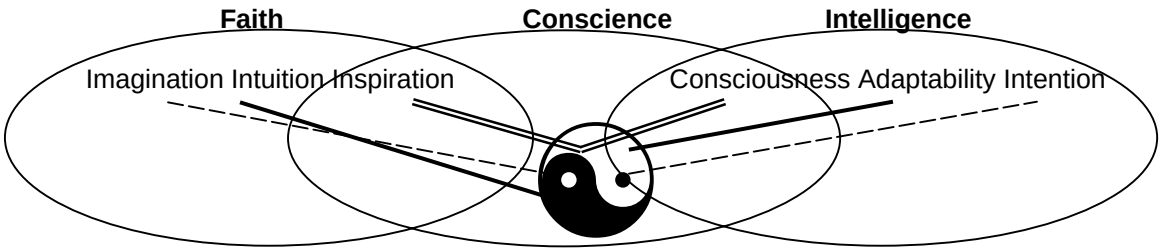
RECONFIGURABLE HUMAN-SYSTEM COSIMULATION

Tudor Niculiu[(a)], Maria Niculiu[(b)]

[(a)]University *Politehnica* Bucureşti, Faculty of Electronics, Telecommunications, and IT
[(b)]University Bucureşti, Faculty of Foreign Languages and Literatures

tudor-razvan@ieee.org mariaoficialfac@yahoo.com



ABSTRACT
Abstraction power is the crucial difference between human and any other natural being. *Divide et Impera et Intellige* applies the hierarchically expressed abstraction. Abstraction can simplify or reflect. Religion had to learn us about God's existence in our being. Philosophy has to learn us about essence, existence, and being. Conscience represents the essence of our existence as being; therefore it tells us that God is in ourselves, for ourselves, and among ourselves. Further, we have to be, in order to search for our essence researching our existence. We try to model the Conscience to simulate the Intelligence, reaching for the reconfigurable human-system cosimulation. The alliance between arts, sciences is vital and demonstrates the insolvability of the nowadays Spirit-Matter dichotomy, and of all secondary dichotomies, actually functionally generated by the Space-Time dichotomy that is necessary to the human *evolution*.

Keywords: Faith, Intelligence, Conscience, Abstraction

1. INTRODUCTION

The Faith experiment took place in the Middle Age by spiritual and chivalrous search, mediated by Masonic buildings. The Cathedrals were the symbol of the coming *revolutions* that intended to institute the *intelligent Faith* as basis of the human society. The concentration of the mind on the reasonable control of the Adaptability followed the spiritual revolution that tried to bring into individual and social conscience the human choice for evolution without disregarding the Eternity or the knowledge of the Way.

Reconfiguration continues the ideas of hard-soft cosimulation, intending to extend the soft flexibility to hard, as parallel soft gets closer to hard performance.

Experimented ways to reconfigurable design are Field-Programmable Gate Arrays for circuits (Miller 1993) and reconfigurable networks for systems (Rabaey 1997). Our project extends the reconfigurability to the simulation itself.

First, by a self-aware simulation, for that we build a knowledge hierarchy corresponding to the simulation hierarchy, we intend to get a self-control of the simulation process. Then, by expressing both simulation and knowledge hierarchies in the reference system of the basic hierarchy types that correspond to essential views in language/ system theory (Keutzer 2000) derived from the main partition of our real life, we aim to create the context for a self-organization of the simulation.

Reconfigurable computing architectures (Ştefan 2010) complement the existing alternatives of spatial custom hardware and temporal processors, combining increased performance and density over processors, with flexibility in application. If one of the imposed properties is considered as not being fulfilled after applying a technique, using a model and suitable methods for measure and reconfiguration, different strategies permit altering one of the techniques/ models/ methods.

The process repeats for the initial description or the one resulted from prior insufficient improvement. This calls for an intelligent choice of the intelligent system that assists/ automates the reconfiguration. The methods are recursive to handle the different components in the system's description.

Measurement functions (Lupu 2004) control the continuation process of the reconfiguration, suggesting bringing reconfiguration in the context of software and hardware, as the strategies can be expressed object-oriented/ categorical and understood mathematically.

```
class Reconfiguration ...
Description reconf (Description descr,
                    Bool increment, Bool integrated)
{ techs := Ø; models := Ø; meths := Ø; good := false;
while (not good) {
    tech := selTech (descr, techs, models, meths);
    if (not tech in techs) {techs.add (tech); models:=Ø};
    if (not model in models) {models.add (model);
                                methods := Ø };
    reconf := model.detSpec(Description);
    meth := model.selMeth (reconf, meths)
    if (not meth in meths) meths.add (meth);
    if (integrated) {
        (good, enough) :=meth.measure (reconf);
        while (not enough) {reconf :=
                                improveLoc (reconf);
        (good,enough):=meth.measure(reconf)}}
    else (good, reconf) :=
          improveGlob (reconf, meth.measure(reconf));
    if (increment) descr :=
              model.returnToDescription (reconf) };
return model.returnToDescription (reconf) }.
```

Representation is a 1-to-1 mapping from the universe of systems (objects of simulation) to a hierarchical universe of models - a representation can be inverted. A model must permit knowledge and manipulation, so it has two complementary parts/ views: description and operation.

