Programs and Problems

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Abstract: *The 'translation' of the living beings 'Recognition' process into a 'formal language' is a very arduous task. In general, formal and computer languages were not designed to process inductive reasoning, redundancy, context appraisal and semantics interpretation. Some themes considered controversial are presented.*

Keywords: *Language, information, proximity, translations, partitions.*

1. INTRODUCTION

'Recognition' is a vital function for all living beings.

Science is founded on a limited number of observations that are generalised and translated into a formal language. It is assumed that all formal theorems are 'true' and have a real world 'image' also 'true'.

The following themes are controversial and deserve attention.

1. Projection space, compacts and continuity, metrics and Cartesian products, partition and precision, minimum pixel, 'Heisenberg incertitude' and finite range and field. Nature is built up of finite sets within finite sets.

2. Instrument, filter, translator, converter, etc. are all formal 'relations'. The expelling of unnecessary information energy and/or mass is a vital function. The 'mensure' of the elemental information of a member of a relation is also an important problem.

3. Choosing partitions operators and filters. The classical cyclic network is the paradigm. Real world partitions are finite because pixels have finite dimensions, fields and ranges are also finite. Back and forward tracking has the objective to minimise the information to be collected and or transported.

4. Problem solving requires the participation of three types of 'actors': external operator, e.g. human; Machine/Program - M&P; Remaining Actors - Rac. Actors M&P will be classified in accordance with their capacity of recovering data/programs (Rcv), decision making (Dmp), learning by experience (Lrn) and generalisation/induction (Gid).

   Rdlg is the ordered set [Rcv,Dmp,Lrn,Gid] and @ symbolises the 'intelligence level'.

5. Learning.

   The main tasks are the definition of an error-function, a correcting procedure, a tutor and the level of precision.

   Learning / individual consists in reducing the error between the outputs of the pupil and tutor.

   Learning / aggregates of individuals is the generalisation of the learning tasks to sets of individuals. The properties of an 'aggregate' depend of the individual and of the network of internal and external bounds.

   Learning / concatenated aggregates. An aggregate of level n is built with aggregates of levels k<n. An individual is an aggregate of level 0.

2. RECOGNITION

'Recognition' is a vital function for all living beings. Survival means to be able to recognise foe and friend and the membership status of both you and the other. Artificial recognition is a novel scientific endeavour.

Science is grounded on a finite number of observations, which justify the preposition and adoption of a theory and/or model that is deemed able to 'emulate' or 'simulate' the reality.

The model is transcribed into a suitable 'scientific' language and further translated into a 'formal' one.

The formal 'image' will be endowed with the properties of the selected formal space. It is assumed that all theorems that can be deducted in the frame of the adopted 'formal' language are 'true' and have a counterpart in the 'real world'.

The adopted 'model' or 'theory' will be, for some time, the orthodox description of that 'bit' of scientific universal knowledge.

Contradictors are declared ignorant, or heretics and chastised and eventually expelled.

If the last situation occurred then heretics may have the opportunity to preach elsewhere and be able to create a new 'theory', that may replace the 'old' one.

The scientific progress is a discontinuous process. The purpose of this paper is to infiltrate in the readers' mind some 'doubts' and ask 'questions' which are the preliminary steps in the devilish path of heresy.

A) Choice of Projection Space.

The credibility of <formalised knowledge> is very dependent of the chosen 'formal' space.

The adoption of a 'formal space' should be clearly discussed and justified. Some typical situations are presented.

A1) About Compacts and Continuity

Solids, liquids, gases, plasmas, aggregates and societies, etc. are not similar to a 'formal compact' and their functions are essentially discontinuous.

One can approximate 'continuity' by substituting 'point functions by 'set functions' and the use of an 'averaging' process. The set above referred may also be named 'ball' or 'pixel'.

The following questions may arise:

- The 'objects' included in the 'pixel' are they enough to justify an 'averaging' process?
- Voids and lacks of 'compactness' are also smoothed by time and space averaging but their localisation is lost in the process. These voids are hidden traps with no 'image' in the formal model.
- Is the volume or the shape of the pixel adequate?

Vide Note 1.

