INFORMATION - FORMA

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Abstract

Introduction of **Forma** as a scalar linear homogeneous measure of information and **sForma** as the **Forma** of any member of a given specie implies the definition of **holon** as an indivisible entity .
The words , *forma* and *holon* are neologisms .

1:: Introduction

The main purpose of this paper is to define a scalar linear homogeneous measure function named *forma* that corresponds to the general concept of <quantity of information> of a set of **entities** all members of the same **specie** ; Vide 2.1.1 and 2.1.4 .

Mass and energy are <extensive> proprieties defined as scalar linear homogeneous set measure functions of a certain specie and the <quantity of information>, *forma* , will also be defined as a measure function of the same type .

If X is a sub-set of the specie , then expressions like mass of X, energy of X and *forma* of X , are legitimate .

The relation of two linear and homogeneous measures is a scalar and an invariant propriety of a given specie . These relations are the <intensive> proprieties . E.g.: sForma(mass)= forma(X) / mass(X), sForma(Energy)= forma(X) / energy (X) and sForma(Cardinal)= Forma(X) / Cardinal(X) .

It is easy to define *sForma* and *forma* as real variables in a continuous space

If *forma* and mass are real variables and *forma* is a continuous function of mass then *dForma*(Mass)=∂(*forma*)/∂(mass) is the density of *forma* referred to mass. and *dForma* defined in a continuous space corresponds to *sForma* in a discrete space .

Languages are very good descriptors of *forma* , texts can easily be translated without corruption and some of these translations can be encryptions .

Suggestions of application of the concept of *forma* to chemical and molecular biology are presented in chapter 5 and similar application of *forma* to languages are expanded in Ref. 3 and 4 .

The economic value of information , *forma*, is a very important commodity and patents can be issued enabling information procedures to be translated into economic values .

The introduction of *forma* as a measure must be understood as a conjecture until the conservation of <information> will be experimentally verified .

Recently, Hawking has presented the proof that **black holes** do not destroy information and consequently information is a conservative function , vide note N9 .

In conclusion, *forma* is entitled to the same treatment as mass and energy .

2:: Revision of Concepts and Reserved Words

The meaning and interpretation of some reserved words are presented and a few neologisms are introduced ..

2.1:: Entities, E, Attributes, A, Equivalence, Eqv , Specie, Spc and Image, I .

2.1.1:: Entity ,E, is any thing real or virtual that can be subjected to examination, observation or experimentation or is an active performer, observer or actor . An entity is called *agent* if it acts , testifies, observes . Things, objects, beings, actions, systems, emotions, thoughts, dreams are all entities .

2.1.2:: Attributes , A, are the result of observation of an *entity* using a *procedure* describing the method, instruments or senses used . Proprieties, predicates, characteristics, images are words with a similar meaning . Different attributes result from the observation of the same entity if different procedures are used. The choice of the procedure depends of the experiment . Attributes of an entity are innumerable .

*2.1.3:: **Equivalence, Eqv,*** the concept of *equivalent-entities* is introduced as follows : if entities E1 and E2 have the same set of attributes, A={a1,..,aN}, then they are declared *A-equivalent* . In games and formal languages, entities can be created and declared axiomatically absolutely *equal* but real entities are not equal but equivalent . Things are described by attributes and attributes are exemplified by sets of things that possess these attributes, this exemplifies the duality of things and attributes .
*2.1.4:: **A-Specie,*** is the set of all entities that are A-equivalent and will be symbolised by *A-Spc* or simply by *Spc*S. See also 2.1.3 ,
*2.1.5:: **A-Image*** of an entity is given by the set A of attributes . *Images* of unequal entities can be equal if all attributes of the set are equal not withstanding the entities may be different .

2.2:: Languages , Lng.

Learning how to describe things and attributes and to translate information implied the creation and development of *languages* .No restrictions are made to the scope of the word language and gestures, dances , sounds or computer instructions are all languages .

Language-communities are formed and the members can send and interpret messages versed in that language .

The number and the complexity of hmnan languages increases continually and the very finiteness of hmnan capacity limits drastically the nmnber of languages that can be learned by any one hmnan . Vide N1, N2 . N3 .

