CS & IT ENGINEERING

Programming in C

Control Flow Statements

Lec- 03

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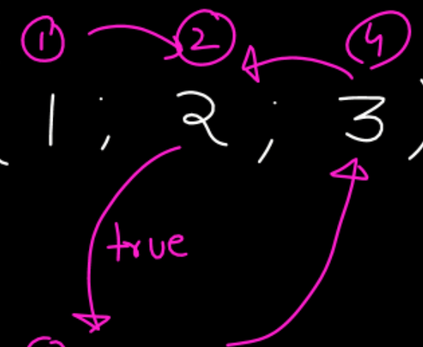
Iterative Statements-II

1.

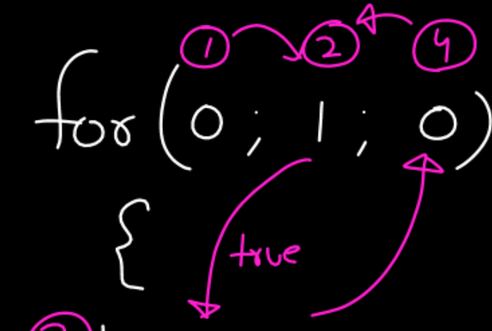
```
for( 1 ; 2 ; 3 )
{
    printf("Hello");
}
```



∞ times

2.

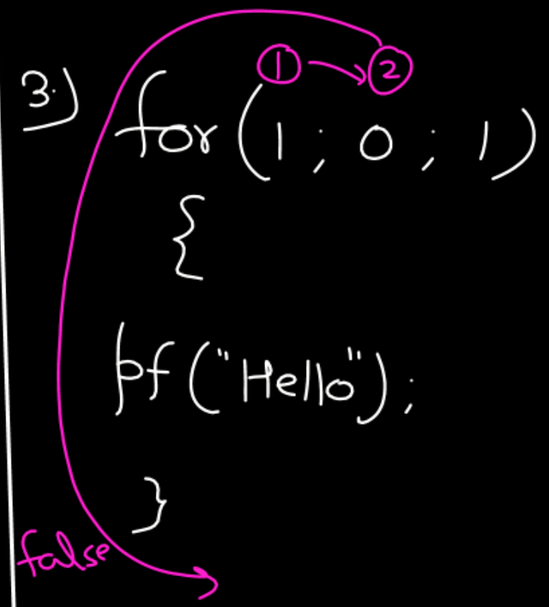
```
for( 0 ; 1 ; 0 )
{
    printf("Hello");
}
```



∞ times

3.

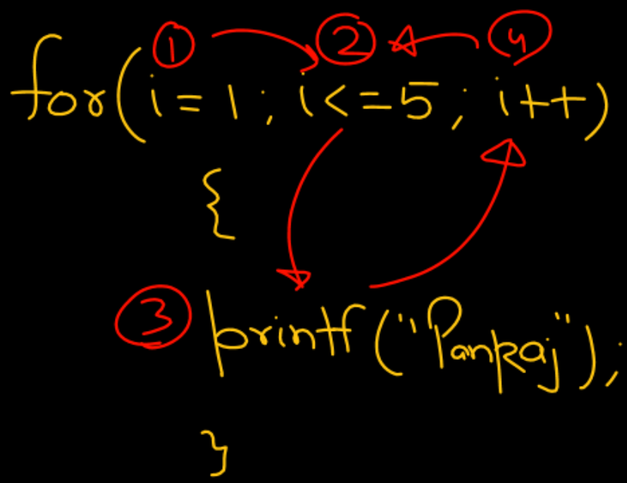
```
for( 1 ; 0 ; 1 )
{
    pf("Hello");
}
```



0 times

* All 3 expressions are optional.

