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A.G.Portela

## 0) INTRODUCTION

. RECOGNITION covers many fields and has an universal application.

. Instead of an historical revue or a very specialised presentation I believe you would prefer to participate on a dialogue over general themes that every one uses without given much thought or hesitattion .

. The digression covers following themes :
  . Languages , Lato senso .
  . Life Paradigm .
  . Projection Spaces and Images .
  . Partition .
  . Reductive and Expansive Interpretation .
  . Atributes (Functionals) .
  . Actors .
  . Agregates .
  . Conclusions .

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1) LANGUAGES

. Language == { Set of Words & Set of Rules }
{ [Wi: with i in 1..N] ; [Rj: with j in 1..p] }

. Types of Rules :
  . R1 semantics : words belong to diccionary,
  sentences ar "well formed" .
  . R2 primitive sentences or premises .
  . R3 connecting or operating rules , 'nexus' .
  . R4 functionals : degree of truthfulness , closeness,
  completion, concistancy , etc. .

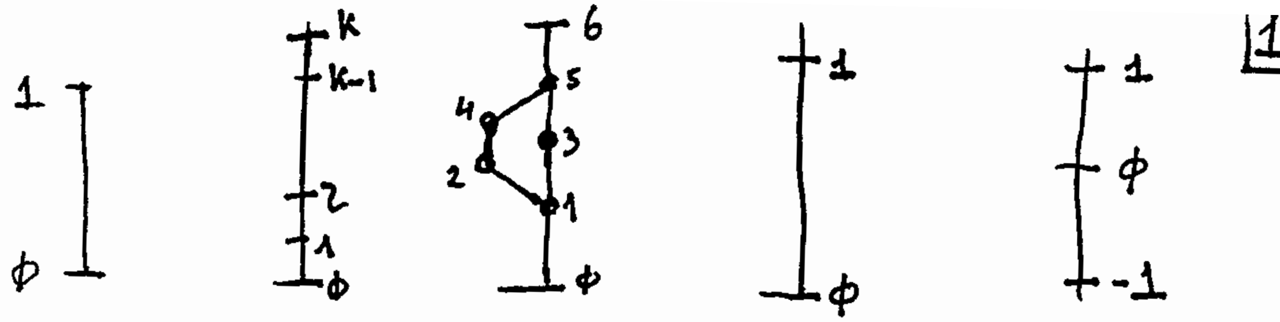
. "Forma" information content of sentences of a given language .

. "Support" the physical manner to conserve or convey "forma" ,
e.g.: contacts, sound, pressure, temperature,
chemicals(odours savours), electro-magnetic devices,
shape of objects and drawings, dance, mouvements, etc..

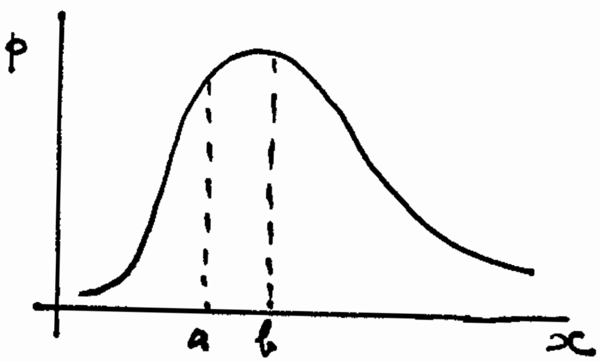
. "Translation" concists in the transfer of "forma" from language
La to language Lb and Tab is the 'translater' .
  . Usualy "forme" is lost or corrupted . Traductore=traditore .
  . Fa1 is the "forma" of a sentence in La ,
  Fb2 is the version of Fa1 in Lb using the translater Tab,
  Fb2 = Tab(Fa1) .
  . The retroversion of Fb2 into La is Fa3 = Tba(Fb2) .
  . If Fa3=Fa1 then pair (Tab,Tba) represents a 1-1 relation and
  the "forma" was preserved .

. "L-operator" or Language pool is an organ or instrument that
receives and emites "forma" in various languages and
supports . A L_operator is described by a graph of
Txy translators .

. "Degree of truthfulness" is a functional with many definitions :
  . True/False Socratic Logic, Boolean reticulate .
  . 0,1,..,N N-adic reticulate .
  . [0,1] Zadeh reticulate.
  . Distribution functions normalized to 1 .




2 adic  K adic  6 adic  $[\phi, 1] \in \mathbb{R}$  $[-1, 1] \in \mathbb{R}$




$p(x)$ Normalized to 1

$$S_{ab} = \int_a^b p(x) \cdot dx$$

ALL intervals $(a, b)$ such that $S_{ab} = g \in [0, 1]$ have the same "degree of truthfulness."

ABSOLUTELY TRUE corresponds to the interval $(-\infty, +\infty)$.

