CS & IT ENGINEERING

Programming in C

Control Flow Statements
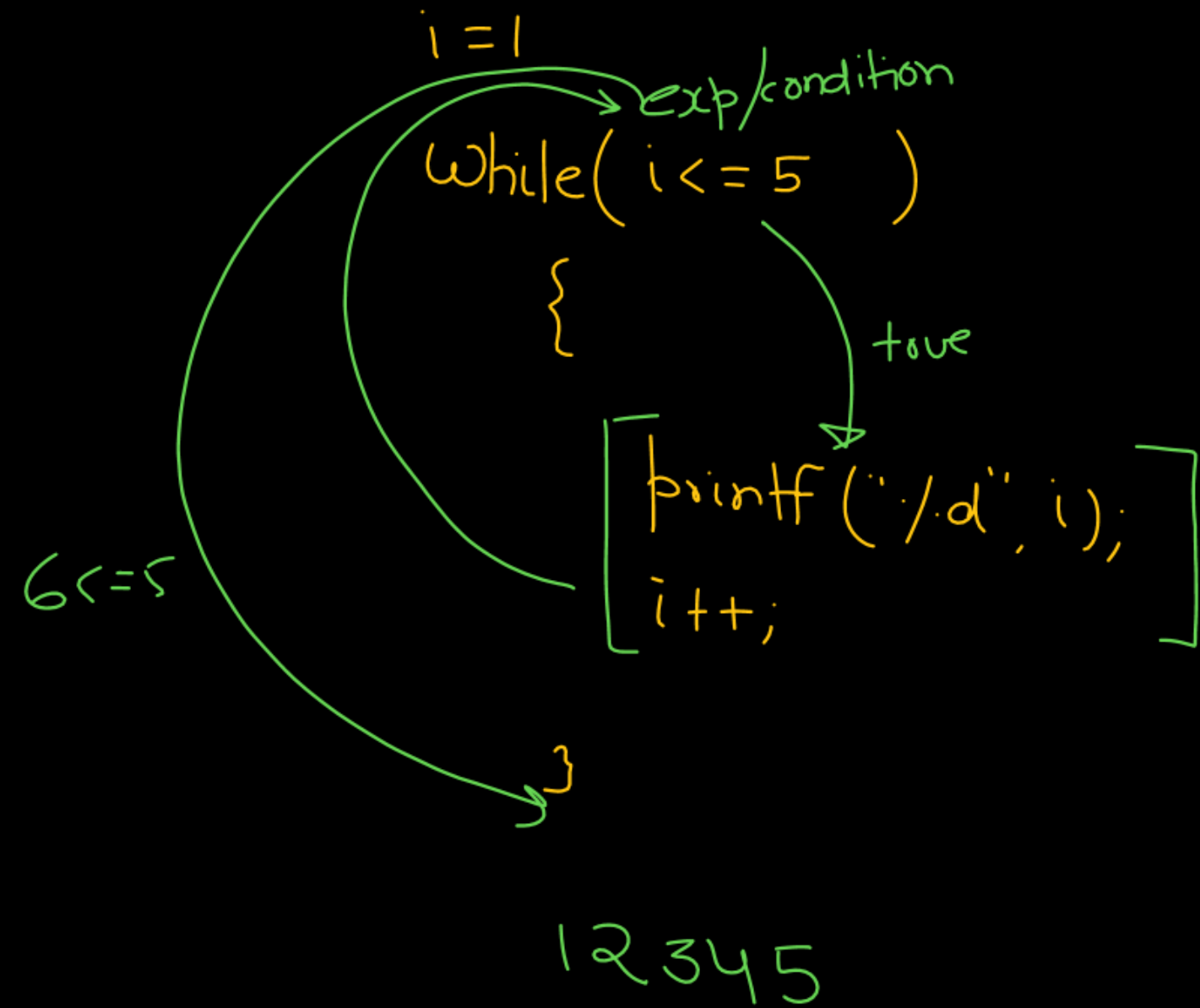
Lec - 04

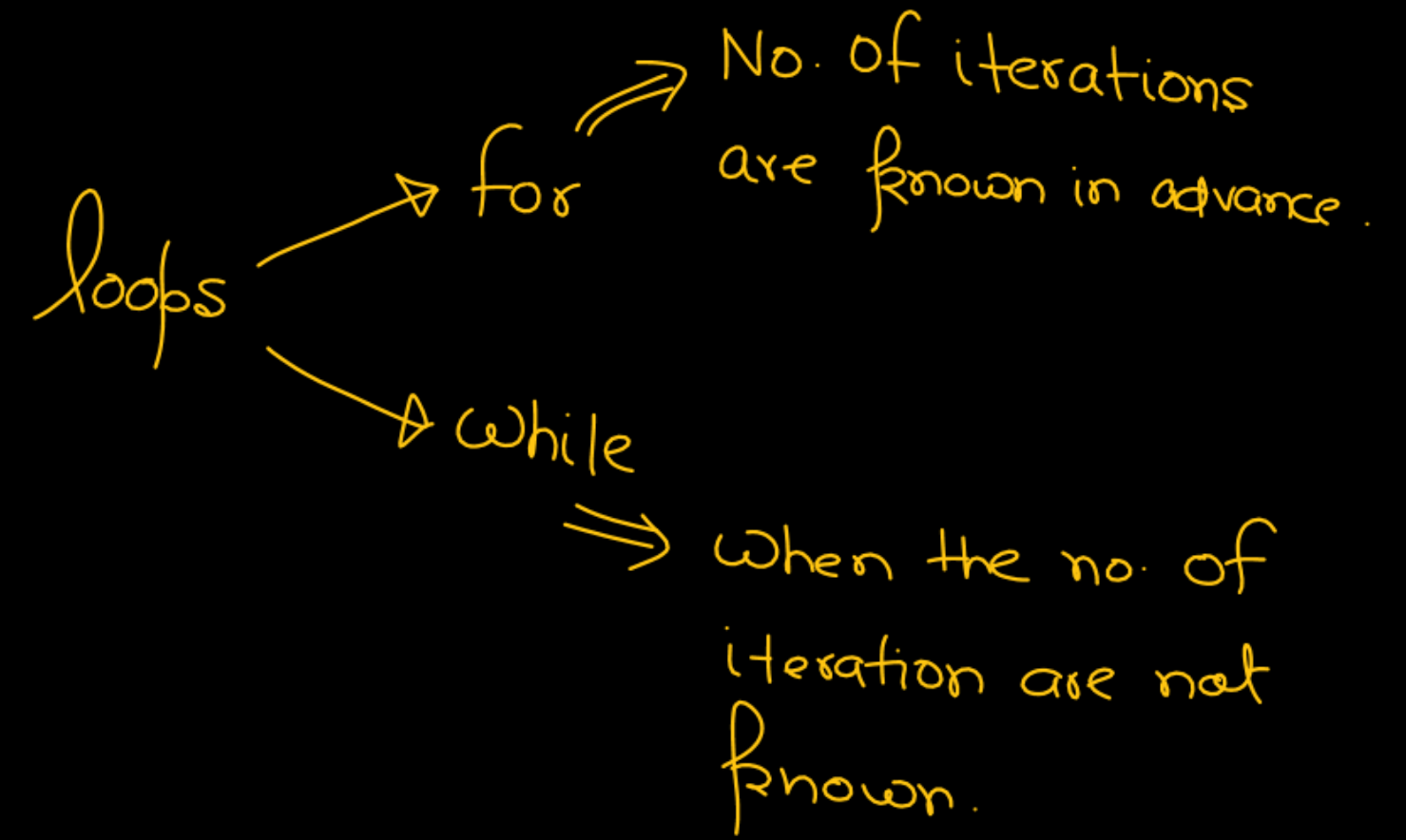