1:

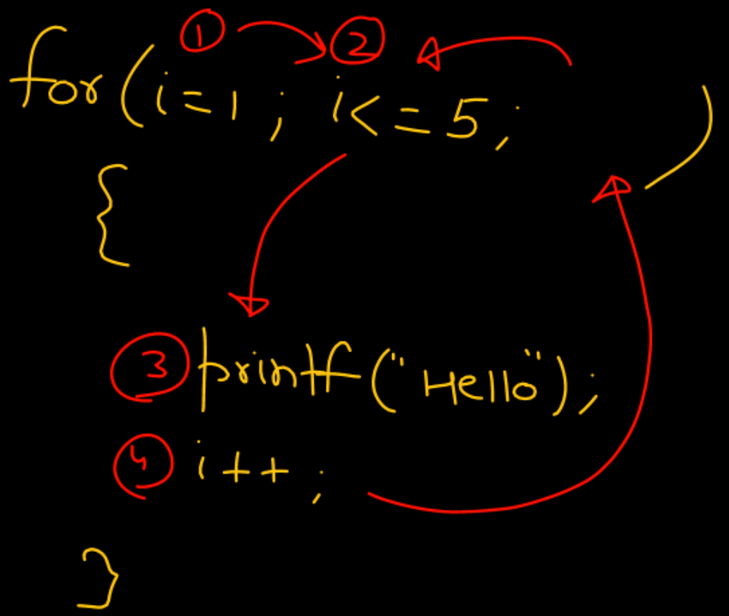


```
int i
i=1
for(   ; i<=5; i++)
{
printf("Hello");
}
```

o/p : 12345

```
for(i=1; i<=5 ; i++)
    {

    printf("Hello");
    }
```



by default
Exp2 ⇒ non-zero (true)

```
for(  ;  ;  )
{
    pf("Hello");
}
```

∞ loop

mandatory

```
for(  ;  )
{
    ≡
}
```

```
for (Exp1/e ; Exp2/e ; Exp3/e)
{

    code

}
```

i 1X3456

1.

```
int i=1;
for( ; ++i<6; )
{
printf("%d", i);
}
```

i	++i<6	pf
1	2<6 → true	2
2	3<6 → true	3
3	4<6 → true	4
4	5<6 → true	5
5	6<6 → false	X

o/p 1 2 3 4 ~~5~~ ~~6~~

2.

```
i=1
for(      ; i++<6;    )
{
printf("%d",i);
}
```

i	i<6, i=i+1	bf
1	1<6 true ✓	2
2	2<6 true ✓	3
3	3<6 true ✓	4
4	4<6 true ✓	5
5	5<6 true ✓	6
6	6<6 false	

o/p 1 2 3 4 5 6

2/ i = 1

```
for(      , i++< 6 ,    )
{
printf("%d", i);
}
bf("%d", i);
```

⇒ 7

i 6 7

i++ < 6

6 < 6 ✗

i	i < 6 , i = i+1	bf
1	1<6 true ✓	2
2	2<6 true ✓	3
3	3<6 true ✓	4
4	4<6 true ✓	5
5	5<6 true ✓	6
6	6<6 false	

2.

```
for(i=1; i<=10; i++)
    {
     printf("Pankaj");
    }
```

i = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

10 times

100 to 200 (including both)

last - first + 1

200 - 100 + 1

⇒ 101

n?0

3.

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

     printf("Pankaj");

    }
```

n times

n>0

4.

```
for(i=1; i<=n; i=i+2)
{
    pf("Pankaj");
}
```

2n

↓

mentos

```
for(i=1; i<=100; i=i+1)
{
    pf("Hello");
}
```

i = 1, ~~2~~, 3, ~~4~~, 5, ~~X~~ = 98, 99, 100

$n > 0$

4.