— x —

TRANSLATION

| | | |
|---|---|---|
| $L_a$ | $L_b$ | $L_a$ |
| $F_a$ | $F_b$ | $F_a^* \neq F_a$ |
| $S_a$ | $S_b$ | $S_a^* = S_c$ |


(a) (b) (c)

USUALY : $S_a^* = S_c = S_a$

But $F_a^* \neq F_a$

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## 2) LIFE PARADIGM

A 'biota' is any think possessing life .
Life means permutation with the 'outside world', OW, (not self) .
This permutation is represented by increting and excreting : mass, energy and information ("forma") .
Regarding "forma" the following operators are considered :

. S 'Sensors'.
They receive "forma" from OW, expressed in various languages and supports and translate them into languages suitable to be interpreted .

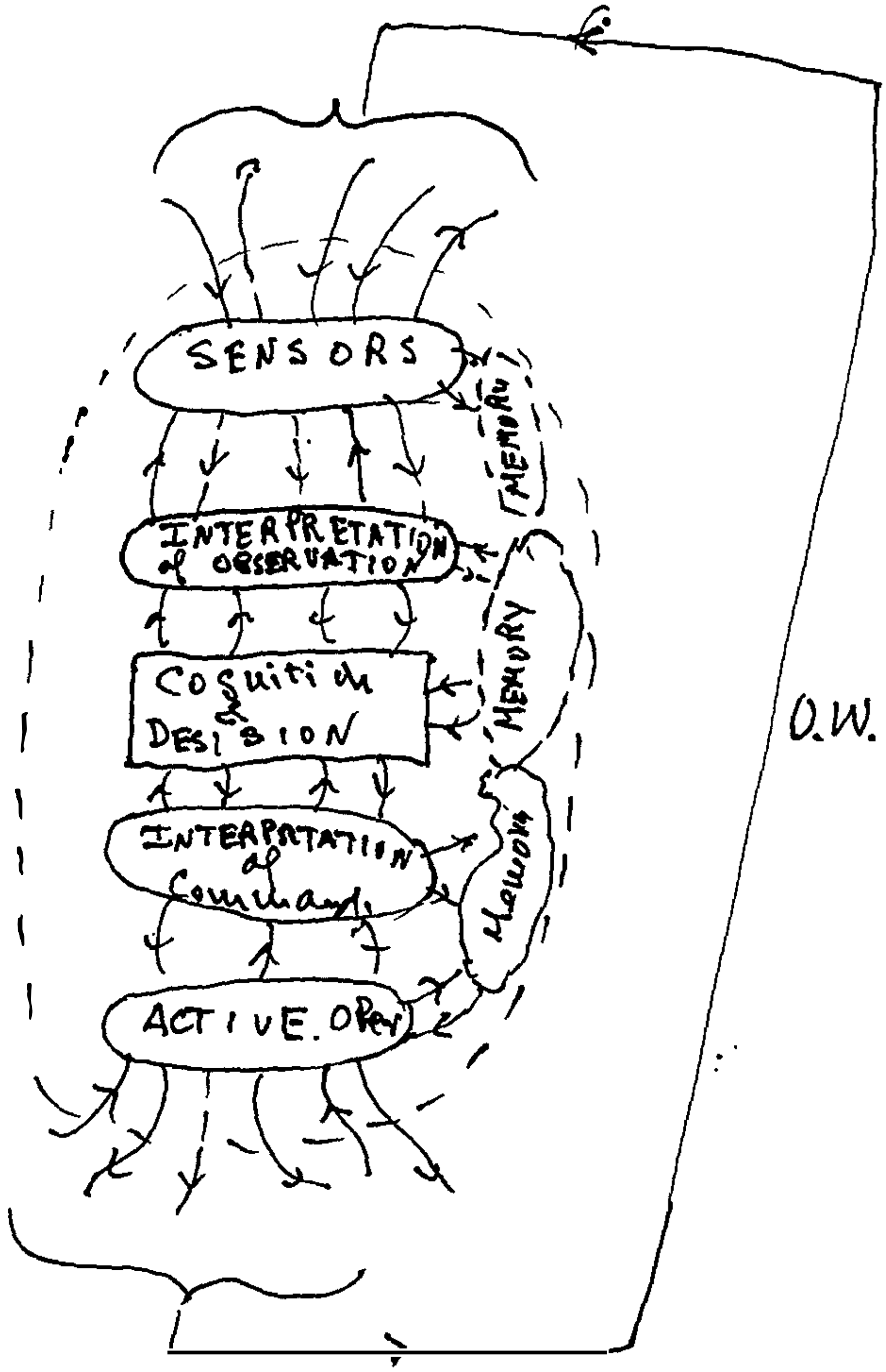
. O 'Observation Interpretation'.
"Forma" from 'sensors' or retrieved from 'memory' are transformed in 'cognition' or 're_cognition' .

. D 'Decision'.
The "forma" received from O and further "forma" collected in 'memory' is processed and various issues are 'virtualy' constructed . After some pondering one issue is adopted , a command is prepared for the next step ..
D is the most risky process for the "biota" .

. C 'Command Interpretation .
The interpretation of 'decisions' and 'commands' has the objectif of preparing detailed commands for action .