If models correspond to classes, in a formal approach, specifications are instances; for language-like models, specifications are expressions.

Hierarchy types open the way to simulate intelligence as adaptable consciousness by integrating the system and the metasystem. Hierarchy is the syntax of abstraction.

There are different kinds of abstraction that need different types of hierarchy. Most abstractions are simplifying the approach, what is compulsory for complex object-systems.

Knowledge and construction hierarchies cooperate to integrate design and verification into simulation. Object-oriented concepts are symbolized to handle data and operations formally. Structural representation of behavior manages its realization.

Classes abstract the form, symbols the contents, and partitions simplify the approach. All these enable the simulation hierarchy to assist construction, verification, optimization, and testing, being managed completely by pure reason, by discrete formalisms/ simulations.

The natural limit of complexity is caused by the essentially sequential approach, whereby the real limit of computability results from the discreteness of our reason. Understanding and construction should use correspondent hierarchy types, i.e., a reflexive kind of abstraction has to be expressed by the knowledge hierarchy type.

2. POWER OF ABSTRACTION

Metaphor is a popular instance of abstraction. God is the absolute abstraction. And if we remember that *liberty is understood necessity* (Georg Wilhelm Friedrich Hegel), we could detail the metaphorical thesis:

God is the evolution goal of our faithful intelligence.

We can reduce abstraction to its simplifying types (classes, symbols, modules, construction) hoping to get to the absolute liberty, i.e., considering God, the simplest item of the Reality, totally unconstrained. But we can simulate/ construct/ live/ work associating a knowledge hierarchy to everything we do, aiming to understand constructively the most complex absolute necessity, defining God.

The power of abstraction is human's gift to surpass the natural limits, extending pure reason to real intelligence. As any other dichotomy pair, faith and intelligence can evolve convergent to integration, or can destroy one another if they are not linked together constructively. *Divide et Impera et Intellige* has three parts as *Alle guten Dinge sind drei.* Mathematics develops from three basic structure types, usually integrating them: algebra, order, and topology. We divided our existence in three collaborating parts: arts, sciences, and Engineering, correspondent to our world of beauty-loving ideas, our world of truth-searching efforts, and our presently exaggerated world of good-aiming constructions.

Einstweilen bis den Bau der Welt
Philosophie zusammenhält,
erhält sich das Getriebe durch
Hunger, Furcht *und Liebe.*
Friedrich Schiller

Mathematics (the most accessible art) discovers and studies structure types: (algebra, topology, order), correspondent to (construction, orientation, understanding), and rarely separately used, example of correct and complete integration to be followed by Science and Engineering. *Art is for art*, so it's defining itself, looking for the Beauty. (Hofstadter 1979)

Physics (the paradigmatic science) should integrate its fundamental forces theories, and as chapters, all natural and social sciences, leading them to really apply mathematics. Social sciences study a universe, as complex and nondeterministic as the natural one, so mathematics is at least as important to them as for natural ones, and science would also better inspire mathematics. Science raises the fear and the research inspired by it to more abstract domains, so it is defined hierarchically, as *Fear of God*, looking for the Truth.

Engineering has to be closely related to mathematical approach and integration of parts, not only to mathematical techniques, as to scientific courage and multiple views, not only to scientific results.

As reality contains the abstract ideas, even if physics could explain everything discretely, the power of continuum cannot be forgotten, i.e., analog engineering cannot be neglected in modeling and simulation. (Zeigler 2000)

Paying attention only to the Good in our life is most dangerous, as this part of the Reality is defined by its complement, so it is not better than this, if not closely constrained by Art & Science.

Das schöne wahre Gute
Johann Wolfgang von Goethe

is compulsory while we evolve to *God-alike humans*.

Hierarchy is a network that can represent any mathematical structure type (algebraic, topological, order). Hierarchies are leveled structures, which represent different domains. A level is an autonomous mathematical structure, containing abstract/ concrete entities, linked by level scoped relations.

