Logical treatment for the oscillatory sequence $1, 2, 3, 4, 3, 2, 1, 2, \ldots$ to find any term and a computer program to assist the operation

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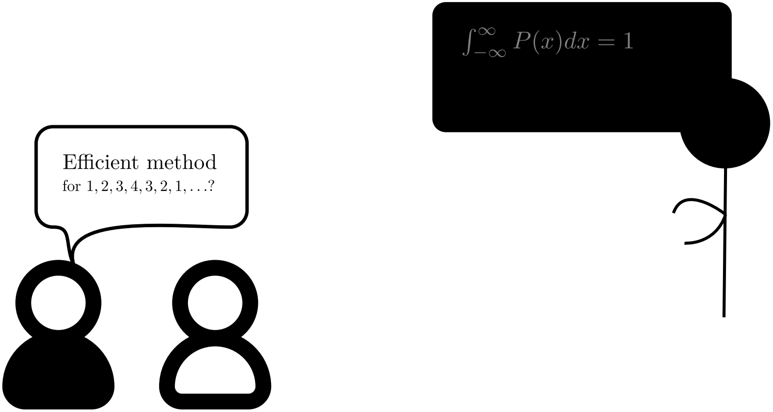

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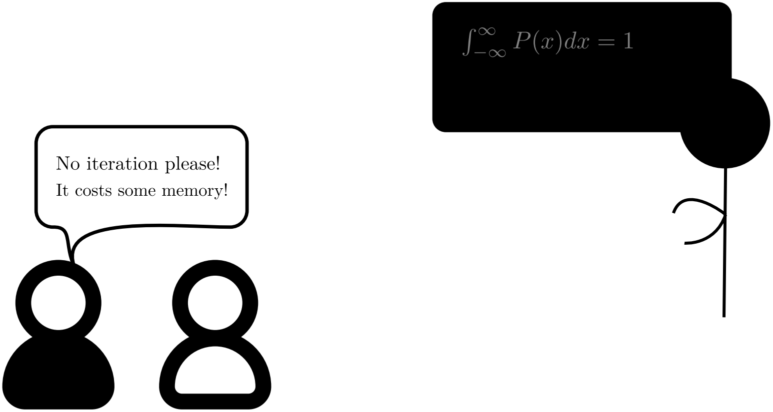

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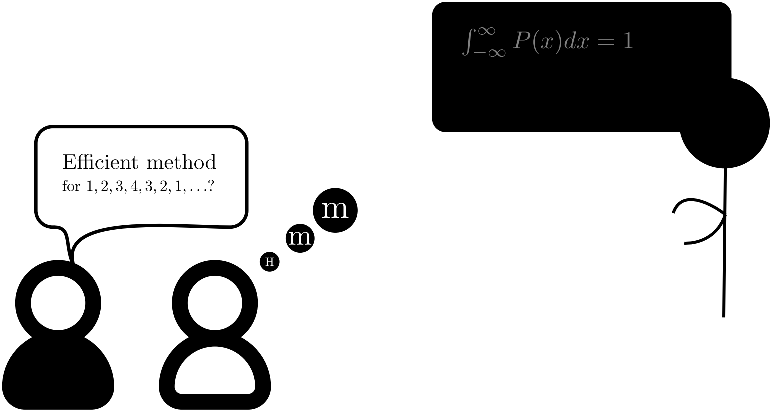

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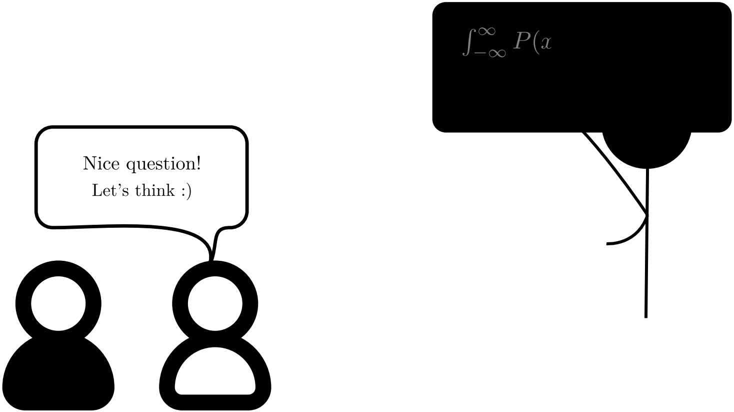