. A 'Active-operators'.
Obey the commands issued by C and act upon the 'outside world', OW .

. OW reacts and the cycle is closed .


SENSORS
MEMORY
INTERPRETATION of OBSERVATION
MEMORY
Cognition & Desision
Memory
INTERPRATATION of Command
ACTIVE. Oper
O.W.

LIFE

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3) PROJECTION SPACES and IMAGES

- All formal languages provide a functional to evaluate the "degree of truthfulness" .

- Comments on Cartesean Products, Spaces and metrics :
  - |R3 x |R1 to |R4 (Einstein Lorentz Metrics)
  - Can one provide a metrics to the Cartesean product (X x Y x Colour x Odour) .
    - A solution to dimension 'colour' .
      The set of colours [Red,Green,Blue] can be converted into an ordered set of frequencies, F ::[Fr,Fg,Fb] and a |R1 is a suitable image space .
    - Regarding coordinates (X,Y) in |R2, the usual metrics can be adopted .
    - The set Odour [A,B,C,D] can be converted as follows :
      - Let CH be the universal N-cardinal set of molecules that participate in the composition of the set [A,B,C,D] .
      - CHa,CHb,CHc,CHd are the compositions of A,B,C,D .
      - CH_::[CH_1, CH_2,..,CH_N] and CH_k is a real number.
    - The Cartesean product (XxY) x F x (CH_1 x CH_2 x..xCH_N) can be endowed with a metrics and converted in |R(N+3) vectorial space .

- The inverse Problem .
  - Given the coordinates X,Y,Fg and the functional G(X,Y,F,CH), determine the composition of 'odour' that maximizes G .
  - Applying the inverse relation, one can obtain a fictitious composition that is 'formaly correct' but devoid of real world correspondance .
  - Supposing the experiment was about ants and their agregates,
    - Ants can nor create the odour with the calculated composition .
    - It is not proved that the set [A,B,C,D] can be 'physicaly' ordered .
    - Mixing may not accomplishe the desired function .

$$\begin{cases} \mathbb{R}^3 \rightarrow \text{Space Coordinates} \\ \mathbb{R} \rightarrow \text{Time} \end{cases}$$

a) $S :: v * T$ , $v :: \frac{S}{T}$

b) Normalization of $v$, using $v^*$ = speed of light

c) $S \in \mathbb{R}$ and is a Space coordinate $S = S(v, v^*, t)$

d) $\mathbb{R}^4 = \mathbb{R}^3 \times \mathbb{R}^1$

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**ANTS**

| | CH1 | CH2 | | CH_N | Total |
|---|---|---|---|---|---|
| A | | 0.2 | | 0.6 | 1 |
| B | 0,5 | 0.2 | | 0.1 | 1 |
| C | | | | | |
| D | | | | | |

Composition

- Ants can produce a given odour?
- A, B, C, D can be ordered?
- Mixing is adequate?

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4) PARTITION

- Set-functions
  Instruments are better described by Set-functions then by point-functions .

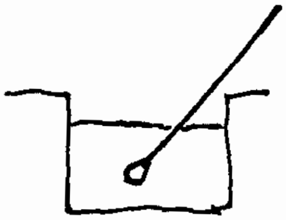
- Observation instruments
  - need a finite n_volume of the 'object' to be observed .
  - take a finite time to measure properly .
  - precision has a lower limit
  - and have a limited range of operation .

- Action instruments have similar constrains .

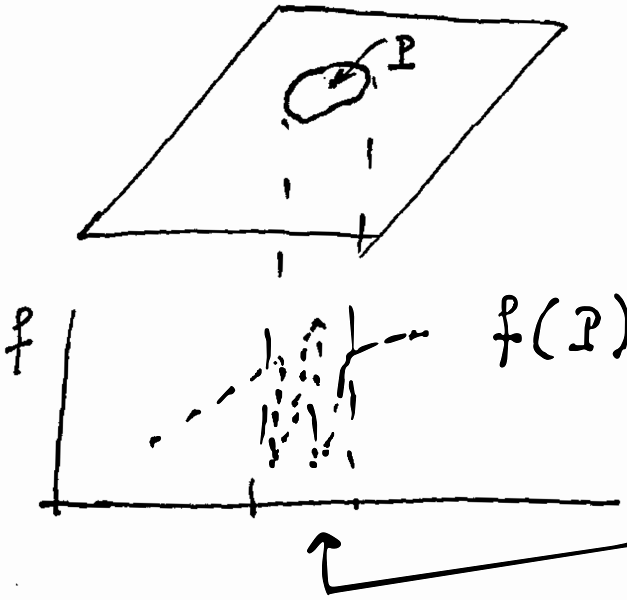
- Typical natural limits :
  - Saturation .
  - Breakage .
  - Change of state .
  - Loosing bounds

- The translation of 'physical' partition into a formal language should comply with the following condictions :
  - parts are lower bounded by the 'physical finenesse' .
  - finite range and field of measures .
  - finite cardinalicity .