Abstraction relates the levels: this induces an order relation between levels, partial, concerning entities, and total, regarding the levels. Beyond the hierarchical point of view, the system can be formalized as an autonomous domain, structured by metahierarchical relations, building a level in a higher order hierarchical system.

Hierarchic structures exhibit two complementary processing strategies: top-down and bottom-up. Coexistent interdependent hierarchies structure the universe of models for complex systems, e.g., hardware/ software ones. They belong to different hierarchy types, defined by abstraction levels, autonomous modules, classes, symbolization and knowledge abstractions.

Abstraction and hierarchy are semantic and syntactical aspects of a unique fundamental concept, the most powerful tool in systematic knowledge; this concept is a particular form of *Divide et Impera et Intellige*; hierarchy results of formalizing abstraction.

Hierarchies of different types correspond to the kind of abstraction they reflect (↑the abstraction goal):

- Class hierarchy (↑concepts) ↔ virtual framework to represent any kind of hierarchy, based on form-contents, modularity, inheritance, polymorphism.
- Symbol hierarchy (↑metaphors) ↔ stepwise formalism for all kind of types, in particular also for hierarchy types.
- Structure hierarchy (↑strategies) ↔ stepwise managing of all (other hierarchy) types on different levels by recursive autonomous block decomposition,
- Construction hierarchy (↑simulation) ↔ simulation (design/ verification/ optimization/ testing) framework of autonomous levels for different abstraction grades of description.
- Knowledge hierarchy (↑theories) ↔ reflexive abstraction, aiming that each level has knowledge of its inferior levels, including itself. This hierarchy type offers a way to model conscience.

The first idea is to (re)consider that reality is more than nature, as the continuum of IR is more powerful than the discrete universe of IN. The second analogy is that integer beauty is not enough to comprehend the Reality. The third argument is that reason is less than our real thoughts, as the cardinal of |Q is $\aleph_0$, while cardinal of IR is infinitely superior.

Although |Q is dense in |R, so pure reason could converge to reality, the complexity problem limits the computability. (Zhong 2003)

The essential limit of the discrete computability, as of the computable intelligence, results from the self-reference, demanded by the integration of level and metalevel needed for consciousness.

A hierarchical type is necessary to represent conscious knowledge. The classical activities in complex systems simulation, that regard different levels of the construction or knowledge hierarchy, can be expressed symbolically then represented object-oriented and simulated structurally:

- Complex simulation needs consistent combination of mathematical domains and an intelligent compromise between consistence and completeness.
- Intelligence simulation implies a hierarchical approach of different types. Any application of it can be imagined as an educational system to discover models for conscience and understanding.
- Constructive type theory permits formal specification and simulation, generating an object satisfying the specification.

The formalism for hierarchy types is the theory of categories. (Ageron 2001) Even if for the moment other aspects can neither be constructive or intuitive, they should not be neglected.

For example, there are much more real things than those reasonably imagined, although between any two real numbers there is a rational one - not intuitive.

We know that if there is no cardinal between that of the countable sets and that of the continuous ones, then there exists no other logical value than true and false, what simply hurts the human in his love for nuances.

This could be avoided only if we believe - not constructive – that an intermediary level between natural reason and Reality exists, as the wise think there is between humans and God: *angels*-Andrei Pleşu.

Faith, Intelligence and Conscience are ☯ in our life
Way-Truth-Life

3. CONSCIENT EVOLUTION

Intelligence = (Consciousness, Adaptability, Intention) and Faith = (Inspiration, Intuition, Imagination) are complementary parts of the human mind, separated by the Conscience = (Consciousness, Inspiration), a non-deterministic interface between the non-conscious faith and the conscious intelligence.

Both intelligent simulation and simulation of intelligence demand transcending the present limits of computability to simulability, by an intensive effort on extensive research to integrate essential mathematical and physical knowledge guided by philosophical goals.

The historical experiment of the pure reason should have ended long time ago. Human thoughts cannot be explained or handled by our adaptability-based reason, even if non-deterministic or parallel. Reason has to extend to intelligence in the context of faith. An obvious way is to integrate consciousness, then intention and imagination to intelligence, then to extend this to inspiration and intuition.

Hierarchy types reveal their comprehensive constructive importance based on structural approach, symbolic meaning, object-oriented representation. The power to abstract is the crucial difference between human and other natural living beings.

