# DESIGN PRINCIPLES FOR SOFTWARE USING TECHNIQUES OF BIOLOGIC INFORMATION PROCESSING

**Karl javorszky**

***Abstract****: We propose to use a technique of counting 'in stereo', by using* ***two*** *counting systems concurrently. Research in number theory has brought up a very slight inner discongruence within the numbering system. The proposal is to root the definition of the term 'information' in properties of natural numbers, with the refinement that the extent of information is equal to the extent of being otherwise. The property of being otherwise can be numerically defined on a collection of pairs of natural numbers. An etalon collection of pairs (a,b) is used to demonstrate the concept of being otherwise. The property of being otherwise is based on the numeric fact, presented in oeis.org/A242615, according to which there are* ***two*** *upper limits of the number of logical relations existing among members of collections, namely sentences which state the existence of* ***similarity, 'n?'*** *contrasted to sentences that describe* ***differences, 'n!',*** *among the members of one and the same collection. The values* ***$f^{-1}$(number of different relations)*** *point back to slightly differing values of* ***n,*** *and this in the form of Δ ($f^{-1}$(n?), $f^{-1}$(n!)) {=, <, =, >, =, <, <<} for n {1, 11, 32, 66, 97, 136, 140}. The numeric incongruences appear to play important roles in Physics, Chemistry, Theoretical Biology. Here, in the context of software design, the practical relevance of being able to switch between* ***two*** *methods of describing one and the same state of a set, becomes apparent in the* ***increased efficiency*** *in the transmission of messages. Recognition of forms and patterns in (eg optical) multitudes becomes possible by using the properties of* ***cycles,*** *which are an artefact of periodic changes which sender and receiver subject the collection of tokens to, in a pre-agreed (or, in Nature, a-priori existing) algorithm. The theoretical foundations for the possibility of recognition of Gestalts are*

*presented to be implications of the inner incongruence of the numbering system, as shown by oeis.org/A242615. There exist* ***shortcuts,*** *abbreviated names for* ***patterns.*** *This is equivalent to a condensation of information.*

***Keywords****: Information, fundamental definition of; memory; learning; AI; enumerations of states of sets.*

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## Introduction

We ask the reader to conceptualize an inbuilt quirk in the numbering system. The quirk itself is pointed out in oeis.org/A242615.

*In essence, we make use of the inbuilt relative inexactitude to create a counting and enumerating system which is more detailed, more exact* ***by orders of magnitudes*** *compared to the counting – enumerating system presently in use. One may hope that the fineness of units used in quantum-based models can be achieved by using the model presented here, which creates fractions of units.*

Example:

We use *two* eyes to perceive the world. Of the *two* pictures delivered by perception, cognition creates *one,* integrated picture. It is a culturally anchored, common sense approach that we speak about the form and content of that *one* picture, which has been assembled, if we talk about the world. As senders of messages, we rely that the receiver has a comparable neurological apparatus at their disposal. If we say "House H is located at the corner of Streets A, B", we think of *one* landscape or system of coordinates, where we can point out a

specific location. We know that the recipient of this message will similarly employ *one* mental or physical map, on which they shall identify a location.

It would be quite unusual, if we said: "As seen by the ***left*** eye, House H is located at corner of Streets A, B, *displaced by the* ***perspective bias 'left'*** *by λ %; a*s seen by the ***right*** eye; House H is located at corner of Streets A, B, *displaced by the* ***perspective bias 'right'*** *by σ %.*" Aside of being unusual, there is nothing to say against this way of messaging the coordinates. The sentence is grammatical and we do have the technical means to establish exactly what we refer to by the terms *(λ, σ).*

**The main hypothesis** is that it is **worth while to refrain from integrating**, merging, fusing the two underlying pictures into one overriding picture, which we then by cultural tradition call The Picture. We do have the accounting tools and computer capacities to categorize and enumerate the slight deviations caused by factors (λ, σ). The slight fragments that distinguish the left picture from the right one are a nuisance in our current understanding. We do not question Nature's ability to merge the two pictures into one within our brain. It can be done, and it is very practical that it is done, and common sense requires that if we talk about pictures we mean the net result, and not the underlying additions and subtractions of some small details that are artefacts of factors (λ, σ).

The question arises naturally, what benefit would it bring if we transmit the same coordinates in a more circuitous way, by using two reference points instead of one to build up the picture. There is no sense in describing a picture more exactly, if it is and remains the same picture about the same state of the world.

The surprise is that there are additional benefits to using two reference systems instead of one, further and beyond of being exact for the exactitude's sake. In the example with the two optical pictures coming from two eyes, the focus is on

that part of the two pictures which are congruent, translatable into each other and refer to one and the same state of the world.