```
for(i=1; i<=n; i=i+2)
{
    pf("Pankaj");
}
```

$n/2$ $\quad n = 11 \quad 11/2 = 5$

$i = 1, 3, 5, 7, 9, 11 \Rightarrow 6$

$n = 10$

$i = 1, 3, 5, 7, 9$ ~~X~~

$n = 10 \quad \left\lceil \frac{n}{2} \right\rceil = \left\lceil \frac{10}{2} \right\rceil = \lceil 5 \rceil$

$\frac{n}{2}$

$$\left\lceil \frac{n}{2} \right\rceil$$

$n > 0$

5)

```
for(i=1; i<=n; i=i*2)
{
    printf("Pankaj");
}
```

$n = 128$

```
for(i=1; i<=128; i=i*2)
{
    pf("Pankaj");
}
```

i = 1, 2, 4, 8, 16, 32, 64, 128

8 values

2^n Mentos

$n = 100$

```
for(i=1; i<=100; i=i*2)
{
    pf("Pankaj");
}
```

i = 1, 2, 4, 8, 16, 32, 64, ~~128~~

7 times

$n > 0$

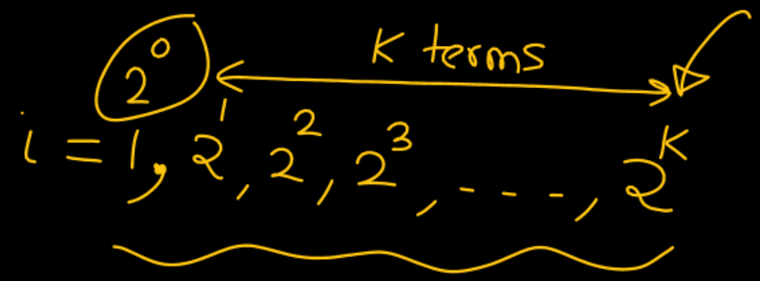
Maths

5)

```
for( i = 1; i <= n; i = i x 2)
    {

    printf("Pankaj");

}
```



K+1 times

$\left(\lfloor \log_2 n \rfloor + 1 \right)$ times

$2^K <= n$

$\log 2^K <= \log n \Rightarrow K <= \log_2 n$

$K \log 2 <= \log n$

$K <= \frac{\log n}{\log 2}$

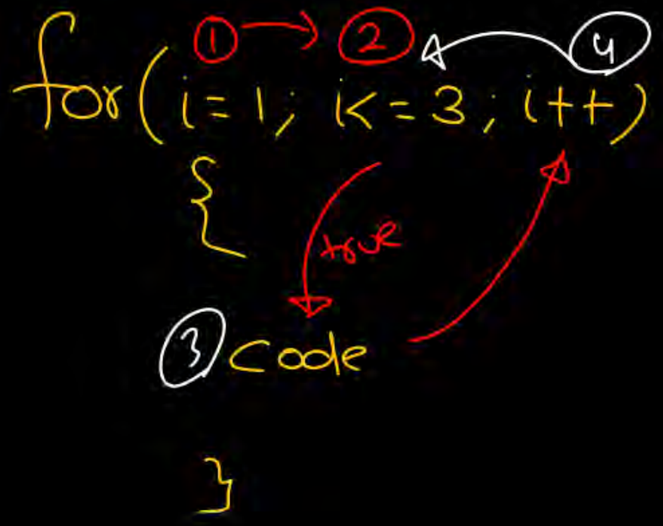
$\lfloor \log_2 n \rfloor$

6. `for(i=1; i<=n; i=i*3)`

```
{
    pf("Pankaj");
}
```

$\left(\lfloor \log_3 n \rfloor + 1 \right)$ times

Q)



$i=1 \rightarrow 1<=3 \xrightarrow{true}$ Code will execute

$i=2 \rightarrow 2<=3 \xrightarrow{true}$ Code will execute

$i=3 \rightarrow 3<=3 \xrightarrow{true}$ Code will execute

$i=4 \rightarrow 4<=3 \xrightarrow{false}$ ✗

$i = 1, 2, 3$

Q.