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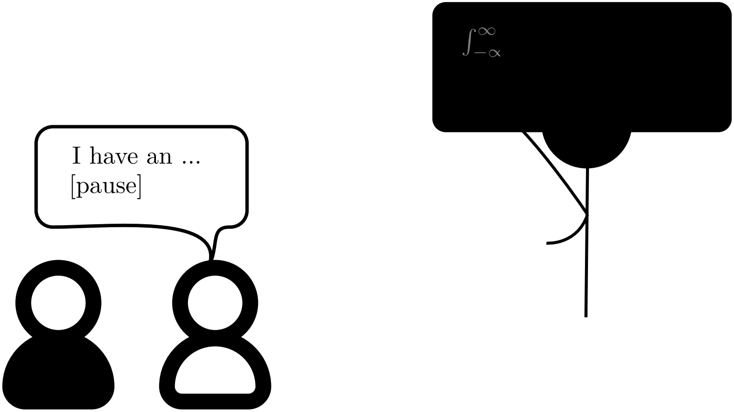

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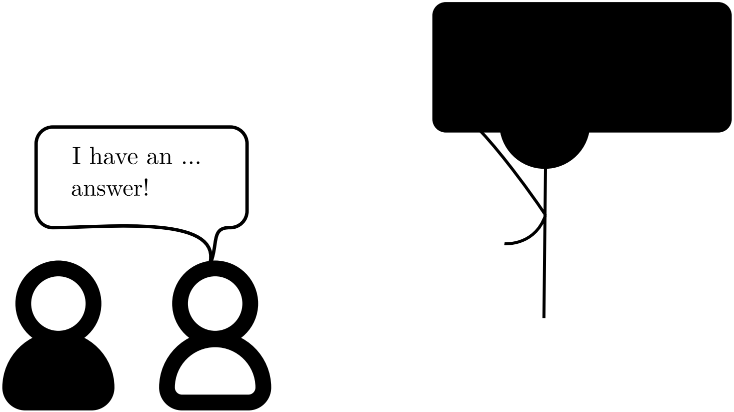

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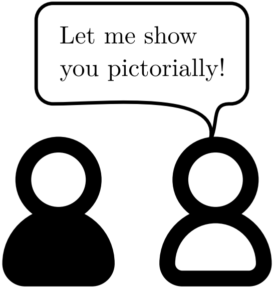

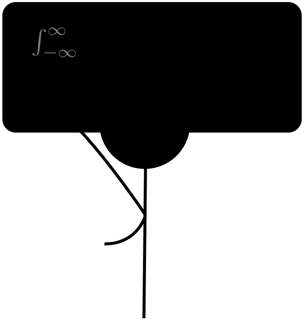

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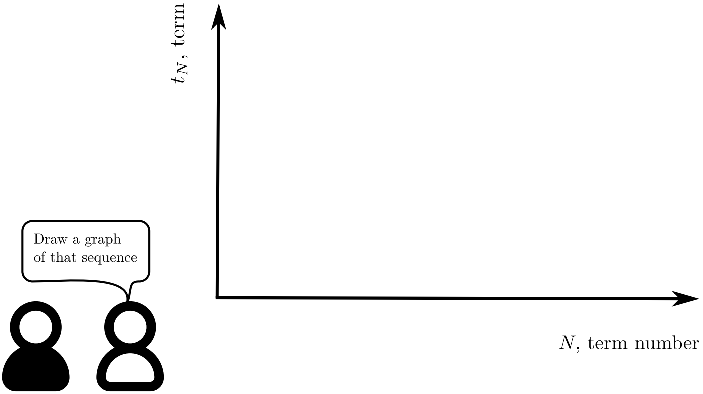

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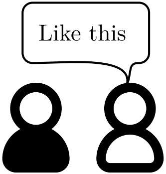