2.3:: Concept of *Holon*, H, Composites, Co .

*2.3.1:: **Holons, H*** . The Universe can be viewed as a *discrete system* and this concept implies the existence of *indivisible parts* which will be called ***holons*** . This indivisibility must not be understood as a real impossibility of dividing an *holon* but only that an holon will not be divided during the observation or experimentation . The *holons* that are present or participate should be classified in the respective A-specie , see 2.1.4, 2.1.5 .

In chemistry, atoms can be considered *holons* if no nuclear reaction do occur , in social sciences every living being may be an *holon* of the society, in cosmology a planet or a star can emulate an *holon* , in molecular biology , codons, a 3 letter word and a stop can perform the function of *holons* , see 2.3.2, and composites like DNA, RPA can be considered *holons* .

The appropriate application of the *holon* concept to real cases will depend of the system to be studied and the problem to be solved .
*2.3.2:: **Composites , Co,*** *holons* can be aggregated and these aggregates will be named ***composites*** which can be endowed with algebraical and topological structures, a molecule is a composite of atoms. .
*2.3.3::**Holons in Languages*** , the concept of *holon* is applicable to languages . An *holon* is a *simple sentence* , SiSe, Vide N3

2.4:: Support of Information , Sup .

Information is an attribute of an *entity* which is the *support* of that attribute , e.g.: electro-magnetic waves, sounds, dances, objects and texts of any language are all *supports* of information .

The amount of mass or energy needed , the speed of transportation are proprieties of the *support* and not of the information . The information contained in a text can be supported by a 1 ton marble stele and moved at the speed of oxcart or by a bunch of photons at the speed of light . Vide N10

2.5:: Remaining Universe , Rem .

When an *entity* is being observed or experimented it is necessary to explicitly list all the variables that describe the interaction between that *entity* and the "remaining Universe" , Rem . But Rem is immense and inexhaustible and its description would imply innmnerable variables .

The usual minimalist attitude is to choose a few variables and assume that all others are invariant or the system is perfectly isolated . It is simple but froth of errors and surprises .

2.6:: Entropy .

The concept of a formal "information" was introduced by C.Shannon half a century ago to solve problems of messages transmission. It was simple and sufficient although "information" was reduced to a single concept, the entropy of a distribution, which is a measure of homogeneity. Vide N4

3:: Information - *Forma*

Information is used in many contexts describing quite different concepts .

To define information as a scalar linear homogeneous measure it was necessary to introduce the reserved word *forma*, from Latin. A short list of proprieties of measures is given, vide note N5

3.1:: Information content or *specific-forma*, sF (..) .

Given a set of photo-copies of the same page where the text, *txt*, as been copied without errors then the texts of the copies and the original all ***contain*** the same *information* and may be considered members of the same *specie*, Spc.

The specie, Spc, is characterised by the invariant information-content of the text that is the *specific-forma, sF* .of the specie , sF(Spc)=sF(text), is an invariant and an universal propriety of the specie, Spc .

3.2:: Quantity of information or *forma*, F(..).

The quantity of information or *forma* of any sub-set, jSpc, of the *specie*, Spc, will be defined as follows: F (jSpc)=sF (txt). Cardinal (jSpc), (1).

As the cardinal is a scalar linear homogeneous measure and sF(txt) is a constant of the specie then F(jSpc) is also a measure of the same type , a scalar linear homogeneous measure .

3.3:: Continuous Representation

Discrete variables were used to introduce the concepts of holons, *specific-forma* and *forma*.

If the domain of forma is considered a continuum then the concept of *holon* is an infinitesimal quantity of an n-dimensional real space, X^n, with an algebraical and topological structure and a measure.

. The information, *forma F*, is a real continuous linear homogeneous function of the variables of X^n, with continuous derivatives until a certain the order q and q>=2 .

In view of these assumptions , the following formal sentences can be written :

$dF = \sum \partial F/\partial Xk .dXk$, k in [1..n] , (2) .

