Lecture 6

Series Problem

Trick (i) Relation b/w i (loop) & series

=

(ii) Generate formula.

Category 1 : Basic sum

Q1

1 + 2 + 3 + 4 ... + N = (Sum of natural numbers)

n = 3

Trick

i	t
1	1
2	2
3	3
4	4
:	:

→ int sum = 0;

→ for(int i = 1; i <= 3; i++){

sum = sum + i;

2 + 3 = 6

}

i = t =

Dry Run

sum = 0 → 1 → 3 → 6

i = 1 → 2 → 3 → 4

1 + 2 + 3 = 6

Q2 1 * 3 * 5 + 7 + ... N

$i * 2 - 1 = t$

$1 \times 2 - 1 = 1$

$2 \times 2 - 1 = 3$

$3 \times 2 - 1 = 5$

5-1 Const. table

i	t
1	1
2	3
3	5
4	7

5-2 Formulate.

Shortcut b & a formula

```
int sum = 1;
for(int i = 1; i <= n; i++){
    sum = sum * (i*2-1)
}
```

$t = i * 2 - 1$

```
int sum = 0;
for(int i = 1; i <= n; i++){
    sum = sum + 2*i - 1
}
```

Dry Run :

sum = 0 → 1 → 4 → 9

i = 1 → 2 → 3 → 4

Q2: $1^1 + 2^2 + 3^3 + 4^4 + \ldots + n^n$

HW: $1^2 + 2^2 + 3^2 + 4^2 \ldots + n^2 =$

i	t
1	1
2	2
3	3
4	4

$$t = i^i$$

```
int sum = 0;
for(int i = 1; i<=n; i++){
    sum = sum + pow(i, i)
}
```

$1^1 + 2^2 + 3^3$

Q4 $1 + x + \frac{x^2}{2} + \ldots\ldots + \frac{x^n}{n}$

i	t
1	$x^1/1$
2	$x/2$
3	$x^3/3$
4	$x^4/4$
!	!

$$t = \frac{x^i}{i}$$

```
int sum = 1;
for(int i = 1; i<=n; i++){
    sum = sum + (pow(x,i)/i)
}
```

Q5 $1 \times 2 \times 3 \times 4 \ldots\ldots n$ $(n!)$

$2! = 1 \times 2$

$4! = (1 \times 2 \times 3 \times 4)$

$t = i$

```
int prod = 1;
for(int i = 1; i<=n; i++){
    prod = prod * i;
}
```

#Category 2 : $t = i \times x + y$

Q1 (1) + 4 + 7 + 10

i	t
1	$1 \times p + q = 1$
2	$2 \times p + q = 4$
3	7

$p + q = 1$

$2 \times p + q = 4$

$p = 3$

$q = -2$

$i \times 3 - 2 = t$

```
int sum = 0;
for(int i = 1; i <= n; i++){
sum = sum + i * 3 - 2
```

Category 3 : Nested loop.

Trick

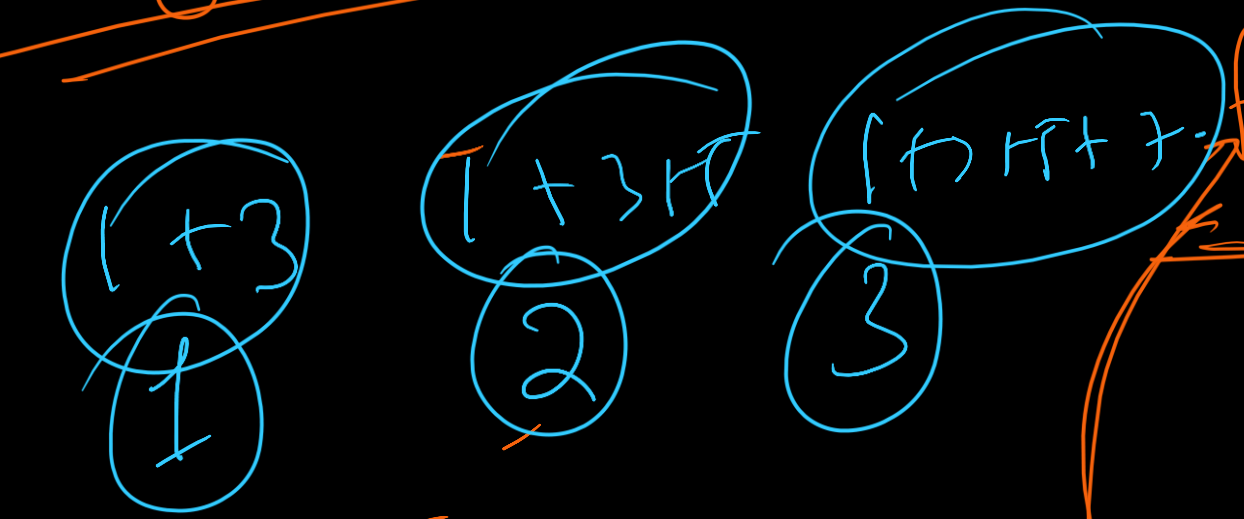
1. Formula for outer series
2. Formula for inner series
3. Relation b/w i & j