1. *Intelligence* and *Faith*, like any dichotomy, can converge to integration or can destroy one another if not associated by *Conscience*
2. *Function* is a transformation that can be mathematically formalized, or physically instantiated as temporal behavior. *Structure* is a set of properties that characterize a mathematical or physical space. The properties can be constant or variable in time, reflecting static or dynamic structures. *Architecture* controls both of them. *Simulation* is the relation between function and structure. Structured set = (Set, structure)
3. *Language*/ *system* is a generic form of a mathematical/ physical *model*, resulting of an inversion-able simulation object representation
4. *Hierarchy* is a functional/ structural concept that fulfils mathematically/ physically the concept of abstraction. Hierarchy is syntax of abstraction
5. *Abstraction* is a human defining capacity that enables him to think.
6. The simplifying abstraction concentrates on a superior level the information that is considered essential for the current simulation approach. Reducing the informational complexity has in view to clear the operation and to ease its formalism; it can be only quantitative, but also qualitative.
7. The reflexive abstraction, expressed as knowledge hierarchy type, tries to understand itself better at higher levels, by understanding more of the inferior levels
8. *God* is in us - as faith is part of our definition, with us - by the others, and for us – the spiritual evolution that is first conditioned, then assisted, to be followed by the social one
9. Against the danger of dichotomy, we concentrate in 3 different ways on the unique Reality (*Plato*): Art for the art - to look for the essential Way, Science with God's fear - to search for the existential Truth, and Engineering - to understand the Being and to concentrate more on the Spirit in our Life

Formal hierarchical descriptions contribute to a theoretical kernel for self-organizing systems. A way to begin is hierarchical simulation. A way to confirm is the object-oriented reconfigurable simulation.

Essential relations are sketched before searching conscience models enabling intelligent simulation: Conscience is self-awareness of individual faith and intelligence, as well as of the relation to the local context (society) and to the global one (Universe/ Reality).

To appear it needed self-knowledge, what could have resulted from community conscience featured by an eternal human structure, e.g., from the past, shepherds, farmers, sailors, Africans, Amerindians, ... Each individual recognized himself in his cohabitants, being most adaptable and having a lot of intuition.

The common measure evolution implies the construction of correspondingly intelligent agents to manage the lower stages and to concentrate on the higher ones. Industry built the agricultural mechanization, and also the concentration on economics.

Human = human (Humanity);
human $\in$ Faith $\times$ Intelligence $\rightarrow$ Faith $\times$ Intelligence;
Humanity = (humans Set, evolution-oriented Structure).
evolution $\in$ Hunger, Fear, Love) $\times$ (Engineering, Science, Art) $\rightarrow$ (Engineering, Science, Art)
Mathematics $\subset$ *Art* = Human :: beauty-oriented activity (Science, Engineering)
Physics = (natural $\cup$ social) Science = Human :: truth-oriented activity (Art, Engineering)
Engineering= Human :: good-oriented activity (Art, Science)

The history of the common measure could be synthesized along the following line:

... $\leftarrow$ Philosophy $\leftarrow$...$\leftarrow$ human Culture $\leftarrow$ specific Knowledge $\leftarrow$material Economics $\leftarrow$brute Force.

Evolution is a multiple *Divide et Impera et Intellige* for conscience, associated to generating the *components* lacking of the mind at start, then assisted by them:

individual-social-universal conscience (subjective-contextual-objective) $\rightarrow$ *inspiration* $\downarrow$
space-time (structure-behavior) $\rightarrow$ *imagination* $\downarrow$
discrete-continuous (natural-real) $\rightarrow$ *intention* $\downarrow$
beauty-truth-good (art-science-Engineering).

The convergence process of evolution demands struggle against time, with structure as ally. Structure is sometimes too conservative, so it has to be reconfigured, at abstract levels, e.g., a plan, as at concrete ones.

The adaptability-based Reason cannot explain or control thoughts, even if sequential is extended to unlimited parallel/ nondeterministic. Anyway, these desired operational properties can be found mainly in the right side of the human mind.

Further, the difference between continuous and nondeterministic sequential is positive. Therefore, the Reason has to be Faith-dependent completed to Intelligence. A being needs more than Intuition and Adaptability to surpass the Matter by Spirit; only the integration of Intuition and Adaptability by Conscience can explain the Human being. We propose the thesis:

Conscience = closure to (*knowledge* o *simulation*)$^{-1}$ *of Conscience*

initially Conscience = Consciousness

The idea can be formally sustained in the category theory. Informal arguments follow. The essential limit of discrete computability, inherited by computational intelligence, is generated by the necessity for self-reference to integrate the level knowledge with metalevel knowledge in Conscience modeling.

4. DISCRETE TO CONTINUOUS

Mathematics develops the countable natural to the uncountable real numbers closing to the inverse, on its three integrated ways: algebra, order, and analysis.

Physics uses particles or fields in various chapters. All other sciences are chapters of physics, inheriting and developing the inheritance. At the limits of reasonable understanding, quantum physics tries to balance the knowledge and the unknown, without success.