$dPk = \sum \partial Pk/\partial Xi .dXi$, i in [1..n] where $Pk = \partial F/\partial Xk$, (3) . Pk can be understood as a density on coordinate Xk and the general expression of dF is :

$dF = \sum \partial F/\partial Xk .dXk + \sum\sum(\partial^2 F/\partial Xk.\partial Xi) .dXk,dXi + etc.$, i,k in [1..n] , (4), Vide N6

3.4:: Sources and Sinks of *forma*

The creation of sources and sinks for information, *forma*, is obviously necessary and follows the procedure used when the scalars mass and energy where formally introduced . Vide N7

4:: Evaluation of *Forma*

The evaluation of the quantity of *forma* and *specific-forma* is the task of the researcher or the modeller dully specialised in the domain under consideration .

The suggestions that will be presented may not be directly applicable but they will eventually help in finding the correct ones .

4.1:: Composites , Co .

To describe a **composite, Co,** the following information must be collected :

a:: the set of the *holonic* species present .
b:: the formula of the members of the composite and the lists of members of each specie .
c:: the graph of connections , nodes and arcs .
d:: the coordinates of the nodes in a n-space .
e:: the isomeric order of the composite .

To describe a **process** more information is needed .

f:: the steps or stages of the process and its duration .
g:: the list of composites and *holonic* elements present in each phase of the process .
h:: complementary information : Vide N3 and N7 .

4.2:: Suggestions

4.2.1: *Holonic* species , HS .

The word "present" is preferred to "participating" , because eventually some non participating *holons* will be present in the reaction process .

The following symbols will be used: jHS={HS1,.,HSm} , (5), is the ordered set of all species of *holons* present and sF(jHS)={sF(HS1),.,sF(HSm)}, (6), is their *specific-forma* ,

In chemical reaction, the nucleons and the electrons of the atoms can be considered the *holons* of the system , the indivisible entities .

The *specific-forma* of a nucleon, sF(jHS) can be evaluated by the expression : sF(HSk) = p .sF(neutrons) + n .sF(protons), (7) , where n is the number of neutrons and p of protons, p , in the nucleon of the atom .

The *specific-forma* of electrons can be calculated by the expression : sF(electron)=orb, (8) , where orb is dependant of the level of the orbit of the electron.

4.2.2: Formula of a composite . Co or CO

The formula of a composite, Co={CO1,..,COg}, (9), is an ordered set of integers representing the number of atoms of specie HSk of the set HS={HS1,..,HSg}, (10), of the participating species in the composite .

The non participating atoms are represented by zero , e.g: : {0,2,0,0,3,1}.

The information content is sF(CO)=ΣsF(HSk), if COk≠0 (11) and the quantity of information is F(CO)=Σ sF(HSk) COk , (12) and k in [1,..,g] .

4.2.3: Graphs , Grf, nodes, Nod and arcs, Arc .

The nucleons correspond to the nodes, Nod and the arcs, Arc, represent the bounds between the nucleons . An equivalent description is a matrix NxN where N is number of nucleons and the elements of the matrix represent attributes of the arcs, e.g.: forces, capacity, *forma*, etc.. An arc is also represented by a pair of ordered integers [a,b] where (a) is the number of starting node and (b) of the finishing node .

If an arc transports more then one type of information, e.g.: electrical, chemical, sound, etc. two solutions are available : create an arc for each type or use multi types arcs .

The specific-information of an arc, [a,b], will be defined as a linear function of its capacity , sF([a,b])= p .Cap([a,b]), where p is a positive real number .

As the capacity of an arc binding two nucleons is not usually measured in chemistry, the suggestion is to assign 1 to the Capacity([a,b]) and adjust p to the values assigned to the other parameters .

4.2.4: Information of a composite , Co.

Specific-forma , sF(Co) and *forma,* F(Co) can be evaluated as follows :

- sF(sAtm)=ΣsF(sAk), (12) , sAk is a species of atoms present in Co . .
- sF(sArc)=ΣsF(sAr), (13), sAr is a specie of arcs used in Co .
- sF(Coo)=ΣsF(Coo), (14), Coo coordinates used in Co and sF(Iso)=isomeric order of the composite
- F(Co)=Σ sF (Xk).N(Xk), (15),X1=Atm, X2=Arc, X3=Coo, X4=Iso and N is the number of each item.