- Set functions :
  - Information is lost , 'forma' is sendt to sinks .
  - Retro version does not permit to recover details that were lost .



Finite Volume
" Tipxe



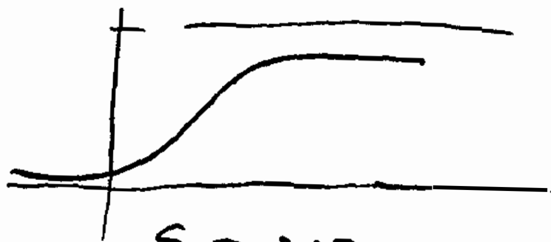

→ pixel or Ball
→ Referance Point

$$F(Px) \simeq f(P)$$

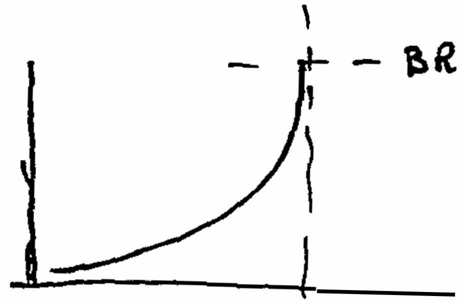
$$f(P) = \lim_{\text{Area } Px \to \phi} \text{ of } F(Px)$$

THE AVERAGING PROCESS
LOOSES fine details.

NATURAL LIMITS:



SATURATION




ICE → WATER → VAPOUR → GAS → DISSOCIATION

SET FUNCTIONS Loose Information

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5) REDUCTIVE and EXPANSIVE INTERPRETATTION .

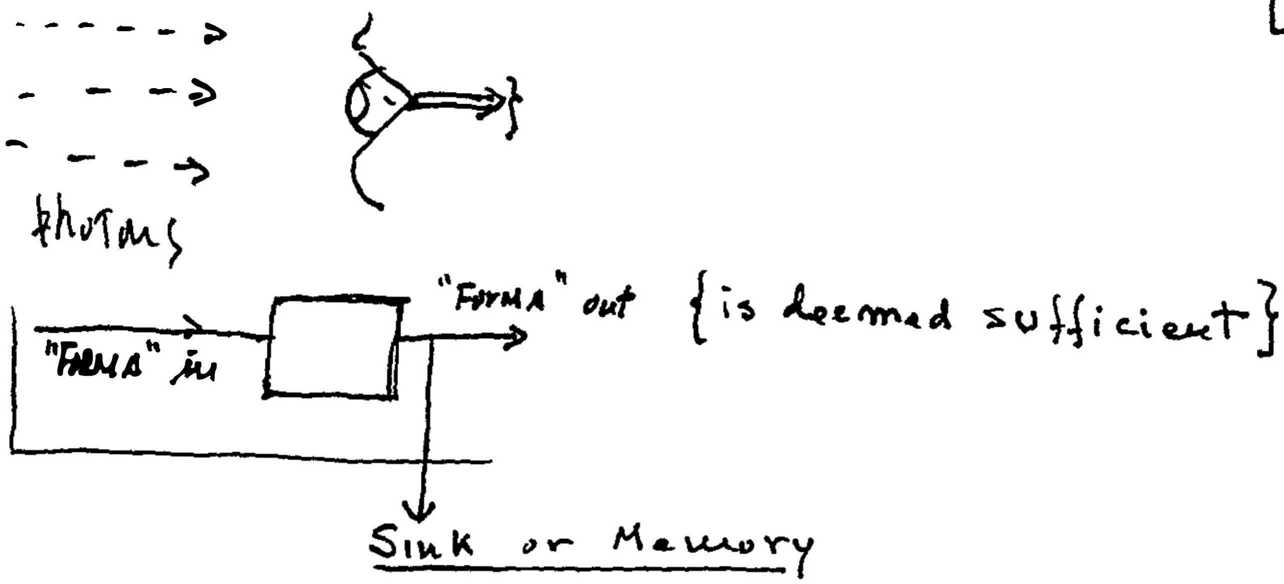
. Based on the LIFE paradigm , (2 and 2a) .

. Information reduction , (abstraction).
  . The choice of what "forma" must be abstracted to be invoiced to the next operator .
  . What should be done to the residue ? sink or memory ? .
  . Reductive Matrix or Interpretation of the input "forma" .