Engineers have always considered digital a mere ingenious abstraction of analog. Presently, we talk about electronic computers, but the nowadays trend is to copy from the living Nature, i.e., emulation of the advantages of living beings, to achieve complex duties unconsciously.

Reality does not reduce to Nature, as card(IN) < card(IR) (*Cantor*). Reason is the closure of the Nature relative to the primary operations, as IQ results from the closure of IN to the inverse operations of addition and multiplication. However, the Reason is dense in Reality – as IR is the analytical closure of IQ, IR = $\{\lim_{n\to\infty}(q_n) | (q_n)\in IN\to IQ\}$.

Reality extends beyond Nature and Reason, for the quality of the quantity, and also regarding the power of transforming operations. IR closes IQ to the inverse of power rising – the last arithmetic operation resulted by recurrence of the prior one, which can be pursued by Reason, e.g., algorithmically.

Further, closing to inclusion order, the set of all subsets of countable sets is the uncountable IR, the power of continuum. To get to complex numbers is a matter of imagination.

Reason closes Nature to the inverse of natural operations. Reality closes Reason to the inverse of reasonable operations.

Conscience needs continuous feedback, not only discrete recurrence,. Social and individual conscience are mostly divergent nowadays, i.e., we only performed *Divide et Impera*, neglecting *et Intellige*. It's high time to correct this!

Formalizing the reflexive abstraction by the knowledge hierarchy type and the simplifying abstraction mainly by the simulation hierarchy type, it follows that:

Consciousness = knowledge ° *simulation* (*Consciousness*)

This fixed-point relation suggests to model conscience by association of a knowledge level to any hierarchical level of the simulation process.

To solve the fixed-point problem we build a metric space where knowledge ° construction is a contraction - the elements implied in the construction get closer to one another in the formal understanding of the formal construct.

If, even in the sketch, we consider general functional relations between the essential parts of the faith-assisted intelligence, it results:

Consciousness = knowledge (*intention* (*Inspiration*, *simulation* (*imagination* (*Intuition*, *Consciousness*))))

A generic modeling scheme defines the model universe as a mathematical theory or a design paradigm. Any entity has behavior (relations to other entities) and structure (internal relations). Behavior can be functional (context-free) or procedural (context-dependent).

Evidently, the anterior relations are oversimplified in order to move towards intelligent simulation. Although we claim they are intuitive and hope they are inspired, to begin, we neglect the essential but too far from reason to understand intuition and inspiration.

An algorithm is an entity that can be computer simulated, so it represents computability, behavior-oriented (understanding, verifying, learning) / structure-oriented (construction, design, plan).

The algorithmic approach is equivalent to the formal one: If a sentence of a formal system is true, then an algorithm can confirm it. Reciprocally, for a verification algorithm of the mathematical sentences, a formal system can be defined, that holds for true the sentences in the set closure of the algorithm's results towards the operations of the considered logic.

David Hilbert's formal systems, *Kurt Gödel*'s construction algorithm, *Alonzo Church*'s λ-calculus, *Stephan Kleene*'s recursive functions, *Emil Post*'s combinational machines, *Alan Turing*'s machines, *Noam Chomsky*'s grammars, *Alexander A. Markov*'s normal algorithms, are the best-known (equivalent) formalisms for sequential reason-based computability.

The alternative ways followed to extend the computability concept are suggested by approaches known from German literature, which is philosophy-oriented, trying to express essential ideas that link to the unconscious part of our mind.

They respectively concentrate on the mental world of the good managed by Engineering, the physical world of the truth researched by science, and Plato's ideal world of abstractions discovered by arts.

1. Faust (Johann Wolfgang von Goethe): heuristics - risking competence for performance, basing on imagination, confined to the mental world.
2. Das Glasperlenspiel (Hermann Hesse): unlimited natural parallelism - remaining at countable physical suggestions, so in the Nature.
3. Der Zauberberg (Thomas Mann): hierarchical self-referential knowledge - needing to conciliate the discrete structure of hierarchy with the continuous reaction, hoping to open the way to Reality.

Recurrence is confined to discrete worlds, while abstraction is not. This difference suggests searching for understanding based on mathematical structures that order algebra into topology. Intelligence in evolution is the faculty to transform abstract, natural/ artificial objects, and representations, in the correspondent worlds of arts, science and engineering.

Transform = analyze/ synthesize/ modify, especially hierarchical reflexive: ideas about ideas, how to get to ideas, objects to transform objects, representations on representations, how to build/ understand representations.

Evolution is linked to the initial design of mental faculties for surviving of the whole system, but also to the space-time context for communication between intelligent agents.

