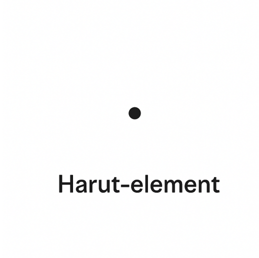
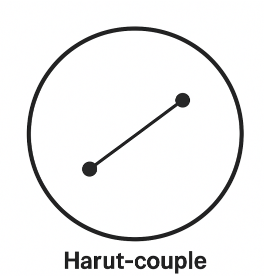
Basic definitions

Harut-element is a fundamental unit of the model. You may think of it as a simple black dot.



Harut-couple is a pair of two Harut-elements.



Harut-system is a set that may consist of Harut-elements and Harut-couples.

Notation

The Harut-element is denoted by the letter `h`.

The Harut-couple is denoted by the letter `H`.

The Harut-system is denoted using parenthesis.

Classification of Harut-systems

Harut-systems can be *stable* or *unstable*.

Stable Harut-system is a system that consists of only Harut-couples. It is denoted as (H, ...).

Unstable Harut-system is a system in which there is one Harut-element. It is denoted as (H, ..., h).

Fundamental principles

1. A Harut-element tends to form a pair with another Harut-element.
2. A stable Harut-system tends to split into two equal parts.

Examples:

(h, h) = (H)

(H, H) = (H) (H)

(H, H, H) = (H, H, h, h) = (H, h) (H, h)

Harut-system dimension

It is the number of Harut-couples in the system. It is denoted as $(H, \ldots)_N$, where N represents the dimension of the system.

Mutation

A mutation is any change in a Harut-system. By change, we mean that elements may be added to or removed from the system. The system may also be divided into equal parts, or parts may be repeated.

Mutations may have a stabilizing or destabilizing effect on the system.

Examples:

$(H, \ldots, h)_N + (h) = (H, \ldots)_N + (h, h) = (H, \ldots)_N + (H) = (H, \ldots)_{N+1}$

$3 \times (H, \ldots, h)_N = (H, \ldots, h)_N + (H, \ldots, h)_N + (H, \ldots, h)_N = (H, \ldots)_{3N} + (h, h) + (h) = (H, \ldots)_{3N} + (H) + (h) = (H, \ldots, h)_{3N+1}$

$3 \times (H, \ldots, h)_N + (h) = (H, \ldots, h)_{3N+1} + (h) = (H, \ldots)_{3N+1} + (h, h) = (H, \ldots)_{3N+2}$

Decomposability

Decomposability is the property of a stable Harut-system to be divided into an equal number of smaller systems without breaking its stability.

This property is denoted as ${}^{m}(H, \ldots)_N$, where m indicates the number of equal parts into which the system can be decomposed while preserving stability.

Any decomposable stable Harut-system is denoted by the letter S (e.g. ^2S – 2-decomposable stable Harut-system)

Harut-mutation

We will refer to a mutation of the form 3 x (^2S, h) + h as a Harut-mutation.

Theorem: **The Harut-mutation has a stabilizing effect on the Harut-system; however, if applied recursively to a system that exists according to its own fundamental life cycle rules, the system degrades. This means that, as a result of its division, all stable Harut-couples will ultimately exist outside the framework of the system, becoming self-contained.**

Proof: We will describe the chain of system stabilization and division in accordance with the fundamental principles of Harut-system lifecycle.

$^2(H, \ldots, h)_N$

→ (stabilization) 3 x $^2(H, \ldots, h)_N$ + (h)

→ $^2(H, \ldots, h)_N + {}^2(H, \ldots, h)_N + {}^2(H, \ldots, h)_N + (h)$

→ $^2(H, \ldots)_N + {}^2(H, \ldots)_N + {}^2(H, \ldots)_N + (h, h, h, h)$

→ $^2(H, \ldots)_N + {}^2(H, \ldots)_N + {}^2(H, \ldots)_N + (H, H)$

→ (division) $^2(H, \ldots)_N + {}^2(H, \ldots)_{N/2} + H$

→ $(H, \ldots)_{N+N/2+1}$

After stabilization and division, the Harut-system $^2(H, \ldots, h)_N$ mutates into $(H, \ldots)_{N+N/2+1}$. Since the Harut-system initially had the 2-decomposable property, we cannot guarantee that the system still possesses this property. We are sure, though, that it is still stable.

Therefore, in accordance with the fundamental principles, the Harut-system must divide into two equal parts; however, after division, it may break down into two stable systems or two unstable ones.

$(H, \ldots)_{N+N/2+1} \rightarrow (H, \ldots)_{(N+N/2+1)/2}$

Or

$(H, \ldots)_{N+N/2+1} \rightarrow (H, \ldots, h)_{[(N+N/2+1)/2]}$

After all mutations, the rank of the system will stably be

$$\left\lfloor \frac{N+\frac{N}{2}+1}{2} \right\rfloor$$

and, in the longest mutation scenario, will enter the life cycle of

$$N \rightarrow \left\lfloor \frac{N+N/2+1}{2} \right\rfloor$$

We will prove that the recursive function converges.

$$N = \left\lfloor \frac{N+N/2+1}{2} \right\rfloor$$

Proof using the deviation from the fixed point method.

The stationary point is L = 2.

Let’s consider the difference $D_i = N_i – 2$.

$$N_{i+1} - 2 = \left\lfloor \frac{3 \cdot N_i + 2}{4} \right\rfloor - 2 = \left\lfloor \frac{3 \cdot N_i + 2 - 8}{4} \right\rfloor = \left\lfloor \frac{3 \cdot N_i - 6}{4} \right\rfloor = \left\lfloor \frac{3 \cdot (N_i - 2)}{4} \right\rfloor = \left\lfloor \frac{3 \cdot D_i}{4} \right\rfloor$$

$D_{i+1} = [3D_i / 4]$, $D_i > 0 => D_{i+1} < D_i$

$$D_{i+1} = \left\lfloor \frac{3 D_i}{4} \right\rfloor, D_i > 0 \rightarrow D_{i+1} < D_i, Q.E.D.$$

The Collatz Conjecture

The Collatz Conjecture states that if you take any positive integer n and apply the following rules repeatedly, you will eventually reach the number 1.

The rules are:

If n is even, divide it by 2

If n is odd, multiply it by 3 and add 1

Let us draw an analogy between numbers and Harut-systems.

$^{2}(H, \ldots, h)_{N} = (H, \ldots, h)_{2N}$

The $(H, \ldots, h)_{2N}$ system represents a number A, such that A mod 4 = 1.

The $(H, \ldots)_{8n+2}$ system represents a number B, such that B mod 4 = 2.

The two divisions in a row indicate that the degradation actually begins with a number C, such that C mod 4 = 0.

Harut-mutation represents the 3x+1 function

Thus, for all numbers where the remainder modulo 4 is 0, 1 or 2, the Collatz Conjecture is verified.

Let us prove that for any number D such that D mod 4 = 3, the Collatz Conjecture also holds.

D mod 4 = 3 => D = 4k + 3

4k + 3 is an odd number => C(D) = 3(4k + 3) + 1 = 12k + 10

(12k + 10) mod 4 = (12k mod 4) + (10 mod 4) = 10 mod 4 = (8 + 2) mod 4 = 2 mod 4 = 2

Thus, any number D such that D mod 4 = 3 will lead to a number E such that E mod 4 = 2.

The hypothesis for such numbers E has already been proven.

Q.E.D.