Q1

1 + (1+3) + (1+3+5) + 1+3+5+7+ n

S1 S2

Dry Run



```
int ns=0; // outer sum
for(int i=1; i<n; i++){
    int sum=0;
    for(int j=1; j<=2*i-1; j++){
        sum = sum + j*2-1;
    }
    ns = ns + sum;
}
```

Q2

$$\frac{1^1}{1} + \frac{2^2}{1\times 2} + \frac{3^3}{1\times 2\times 3} + \dots + \frac{n^n}{n!}$$

$t = i^i / i!$

j	t
1	$1^1/1!$
2	$2^2/2!$
3	$3^3/3!$

$t = j^j / j!$

```
int ns = 0;
for(int j = 1; j < n; j++){
    int prod = 1;
    for(int i = 1; i <= j; i++){
        prod *= i; }
    ns = ns + (pow(j, j) / prod)
}
```

Category 4: p = p * 10 + n

3

2 * 10 + 3 . 33 * 10 + 3 333 * 10 + 3

2 + 23 + 333 + 3333

```
int sum = 0; int p = 3;
for (int i = 1; i <= n; i++) {
    sum = sum + p;
    p = p * 10 + 3;
}
```

0 + 3 + 33 + 333

print

33 * 10 + 3

330 + 3

Dry Run

sum = 0 + 3 + 33

p = 3 33 333

i = 1 2

Category 5 : Special Series

(i) Square Series

1 2 4 + 9 - 16

1 2 - 3 4

i	+
1	+1
2	-4
3	+9
4	

i 4

i 4

i "

i "

Cube Series

1 - 8 27 64

```
int sum=0;
for(int i=1; i<=n; i++){
    if(i%2==0)
        sum=sum+pow(i,2)
    else sum=sum-pow(i,2)
}
```

Note on sign flip.

$\equiv$

Even Odd funda

$+ \quad -$

Triangular Series

1 3 6 10 15

$i * ((2 + i)) / 2 = t$

i	t
1	1
2	3
3	6

```
for(int i=1; i<=n; i++){
    printf("%d", i*(i+1)/2);
}
```

Fibonacci Series

0 1 1 2 3 5

a b

a b c

```
for int i = 1; i<=n; i++) {
    c = a+b; printf(c);
    a = b;
    b = c;
```

i+2

a b c

```
c = a+b;
printf(c);
a = b;
b = c
```

a = 0 1 1 2

b = 1 1 2 3

c = 1 2 3

T

1 1 2 3

Tricky Questions Practice

Q -1 4 -7 10 -13 16 -19

```
int b = 1
for (int i = 1; i <= n; i++) {
    if (i % 2 == 0) printf(b)
    else printf(-b)
    b = b + 3
}
```

9 10 15 60 15 110

```
int p = 10;
int q = 5;
for(int i = 1; i <= n; i++){
    if(i % 2 == 0){
        printf(p);
        p = p + 50;
    } else {
        print(q);
        q = q + 10;
    }
}
```

3 +2 5 +2 7 +2 9

int p=6; int q=3;