4.3: Dynamic Processes

To describe a dynamic process more information is needed . Time is considered discrete and the evolution of the process should be understood as a temporal successions of stages and in each stage a complete description of the system is made .

Eventually some complementary information must be evaluated, namely the time of residence of the system in each stage .

5:: Examples

To describe how *forma* could be applied some examples are presented : mixtures, chemical processes and molecular biology systems .

Considering languages essential to convey *forma,* Ref. 3 and 4 are suggested reading .

Ref 1 and 2 are good examples of the domain of application of the concept of the conservation of information although no explicit reference to information is mentioned in the text ..

5.1:: Mixture of p species

Mx is a mixture of p types of ingredients, members of the species (S1,.,Sp) .

The *specific-forma* of specie Sk, is sF(Sk) and the *specific-forma* of the mixture, Mx, is sF(Mx) =Σ sF(Sk), k in [1..p], (16).

The quantity of information or *forma* of the mixture is F(Mx)=ΣsF(Sk).Qk, k in [1..p] ; (17) and Qk is the quantity (or cardinal), of the set of the specie Sk .

The information , *forma,* regarding the mixing technology *sF(B)* should be added .

5.2:: Typical Transformations

The system , Sys, consists of two recipients, R1 and R2, both containing oil and water and Sys may not be in equilibrium .

The symbols used are : **o** :oil, **w** :water, **t**: temperature, **p**: pressure, **sF( )** :*specific-forma*, **F( )** : *forma* . All measures of *forma* uses the some unity .

R1 contains 100gr of oil and 200 gr of water and R2 10 gr of oil and 1000 gr of water .

The initial values are :
sF(R1)=sF(o)+sF(w)+sF(p1)+sF(t1), (16) sF(R2)=sF(o)+sF(w)+sF(p2)+sF(t2), (17)
sF(R1+R2) =sF(o)+sF(w)+sF(p1)+sF(t1) + sF(p2)+sF(t2) , (18)
F(R1)=100.(sF(o)+200.sF(w)+sF(p1)+sF(t1), (19) F(R2)=10.(sF(o)+1000.sF(w)+sF(p2)+sF(t2), (20)
F(R1+R2)=110.(sF(o)+1200.sF(w)+sF(p1)+sF(t1)+sF(p2)+sF(t2), (21)

Typical alterations of the system , Sys :

5.2.1: Elimination of oil in R1 but R2 is not altered . The consequences are :
sF(R1+R2) is not altered but F(R1+R2) is reduced by 100.sF(o) unities of *forma* .

5.2.2: Elimination of all the oil in R1 and R2 . The consequences are :
the loss of information about the specie *oil* and a reduction of *forma* F(R1+R2) .
In the strict context of the experiment, an extinction of a specie has occurred .

5.2.3: R1 and R2 are not altered but the two liquids are homogenized .
It is assumed that the formulas of oil and water are lost in the process but the densities, d1 and d2, of the mixtures are given .
The specific-*forma* is now sF(R1+R2)=sF(R1)=sF(R2)=sF(d1)+sF(d2)+sF(t1)+sF(p1), (22) and the *forma* is : F(R1)=QR1.sF(d)+sF(t1)+sF(p1), (23) ..
A similar loss of information occurs for F(R2) and F(R1+R2) .
The loss of the formulas of water and oil is not compensated by the information of the densities of the mixtures .

5.2.4: Regarding *sources & sinks*, these are supposed to be external for mass, energy and *forma*.

5.3:: Chemical Processes.

Some essential pre-conditions must be assumed :
a:: the elementary entities, *holons*, are members of the various species of nucleons and electrons that are present or participate in the process .
b:: atoms are composites of a nucleon and the assigned electrons ,
c:: molecules are composites of one or many atoms .
d:: no nuclear reactions do occur . Vide 4.2.1 .

The *specific-forma* of nucleons and electrons, will be given by expressions (7) and (8) respectively , see 4.2.1 .