A2) About projecting n-uples into vector spaces.

A n-uple is an element of a Cartesian product and a n-vector space is a Cartesian product endowed with a metric.

In general, the $\Re^n$ space is assumed and no justification of its choice is given.

Vide Note 2.

A3) Partition and Precision

Observation and acting instruments need 'pixels' with a finite minimum dimension, because all mensures need a minimum space and take a minimum time.

Lower limits in all directions induces a minimum volume and a minimum 'fineness' of the physical partition.

The experimental field of observation or experimentation is finite. Finite range and finite 'pixel' imply finite physical partitions.

The 'precision' of an instrument and topological 'fineness' are both limited by the 'fineness' of physical partition.

In physics the 'Heisenberg incertitude' defines a universal lower bound of physical partition.

Nature is built up of finite sets within finite sets and there is always a minimum 'generalised' volume of a n-dimensional ball or pixel.

In a dynamic process, spatial and time dimensions can be interchanged, sometimes it is better to get a high frequency succession of 'blurred' pictures then a low frequency one of 'first class' pictures.

The world is better described with integers, rings and modules then with reals and vectors.

B) Operators, instruments, filters.

B1) Translation

) <Translation>, version and retro version, has here the very broad meaning of a transfer of information between two languages. Information, energy and mass translation are acceptable expressions.

Translation is generally not very efficient operation and some information, energy and mass is lost to sinks.

Vide Note 3.

B2) Reconstruction.

Reconstruction of a noisy, deformed and or weak 'unit step' signal input and the output a perfect 'unit step' one.

If successive reconstruction are made before the signal becomes irreparable then the information content is preserve dynamically.

Although information is lost, the deteriorated signal can be reconnoitred and a 'good' one is emitted.

B3) Expel

The conversion of the input information content is partial and the remaining information is expelled out (lost, destroyed).

This destruction is essential and vital.

If all photons, phonons, pheromones, pressure, chemicals, etc., reaching the senses and body of a living being would be forwarded without expelling 'unnecessary' information then the dimension and complexity of the brain would be amazing.

There are essentially the following methods of 'expelling' unwanted information:

1. Space dimension reduction.

Projections where the input is a n-mult or a $\Re^n$ and the output is a m-mult or a $\Re^m$ and m<n.

Vide Note 4.

2. Reductive relations.

Given a set of p numbers the relation outputs q<p numbers, in general q=1. Sum, product, moments, averages, integrals, functions, conversions of set functions to point functions are typical.

Vide Note 5

3. Noise reduction.

'Noise' is any non wanted intruder in communication. Certain types of 'noises' are identifiable and can be filtered.

Vide Note 6.

B4) Mensure of Information

The 'mensure' of information content is an essential problem that needs very careful handling:

The following procedure is proposed when the domain must be partitioned in a finite number of parts, N.

The parts must the have same 'information content', IC, given by the following expression : IC = Log(2)/Log(N).

Examples of (N^{IC}) relations: 2^{1}, $100^{.301}$, $1000^{.150}$, $10000000^{.050}$, $10000000000^{.033}$.

Vide Note 7.

C) Choosing Partitions

The theme will be presented based on a classical cyclic network of 'instruments' with a centralised decision maker.

C1) Instruments.

All 'instruments' have a similar basic structure:

1. Information sources(inputs),
2. Information exits (outputs),
3. Local memory,
4. Operating centre and connecting network.

Note that each type of 'information' has a specific 'language', and a corresponding physical 'support'.

Vide Note 8.

C2) The building blocks

The 'instruments' participating in the cycle are:

1. <Observation Instruments> or <sensors> <S>.

The main functions are described in C1).

The set of 'images' transferred by <S> can be described as the 'image of the world' as seen by the set of instruments.

Vide Note 9.

2. <Reducing relations>, filters, <F>.

The 'reducing filters', F :: (F1..Fm), operate in a similar manner, the network describes the sources of information and the destination of the outputs. <F> replaces <S> in all symbols referenced in note 9.

3 <Decision Maker Operator>, <D>.

The decision making process is 'mutatis mutandis' similar and the objective is to conceive, decide and command the <acting> 'instruments.