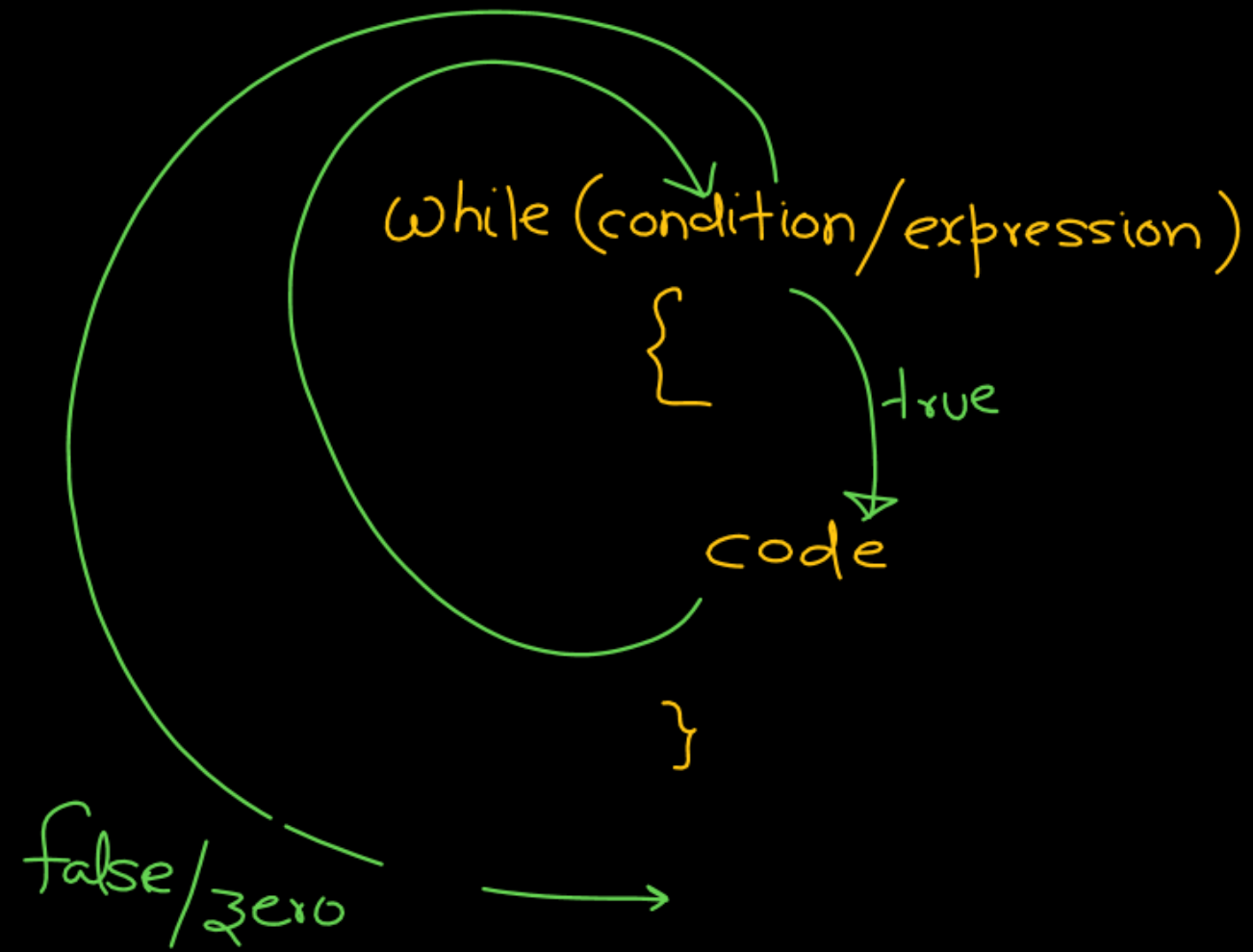By- Pankaj Sharma sir