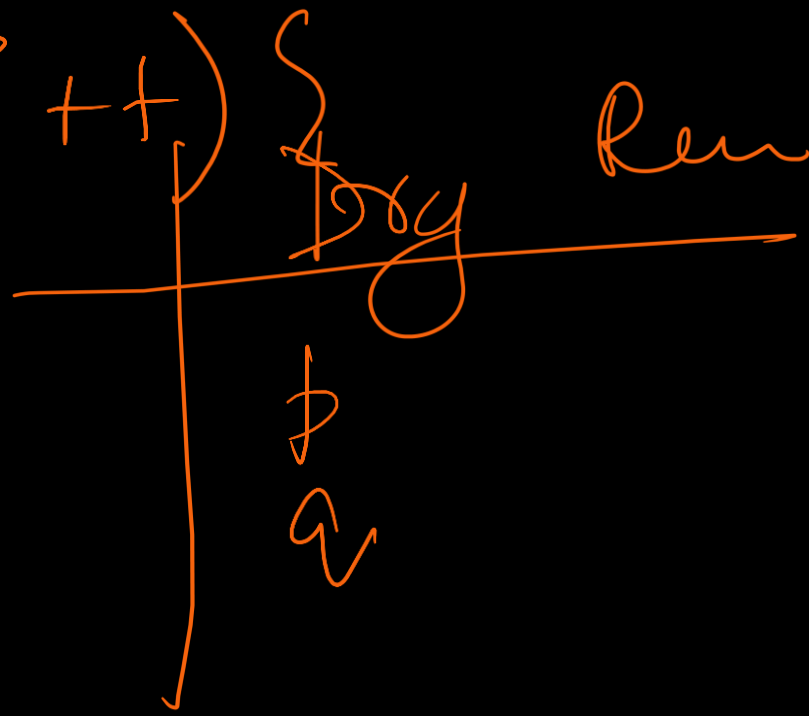
for (int i=1; i<=n; i++) {

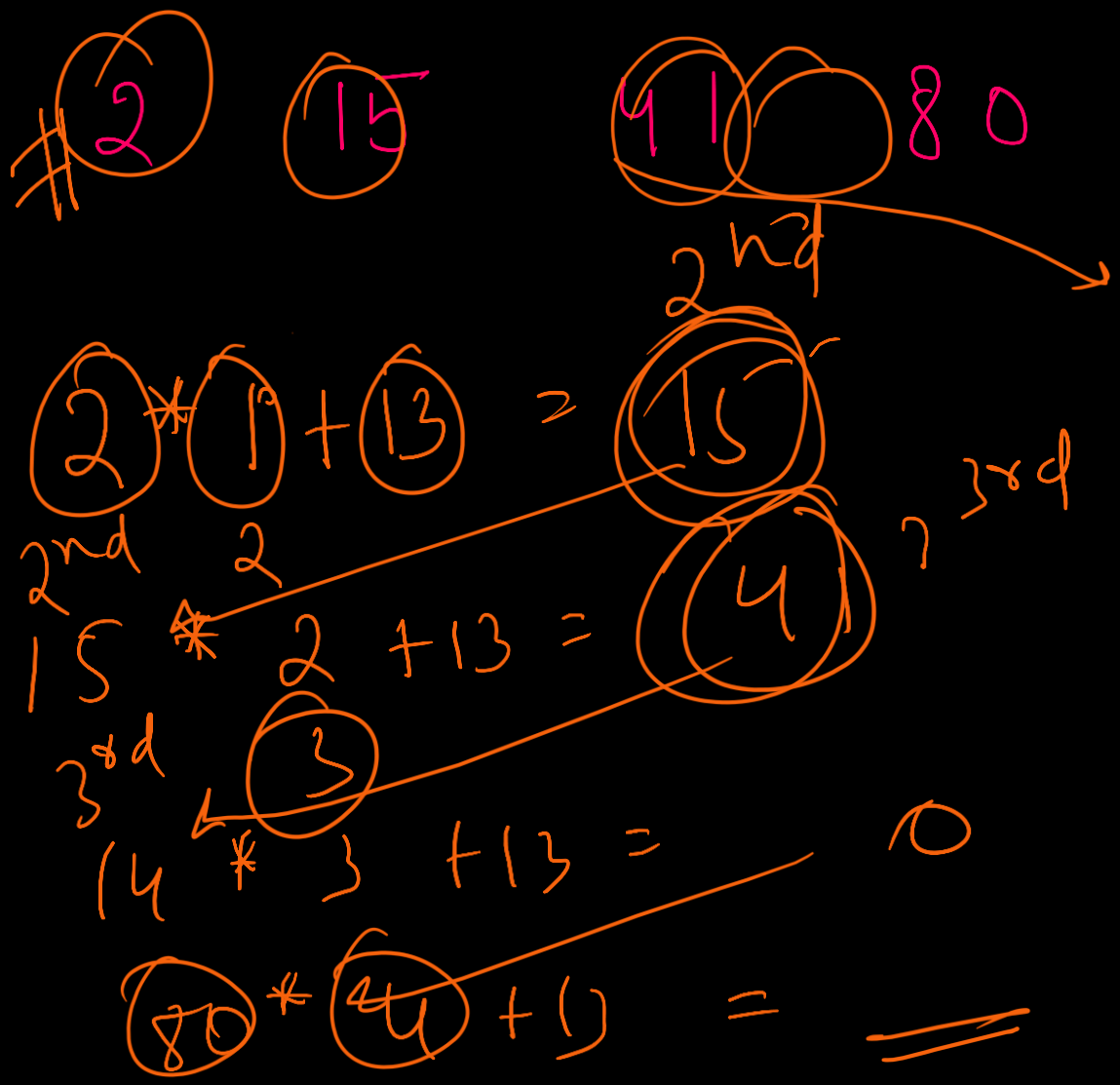
printf(p);

p = p + q;

q = q + 2;

}






```
p = p * i + 13
int p = 2
for (int i = 1; i <= n; i++)
{
    printf(p);
    p = p * i + 13
}
```

1 * 2 2 4 8 16 32

×2 ×2 ×2

2 =

```
int p = 1
for (int i = 1; i <= n; i++) {
    printf(p);
    p = p * 2;
}
```