4 <Active or Executing Instruments>, <A>.

The main function is to act upon the 'outside world'.

The Symbol <A> (acting) will be employed.

Finally, the 'outside world' will react to the actions <A> and the <observation instruments> will sense that reaction and the cycle is closed.

C3) A paradigm for networks.

The proposed paradigm is the 'minimisation' of the information fluxes in the network, as for instance reducing the transfer of unnecessary information, increasing the local memory or the accessibility to the central memory, limiting redundancy, etc.

The task to be performed is to check if all instruments comply with the paradigm 'fluxes minimisation'. A systematic process of checking the network is proposed, starting at the decision centre, <D>.

1. Back-tracking.

Back-tracking means to follow the network but in reverse sense, e.g.: Decision >>> Filters >>> Sensors.

Vide Note 10.

2. Forward-tracking.

The decision centre,<D>, is also the starting point, but the sense of tracking is direct : Decision >>> Acting Instruments.

Sometimes it is necessary to include an intermediary step, <P>, preparation.

E.g.: Decision >>> Preparation >>> Acting Instruments.

The paradigm is the same.

3. 'Outside world'.

The difficult problem is the creation of a model of the 'outside world' and the corresponding formal description, complying with the paradigm of 'minimum information flux', is difficult and time consuming.

Vide Note 11.

D) Problem Solving.

The presentation of various types of relations ('translations'), and the introduction of some 'reserved' words and their symbols is available in Note 12.

D1) Programs classification.

The principal 'interventors' or actors, in the process of problems solving, are:

- Hop - external operator, generally a human operator.
- M&P - Machine & Program pair.
- Rac - set of other actors that take part in the process.
- Act - complete set of actors. M&P+Hop+Rac = Act.

The dialogue between the Hop and M&P is possible by means of two successions of translations:

Hop>>P>>M and M>>P>>Hop.

The M>>P and P>>P translations will depend of the level of 'intelligence' and the amount of 'information' the pair M&P is authorised to possess and or accede.

Regarding the concept of 'intelligence', @, see note 13.

Programs will be classified using 4 attributes, namely:

- Rcv - data and programs that M&P is authorised to accede.
- Dmp - Degree of liberty to make decisions, solve ambiguities or generate information that is lacking.
- Lrn - learning ability.
- Gid - enabled with generalisation capacity and with inductive reasoning.

The classification is given by the ordered set:

Rdlg = [Rcv,Dmp,Lrn,Gid] and all 4 members take values in the interval [0,1] of $\Re$.

Some typical programs

1. Low intelligence or Slave programs, @<0.1 Rdlg=[r,0,0,0] and r>0.

Program has some recalling ability, 0<r<1, but can not take decisions, learn, generalise or inductive reasoning, which are all accomplished by the 'human' operator.

Very low intelligence, @<0.1.

Vide Note 14.

2. With limited 'decision making' capacity.

0.1<@<0.4, Rdlg=[r,d,0,0] and r,d>0.

The program can recover information and make decisions of a certain class, the remaining decisions are made by Hop.

No learning and or inductive abilities are provided.

Less then average intelligence, 0.1<@<0.4.

Vide Note 15.

3. 'Learning' ability is provided.

0.4<@<0.6, some 'low level' Dmp is provided.

Rdlg=[r,d,l,0] and r>0 and d>0 and l>0.

The program can recover, make decisions and learn.

The learning modules are sets of relations where the parameters must be adjusted.

The learning process consists of exploring the 'outside world' until the 'best' set of parameters is obtained.

A procedure is available to determine the 'value' of a set of parameters and a definition of 'best set' is given.

Learning is a trial and error procedure where errors and victories are memorised.

The corrective procedure to generate a new set of parameters is a function of the previous set and the 'value' of result.

The combinatorial explosion is the main problem.

The possible improvements are : to increase computation speed, parallelism and the development of 'deceiving' heuristics in n-contenders games.

Vide Note 16.

4. 'Induction' procedures are provided.

0.6<@<1, some 'High level' of Dmp.

Rdlg=[r,d,l,k] and r,d,l,k >0.