TOPICS TO BE COVERED

Iterative Statements-III

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

        printf ("%d",i);

    }
```

i = 1

exp/condition

While(i <= 5)

    {

true

```
[ printf ("%d", i);
  i++;                ]
```

6<=5

}

12345

while (condition/expression)

{

}
true

code

false/zero →

loops → for → No. of iterations are known in advance.

loops → while ⟹ When the no. of iteration are not known.

WAP to take a no. from user & print the no. of digits in entered no.

i/p : 126
o/p : 3

i/p : 2389
o/p : 4

i/p : 3
o/p : 1

$n = 126$

① $n = n/10$ ($n = 126/10 = 12$)

$n = 12$

② $n = n/10$ ($n = 12/10 = 1$)

$n = 1$

③ $n = n/10$ ($n = 1/10 = 0$)

0

$n = 1289$

① $n = n/10$

$n = 128$

② $n = n/10$

$n = 12$

③ $n = n/10$

$n = 1$

④ $n = n/10$

$$\boxed{0}$$

```
int c = 0;
while( n != 0)
{
        c++;
        n = n/10;
}
```

$n \geqslant 0$

i/p : 0

o/p : 1

```c
int c=0;

if(n==0)
    c=1;
while(n!=0)
{
    c++;
    n=n/10;
}
printf("%d",c);
```

```
while (expression)
{

    Code

}
```

```
while ( ) {



      }
```

→ Expression is not
        optional

```c
int   i=1;
while (i > 5)
    {

    printf("Pankaj");

    }
```
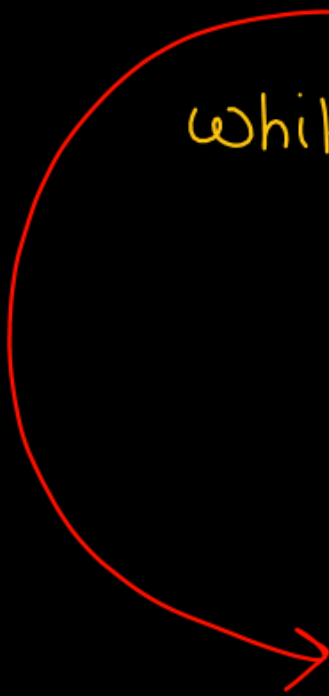
1>5

```
int i = 1;
do {
    printf("Pankaj");
} while (i > 5);
```

do while ⇒ will execute the code atleast 1 time irrespective of whether the condition is true or false.

Pankaj

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

code   printf("%d",i);


   }

O/P: 1 2 3 4 5 6 7 8 9 10
```

i	i<=10
1	1<=10 ⟶ ✓ pf 1
2	2<=10 ⟶ ✓ pf 2

continue :

```
{
    ___
    ___    |✓
    ___    |
           ↓
    continue;
    ___  ]  Skip the remaining part
    ___  ]  of current iteration &
         [continue] with next iteration.
}
```

```
                    ①⟶②
for (i=1; i<=10; i++)
{
        ↓
    if (i%3==0)

        continue;

    printf("%d", i);

}
        3

    O/p: 12457810
```
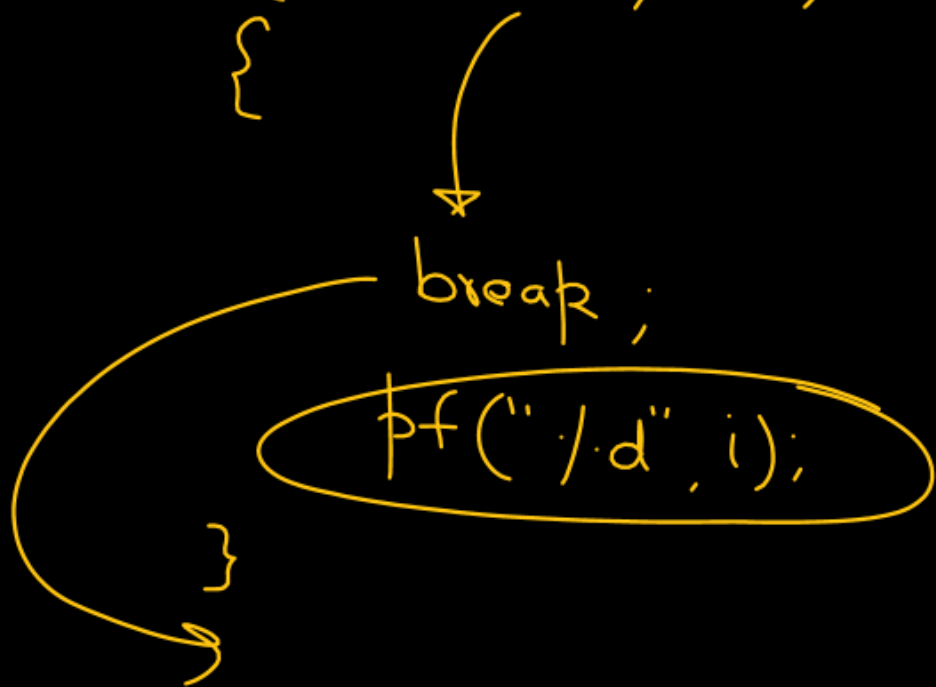
i	i<=10	if
0		
1	1<=10 →true Code → 1%3==0 →false continueX
2	2<=10 →true code → 2%3==0	pf ✓
	└false continueX pf ✓	
3	3<=10 →true code →3%3==0 →true continue pfx
	└→(i++)	
4	4<=10 →true code →⚬ 4%3==0 →X continueX pf ✓
5		5%3==0 →X continueX pf ✓
6		6%3==0 →✓ continue pfx └→i++

