

Research with OEIS

Pratik Koirala

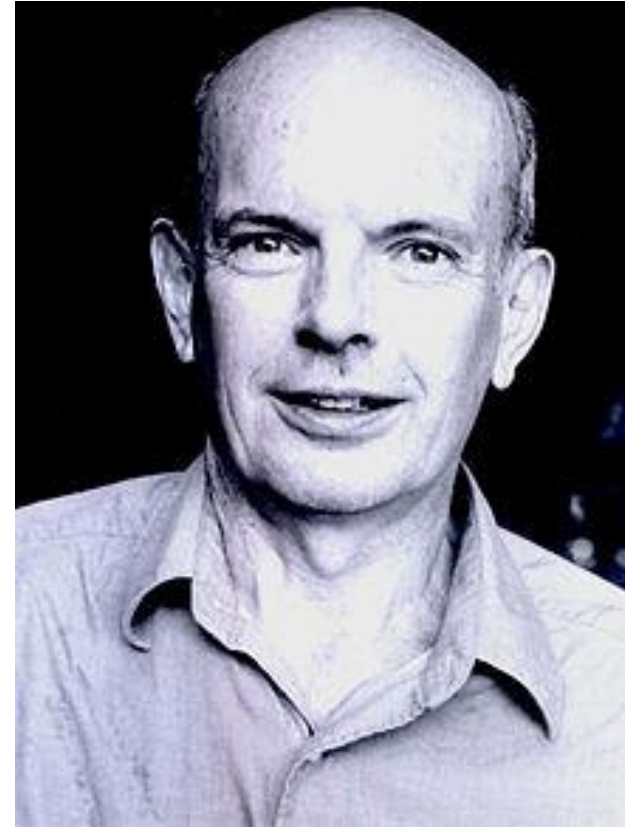
Otis Tweneboah

Mentors: Dr. Brian Nakamura, Dr. Eugene Fiorini

OEIS , The Online Encyclopedia of Integer Sequence

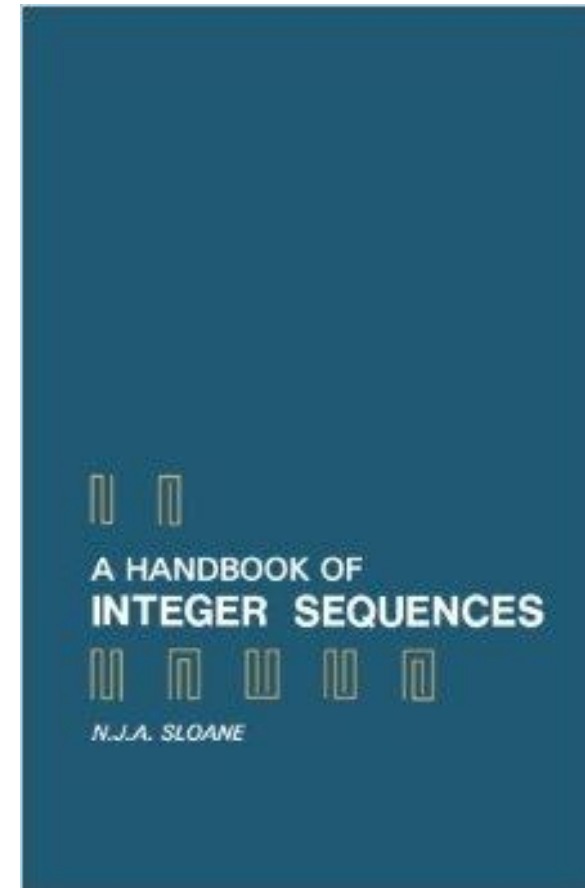
N.J.A Sloane

- Cornell University, PhD, 1967
- Fellowship:
 - AT&T Fellow, IEEE Fellow, American Mathematical Society Fellow
- Visiting Researcher, Rutgers
- Awards:
 - IEEE Richard W. Hamming Medal, 2005
 - Mathematical Association of America David P. Robbins award, 2008
 - 2013 George Polya Award from Mathematical Association of America