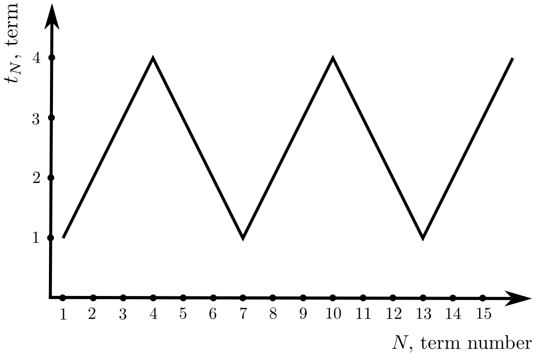

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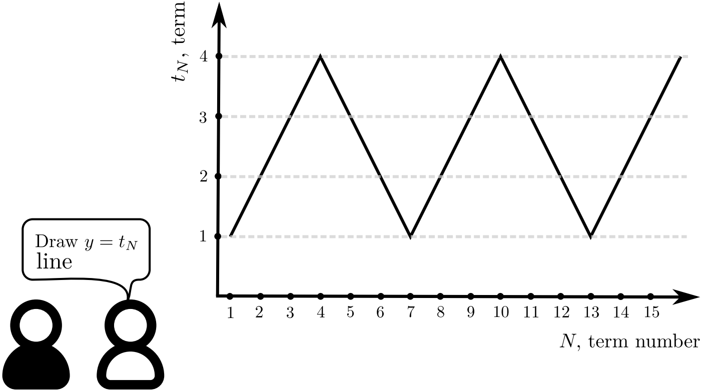

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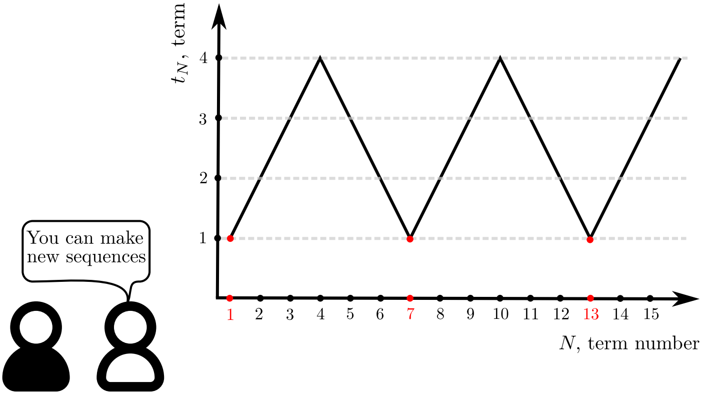

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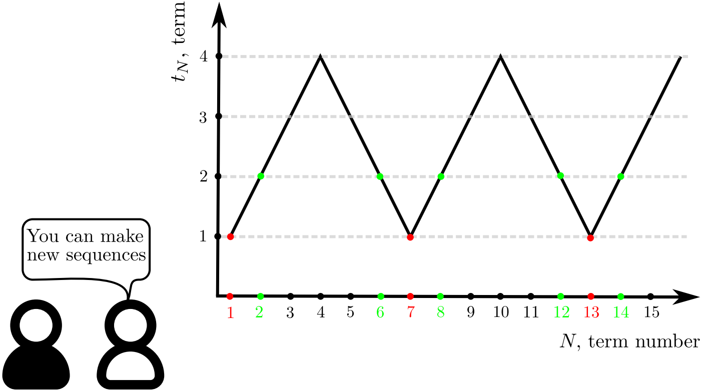

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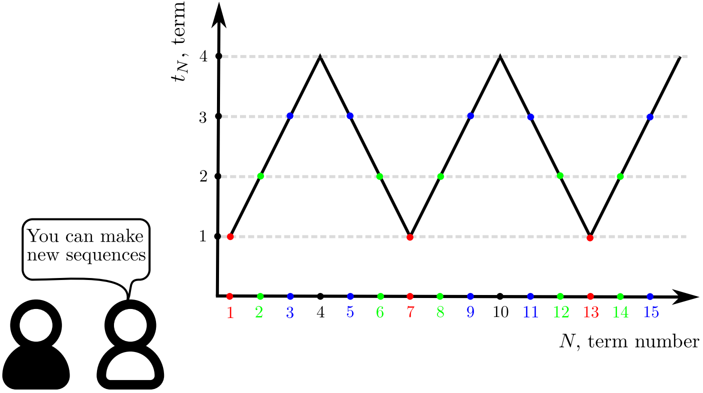