Recurrence of structures and operations enables approximate self-knowledge (with improved precision on the higher levels of knowledge hierarchies). A continuous model (Traub 1999) for hierarchy levels, without loosing the hierarchy attributes, would offer a better model for conscience and intelligence.

A possible interpretation of knowledge hierarchies is: real time of the bottom levels - corresponding to primary knowledge/ behavior/ methods, is managed at upper levels - corresponding to concrete types/ strategies/ models, and abstracted on highest levels - corresponding to abstract types/ theories/ techniques.

Knowledge is based on morphisms that map the state-space of the object-system onto the internal representation of the simulator. An intelligent simulator learns generating and validating models of the object-system. Therefore: representations for design and verification should be common; the algebraic structures on which the different hierarchy types are based on should be extended to topological structures; the different simulation entities should be symbolic, having attributes as: type, domain, function.

Knowledge-based architecture separates representation from reasoning. A topology on the space of symbolic objects permits grouping items with common properties in classes. A dynamically object-oriented internal representation results, that can be adapted to the different hierarchy types.

Topological concepts, as neighborhood, or concepts integrating mathematical structures, as closure, can be applied in verification and optimization, for objects as classes.

The simulation environment prepares a framework for representing entities and relations of the system to be simulated, as general knowledge about the simulated universe.

Knowledge-based architecture, both at environment and simulation component level, ensures flexibility of the framework realization, by defining it precisely only in the neighborhood of solved cases.

For representation, this principle offers the advantage of open modeling. The user describes models, following a general accepted paradigm that ensures syntactic correctness, leaving the meaning to be specified by user-defined semantic functions that control the simulation.

For example, a module in an unfinished design can be characterized by constraints regarding its interaction to other modules; the constraints system is a model, open to be interpreted, thus implemented, differently, adapting to criteria in a non-monotonic logic.

Mathematics contains structures that suggest to be used for self-referent models. The richest domain in this sense is functional analysis (Rudin 1973) that integrates algebra, topology and order:

- contractions and fixed points in metric spaces
- reflexive normed vector spaces
- inductive limits of locally convex spaces
- self-adjoint operators of Hilbert spaces
- invertible operators in Banach algebra.

Let $(U, \{H_i \in S_h\})$ be a universe, structured by different hierarchies H_i and S_h the set of hierarchies defined on universe U.

Then $H = (Rel_{eq}, \{(Level_j, Structure_j) \mid j \in S_l\}, Rel_{ord}, \{A_j \mid j \in S_l\})$ is a generic hierarchy, with: S_l the set of hierarchy levels, Rel_{eq} the equivalence relation generating the levels, $Structure_j$ the structure of level j, Rel_{ord} the (total) order relation defined on the set of hierarchy levels, and $A_j \subset Level_{j-1} \times Level_j, j \in S_l$ the abstraction relation. U is a category, e.g., containing Hilbert spaces with almost everywhere-continuous functions as morphisms, enabling different ways to simulate self-awareness. A hierarchical formal system can be defined:

Considering self-adjoint operators as higher-level objects of the knowledge hierarchy, these levels can approach self-knowledge in the context of knowledge about the inferior levels as of the current one, and having some qualitative knowing about the superior levels. The correspondence problem, i.e., associating the knowledge hierarchy to the simulation hierarchy, is managed by natural transformations over the various functors of the different hierarchies regarding the simulated system. To complete the simulation of the intelligence's components, intention is first determined by human-system dialog.

$(U, \{H_i \in S_h\})$, $card(U) > \aleph_0$ // hierarchical universe

$\Sigma = F \cup L \cup A \cup K$ // functional objects

$F = \{f \mid f : U^* \rightarrow U\}$ // global functions

$L = \{f \mid f : Level_j^* \rightarrow Level_j\}$ // level structures

$A = \{f \mid f : Level_j^* \rightarrow Level_{j+1}\}$ // abstractions

$K = \{f \mid f: Level_j^* \times Level_{j+1} \rightarrow Level_{j+1}\}$ // knowledge abstractions

$I = \Sigma^* \cap R$ //initial functions

$R = \{r \mid r \in \Sigma^* \times R^* \rightarrow \Sigma \times R\}$ // transformation rules.

5. SEMIOTICS ⊂ SYNTAX × SEMANTICS

Transferring an ontological approach, communication through language requires the distinction of three levels:

1) the level of reality;
2) the level of cognitive representation of this reality;
3) the level of material representation - text, signs, images etc

When we acknowledge an object in association with a certain sign, than marks are created in our brain in virtue of which the simple appearance of the same sign will *evoke a thought or reference* directed to this object as the impressions stored in the memory were reactivated –see Figure1 (Ogden and Richards 1930).

