Numerical Experiments Around the Lychrel Conjecture

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The conjecture is a recreational problem, published in mainstream scientific litterature and magazines, for the problem can be easily understood with minimum knowledge of mathematics [1, 2]. It involves performing a sequence of *reverse-and-add* operations on any natural numbers until a palindromic number is reached. Such a sequence is called a *thread*. Formally, if we denote by A the number expressed as an arranged set of digits $(\alpha_0, \alpha_1, \alpha_2, \ldots, \alpha_N)$ in an arbitrary base X, we shall call $\mathring{A}$ its palindromic transpose, the number whose digits of A have been reversed :

$$A = \sum_{i=0}^{N} \alpha_i X^i \Leftrightarrow \mathring{A} = \sum_{i=0}^{N} \alpha_{(N-i)} X^i$$

A thread is thus the following sequence $(T_n) : A_{n+1} = A_n + \mathring{A}_n,\ \forall n \in \mathbb{N}$. The first natural number A_0 in the sequence is called a *seed*. A *Lychrel number* is therefore defined as a seed that does not yield a palindromic number through the iterative process of inversion and addition. In other words, the sequence (T_n) contains no palindromes, ie $\forall n \in \mathbb{N}$ and $\forall A_n \in (T_n), A_n \neq \mathring{A}_n$. Although this contribution deals with computational *number theory*, it should provide the *numerical analysis* community with methods for manipulating large numbers (with hundread of thousands digits) and data vizualization. About the conjecture itself, the author has generalized the computation of threads expressed in base up to 60 and developed graph representation providing powerful insights into the network structure of threads (see figure 1). The numerical results obtained will be discussed in the light to the generalised existence proof of Lychrel Numbers.

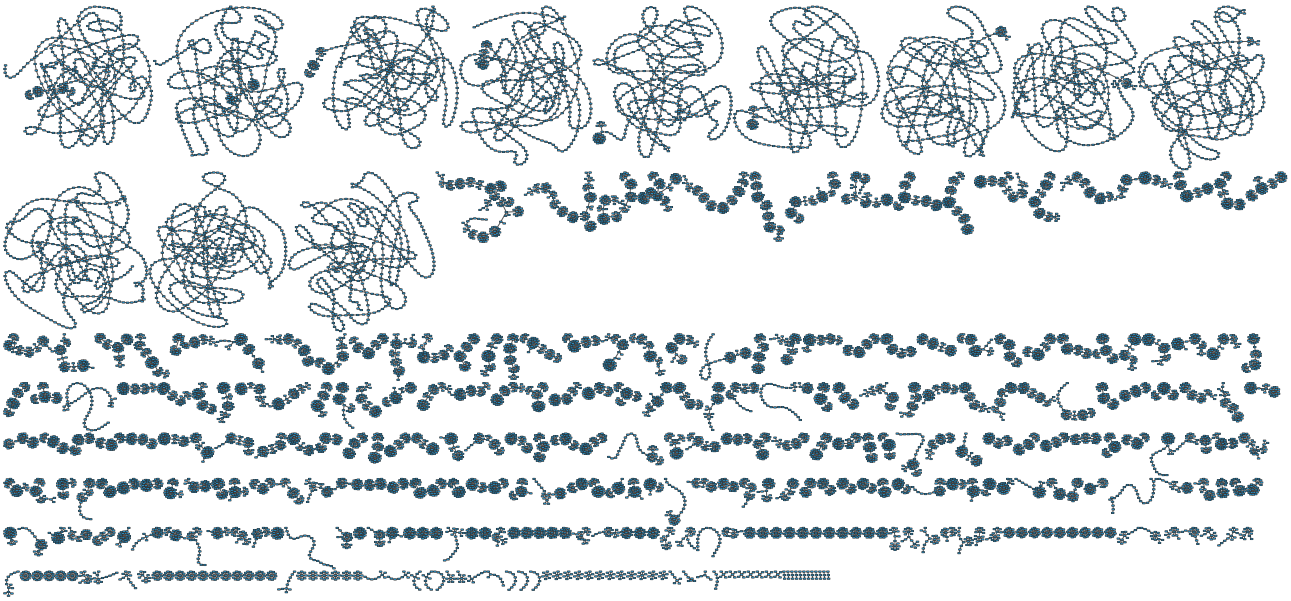

FIGURE 1 – Emerging network structure from the computation of threads for the first 10000 integers expressed in base 16

Références

[1] JEAN-PAUL DELAHAYE, *Déconcertantes conjectures*, Pour La Science N° 367, 2008

[2] Reiter, C. A. (1998) "With J : Using exact arithmetic." APL Quote Quad 28 (3) : 13-15.

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