```
for(i=1;i<=10;i++)
  {
  code
  }
```

i = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ⇒ code ↵

10 times

Q

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

code

}
```

what can be ?

```
for(j=1;j<=4;j++)
    {
      printf("Pankaj");
    }
```

O/P : 4 times ⇒ Pankaj

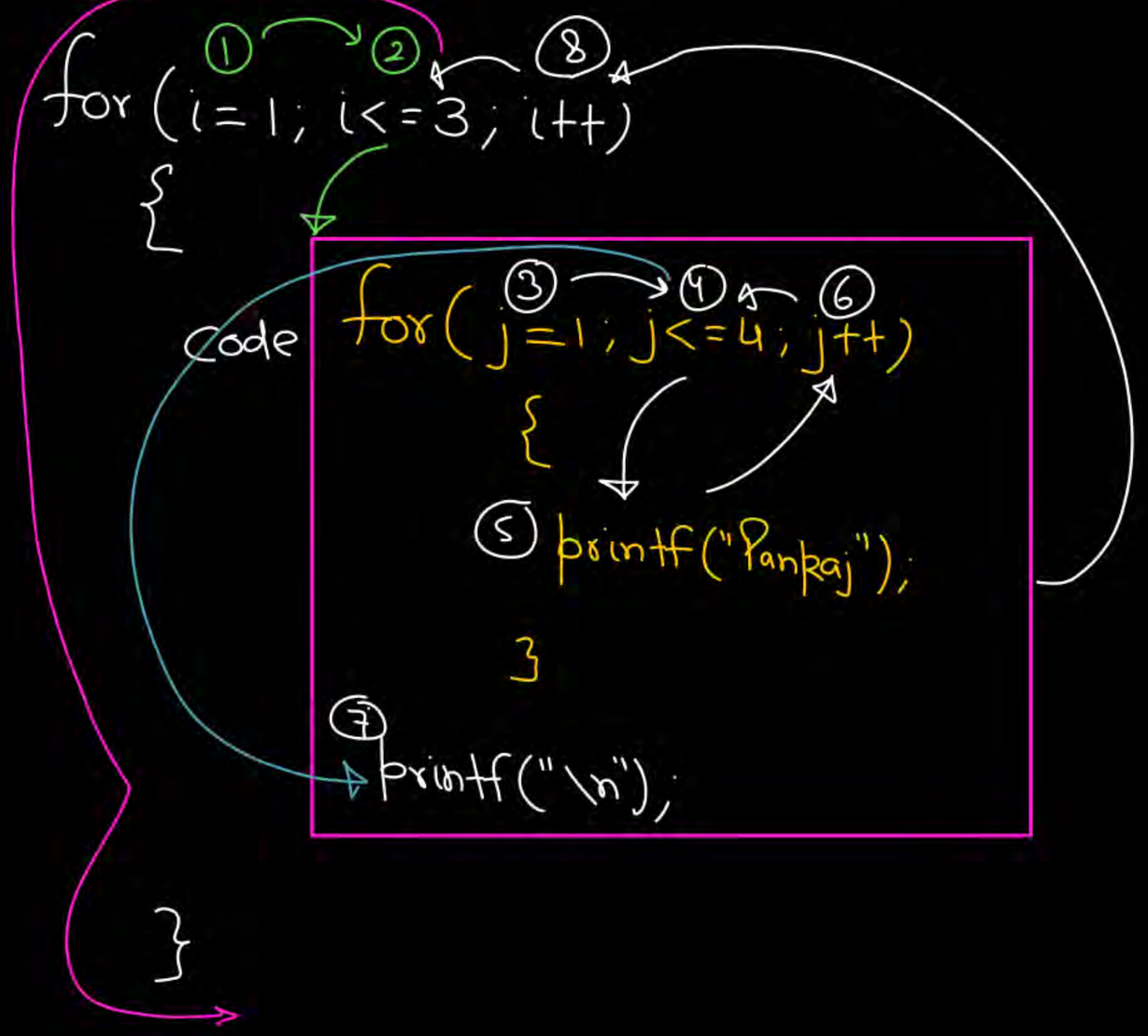
```
for(j=1;j<=4;j++)
    {
      printf("Pankaj");
    }
```

```
for(i=1; i<=3; i++)
    {
        Code
    }
```