The 'human operator', Hop, gives complete freedom.

The program contains 'inductive' procedures that enable the creation of new rules (relations) and data, either by generalisation or by 'inductive' reasoning.

Vide Note 17.

D2) Types of Learning.

Various types of learning are available.

1. Learning with a tutor.

The pupil and the tutor answer the same question using procedures PP and TT and give answers Op and Ot respectively.

Prx(Op,Ot) is the 'proximity' of (Op,Ot), in general, the field of Prx is $\Re$.

Vide Note 18.

The main tasks are:

- To design a functional Prx to endow the cartesian product with a quasi-metric.
- Construct a procedure to correct the parameters, pa of PP.
- Define the lower level of Prx, e.g.: Prx< Prx0= 0.0001.

Vide Note 19.

2. *Learning without a tutor.*

It is generally reducible to type 1.

The difference results from the definition of Prx.

Vide Note 20.

3. Learning and Aggregates.

The concepts of 'holonic entity', HL (holon) and 'aggregate', 'society', community, AG, are best explained with examples:

molecules, community of bees, human societies are 'aggregates' and the corresponding 'halons' are atoms, bees, humans.

The 'attributes' of an 'aggregate' depend not only of the type of 'holons' but also of the <network> of internal and that connect the individual holons and these with the external world .

3.1 Problems regarding 'aggregates' :

- Identification of the type of 'holons' and choosing the best 'attributes' to describe them.
- Idem for the 'connecting network'.
- Investigation of the following correlations:

  (holon attributes >> aggregate output)

  (network " >> " ") .

3.2 The 'output' of an aggregate has, at least, two extreme interpretations:

- The complete list of the outputs of every 'member' of the 'aggregate' , the holonic output .
- The output value of a reductiv_function Fr, of the holonic ouputs

The second interpretation is more productive and frequent.

Vide Note 21

3.3 Learning with a reductiv_function Fr .

A very important property of Fr is that the errors made by individual holons may not overly influence the final value of Fr , e.g.: average, somatorium , etc..

That explains why with imperfect holons and textures one is able to obtain very precise results at the Fr level .

The main problem is : given the types and number of the participating 'holons' and the 'network' of connectives, to determine the final 'aggregate output' .

These are the problems being investigated now in chemistry, bio-chemistry, biology, sociology, economics, climat, etc. ,

Vide Note 22 .

4 Learning and Concatenated Aggregates .

The next step is to create an 'aggregate' of level 2, (2_agregate) and its members are aggregates of level 1, (1_agregates).

The members of 1_aggregates are holons, (0_agregates).

Typical experiments can be divided.

4.1 The 2_agregate is composed of two 1_agregates of the same type. The cardinals of the 1_agregates may be different.

4.2 The 2_agregate is composed of various 1_agregates of different types and cardinality.

Tests on 'predator capacity' of 1_agregates and the evaluation of the dynamical stability of the 2_agregate should be made.

4.3 Influence of the 'outside world' on 2_agregates and vice-versa.
4.4 Extension to n_agregates, n>2.

NOTES

1. The usual method to build a pixel comprises:

1.1 Initial configuration is a n_dimension real space nRS, with n-1 special dimensions plus a time dimension.

1.2 Construct a n_dimensional parallel_tropo nPT, a sub-space of nRS, that can be moved by translation.

The position of nPT is defined by the coordinates of a given interior point, P, of nPT.

nPT contains many 'objects', molecules, atoms, etc. and these 'objects' have 'attributes'.

1.3 Define U as a set-function of nPT.

As nPT can be moved the value of U may also alter.

Normally U is mensurable by means of an 'averaging' process and is a real-value function.

1.4 Define the function W(P)=U(nPT), where P is a point of the nPT and W is also real_valued function.

1.5 Any domain of the n_space can be partitioned using nPT as a pattern for the partition.

If the domain is finite and the nPT is finite in all n dimensions then the cardinal of the partition is also finite.

2. An example of n-uples.

Symbols: W ordered set [Colour, Odour, Volume, Price ;≥], Colour ordered set [R,Y,G,B;>], Odour not ordered set [s,p,q], Volume real, Price integer, ≥,> order symbols.