The description of a composite implies acquiring information regarding the *holons* that participate in the composite and the graph that connects these *holons* . For example :
let {S1..Sn} be the set of species that participate in the building of a composite Co and {sF(S1)..sF(Sn)} are the respective *specific-forma* of the n species then the composite proprieties are
specific-forma : sF(CS)=ΣsF(Sj)+ΣsF(Arc-k)+ΣsF(Node-1 .Coord.)+sF(isord), (24) and
forma : F(CS)=ΣsF(Sj).Mj+ ΣsF(Arc-k).Ak+ ΣsF(Node-i .Coord.).Oi+sF(isord) , (25) , where :
Mj is the number of members of specie-j, Ak the number of arcs of type-k, Oi the number of coordinate order, isord the isometric order and coord the coordinates of the nodes in the chosen space .

5.4:: Chemical Reaction

The system is a closed vessel containing various molecules, eventually in a non equilibrium state and temperature and pressure are not uniform .
The initial quantities are: qO2 =10, qH2 =5, qOH=0.1, qO2H2=0.5, qOH2=5 and the final ones are : qO2 =0, qOH=0, qO2H2=0 .
Applying the law of conservation of mass, qH2 and qOH2 can be calculated .
The specific-forma of each molecular specie is given, for instance : sF(O2)=11, sF(H2)=3, sF(OH)=33, sF(O2H2)=72, sF(OH2)=67, (26)
The specific--forma of the system is initially
sF(System)=sF(O2)+sF(H2)+sF(OH)+sF(O2H2)+sF(OH2)=12 , (27) and in the end is
sF(System)=sF(H2)+sF(OH2)=9, (28) .
The quantity of forma of the System is F=Σ sF(X) .q(X), where X is the symbol of the molecule and q(X) means the quantity .
The Initial *forma* is F(Sys)=194.3 , the final is F(Sys)=46.2 and the *forma* lost is 148.0 which is discharged in some virtual or real sink .

5.5:: Polymer

Given the monomer, pfe, a polymer is constructed . The purpose is to calculate the *forma* and *specific-forma* of the polymer
The symbols are as usual, sF( )=*specific-forma*( ) , F( )=*forma*( ), n( )=number of ( ), t( )=type of ( ), Arc=connecting arc, isord=isomeric order and coord =coordinates of the nucleons .

The *specific-forma*(pfe) is given , sF(pfe)=123 .

5.5.1 Polymer with 2 equal monomers , Po2 .

Let : n(pfe)=2, n(Arc)=1, t(Arc)=1, an one dimension space is sufficient to describe the graph coordinates, X1= 0 and X2= 1 and n(iso)=1, out of 2 orders, sF(t(arc))=12, sF(x1)=sF(x2)=sF(coord)=4, sF(iso)=2 .

The resultant values of *specific-forma* and *forma* are:
sF(po2)=sF(pfe)+sF(t(arc))+sF(coord) +sF(iso)=141.
F(po2)=n(pfe).sF(pfe)+sF(t(arc))+2.sF(coord) +sF(iso)= = 264 .

5.5.2 Polymer with 3 different monomers , Po3 .

sF(pfe1)=123, sF(pfe2)=12, sF(pfe3)=23, n(pfe_)=1, n(Arc) =3, t(Arc) =1, two dimension space is necessary , X1=0, X2=1, X3=5, Y1=0, Y2=1, Y3=9 and sF(coord)=4 n(iso)=2, out of many orders and sF(iso)=9 , sF(t(arc))=12, the same for all types, sF(Coord)=8 .

The *specific-forma* and *forma* are:
sF(po2)=ΣsF(pfe-k)+sF(t(arc))+sF(coord)+sF(iso)= 187 , k∈[1..3] .
F(po2)=ΣsF(pfe-k)+sF(t(arc)).3+6.sF(coord)+sF(iso)= 251 , k∈[1..3] .

5.5.3 Polymer with 99 of the same monomer , Po99 .

. The sF(Graph) is enormous on account of the quantity of arcs and types of arcs and of the graph description in a 3-dimensional space needing much more information . The intricacy of the problem grows immensely with the number of atoms , see note N8 .