Using the two metrics in a fashion that is not optimized towards congruence, one sees interdependences in the system which are best approached in a context of economics.

It is more *efficient* to transmit a message in batches of *66* tokens which can be in any order (think of beads in a sack) than have *66* tokens in a sequential order (think of beads forming a necklace).

It is more *efficient* to transmit a message in batches of *6 * 11* tokens which are sequenced than have *66* tokens which can be in any order. in a sequential order (think of beads forming a necklace).

The term *efficient* refers to the number of tokens needed to carry a given number of messages. The question: *"How many logical relations make up one object?"* can now be numerically approached.

The stereo approach to counting is logically solid, is nothing but an added chapter to arithmetic. Its basic concepts run against deep-seated neurological and cultural conventions and habitudes, but not against rules of computing.

## Formal Introduction of the Model

1. What is the problem?

The meaning of the term 'information' needs to be rooted in the numbering system. Information is a phenomenon of Nature and also of our mental creations. It has to be understood as a fundamental property of our numbering system. The numeric facts shown in A242615 allow for using *two* reference points on **N.** Every measurement (statement, result) can be reformulated using principles and techniques known from interferences.

A second problem is, that in the theory in force until presently, it is not possible to *compress and unfold* information, like we observe Nature doing it in the genetic information transfer and in the memory. If one has only *one* **N**, one cannot collapse and recreate the rules that enforce properties of material assemblies. Having in addition to **N** further two variants of **N: Nλ, Nσ** allows protracted exchanges of *relation* ↔ *fragment of object.*

2. Why is it interesting and important?

It is high time to update the philosophy behind the fundamental axioms that restrict our ways of thinking about counting. In the 21st century, in the midst of a social revolution regarding individuality, we should switch from the idea of the unit being of one standard kind, indistinguishable from any other units, to the idea of the unit being an individual, contained in a cohort of individuals, which are by their nature both similar and different compared with the other units of the cohort.

The time of infallibility and persuasion by the sword has passed her best days. It is time to allow for Truth to be not the one-and-only variant but to acknowledge the existence of alternative truths in the abstract fields, too. Using a model in which alternative truths exist requires multidimensional thinking, which the human brain is not as good at as are computers. A world view built by computers needs some getting used to, but its utter boring rationality gives one a solid halt in a world that is full of logical rivalries, contradictions, local breakdowns. The picture is not as unified and harmonic as previously, but is much closer to reality.

3. Why is it hard?

European culture, rooted in Judeo-Christian concepts of monotheism, has been maintaining that its concepts fit into each other seamlessly, perfectly, free of contradictions and ambiguities. The Cathars, who have evolved a system of concepts of duality, have been put to the sword as heretic in the 14th century.

Their fate has been a strong warning for anyone experimenting with epistemological concepts of dialectic and tensions within the system model.

In our schools, children are taught, that *a+b=c* as a narrative has only one valid interpretation, namely that of *c,* where all differences that are present in the version *a+b* will **magically disappear** in the process of addition. While *a,b* can reasonably be assumed to be *two* ideas, *c* is imagined to be made up of *one* kind of units. The unification and regularization of basic units offers many advantages, yet the idealized version negates the existence of differences that were present in the form of *a,b.* Our children are offered a **heavily sanitized, family-friendly version** of the relations between the parts and the whole. In that version, taught up into our days, everything adds up finely, and there are neither rivalries nor conflicts among the parts of a whole.

We have been taught to use *one* sheet of millimeter paper as the background of any of our mental creations and explanations. This attitude may be practical and easy to administer, but it fails to take into account the actual reality of our living in a world that is based on *duality.* Whether it is *proton ↔ neutron, DNA ↔ RNA, female ↔ male, foreground ↔ background, sequential ↔ contemporary, breathing in ↔ breathing out, etc.,* we are confronted with empirical observations that call out our time-honored, traditional, idealized and simplified fundamental concept of *mono-perspectivism.*

We know of the practical advantages of using interferometry. Triangulation as a technique is a simple implication of using *two* sets of references (as opposed to the present basic system of ideas, in which all measurements are related to that one-and-only reference point of *0, Zero.*

As the examples with the picture in the brain, and in our communications among each other, show, having a convention that the *one, merged* picture is the only one to be referred to, brings forth advantages of uncomplicated and easy design principles for any system of thoughts that builds a model to depict Nature with. The unfortunate fact is, that Nature builds from the bottom up and

not from the top down. Before the merged picture can evolve, there must exist *two* versions of it, which become merged by faculties of our brain. The *two, slightly deviating* pictures are ***logically prior to*** the *one, perfectly fitting picture.* Nature builds on the differences, uses the differences while integrating the two pictures into one. In the organizational level of adaptive, self-correcting feedback loops (our neurology, eg), the remainders and rests of the two pictures are recycled. Those fragments of the two basic pictures, which after having served their usefulness as constituents of the merged picture, remain as fragments (like snippets of pieces of cloth in a tailor's shop) and are recycled by the brain (we encounter them in the form of dreams); unrecycled these rests and remainders perform the procedure of *entropy*.