break

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

            break;

            pf("%d", i);

}
```

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

    if ( i / 3 == 0 )
            break;
    printf("%d", i);

}
```

break

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

    if(i%3==0)
        break;
    printf("%d", i);

}
```

O/P: 1 2

i	i<=10	if
1	1<=10 ✓ → 1%3==0 false → breakx pf ✓
2	2<=10 ✓ → 2%3==0 false → breakx pf ✓
3	3<=10 ✓ → 3%3==0 true → break ✓

① → ②

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

|| → ⇒
3|32
4|

i=4 j=1,2,3,4,5

4|

i=5, j=1,2,3,4,5

① for(j=1; j<=5; j++)
{

if ((i+j)/3==0)

break;

printf("%d %d", i,j);

}

② printf("\n");

}

i

1   i<=5 → j loop → j=1

(1+1)/3==0 false break

bf → ||

j=2

(1+2)/3==0 true break

ln ✓

2

j=1,2,3,4,5

(2+1)/3==0 true break → j loop

3

j=1,2,3,4,5

(3+1)/3==0 X   (3+3)/3==0 break
(3+2)/3==0 X

11 12 21 41 42 43 51 52 j वाला loop इतना ऊपर

$i=1$ $j=1,2,\boxed{3},4,5$

$$
\begin{aligned}
&\text{for}(i=1; i<=5; i++) \\
&\{
\end{aligned}
$$


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

    if ((i+j) % 4 == 0)
            break;
    printf(" %d %d", i, j);
    }
```

}

$i=2$ $j=1,2,3,4,5$ → loop terminate

$i=3$ $j=1,2,3,4,5$

$i=4$ $j=1,2,3,4,5$

$i=5$ $j=1,2,3,4,5$

$$i=1 \quad \begin{vmatrix} i=3^1 \\ j=3 \text{ to } n \\ (n-3+1) \end{vmatrix} \begin{vmatrix} i=3^2 \\ j=3^2 \text{ to } n \\ (n-3^2+1) \end{vmatrix} \cdots \begin{vmatrix} i=3^k \\ j=3^k \text{ to } n \\ (n-3^k+1) \end{vmatrix}$$

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

$$(n-1+1)$$

① for(i=1; i<=n; i=i*3)

    {

      for(j=i; j<=n; j++)

        {

          printf("Hello");

        }

    }

      }

$$\underbrace{\qquad}_{1} \quad + \quad \underbrace{\qquad}_{k}$$

$$(n-1+1)+(n-3+1)+(n-3^2+1)+ - - +(n-3^k+1)$$

$$(k+1)(n+1) \quad -1-3-3^2-3^3 \cdots \cdots -3^k$$

$$(k+1)(n-1) \quad -(1+3+3^2+ \cdots +3^k)$$

$$(k+1)(n+1) \quad - \quad 1\dfrac{(3^{k+1}-1)}{3-1}$$

① `for(i=1; i<=n; i=i*3)`

```
{
    for(j=i; j<=n; j++)
    {
        printf("Hello");
    }
}
```