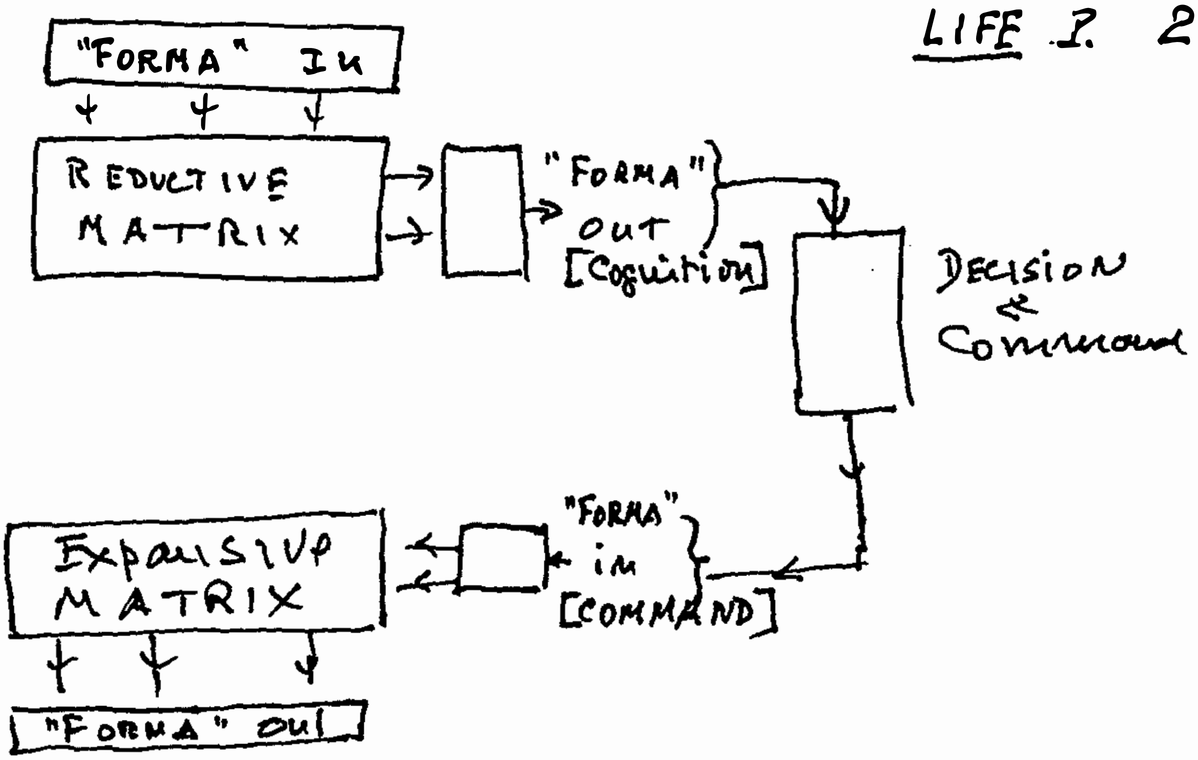
. Information Expantion , (development) .
  . Interpretation of Commands and decisions .
  . Expansive Matrix or Interpretation of commands .

. How to buildt both matrices ? .

. Learning Process . How to correct parameters ? .




LIFE I. 2




## LEARNING PROCESS

- How to correct parameters.

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6) ATRIBUTES (FUNCTIONALS).

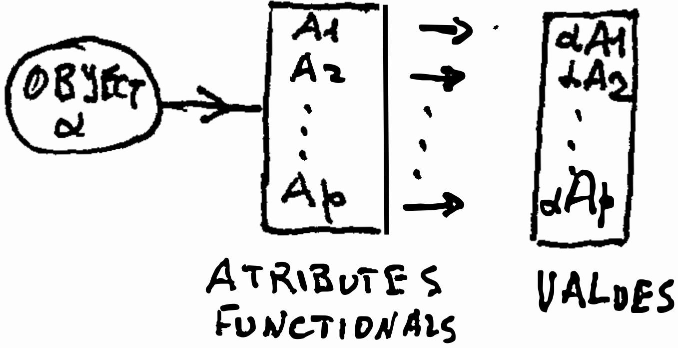
. F-Identical" .
Given a set of functionals F::[F1..Fp], objects A and B are F-indentical if Fi(A)=Fi(B), for all i in [1..p] . Obviously, if G is a sub-set of F then F-indentical objects are also G-indentical .

. Funtions Fi are in general, reals or convertible to reals and F can be projected in |Rp endowed with the usual metric .

. F-Distance of objects A and B can be defined and the concept of F-Identical con be expressed by giving the coordinates of a paradigm and a distance .

. Proximities .
The word is reserved to describe all sorts of functionals that translate the concept of 'nearness' without fulfiling the formal rules of 'distance'.

. Pattern-Recognition is very much dependent of the atributes to be observed or measured . Vide 6a .




or $(\alpha A_1, \alpha A_2, \ldots, \alpha A_p \,;\, ?) = \alpha A$

OBJECT (β) has the following set of Atributes βA

$PROX_A(\alpha, \beta)$ = Function of $(\alpha A, \beta A)$

The Ball of radius $R_\alpha = PROX_A(\alpha, \beta)$, for all β, contains all objects that $R_\alpha$ prox. of α.