4. Why do naive approaches fail?

For psychologists, it is a natural and fundamental truth that there exist several versions of truth, each equally legitimate and valid. In the STEM environment, the concept of multicausal genesis is not rooted generally yet.

The a-priori existence of *patterns* is an undisputable fact of Nature. The classical mathematical philosophy does not foresee any meaningful relations among natural numbers as they stand. The importance of ***cycles*** as porters of a-priori logical relations between amounts, places and time has not yet been recognized.

The *upper limits* for the number of sentences that can be said about a collection of *n* members have only been dealt with, so far, in the form of counting sentences that describe differences among the members before a background of similarities. The parallel measure, the maximal number of distinct sentences that describe similarities among the members before a background of diversities, has not been addressed yet. *The existence* of upper limits of relations on objects *f(n)* paves the way to ideas of thresholds, quality transformations, saturation: these ideas are fundamental in biology, but not yet working day concepts in the technical sciences. *The extent* of upper limits – as

we contrast the maximal similarity among objects with the maximal diversity among objects – opens up a completely new area of arithmetic, geometry and information transmission. The terms of trade in the *three-way Bazar* are **sliding *f(n).*** There exists a numeric table for the terms of trade among *{number of similarity relations, number of diversity relations, number of objects}.*

5. Why hasn't it been solved before?

Reason 1.: Ideologic, theological reluctance to depart from the unified concept. This is well reflected in the underlying idea of the Shannon concept of information: that messages transmission is identifying 1 of elements of **N** and communicating the algorithm to the receiver, who has at his disposal the same **N.**

The idea to use *two* measuring rods that are calibrated slightly differently, and use the immanent interference pattern between the two to identify 1 of elements of **N** as the background, and communicate the algorithm to the receiver, who has at his disposal the same interference pattern established by the slight relative mis-calibrations of the two measurement rods, this idea introduces concepts and techniques of *accounting*, with two different ledgers and one consolidated one. Maybe the idea is too much practical for number theory.

Reason 2.: Ehrenfels inhibition is the name for the observation, that humans' observational capacities are more challenged if the stimuli to be remembered are irritatingly close (similar) to each other. There appears to be a requirement of balance among similar and diverse so that our neurology functions best. We are, our neurology is optimized for an environment that contains in a relatively stable proportion input and impressions of a similar and of a different nature. We would not be optimized for a feature of Nature if that feature was not there. So there exists in Nature, by itself, a proportion between that what remains similar and that what changes. Tradition has it that one speaks about that, and uses as a background that, what remains and is the same. Relative to this background, processes can be observed to take place. Exchanging the

perspectives and inquiring what the picture looks like if changes and rearrangements are axiomatic and are used as background, before which we can observe that what happens regularly, inevitably, predictably is a mental dexterity which salesmen, diplomats, lawyers and psychologist are trained in, but not those educated in the technical sciences. The background and the foreground are of course merged in our cognition, and they are irritatingly similar to each other. Dissecting their properties needs some returning attention.

Reason 3.: Availability of computers is a key factor. It is absolutely impossible to gain insight into the interactions of *(a,b)* in the adult version of the story of their romance, without a computer.

6. What are the key components of my approach and results?

The building blocks of the model are:

a. the actors

We conduct a mental experiment with a cohort of pairs of natural numbers *(a,b).* The cohort we prefer to use contains pairs of members which each can have *16* different variants, yielding a cohort size of *136* so-called *logical primitives. (© M. Abundis).*

b. the habitat

The logical primitives undergo ***periodic changes***. We use *aspects* of the members, like *a+b, a-b, b-2a* to create ***sequential orders.*** When 2 aspects are concurrently the case (two periodic changes happen concurrently, like the Earth's rotation and the Moon's position), there exists a coordinate for a ***planar place*** which is given by the two relevant sequential ranks, for each primitive. Using such planes that can be arranged perpendicularly, by having common axes, we find *two* Euclid-type spaces. The primitives have by this method found ***a spatial position***, actually *2* of such.

c. the paths in the habitat

The spatial grid itself is built up by ***cycles.*** Cycles appear as constituents of a procedure that is known as 'reordering'. The topography of the habitat is rooted in the properties of the *similarity-related* cycles, the content of the habitat is determined by the cycles that are present due to the *diversities* among the members.