i=1 Code will exe ✓

i=2 code will exe ✓

i=3 Code will exe ✓



Pankaj Pankaj Pankaj Pankaj
Pankaj P- - - - - -
Pa- - - - - -

i	
1	$1<=3$ ✓ → Code
2	$2<=3$ ✓ → code
3	$3<=3$ ✓ → code
4	$4<=3$ ✗

1 → loop

j	
1	$1<=4$ ✓ → Pankaj
2	$2<=4$ ✓ → Pankaj
3	$3<=4$ ✓ → Pankaj
4	$4<=4$ ✓ → Pankaj
5	$5<=4$ ✗

1 → Newline

2 → loop

j	
1	$1<=4$ ✓ → Pankaj
2	$2<=4$ ✓ → Pankaj
3	$3<=4$ ✓ → Pankaj
4	$4<=4$ ✓ → Pankaj
5	$5<=4$ ✗

2 → Newline

j=1,2,3,4 → Pankaj
Newline

1.

```
for(i=1; i<=3; i++)        // ① ②
{
    for(j=1; j<=4; j++)
    {
        printf("%d %d ", i, j);
    }
    printf("\n");
}
```

i	1 1 1 2 1 3 1 4
1	1<=3 ✓ → j = 1, 2, 3, 4 → Newline
2	2<=3 → ① loop j = 1, 2, 3, 4 ② Newline
3	3<=3 → ① loop j = 1, 2, 3, 4
4	4<=3 ✗

1 1 1 2 1 3 1 4
2 1 2 2 2 3 2 4
3 1 3 2 3 3 3 4

```
for (i=1; i<=3; i++)
  {
    code  for( j=1; j<=4; j++)
            {
            printf("Pankaj");
            }
  }
```

It print Pankaj 4 times

i	
1	$1<=3$ ✓ → Code ✓ ⇒ 4 times
2	$2<=3$ ✓ → Code ✓ ⇒ 4 times
3	$3<=3$ ✓ → code ✓ ⇒ 4 times
4	$4<=3$ ✗

3

$4+4+4$
$= 3 \times 4$

$i=1 \Rightarrow$ 4 times
$i=2 \Rightarrow$ 4 times
$i=3 \Rightarrow$ 4 times

} for each value of i ⇒ 4 times

```
for(i=1;i<=3;i++)
    {

        for(j=1;j<=10;j++)
            {
            pf("Pankaj");
            }

    }
```

i=1 ⟹ 10 times

i=2 ⟹ 10 times

i=3 ⟹ 10 times

10 + 10 + 10

= 3 × 10

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

        for(j=1; j<=10; j++)
            {
            pf("Pankaj");
            }

    }
```

$i=1 \longrightarrow$ 10 times

$i=2 \longrightarrow$ 10 times

$i=3 \longrightarrow$ 10 times

⋮

$i=n \longrightarrow$ 10 times

$10+10+10+\cdots$ n times

$= 10 \times n$