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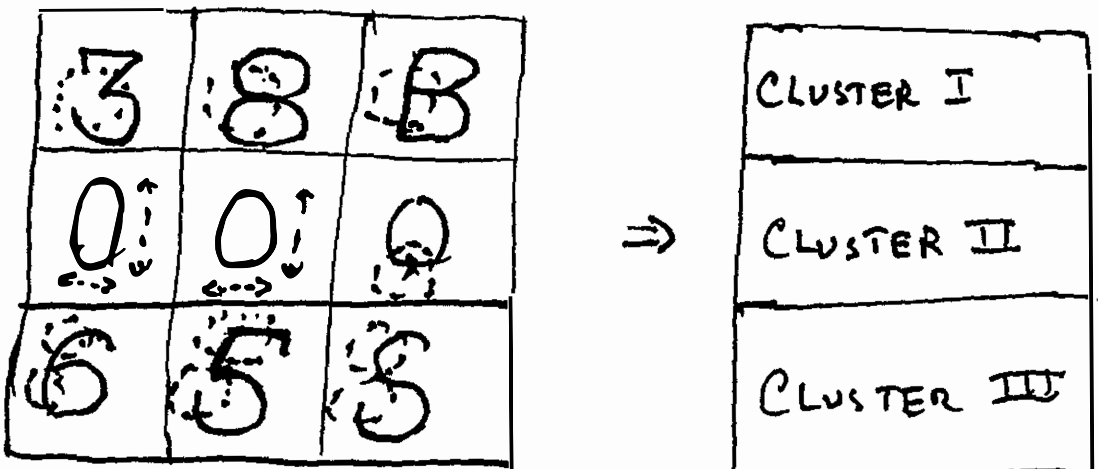



1° STEP | Coarse Partition and N atributes
End Product = 3 sets of chars or (Clusters I, II, III)

2° STEP | Reduce field of OBSERVATION
Increase fineness of Partition
eventualy change the atributes
End Product = Discrimination of charactes in each cluster.

## 7) ACTORS .

. Classification of Actors :
  . Human Operator (HOP)
  . Machine & Program (M&P)
  . Remaining Actors (RAC)
  . ACT = HOP + M&P + RAC

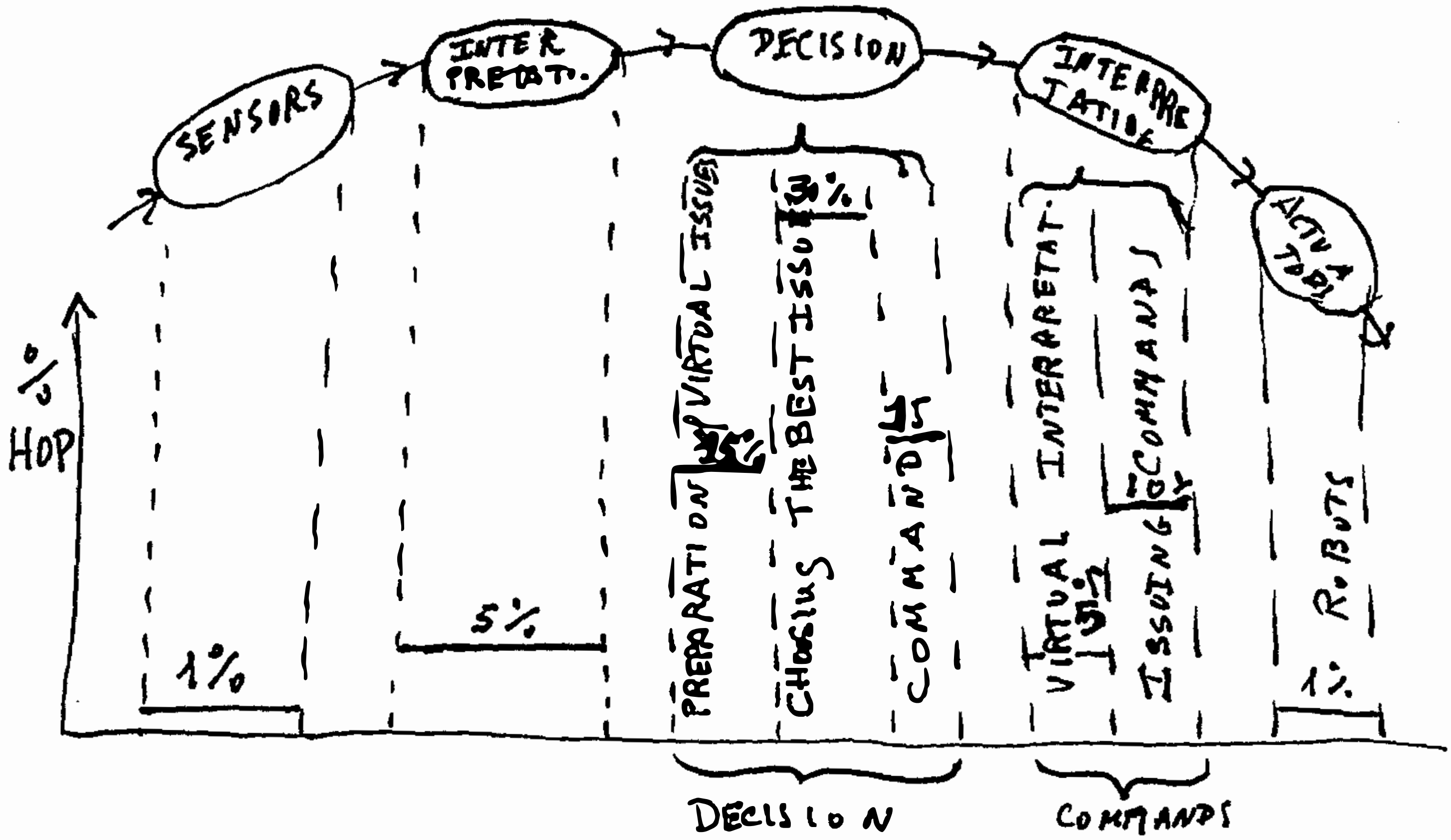
. Dialogue HOP>M&P and M&P>HOP
  . The flow of "forma" should be 'minimal' .
  . Increasing the 'intelligence' of M&P the flow of "forma" decreases.