The definition of the following Cartesian product can always be performed and is a legitimate operation, e.g.:

U = Colour x Odour x Temperature x Price.

Any element Wk of W is a 4_uple symbolised by Wk :: (R, p, 30.7, 8)

If colour was refereed by frequency and odour by a scale number, as for instance 3.5 and 34 respectively, then Wk would be represented by (3.5 34 30.7 8) and it is tempting to project Wk in $\Re^4$.

Sometimes it is very difficult to create a metric and justify it semantically.

3. Translation

The latin word 'Traductor', TR_, will be reserved to represent the following complex operation:

TRi Conversion of the information input into the information output. L1 and L2 are the sets of languages used in input and output respectively.

TRe Conversion of energy inputs of types E1 into energy outputs of types E2.

TRm Conversion of mass inputs of types M1 into mass outputs of types M2.

The triad TR :: {TRi,TRe,TRa} is the description of the interfacial operations between two or more entities.

It is feasible to endow the triple with a metric enabling transfers among the three members of TR.

The members of TR operate with an overall inefficiency and some physical models are based on it.

4. Space dimension reduction.

The input is a n_mult or a $\Re^n$ and the output is a m-mult or a $\Re^m$ and $m<n$. E.g.: (1) input is a 3-dim. object and the output is its volume; (2) projections and sections of objects.

5. Reductive relations.

Given a set of p numbers the relation outputs q numbers and $q<p$. If the initial set is a function and $q=1$, the relation is called a functional.

Given the individual weight of 10 boxes, output only the total weight.

Given the hourly temperature mensurements, output the max. and min. values.

Given a list of 4 characters numbers, output those that contain the succession '247'.

If the energy input>0.5 units then the output is X='true' else X='false'.

'Simil' is an instrument that given 2 photos outputs a number S of the set [0..100]. The procedure is: " if the similarity coefficient S is above 90 then the 2 photos are of the same person ".

Given a density distribution function, the moments of that function is a functional.

6. Noise reduction

'Noise' is any no wanted information intrusion in communication.

If a mixture of speeches, each conveying the some amount of energy and information content are simultaneously transmitted, it is a pure semantic question to declare which speech contains the 'information' to be retrieved and which are the speeches contributing to 'noise'.

If the 'noise' belongs to a type for which a filtering process is available then the 'noise' can be filtered and the information content of the elected speech can be retrieved.

7. Mensure of Information

The 'mensure' of information content is an essential problem that needs careful handling.

The following procedure is proposed based on the 'fineness' criterion expanded in A3.

7.1 The 'fineness' of a formal partition is lower bounded by that of the 'real' or physical problem and postulating that the range and field of all instruments are finite then the 'universal set', U_set, of all feasible partitions are finite.

Crd(U_set) is a positive finite integer.

7.2 The parts (pixels, balls) of a partition may be adjusted to their emplacement in the region. Sets with large cardinals are used when a high precision or descrimination is needed.

7.3 A procedure is provided to evaluate the information that is contained in a set.

7.4 Partitions may be subjected to conditions, e.g.: < all parts must have the same 'information content' >. Functionals are the formal translation of these conditions.

7.5 To mensure the 'information content', IC, the partition must comply with the following conditions:

- All parts have the same 'information content', IC.
- The value of the 'information content' of each part is:
- IC=Log(2)/Log(N).

8. Cyclic network and instruments

The reference is a classical cyclic network of 'instruments' with a central decision-maker and it is assumed that each 'instrument' has a similar structure.

8.1 Information inputs are classified in 2 types, Ip_set - primary or useful information for the correct operation of the receiving 'instrument', and Is_set - the secundary information or noise.

8.2 Information outputs are similarly classified, Op_ set and Os_ set are primary and secondary output information respectively.

Generally 'noise' is sent to sinks.

8.3 A local Memory, M_, is available.

8.4 An operating centre, C_ connected to Ip_, Is_ , Op_ , Os_ and M_ is available and its mission is to centralise the operation of the 'Instrument'.