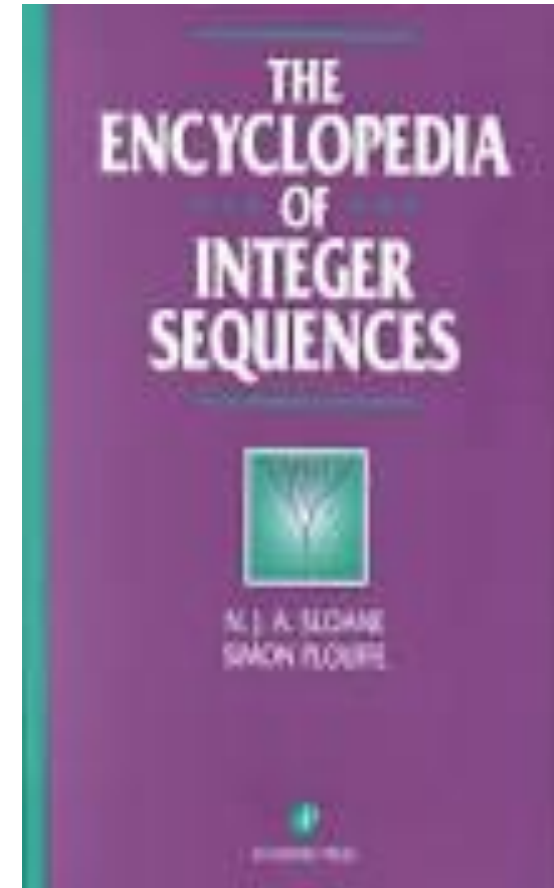
1973

- Punch cards, 1964
- Book published → 2,372 sequences
- Lexicographic order



1995

- Another book published → 5000 sequences
- Mathematicians supplied steady flow of sequences
 - 16,000 sequences
 - Email service
 - Website



- 1996

- OEIS website (www.oeis.org)
 - Identify sequences
 - Obtain formulas, more terms, etc.

- 2015

- Over 250,000 sequences
- 29 Chief editors, over 100 assistant chief editors
 - Volunteers
 - Review, approve, recommend submissions



Some Examples of Sequences

- **Recamán's Sequence**
- **Catalan Numbers**
- **Collatz Conjecture**

Recamán's Sequence (A005132)

