Competitive Programming

Numeric Series and Patterns

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Basic series

- Fibonacci Series
- Lucas Numbers

Print Fibonacci Series

- In Fibonacci series, the next number is the sum of previous two numbers.
- The series starts with 0 and 1, and then the next numbers are a sum of the previous 2 numbers.

Print Fibonacci Series

- For example: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 etc.
- Here the first 2 numbers are 0 and 1.
- The next numbers are:
  - 1 (= 1 + 0)
  - 2 (= 1 + 1)
  - 3 (= 2 + 1)
  - 5 (= 3 + 2)
  - And so on…
- Write a program the first n numbers of the Fibonacci series.
- Hint: You already know the first 2 values. How can you calculate the remaining?

Input and output format

- Input Format
  - The first line contains T the number of test cases.
  - The following T lines contain n, the input for the Fibonacci Series.
- Output Format
  - Print the values on a single line, separated by a space character.
  - At the end of the line, print a new line.

Sample input and output

Input

5

3

4

8

9

7

Output

0 1 1

0 1 1 2

0 1 1 2 3 5 8 13

0 1 1 2 3 5 8 13 21

0 1 1 2 3 5 8

Fibonacci series

first	second	sum					
0	1	1	2	3	5	8	13
1	2	3	4	5	6	7	8

Pseudo code

```
first = 0
second = 1
for i = 3 to n:
        sum = first + second
        first = second
        second = sum
        print sum
```

Print Lucas Numbers

- In Lucas series, the next number is the sum of previous two numbers. The series starts with 2 and 1, and then the next numbers are a sum of the previous 2 numbers.

Print Lucas Numbers

- For example: 2, 1, 3, 4, 7, 11, 18, 29, etc.
- Here the first 2 numbers are 2 and 1.
- The next numbers are:
  - 3 (= 1 + 2)
  - 4 (= 3 + 1)
  - 7 (= 4 + 3)
  - 11 (= 7 + 4)
  - And so on…
- Write a program the first n numbers of the Lucas series.
- Hint: You already know the first 2 values. How can you calculate the remaining?

Input and output format

- Input Format
  - The first line contains T the number of test cases.
  - The following T lines contain n, the input for the Fibonacci Series.
- Output Format
  - Print the values on a single line, separated by a space character.
  - At the end of the line, print a new line.

Sample input and output

Input

5

3

4

8

9

7

Output

2 1 3

2 1 3 4

2 1 3 4 7 11 18 29

2 1 3 4 7 11 18 29 47

2 1 3 4 7 11 18

Lucas numbers

first	second	sum					
2	1	3	4	7	11	18	29
1	2	3	4	5	6	7	8

Pseudo code

```
first = 2
second = 1
for i = 3 to n:
        sum = first + second
        first = second
        second = sum
        print sum
```

Logic Pyramid

- Identify the logic behind the series
  - 6 28 66 120 190 276....
- The numbers in the series should be used to create a Pyramid.
- The base of the Pyramid will be the widest and will start converging towards the top where there will only be one element.
- Each successive layer will have one number less than that on the layer below it.
- The width of the Pyramid is specified by an input parameter N.
- In other words there will be N numbers on the bottom layer of the pyramid.

Logic Pyramid

- First number in the series should be at the top of the Pyramid
- Last N number of the series should be on the bottom-most layer of the Pyramid, with Nth number being the right-most number of this layer.
- Numbers less than 5-digits must be padded with zeroes to maintain the sanctity of a Pyramid when printed.
- Have a look at the examples below to get a pictorial understanding of what this rule actually means.

Constraints

- $0 < N <= 14$

Sample input and output

Input:

3

Output:

```
      00006
   00028 00066
00120 00190 00276
```

Sample input and output

Input:

5

Output:

```
            00006
         00028 00066
      00120 00190 00276
   00378 00496 00630 00780
00946 01128 01326 01540 01770
```

Divide into small parts

- How many rows?
- How many elements in each row?
- How many spaces in each row?
- How to find the value of element?
- How to print in padded way?

How many rows?

- If input is N → N rows

How many elements in each row?

- 1st row → 1 element
- 2nd row → 2 elements
- …
- Row number → Number of elements

How many spaces in each row?

Input:

5

Output:

```
------------00006
----------00028-00066
------00120-00190-00276
---00378-00496-00630-00780
00946-01128-01326-01540-01770
```

(total-current row) * 3 spaces

Pseudo Code

```
for row = 1 to n:
        print (n – row) * 3 spaces
        print (row) * elements + " "
        print newline
```

Printing Elements

```
i = 1
for j = 1 to row:
        print element(i)
        i = i + 1
```

Pseudo code

```
i = 1
for row = 1 to n:
        print (n - row) * 3 spaces
        for j = 1 to row:
                print element(i)
                i = i + 1
        print newline
```

How to find the value of element?

6	28	66	120	190	276

- 28 - 6 = 22
- 66 - 28 = 38
- 120 - 66 = 54
- 190 - 120 = 70
- 276 - 190 = 86

How to find the value of element?

6	28	66	120	190	276

- 28 - 6 = 22
- 66 - 28 = 38 (22 + 16)
- 120 - 66 = 54 (38 + 16)
- 190 - 120 = 70 (54 + 16)
- 276 - 190 = 86 (70 + 16)

How to find the value of element?

element(i) = element(i-1) - element(i-2) + 16 + element(i-1)

= 66 - 28 + 16 + 66

= 38 + 16 + 66

= 120

element(i) = element(i-1) * 2 - element(i-2) + 16

= 66 * 2 - 28 + 16

= 132 - 28 + 16

= 104 + 16

= 120

Pseudo code: element(n)

```
first = 6
second = 28
if n == 1:
        return first
if n == 2:
        return second
for i = 3 to n:
        next = (second * 2) - first + 16
        first = second
        second = next
return next
```

How to find the value of element?

6	28	66	120	190	276

- 3 * 2 = 6
- 7 * 4 = 28
- 11 * 6 = 66
- 15 * 8 = 90

Pseudo code: element(n) (Alt. logic)

```
first = 3
second = 2
for i = 1 to n:
        next = first * second
        first = first + 4
        second = second + 2
return next
```

How to print in padded way?

- Java

```
String.format("%05d", number);
```

- C/C++

```
printf("%05d", number);
```

- Python

```
print(format(n, '05'))
```

Queries?

Thank You…!