8.5 A network connects all instruments and these with the 'outside world'.

Note : Each type of information has a specific 'language', L, and a corresponding physical 'support', S.

9. Observation Instruments or sensors.

Some typical symbols regarding 'sensors', S, are presented:

S :: set of the < Observation Instruments >, S1..Sn).

n :: number of instruments.

IpS :: set of primary inputs, (IpS1..IpSa).

LIpS :: set of languages used in IpS.

IsS :: set of secondary input, (IsS1..IsSb), (noise).

LIsS :: set of languages used in IsS.

OpS :: set of primary outputs, (OpS1..OpSc).

LOpS :: set of languages used in OpS.

OsS :: set of secondary outputs, (OsS1..OsSd), sink).

LOsS :: set of languages used in OsS.

MS :: memory.

10. Back-tracking.

Some additional symbols will be introduced based on those mentioned in Note 9.

XN :: neighbourhood of X, is the set of all points directly connected to point X.

X is the starting point or the arrival point.

SXN :: sub-set of NX, where X is the starting point.

AXN :: sub-set of NX, where X is the arrival point.

Starting at the decision centre, <D>, then backtracking to the filters <F> and finishing at the sensors <S> level, the following checking operations should be done.

a) Evaluation of the information both the principal Op_ and secondary Os_ , sent to the instruments belonging to S_D

b) Evaluation of the information received, (Ip_ and Is_) from the instruments that belong to A_N.

c) Verification of the 'fineness' of the partition of the domain of each variable. An exaggerated partition would implicate high precision instruments, namely sensors.

d) Reduce the amount of secondary information transmitted to successor instruments, namely at the 'filtering' level.

e) All spurious information that could have been eliminated by an instrument, should not be transferred to the next one.

f) If necessary, distribute the 'memory' to reduce high fluxes of information between 'instruments'.

11. Forward-tracking.

The amount of information to be fed to the actuators, <A> by the decision centre, <D> depends on:

a) The amount of processing that could have been done by <D>.

If necessary an intermediary instrument named <P> (prepare) must be added between <A> and <D>, with the task of prepare detailed instructions to be delivered to <A>.

The job of <P> is to 'deduce' all theorems and corollaries that are the formal interpretation of the commands issued by the decision maker <D>. The <OpD> plus the (MP) retrieved from the memory of <P> should be enough.

b) The 'outside world', all along the cycle, is receiving information from various sources, namely, OsS, OsF, OsD, OsS, OsP and OsA, the discarded information to sinks, and OpA the principal information.

c) The 'outside world' responds essentially to the 'actions', OpA and these reactions are 'observed' by the instruments <S>.

The cycle is closed.

The most difficult problem is the description of the 'outside world', with the minimum information input and output.

12. Relations.

Some 'reserved' words and their symbols are introduced on account of their special interpretation in the present context.

'Data' has the same meaning as 'information', e.g.:

DV(variable), DC(constant), DP(parameter), DH(past/historical).

'Relation' R_ or X:>Y or X:=Y or (X,R,Y), are equivalent formulae and can be interpreted as 'translation' of X into Y by means of R_ , e.g:

D:>D' <Data relation>, D and D' are data.
R:>D <Functional F>, relation R is converted to data D through F.
R:>R' <Transformation T >, relation R is converted into the relation R' through T.

The symbol :> means that the relation reduces the information content, IC(Input R> IC(Output R').

The symbol for non reducing relations is := 'Transformations' or 'transforms', T, are generally non-reducing relations, R:=R'. If the inverse relation, IT, is also non-reducing one can write symbolically IT*T = 1.

13 'Intelligence'

Using the concept of 'intelligence' of a 'living beings', namely humans, as a reference or paradigm, one can order by 'intelligence' a set of M&P.

'@' is the symbol of 'intelligence level'.

14. Very low intelligence, Slave programs, @<0.1 Rdlg=[r,0,0,0] and r>0.

The M&P, is fed with Data, D, and a redutive relation R=(D,R:>,D'), both written in a suitable language.

The solution D' is the result of the strict fulfilment of the instruction contained in the expression D'=R(D).

Some sub-species of slave programs can be given:

D=DV, only variables, DV, change but the parameters of the program are invariant.