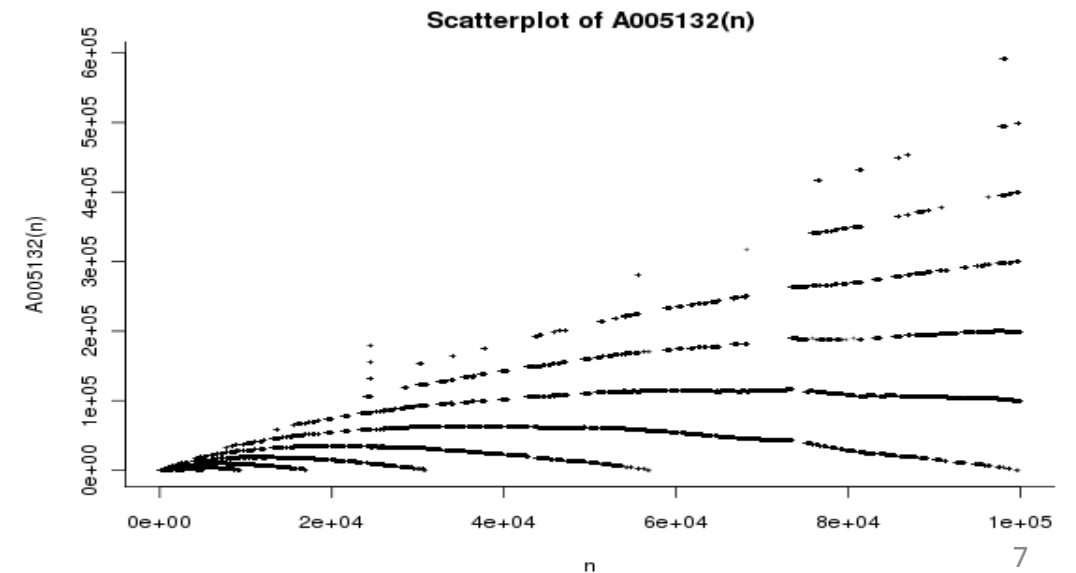
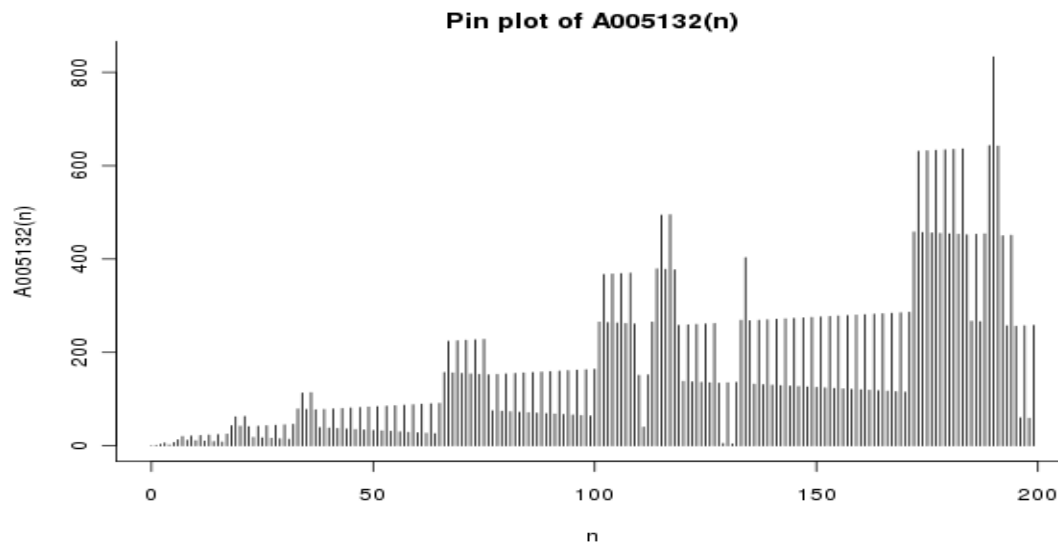
- Recamán's sequence is a mathematical sequence, defined as such: $a_0 = 0$

$$a_n = \begin{cases} a_{n-1} - n & \text{if } (a_{n-1} - n) > 0 \text{ and not already in the sequence} \\ a_{n-1} + n & \text{otherwise,} \end{cases}$$

n	0	1	2	3	4	5	6	7
a_n	0	1	3	6	2	7	13	20

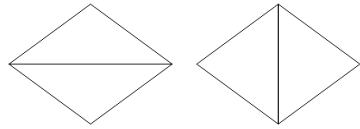
Consider $n = 8$. we have $a_7 - 8 = 12$.

Since $12 > 0$ and it is not in the sequence up to that point, $a_8 = 12$, the next term in the sequence.

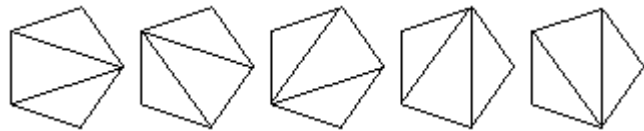


Catalan Numbers (A000108)

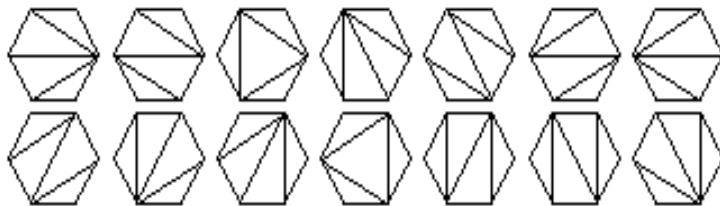
- The Catalan numbers, named after Eugene Charles Catalan.
- Catalan numbers are used to count MANY things
 - Balanced Parenthesis, Hands Across a Table, Binary Trees, etc.
- For instance, it describes the number of ways a polygon with $n+2$ sides can be cut into n triangles
- Example;
polygon with 4 sides can be cut into 2 triangles in 2 ways



pentagon with 5 sides can be cut into 3 triangles in 5 ways



hexagon with 6 sides can be cut into 4 triangles in 14 ways



Catalan Numbers (A000108)