5.6:: Molecular Biology

5.6.1:: Introduction .

Genes are described in a language with an alphabet of 4 letters, the 4 nucleotides, adenine, cytosine, guanine and thymine (A,C,G,T) .

The language of the proteins is based on an alphabet having 20 letters (20 amino acids) and these amino acids can be connected and constitute proteins and life-forms are build with proteins

In molecular biology , the genetic instructions to build proteins uses a language of 3 words (codons) and a stop, the codons point to an amino acid from the given set of 20 amino-acids.

Note that the total number of instructions is 64 . but the cardinal of the set of amino-acids is only 20 .

The rungs of the helix of DNA is a word of a 4 letter alphabet and must be translated in mRNA a 3 letter language and these are further translated to tRNA that have the mission to find the appropriate amino-acid .

5.6.2:: *Holonic* bases

The choice of the *holonic* base depends of the problem to be solved , for instance :

a:: Evaluation of the *forma* of the rungs of the DNA helix .
Eventually the chemical example, 5.3, can be used as a paradigm and *holons* are the chemical species .

b:: Evaluation of the *forma* of the helix .
If the *forma* of the components of the rungs are known they can be considered the referential *holons* provided that they are not de-composed during the process .

This method can be continued and each level of intrincacy is build using , as *holons*, the composites evaluated in the anterior level , vide N8 and N10 .

6:: Conclusion

The concept of information was redefined as a conservative measure and given the name *forma* .

The examples and applications presented in chapter 5 show that there are essentially three difficult problems to solve :

a:: the definition of the set of *holonic* species . Remembering that it is essential that the members of the *holonic*-species of the chosen set are not dismembered during the process or reaction ,

b:: the attribution of values to the specific-forma to each *holonic*-specie must maintain a reasonable relation of values between species .

c:: when choosing values for all chemicals or biological processes it is of paramount importance that not only relative values but also absolute ones have been reasonably chosen to achieve a good and complete description of the composites .

d:: once the tasks (a), (b) and (c) are conclude, the description of a composite is quite a straight forward operation but a very intricate and time consuming one .

Notes

N1 The information acquired and processed by a living entity can be called knowledge . The partition of human knowledge in specialities using various scientific languages promotes the creation of islands of knowledge and a certain isolation of scientists of different specialities which is an unfortunate consequence.

N2 Language is any finite set of symbolic entities that enables the description of things , entities, objects, living beings, actions, systems, emotions, thoughts , dreams and communication . Languages were created with different finalities and receive adequate names , e.g.: idiomatic, heuristic, formal, codes , jargons, etc.

Languages are build upon a finite set of a *simple sentences, SiSe* and formally all SiSe can be expressed as an ordered triple [a,R,b], meaning that (a) is related to (b) and (R) is the symbol of the relation .

By definition or construction a SiSe can not be decomposed in other SiSe of that language .

Simple sentences can me viewed as the building blocks of the language .

If two things are described by the same set of sentences of a formal language then both things are supposed equivalent in an interpretive language .

If the same thing is described by different sets of sentence in two different formal languages but each set is a formal translation of the other set then the two sets are considered equivalent to describe that thing . Human languages can be provided with many functions and operators e.g.: Vide N3 .

N3 Functions and Operators

a:: Degree of Development , GD . Each language has an universal-repository of sentences, U-Lng, and \$(U-Lng) is its cardinal . Each member of the linguistic-community knows a sub-set, kU of U-Lng and the member linguistic development is GD=\$(kU) / \$(U-Lng) . \$ means Cardinal .

b:: Degree of Membership, GM . is a measure of the membership truthfulness of any given entity and GM an element of a reticulate with an universal , [-1..1] of real, and two connectives , max, min , with the following interpretation : GM=1 absolutely False , GM= -1 absolutely True and GM=0, means unable to evaluate GM . Any other suitable reticulate can be used .

c:: Degree of Confidence , GV . the degree of confidence of the truthfulness of any information depends of its source , author , channel of communication . The interpretation of GV is similar to GM .

d:: Translation, [a , b] . The word *text* will be employed to describe a structured and well formed set of sentences of the language .