. Atributes of M&P :
To mensure the 'intelligence' of M&P some atributes are needed :
  . Rcv Data and Programs that M&P can accede .
  . Dmp Degree of liberty to make decisions .
  . Lrn Learning ability .
  . Gid Generalization and induction .

. Classification of M&P :
  . The base is the following ordered set of atributes :
    Rdlg :: [Rcv, Dmp, Lrn, Gid, >] , all 4 members of the set Rdlg take values in [0,1] interval of the reals .
  . @ is a functional that evaluates the intelligence of M&P . The domain of @ is Rdlg and its range is a finite interval of the reals .

# HOP / M&P






## ATRIBUTES of M&P

- Rcv Access to Data and Programs
- Dmp Decision Macking
- Lrn Learning . .
- Gid Generalization an Inductive Reasoning

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## 8) LEARNING .

. Learning is equivalent to
< adjusting parameters > .
It is given :

- . function F(D,P), (data and parameters) ,
- . set SD of data D .
- . correponding set SF of the correct values of F!,
- . function Fe that evaluates the 'error' between F and F! ,

The problem concists in devising a method to find the parameters that minimize de 'error .

. Learning is equivalent to
< choosing the function and adjusting parameters > .
A set of functions is given instead of a definite function .
The job of M&P is to find the best function F(D,P), and the best parameters .

. Learning is equivalente to
< set of agents trying to find the issue that maximize a given functional >

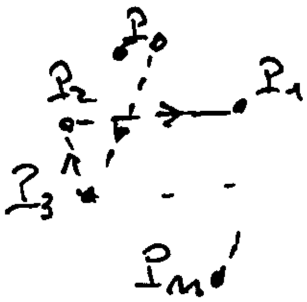
- . All agents are similar, except for some parameters that can very in very limited domain .
- . Each agent can try to find an issue for the problem. and a given funtional classifies the performance .
- . The classification changes the parametres of the agent .
- . The best results are memorized .
- . After some trials the best solution is declared the quasi-best issue .
- . Vide, 9 AGREGATES .

| DATA | F! | $F_1$ | $F_2$ | | $F_q$ |
|---|---|---|---|---|---|
| $1X_1, \dots, 1X_n$ | $1F!$ | $1F_1$ | $1F_2$ | | $1F_q$ |
| $2X_1, \dots, 2X_n$ | $2F!$ | $2F_1$ | $2F_2$ | | $2F_q$ |
| — — — | — | — | — | — — — | — |
| $pX_1, \dots, pX_n$ | $pF!$ | $pF_1$ | $pF_2$ | | $pF_q$ |

Errors $= \varphi(kF!, kF_1)$

Parameters are corrected according to $\varphi$.

——— x ———




Functional $\Psi = \sum (d(P_i, P_j))$

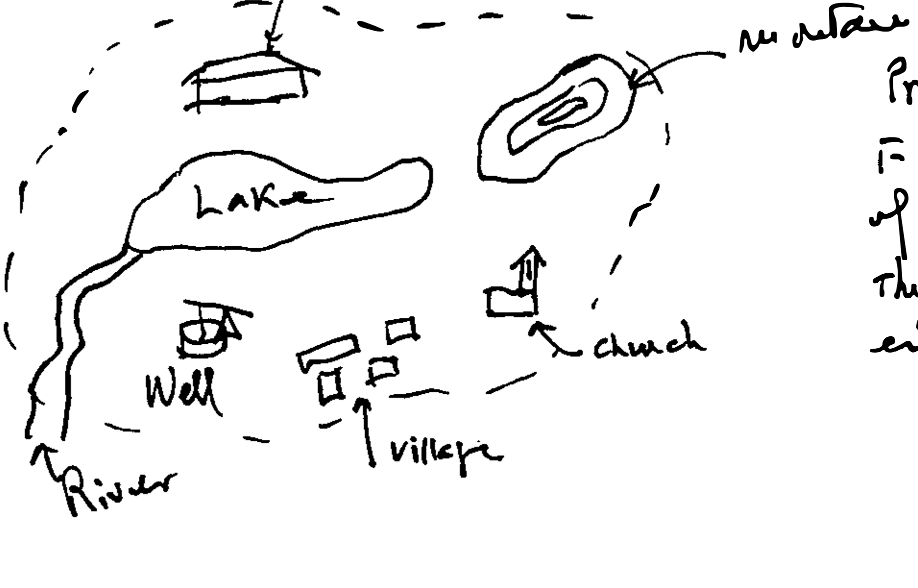
Starting point $P_0$

Finish " $P_n$

No visiting the same Point twice.