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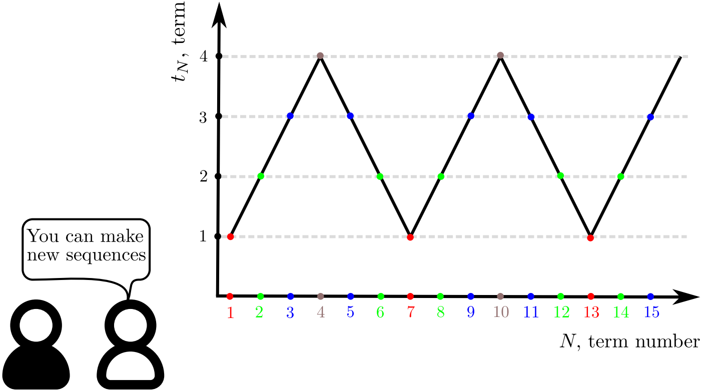

Now, we have four new arithmetic progressions

t_N	Lying on the $y = t_N$ line	General term
1	$1, 7, 13, 19, \ldots$ to i terms	t_i
2	$2, 6, 8, 12, 14, 18, \ldots$ to j terms	t_j
3	$3, 5, 9, 11, 15, 17, \ldots$ to k terms	t_k
4	$4, 10, 16, \ldots$ to l terms	t_l

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General terms formulae are

- $t_i = 6i - 5$ such that $i = 1, 2, 3, \ldots$
- $t_j = 3j$ when j is even
  $= 3j - 1$ when j is odd, such that $j = 1, 2, 3, \ldots$
- $t_k = 3k - 1$ when k is even
  $= 3k$ when k is odd, such that $k = 1, 2, 3, \ldots$
- $t_l = 6l - 2$ such that $l = 1, 2, 3, \ldots$

Logical part

- Notice t_i, t_j, t_k, and t_l are just no. of terms (N) in our original sequence. i.e. $t_x = N$ where $x \in i, j, k, l$

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For example,

$$t_i = 6i - 5 = N$$
$$\therefore i = \frac{N+5}{6}$$

Condition: If $i \in \mathbb{N}$ then, the N^{th} term is 1.

Similarly,

$$t_j = 3j = N$$
$$\therefore j = \frac{N}{3}$$

Condition: If $j \in \mathbb{N}$ and j is even then, the N^{th} term is 2.

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$$t_j = 3j - 1 = N$$
$$\therefore j = \frac{N+1}{3}$$

Condition: If $j \in \mathbb{N}$ and j is old then, the N^{th} term is 2.

Similarly,

$$t_k = 3k - 1 = N$$
$$\therefore k = \frac{N+1}{3}$$

Condition: If $k \in \mathbb{N}$ and k is even then, the N^{th} term is 3.

$$t_k = 3k = N$$
$$\therefore k = \frac{N}{3}$$

Condition: If $k \in \mathbb{N}$ and k is old then, the N^{th} term is 3.

$$t_l = 6l - 2 = N$$
$$\therefore l = \frac{N+2}{6}$$

Condition: If $l \in \mathbb{N}$ then, the N^{th} term is 4.

Axioms (in-general)

- If all $(n - 1)$ tests fail then, the last test n must be true where, $n =$ total number of tests.
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This is really helpful while implementing the logic we found earlier.

Computer Program & Closing Remarks

```python
#! /usr/bin/python3

N = int(input("Enter the value of N as you like: "))
if (N + 5) % 6 == 0:
  print("The {}th term is 1".format(N))
elif N % 3 == 0:
  if (N / 3) % 2 == 0:
    print("The {}th term is 2".format(N))
  else:
    print("The {}th term is 3".format(N))
elif (N + 1) % 3 == 0:
  if ((N + 1) / 3)% 2 == 0:
    print("The {}th term is 3".format(N))
  else:
    print("The {}th term is 2".format(N))
else:
  print("The {}th term is 4".format(N))
```