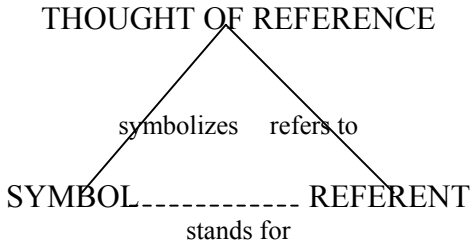


Figure 1: Semiotic triangle

The solid lines in this triangle are meant to represent the causal relations of *symbolization* (remembrance, evocation) and *reference* (memory, perception).

Opposite to these, the dashed line signifies that the relation between symbol (word) and referent (reality), linguistically the most important, is barely *imputed*. The immediate conclusion is that the multiple perspectives in multilinguistic endeavors are (at best) locally, temporarily and partially resolvable.

Assuming the *referent* (reality) is an existing entity for all the interlocutors, they may still have different *thoughts* (concepts) associated to the same referent, depending on their social-geographical personal universe or past experiences.

It is therefore a difficult task for the translator to find the most suitable *word* for the most similar *reference* in the target language.

As difficult as the above situation may seem, it can get even worse: the situation in which the *referent* exists in one language - and has both a reference and a symbol accordingly *attached* - and is inexistent in other(s). Language can here not overpass its limits, e.g., *snow* for the languages of the hot climate countries.

Without giving up anything essentially human, culture, social or natural togetherness, different approaches, humans have a lot in common: philosophic desire, comprehension of the own hierarchy in the context of the other two, free life based on understanding the necessities, constructive fear of the unknown, and especially the love for creation. Except the three cultural ways, that permanently *Divide et Impera et Intellige*, there is no other. (Niculiu 2008)

We need Consciousness to return intelligently to Faith

People of one choice exist, in all senses of the word. They either comprehend all the alternative ways and their convergence, or, in the context of natural love for philosophy and interest for the other selectable directions, put more passion in one direction. Of the first category are temporary elected, in different convergent hierarchical modes, the social leaders, of the second, the institutional directors.

Both kinds of leaders are more philosophical than their cohabitants, even if the ones master the strategic perspective given by an attained peak, while the others have the joy of the courage to climb into profoundness.

The elected artists permanently reconfigure a system of laws, to be beautiful by intelligibility, true by consistence, and good by human understanding. The elected physicists, pure or from different correlated scientific domains all collaborating with mathematics and engineering, govern by research strategies with Gods Fear. The elected engineers critically construct and criticize constructively.

For any social role, the elected concentrate, respectively, on Faith (mathematicians), Intelligence (physicists), and Conscience (engineers).

There always exists a human, called No.1 or the Philosopher, depending on the stability of the times, cloudy or clear Sky. He will always lead directly the elected or the philosophers, who will know to educate and learn optimally the humans of all ages, including themselves.

We have to start. Otherwise, it is no hurry.

Intellige is to link, to understand, and to be aware. In Latin: *intellego* = to understand, to feel, to master, to gather in mind. Artificial has a derogatory sense; however, the root of the word is art. Arts remind of liberty, as *Arts for arts*.

Artificial is at first sight the complement of natural. Our ideas transfer us to places that are neither natural nor artificial. Maybe artificial means something natural created by the human being and Nature is an extension of our body. However, we feel to be superior to Nature, as to our body: we can think. (Penrose 1994)

Why are only humans creating arts, why do they need to know more, and why do they construct other and other natural things they have not found in the Nature? We learned the arts have to discover the Beauty, that science has to look for the Truth, and that engineering invents things to help us, caring for the Good.

Arts are free, and even when they return to Reason, as mathematics, they bring results, that could before just be seen by Intuition, to send by Inspiration and Imagination to Intelligence.

Physics reaches and gets conscious of Reasons limits, both by the quantum theory and by the too complex phenomena, e.g., society and human. It looks like there is no difference for the intelligence that is useful to one of the ways.

An example, that confirms that they simply represent different approaches to understand and develop the (presently natural) Reality, is *architecture*, which we cite in each of them.

To conclude: Intelligence is more than Reason, to make us feel as beings superior to Nature, what also means that we have to respect Nature more:

Spiritus Sanus in Mens sana in Corpore sano

Therefore, there is something else in the Intelligence, which allows us to consider ourselves humans, human groups, peoples, beings on the Earth, or conscious beings in the physical Universe. We also feel that there is something essential beyond the physical – the metaphysical (*Plato*). More, there is something exterior to the human intelligence, without that we could not fight the Time to evolve. We have to feel complete, even if we need education and permanent work in communication with the other humans, of the past, the present, and the future.