The program can recover 'historical information', DH, namely from data-banks, symbolically, D=DV+DH.

The parameter of the program are invariant.

The program can operate with different sets of parameters.

In general, D=DV+DH+DP.

Note that both Rcv and @ have been increasing.

15. With limited 'decision making' ability 0.1<@<0.4, Rdlg=[r,d,0,0] and r,d>0.

The following examples are frequent:

Data is lacking. The program can invoke a procedure that outputs the needed information, e.g.: using a random function, or the last value in memory as a substitute.

Exhaustive choices. The program uses various modules of relations and or data but no addresses are given or suggested.

The program can invoke a functional that outputs a 'figure of merit' of any chosen relation or data.

If the relations and or data are members of finite sets then all possible addresses can be tested, their respective 'figures of merit' evaluated and the 'best' solution chosen.

The 'functional' is strictly ordered and a formal translation of 'best' choice is available.

16. 'Learning' ability is provided.

0.4<@<0.6 Rdlg=[r,d,l,0] and r>0 and d>0 and l>0.

Some examples:

Concave & convex and uni-connected sets. Many attractors are present and the main difficulty is to come out of a local extreme which is not the extreme of all local extremes.

Concave & convex and multi-connected sets. An even more difficult problem on account of voids.

17. Inductive faculty

If the access to data and relations is not restrained some generalisation procedures can be implemented, e.g.:

<if Dg has bitten John> and <Dg is a Dog> and if the number of humans bitten by Dg reach the level of 5 then <Dg may bite any human> is an legitimate generalisation.

Generalisation is 'fail safe' posture.

Given a set A and subset B of A and a sentence <d> that was proved 'true' in B declare <d> also 'true' in A.

Find the verbs that are symmetrical or reciprocal.

Access to texts versed in language L are available.

These attributes are dependent of L.

18. The following symbols will be introduced:

Iv is an admissible input (or question).

O_ is the answer to a question.

pa is the set of parameters of the learning procedure, PP.

Op is the pupil 'answer', Op=PP(Iv,pa),

Ot is the tutor 'correct' answer, Ot=TT(Iv),

Prx(Op,Ot) is the 'proximity' of Op,Ot. In general the field of Prx is $\Re$.

19. Some typical examples:

1. The input Iv and the Tutor function TT are invariant.

2. The input Iv varies slowly and the tutor function reacts accordingly. The learning speed is higher then that of the variables. The objective is to maintain proximity value constantly below the limit Prx0.

3. Let [I] be the admissible set of inputs, [Iv] a subset of [I] considered 'representative' of [I]. Ivj is a member of the set [Iv]. If the 'proximity' satisfies the following condition, Prx(PP(Ivj,pa),TT(Ivj)) < Prx0, then the pupil has passed the exam and the parameters pa are accepted as adequate.

Interpolation and or extrapolation are justifiable?

20. Learning without a tutor.

Can be converted to learning with a tutor.

The difference results from the definition of Prx.

Prx'(PP(Ivj,pa)) = Prx(PP(Ivj,pa),TT(Ivj)), vide Note 19.

21. Aggregate vs holons.

The properties of a nylon rope are the target issue and the problem is what to do at the holonic level, namely the properties of the molecular constitution, the network of connections to build a fibber and how to entangle the elementary fibres.

22. Testing aggregates.

Given the attributes of the members of the aggregate that are similar except for some parameters that can suffer small variations, the problem is to find what type of society will be created, will it be stable, divergent or chaotic.

Regarding the initial connective network either it is given, or the members have to build it from scratch.

What type of hereditary rules should be imposed?

Is it 'true' that stability can only be achieved if a special singular 'holon' provides an overriding attraction as it happens in bee communities?

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REFERENCES

The absence of references requires an explanation.

It is a good practice, if one invokes or uses arguments or information from other sources then these should be referred.

In strict compliance with this rule, a very long list of references would be generated but considering that the purpose of this paper is not to present a novelty or prove a thesis or defend a cause but primarily to call attention to some points considered controversial using a quasi-colloquial language, the author feels that references are dispensable.