Using these building modules of the model, ***we observe:***

a. agglomerations

The collection being subject to more than two reorders at the same time, it is inevitable, that on specific spatial coordinates agglomerations of amounts come into existence. Like in traffic simulation: if sufficiently many cars are on the road traveling to sufficiently diverse and similar goals, pileups are unavoidable. The pileups come in ***types.*** (Like traffic jams can be differentiated on the number of cars involved, their momentum, composition of types of cars, etc.) As these agglomerations appear out of nowhere in our perception, although they had always been there, only we have not knowingly recognized them, like archetypes, we propose to name the various types of material agglomerations due to periodic changes that elementary logical symbols undergo, ***logical archetypes.*** The concept of logical archetypes should correspond to the concept of ***chemical elements.***

b. regularity

It is in the nature of periodic changes that they are a sequence of recurring states. The regularity allows a concept of ***evolutionary adaptability.*** Whether self-organization is an immanent property of Nature, can be decided by investigating the following hypothesis:

*Any random arrangement of the logical primitives is closer (more similar, easier to transform into) to an order based on properties of logical primitives, than to a different arrangement which is not based on properties of logical primitives.*

In our man-made habitat, it is easy to see that periodic changes impose a ***rhythm*** on the assembly.

c. predictability

Recurring states can be predicted.

A state can be identified/predicted by the appearance of such members of cycles which are known to be predecessors in cycles containing the constituent of the state to be predicted/identified. Thy cycles bring forth signs of change.

d. alternatives

The whole model is – but for the logical archetypes – a collection of alternatives. The alternatives have a numeric property of their extent of being otherwise. It is a huge accounting challenge, but it is theoretically possible to classify and tabulate all possible alternatives. Of this lot, only such need to be used, which are included in all ways of describing the collection: as a web of relations similarity-based, as a web of relations diversity based, as a content that is expressible in both descriptions, as a process that creates and reduces <*so-and-so much*> discongruence.

## Closing remarks

The present paper offers an invitation. Why don't you explore the completely new landscape, which gives a formidable background for quite many of established concepts from Physics and Chemistry?

The ideas presented here make the impression of being no less than revolutionary. This reflects less on the novelty of the new algorithms, but rather on the conservativism and rigidity required in the technical sciences. There is nothing extraordinary in the idea to assemble an etalon cohort of simple symbols and subject them to periodic changes. The question is what one reads out of the observations and whether one dares believe that one has proceeded logically and rationally while attaining the observed results.

In the context of software, basic design principles of, one can rephrase the general concept in terms of search strategies. We can address 1 member of **N** by sequential methods or by methods of queries (contemporary searches, based on categories of commutative symbols). It has been shown (cf A242615) that query-based searches are ~ *350 %* **more efficient** relative to sequential searches if the batch of information carrying vehicles numbers ~ *66*.

Using the cycles as indexes of relationships, one finds a **lexicon** which is by its immanent features **already cross-referenced.**

## Summary

It is unavoidable for the Reader, if they wish to continue investigations into cohesive counting, that they generate, program, set up their own *tautomat.* This extensive system of tables is comparable to the trigonometric tables, inasmuch as relations among numeric values are explicated. Please be aware that the model created by observing paths of strings of elements that belong to one cycle is in its complexity and versatility comparable to a **mother of all hybrids of Sudokus with Rubik cubes.** Instructions on how to build your own tautomat are eg in *Picturing Order.* The back-of-the-envelope laboratory prototype at www.tautomat.com is also available.

For a research institute which has insight, resources, circumstances to set up a public version of The Tautomat (like the Online Encyclopedia of Integer Sentences, a common resource), the advantages would be formidable. If you host the etalon laboratory animal, you will be the first to know, which variations and mutations that system of implications will more create, aside the few mentioned here. This could be a massive competitional advantage. One cannot lose a bet on the idea that ordering and reordering simple logical tokens will turn up typical patterns and that these manifold typical patterns will be of interest to Physics, Chemistry and Physiology.

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## Authors' Information

***Karl Javorszky:*** *clinical psychologist; retired. Loeblichgasse 13/16, A-1090 Wien, e-mail: karl.javorszky@gmail.com*

*Scientific Interest: Memory, How registering and reconstructing information is actually done, as a task of accounting and data processing.*