- Catalan numbers can be computed using this formula:

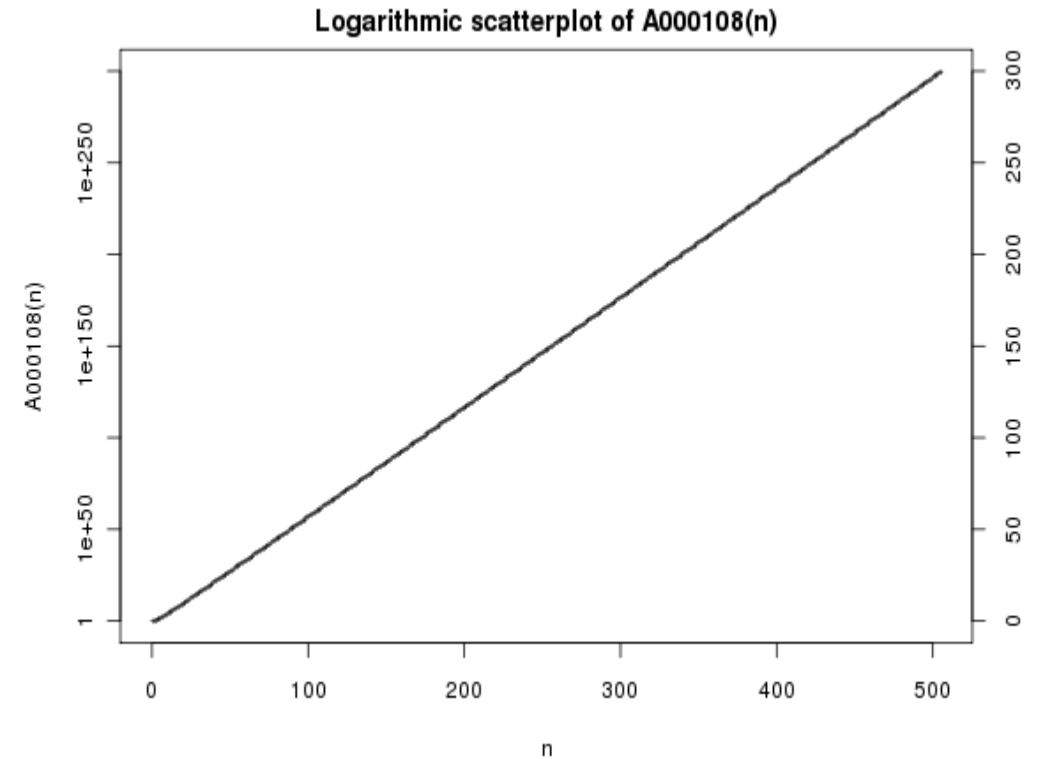
$$C_n = \frac{1}{n+1} \binom{2n}{n}$$

n	0	1	2	3	4	5	6
a_n	1	1	2	5	14	42	132

- Lets try polygon with 7 sides using the formula above.



Number of ways polygon with 7 sides
 $n = 5$



Collatz Conjecture (A006577)

- The Collatz conjecture is common know as **$3n + 1$ conjecture**
- Defined as such:

$$F(n) = \begin{cases} 3n + 1 & \text{if } n \text{ is odd} \\ \frac{n}{2} & \text{if } n \text{ is even} \end{cases}$$

- The Collatz conjecture states that for every starting value n , repeated applying operation $f(n)$ will always eventually produce 1.
- Example:

n	F(n)
1	1
2	2, 1
3	3, 10, 5, 16, 8, 4, 2, 1
4	4, 2, 1
5	5, 16, 8, 4, 2, 1

Research Project

- Study currently posted sequence in the OEIS website
- General conjectures/problems associated with OEIS
- Generate new terms, new sequences
- Incorporate programming concepts
 - Python, C++

Thank you.
Questions?