The set of options is tried many.

——— x ———




Problem

Find location of paths country.

The various human establishments

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## 9) AGREGATES .

. Definition .
U is the universal set of elements (holons or agents) .
A is a set of subsets of U with a cardinal >=2 .
GA is the graph of all oriented arcs that connect the elements of A and some of these with the complement of A , (U-A) . No isolated elements exist .

. Agregate levels :

| | | |
|---|---|---|
| Level 0 | 0_X | Holons, elements of U, cardinal=1 . 0X :: x . |
| Level 1 | 1_A | Elenents of 1_A are holons, cardinal(A)>=2. |
| Level k | k_A | Elements of k_A are agregates of level <k and at least 1 is of level = k-1 . Cardinal(k_A) >=2 . |

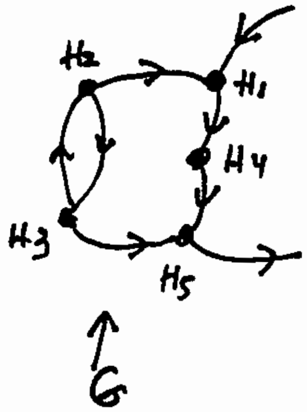
. Agregates are importante because they perform better then the same holons or agents acting independently .
The atributes and performamce of an agregate depend of :

- . Rdlg :: [Rcv,Dmp,Lrn,Gid] and @ , vide : (7) . The agent (holon) is not very intelligent, but can follow a trail, move towards an attractor and away of a repulsor, transfer somatic experiences to the next generation and teaching by exemple .
- . nexus connecting bounds or oriented arcs of G .
- . G graph of the 'nexus'. It is a stereo-graph .

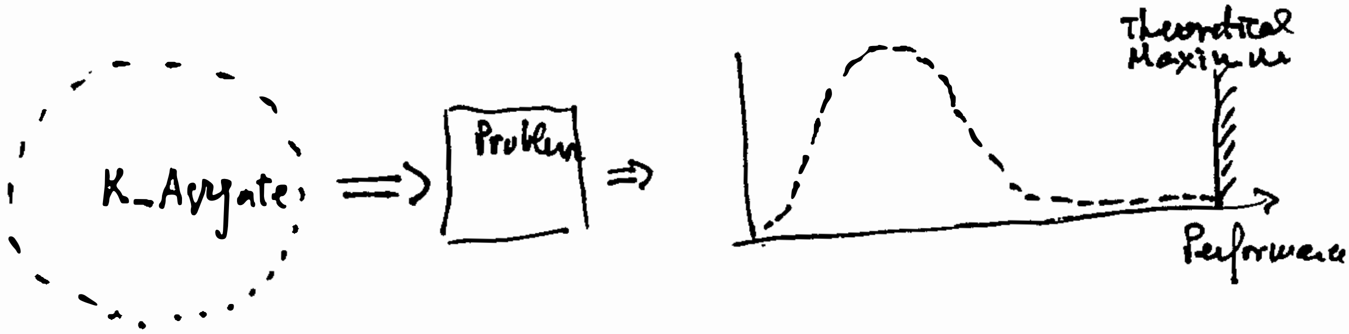
. Agregates can be used to study :
- . Predator / Prey behaviour .
- . In a given context, the influence of Rdlg, nexus and G .
- . the best stereo-graph .

. Agregates can find quasi-optima solutions .

. Applications
- . quasi-optima solutions for NP_probles .
- . complex social behaviour .
- . social contracts .
- . politics .




1_ Agregati { [ $H_1, H_2, \ldots, H_5$ ]
G = Stereo Graph
$N_{ij} = (H_i, H_j)$ :: Nexus




BEST PERFORMERS → will be entitled to :
. more food
. more proliferation
. Longer life.

AFTER some Generations a reasonable solution is attained ! .

## 10) CONCLUSIONS

- LOWER BOUND for FINENESS of the PARTS .
- INSTRUMENTAL VARIABLES are FINITE .
- PARTITIONS have FINITE CARDINALS .
- PREFER RINGS, MODULES are better PROJECTING SPACES .
- The WORLD is a K_AGREGATE and NOT a COMPACT and DENSE .

- BEWARE the REALS and REAL SPACES .
- PROBLES creep up when RETRO-VERTING .

- k-AGREGATES are powerfull MODELS .