The *translator* [a,b], transfers information of the set of sentences Ta of the language, La to the set Tb of the language Lb and the translator [b,a] executes the reverse operation .

If Ta=[b,a](Tb) then the pair {[a,b], [b,a]} is 1-1 relation . It is very difficult to conceive a 1-1 relation , for two non-formal languages .

e:: Aggregation & de-aggregation . Languages are provided with a pair of operators : ***Agr***, that aggregates simple-sentences, SiSe, to build composite sentences and ***Dga***, that de-aggregates composite sentences in the respective simple-sentences, SiSe .

N4 The most used model to define <information> is due to C.Shannon, $Sinf = \Sigma\, Pi\, Log(Pi)$.

This expression is applied to systems that can occupy N states and Pi is the probability associated to the state i and $Pi \in [0,1] \subset$ real , $\Sigma\, Pi=1$ and $i \in [1..N]$ and N is positive integer >0 .

The function Sinf measures the level of the homogeneity of the system . The typical states are :

a:: Pi = 1/N for all Pi and $Sinf=(1/N) .\Sigma\, Log(1/N) = Log(1/N)$, the system is complete homogeneous and the information about the position of the system is null, all states being equi-probable ,

b:: Pj tends to 1 and for all i<>j , Pi tends to 0 then Sinf tends to 0, the system tends to occupy permanently the state j the information is at a maximum .

It is assumed that the degree of homogeneity of the system is reasonably stable during the collection of data and that needs an appreciable time .

The formula of Sinf is a very old measure of homogeneity of a mixtures and used in thermodynamics .

N5 Not all measure-function can be instrumentally measured but are functions of other variables that are instrumentally measurable.

Some typical proprieties of measures are presented :

a:: sF(SP)=F(SPj)/cardinal(SPj) is an universal propriety of the specie, SP and $SPj \subseteq SP$.

b:: If Utxt is the universal set of texts of a language and PUtxt is a partition of Utxt and T1 and T2 are parts of PUtxt) then , T1 and T2 are disjoint sets .

c:: The transvection (a generalised product) of an intensive variable by an extensive one is an extensive variable if the pair of variables are conjugated . E.g.: power x time, force x displacement, tension x deformation, pressure x volume, temperature x entropy, all these products are energy and density x volume is mass and price x quantity is an economic value .

d:: The values of sF(Sys) and F(Sys) are :sF(Sys)=ΣsF(kSP) and F(Sys)=Σ sF(kSP) . Cardinal(kSPj) , where : k in [1..n] and kSPj ⊆kSP .

N6 The matrix representation is [Mki] and $Mki = \partial Pk / \partial Xi = \partial^2 F / \partial Xk . \partial Xi$.
The system is stable if the first partial derivative, Pk, is null and the matrix [Mki] is negative definite . Note that if q>2 then derivatives till order q should be written .

N7 These external sinks and sources are receivers and providers of mass, prM, energy, prE and *forma* prF .
Let F(SysI) and F(SysF) be the initial and final *forma* of the system, Sys, see N5.d ,
The conservation of *forma* implies that F(SysI) = F(SysF) + ΔF and ΔF is the amount of forma , positive or negative that must be transferred to the "system of Sources &Sinks of forma" .

N8 Complexity has a formal definition based on the Turing machine . In idiomatic languages the word complexity is also used with the meaning of *int icacy* . Here the two words will be used with different interpretations, complexity has the restricted meaning of *formal complexity* and *intricacy* means a very complicated and difficult problem to propose or solve but not necessarily a complex one

N9. "Hawking slays his own paradox" and proves that black holes do not destroy information, meaning that information like mass and energy are *conserved* . See Ref 5 . .

N10 The main scientific and technical effort has been to reduce the ratios of *forma* to mass, volume, area, energy and price .
If a new support for *forma* would be discovered that could propagate at a speed not limited by the speed of light, then it would be possible to revise the usual theory of the creation of the Universe . .

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