$i=1$	$i=3^1$	$i=3^2$	$\cdots\cdots$	$i=\boxed{3^k}$
$j=1$ to n	$j=3$ to n	$j=3^2$ to n		$j=3^k$ to n
$(n-1+1)$	$(n-3+1)$	$(n-3^2+1)$		$(n-3^k+1)$

$$\underbrace{1}_{} \qquad \underbrace{+ \qquad\qquad\qquad}_{k}$$

$$(k+1)(n+1) \quad - \quad 1\left(\frac{3^{k+1}-1}{3-1}\right)$$

$$= (k+1)(n+1) - \frac{\left(3^{k+1}-1\right)}{2}$$

$$= \left(\lfloor \log_3 n\rfloor +1\right)(n+1) - \left(\frac{3^{\lfloor \log_3 n\rfloor +1}-1}{2}\right)$$

$$3^k <= n$$

$$\log 3^k <= \log n$$

$$k \log 3 <= \log n$$

$$k <= \frac{\log n}{\log 3}$$

$$k <= \log_3 n$$

$$k = \lfloor \log_3 n\rfloor$$

②

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

$$\sum_{i=1}^{n} \sum_{j=1}^{i^2} \left(\sum_{k=1}^{n} 1 \right)$$

②

$$\sum_{i=1}^{n}\left(\sum_{j=1}^{i^2} n\right)$$

$1 \text{ to } i^2 \Rightarrow$

$$\underbrace{n + n + n + \cdots \cdot + n}_{j=1 \qquad\qquad\qquad j=i^2}$$

$$= \quad n \cdot i^2$$

$$\sum_{i=1}^{n} n \cdot i^2$$

$$\sum_{i=1}^{n} \sum_{j=1}^{i^2}\left(\sum_{k=1}^{n} 1\right)$$

$$\sum_{i=1}^{n} i^2 \cdot n$$

$$= n \left(\sum_{i=1}^{n} i^2 \right)$$

$$= n \cdot n(n+1)(2n+1)/6$$

$$\sum_{i=1}^{N} i \qquad 1+2+3+\cdots+N = \frac{N(N+1)}{2}$$

$$\sum_{i=1}^{N} i^2 \qquad 1^2+2^2+3^2+\cdots+N^2 = \frac{N(N+1)(2N+1)}{6}$$

$$\sum_{i=1}^{N} i^3 \qquad 1^3+2^3+3^3+\cdots+N^3 = \left[\frac{N(N+1)}{2}\right]^2$$

$$S_n = \frac{n}{2}\left[\text{first} + \text{last}\right]$$

$$S_n = \frac{a(\gamma^n - 1)}{\gamma - 1} \quad \bigg| \quad \frac{a(1-\gamma^n)}{1-\gamma}$$

$$\sum_{i=1}^{n} 2 \cdot i = 2 \sum_{i=1}^{n} i$$

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

Last first

$$1 \text{ to } 100 \Rightarrow 100 - 1 + 1$$

$$= 100$$

(3)

```
for(i=1; i<=n; i++)
    {
        for(j=i; j<=3*i; j++)
        {
            1 statement
            printf("Ponkaj");
        }
    }
```

$$\sum_{j=i}^{3i} 1$$

$j=i$ $j=3i$

$$1 + 1 + 1 + \cdots + 1$$

$$\sum_{j=1}^{10} x$$

$$x + x + x + \cdots$$

③

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

i to 3i

$\Rightarrow 3i - i + 1$

$= 2i + 1$

$$\sum_{j=i}^{3i} 1$$

$\boxed{j=1}$ $\boxed{j=3i}$

$1 + 1 + 1 + \cdots + 1$

$\Rightarrow \boxed{2i+1}$

(3)

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

        for( j= i ; j<= 3*i ;(j++))
            {

                1 statement
                printf("Pankaj");

            }

    }
```

Math ✓

$$\sum_{i=1}^{n} \left(\sum_{j=i}^{3i} 1 \right)$$

$$\sum_{i=1}^{n} 2i+1$$

$$\sum_{i=1}^{n} (2i+1)$$

$$\Rightarrow \quad 2 \cdot \overbrace{\sum_{i=1}^{n} i} + \sum_{i=1}^{n} 1$$

$$\Downarrow$$

$$2 \times \frac{n(n+1)}{2} + \quad \underbrace{1+1+\cdots}_{n \text{ times}}$$

$$n^2 + n + n$$

$$= n^2 + 2n$$

$$= n(n+2)$$