```
for(i=1; i<=n; i++)
    {
        for(j=1; j<=n; j++)
            {
            pf("Pankaj");
            }
    }
```

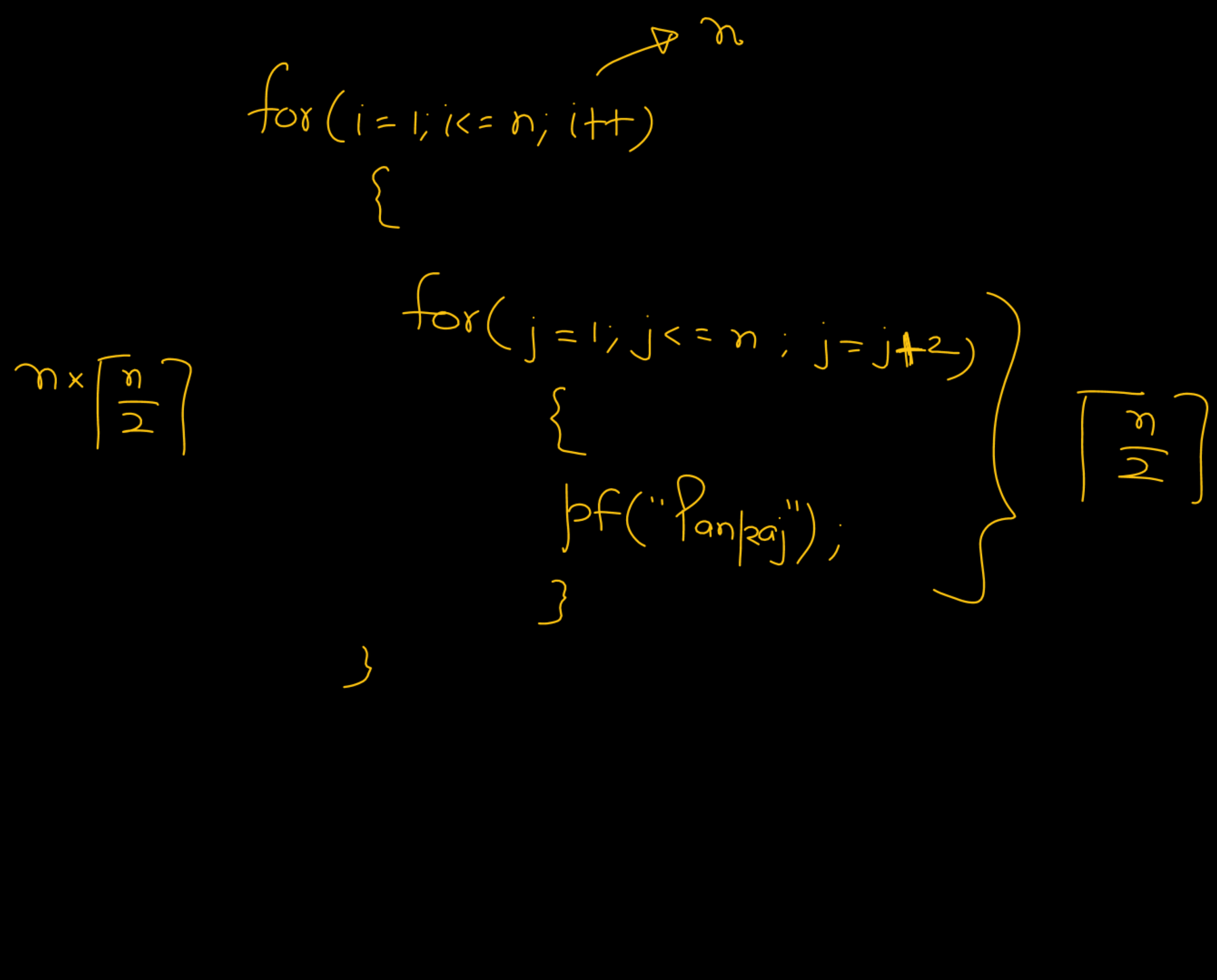
n times

n times

$= n \times n = n^2$ times

```
for(i=1; i<=n; i++)          → n
{
    for(j=1; j<=n; j=j*2)    ⟹ (⌊log2 n⌋ + 1)
    {
        pf("Pankaj");
    }
}
```

$n(1+\lfloor \log_2 n \rfloor)$


n
for(i=1; i<=n; i++)
{
for(j=1; j<=n ; j=j+2)
{
pf("Pankaj");
}
}
n × ⌈n/2⌉
⌈n/2⌉

