    return 0 ;
}
```

(A) 33
(B) 34
(C) 100
(D) 10

$$\frac{8}{3} = \frac{\text{①}}{\text{④}}$$

$$8/3 = 2 \quad \text{⑦}$$

$$1 < = 100$$
$$4 < = 100$$
$$7 < = 100$$
$$\vdots$$
$$99 < = 100$$

$$\left\lceil \frac{100}{3} \right\rceil = \lceil 33.3 \rceil = \text{34}$$

$$\frac{16}{3} \qquad 5.\overline{3} \ldots$$

$\iota = 1$ ✓

$\iota = 4$ ✓

$\iota = 7$ ✓

$\iota = \underline{10}$ ✓

$\iota = 13$ ✓

$\iota = 16$ ✓

For loop

Nested for loop

```
int i, j;
for (i=1; i<=3; i++) {     Control goes to outer loop

    for(j=1; j<=3; j++) {

        stmt;
    }
}
```

total
9 times
= 3^2 = 9

i = 1	J = 1	stmt	
	J = 2,	stmt	
	J = 3,	stmt	4<=3 Inner loop break
i = 2	J = 1	stmt	
	J = 2	stmt	
	J = 3	stmt	4<=3 Inner break
i = 3	J = 1	stmt	
	J = 2	stmt	
	J = 3	stmt	4<=3 Inner loop break
i = 4		outer loop breaks	

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int c, j;

for $(i=1; i<=n; i++)$ {

  for $(j=1, j<=m; j++)$ {

   stmt;

  }

}

Total
No. of
times
loop execute
$= n \times m$

$i=1$ —— $j=1$
$j=2$
$j=m$

$i=2$ $j=1$
$j=2$
$j=m$

$i=3,$ $j=1$
$j=2$
$j=m$

$i=n$ $j=1, j=2, j=m$

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```
#      int i, j
       for (i=1; i<=10; i++) {
             for (j=1; j<=i; j++) {
                  stmt;
             }
       }
```

No. of times loop execute or
stmt execute?

_____

$$1 + 2 + 31 \cdots + n = \frac{n(n+1)}{2}$$

$$\frac{1 + 2 + 31 \cdots + 10}{} = \frac{10 \times 11}{2} \boxed{55}$$

\# int c, j

for $(i = 1; i <= 10; i++)\ \{$

    for $(j = 1; j <= i; j++)\ \{$

        stmt;

    $\}$

$\}$

$i = 1$	$J = 1$	① time
$i = 2$	$J = 1, J = 2$	② time
$i = 3$	$J = 1, J = 2, J = 3$	③ times
$i = 4$	$J = 1, J = 2\ J = 3$	④ times
$\vdots$		
$i = 10$	$J = 1, J = 2. - J = 10$	⑩ times

While loop

while (Condition) {

}

Expected Relation Expression

Any Expression evaluate to $\dfrac{\text{Non Zero}}{\text{or}}$ True

Zero - false

If condition is true

then while block will

execute.

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While loop

stmt

while ( )

false

-true

stmt₁
stmt₂
⋮

* No. of times loop execution depends upon condition then, while loop is used.

goes out of loop

* if size / No. of iteration is known in Advance then for loop is used

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While loop

```
int i;
for (i=1; i<=100; i++) {
    stmt;
}
```

While loop equivalent
for loop.

```
int i;
i=1;
while (i<=100) {
    stmt;
    i++;
}
```

Slide

\#   No. of times printf statement executed is <u>4</u>

\# include < stdio.h >

int main() {

    int $i = 2$

    while ($i <= 27$) {

      printf ("I am a good student");

      $i = i * 2;$

    }

}

$i = 2$ | $2 <= 27$ — ①

$i = 4$ | $4 <= 27$ — ②

$i = 8$ | $8 <= 27$ — ③

$i = 16$ | $16 <= 27$ — ④

$i = 32$ | $32 <= 27$ — Condition <u>false</u>

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While loop

No. of times printf statement executed is

       # include <stdio.h>

(A) 4   (C) 6

$6 < 10$ ① int main() {

          $2 + 4 + 0 = 6$

(B) 5   (D) 7

$7 < 10$ ② int $i = \underline{2} + \underline{4\%6} + \underline{9/10}$;

$8 < 10$ ③   while $(i < 10)$ {

$9 < 10$ ④   printf ("I am a bad Teacher");

$10 < 10$ <u>false</u>   i++; }

      return 0;

    }

Slide

For loop

What is the output of the program

```c
#include<stdio.h>
int main(){
    int i,sum=0;
    for (i=1; i<=100;i++){
        sum= sum+i;
    }
    printf("%d",sum);
    return 0 ;
}
```

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

$i=1$ Sum $= 1$

$i=2$ Sum $= 1+2$

$i=3$ Sum $= 1+2+3$

$i=4$ Sum $= 1+2+3+4$

$\vdots$

$i=100$ Sum $= 1+2+3+4+\cdots+100$

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

$$= \frac{100 \times 101}{2} = 50 \times 101 = \boxed{5050}$$

Success

Slide

Consider the following C program:

```c
#include <stdio.h>
int main(){
    int a = 6;
    int b = 0;
    while(a < 10) {
        a = a / 12 + 1;
        a += b;
    }
    printf("%d", a);
    return 0;
}
```

$(6 < 10)$

$(1 < 10)$
$a = 1/12 + 1 = (1)$
$a = 1 \quad (a = a + 0)$

$\dfrac{(1 < 10)}{}$

Which one of the following statements is CORRECT?

(A) The program prints 9 as output
(B) The program prints 10 as output
(C) The program gets stuck in an infinite loop
(D) The program prints 6 as output

$a = 6/12 + 1$
$= 0 + 1$
$a = 1$
$a = a + b \quad 1 + 0 = (1)$

```
int i;
for ( i=2; i<=n; i=i*2)
        stmt;
```

formula

No. of times
for loop execute
for any value <u>n</u>

Topic — for Loop, Nested

Topic — while Loop

Topic — practice

Topic

Topic

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