

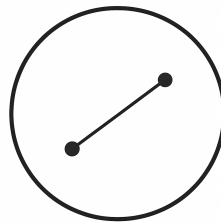
## Basic definitions

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



Harut-element

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



Harut-couple

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 curly braces.

## 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  $(H, \dots)$ .

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

## 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  $(H, \dots)_N$ , 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:*

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

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

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

## 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  $^m(H, \dots)_N$ , 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  $3 \times ({}^2S, h) + h$  as a Harut-mutation.

***Theorem:* The Harut-mutation is stabilizing; however, if applied recursively to a Harut-system requiring stabilization, the system degenerates.**

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

$${}^2(H, \dots, h)_N$$

$$\rightarrow (\text{stabilization}) 3 \times {}^2(H, \dots, h)_N + (h)$$

$$\rightarrow {}^2(H, \dots, h)_N + {}^2(H, \dots, h)_N + {}^2(H, \dots, h)_N + (h)$$

$$\rightarrow {}^2(H, \dots)_N + {}^2(H, \dots)_N + {}^2(H, \dots)_N + (h, h, h, h)$$

$$\rightarrow {}^2(H, \dots)_N + {}^2(H, \dots)_N + {}^2(H, \dots)_N + (H, H)$$

$$\rightarrow (\text{division}) {}^2(H, \dots)_N + {}^2(H, \dots)_{N/2} + H$$

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

After stabilization and division, the Harut-system  ${}^2(H, \dots, h)_N$  mutates into  $(H, \dots)_{N+N/2+1}$ . 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.

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

Or

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

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

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

We will prove that the recursive function converges.

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

Proof using the deviation from the fixed point method.

The stationary point is  $L = 2$ .

Let's consider the difference  $D_i = N_i - 2$ .

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

$$D_{i+1} = \lfloor 3D_i / 4 \rfloor, D_i > 0 \Rightarrow D_{i+1} < D_i$$

# 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.

# The Harutyunyan Conjecture

Conjecture: the Collatz Conjecture degenerates if its sequence eventually reaches any odd number  $n$  where  $n - 1$  is a multiple of 4 or even enough for the sequence to eventually reach a multiple of 4.