```
for(i=1; i<=n; i=i*2)
{
    for(j=1; j<=n; j=j*2)
    {
        pf("Pankaj");
    }
}
```

$1 + \lfloor \log_2 n \rfloor$

$1 + \lfloor \log_2 n \rfloor$

Independent nested loop

$(1 + \lfloor \log_2 n \rfloor)^2$

```
for( i=1; i<=4 ; i++)
    {
        for( j=1; j<=i ; j++)
            {
              pf("Pankaj");
            }
    }
```

Analysis → Loop unfolding

i	j
1	1 to 1 → ①
2	1 to 2 → ② 1,2
3	1 to 3 → ③ 1,2,3
4	1 to 4 → ④

1+2+3+4

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

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

        bf("Pankaj");
        }

  }
```

i=1	i=2	i=3	. . .	i=n
j=1	j=1,2	j=1,2,3		j=1,2,3,---n
①	② times	③ times		↓ (n) times

$1+2+3+\cdots+n$

$= n(n+1)/2$ times

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

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

        pf("Pankaj");
        }

  }
```

i=1

```
for(j=1; j<=1; j++)
  {
  pf("Pankaj");
  }
```

1

i=2

```
for(j=1; j<=2; j++)
  {
  pf("Pankaj");
  }
```

2

i=3

```
for(j=1; j<=3; j++)
        {
        pf("Pankaj");
        }
```

3

i=1	i=2	i=3	...	i=n
j= 1 to 3	j= 2 to 6	j= 3 to 9		j= n to 3n
3-1+1	6-2+1	9-3+1		3n-n+1
③ times	⑤ times	⑦ times		(2n+1) times

$$[3+5+7+\cdots+(2n+1)]$$

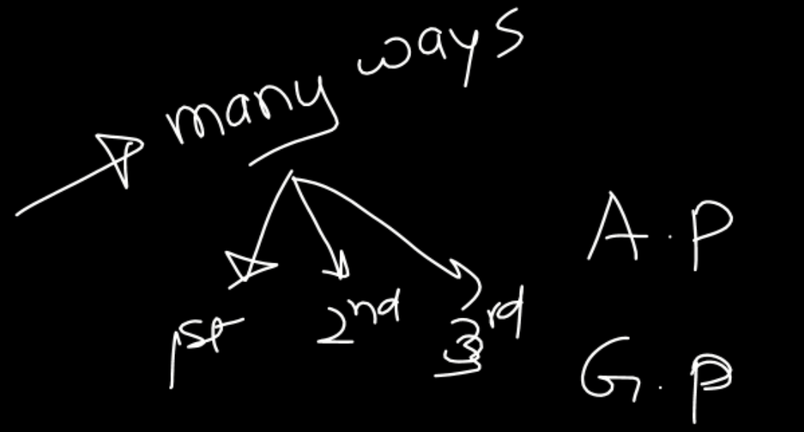
```
for(i=1; i<=n; i++)
    {
      for(j=i; j<=3*i; j++)
          {
          pf("Pankaj");
          }
    }
```

No. of terms = n

AP

$$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$$

$$= \frac{n}{2}\left[f + l\right]$$



Purpose ↓

$$3 + 5 + 7 + \cdots + (2n+1)$$

$$\Rightarrow \frac{n}{2}\left[3 + (2n+1)\right]$$

$$= \frac{n}{2}\left[2n+4\right] = \frac{n}{2}\left[2(n+2)\right] = n(n+2)$$

$$3+5+7+\cdots+2n+1$$

$$(2\cdot1+1)+(2\cdot2+1)+(2\cdot3+1)+\cdots+(2\cdot n+1)$$

$$(2\cdot1+2\cdot2+2\cdot3+\cdots 2\cdot n)+(1+1+\cdots\cdots 1)$$

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

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

$$= n^2+n+n$$

$$= n^2+2n = n(n+2)$$

$$S = 3 + 5 + 7 + \cdots + 2n + 1$$


THANK YOU GW
SOLDIERS !