We need Conscience to link Faith to Intelligence

We have to remember the abstractions that assisted us to go further. We said complete human to someone complete in a context, what implicitly supposes the power to go beyond the context. This is the story of the integers (*integer* = perfect, complete): they have a beautiful complete theory, however, do not forget to build the rational numbers to feel as close as needed to any real number. Nevertheless, they realize this is not enough, rewarded by the conscience of the continuous Reality – infinitely more powerful than the discrete/ countable one. To IR, we get by the perfect circle that is beyond the power of Reason. For example, we plan to realize artificial intelligence, to have a friend that is conscious of the problems to solve together.

For the moment, there is no artificial intelligence. However, we learn to be conscious of the computer limit to process only rational numbers. This means it uses a sequence $(x_n)_{n\in IQ}$ that converges to $\sqrt[n]{a}$ (*Newton*), what reminds us of the density of IQ in IR.

6. INTELLIGENT SYSTEMS

The reasoning of systems capable of reflexive abstraction, i.e., intelligent, starts by describing the problem, and is controlled by problem solving strategies; these derive from the approach principles contained by a knowledge level superior to that of the current simulation.

The principles are structured/ typified corresponding to the higher level => hierarchy types. For the classical representation problem space = (states, actions), problem solving means the process starting from an initial state to look for an operation set that leads to a result state. Solving strategies structure the process to look for the solution (goal-project-concept).

Intelligent systems demand a *cosimulation* of the parts belonging to different domains, e.g., hardware & software, in the context of unified representation for design and verification.

Unified simulation of hard-soft systems is imposed by the incompatibility or non-optimality that results by the initial partition of the system, as by the inefficiency of traversing the design-verification cycle for a fixed partition.

Unified simulation methodologies eliminate the rigid partition constraint: It implies planning and learning, i.e., the possibility of communication between different levels of the knowledge hierarchy. Intelligent simulators can learn by iterative generation and validation of models, possibly interactive.

The objective of the *human-machine dialog* is to advance toward the simulated intelligence by transmitting the knowledge between human and his mental/ physical extensions in a common language. The input dialog is oriented toward learning.

Knowledge bases on a morphism that applies the behavior of the object-system on the internal model of the simulator. The output-dialog on the result specifications is oriented toward planning. The dialog can be extended to the internal unfinished zones, to maintain the integrity of the hard-soft simulation.

Further, communication concordant to the human-machine dialog principles can be also extended from assuring the interface problems between the knowledge hierarchy (planning/ learning) and similar activities corresponding to the hierarchy types that are based on simplifying abstraction forms.

The three different essential ways to approach this goal have common central themes: learning and planning, knowledge representation, and functional constraints.

- Concept-symbol analogy: concept representation and symbol operation try to simulate the mental processes.
- Structural analogy: the activity of brain is emulated by neural networks, cellular automata, genetic algorithms, membranes or quantum computing.
- Hierarchic-parallel analogy: thinking is considered a collective phenomenon that is produced by constitutive phenomena parallel and recurrently.

The limits of the knowledge domain for intelligence simulation are *reconfigurable*: learning can guide the representation - semantics and architecture of the system, and functional constraints can formalize the cognitive constraints in the spatial-temporal reasoning context.

The informatics extensions of the contemporary human impose the knowledge of a third language to use his artificial mental or physical extensions, next to the mother language for context integration and to the one surpass the context - nowadays, American English.

The evolution of the programmable systems from punctual activities as answer to explicit orders, to autonomous activities, supposes a knowledge-based high-level symbolic object-oriented dialog, to awake the consciousness by explicit selections, and the adaptability by assisted decisions. As result of formal version of (part of) the natural language, a high-level language for intelligent dialog has to inherit:

- syntactical regularities (studied by computational linguistics) and semantic correspondences (studied both in language philosophy as in AI),
- regularities of the cognitive processes (studied by cognitive psychology and intellectics),
- relations with the I/O system (perception/ action) of the individual intelligent agent, and with the interactions of the individual intelligent agents (social relations) in the intelligent system.

Formalized conform to information theory, syntax and semantics offer a representation of a world preexistent to the dialog. The resulted formal system has to be correct - any formula corresponds to a fact and any formal computation to a real reasoning, and complete – any real fact corresponds to a formula and any real reasoning to a formal computation.

Consequently, understanding is simulated by the evolution of the representation language in the symbol hierarchy. This approach is that of the classical artificial intelligence. Its limits proceed from restriction to logic sequential mathematical discrete reasoning, what results in the incapacity to represent conscience, intention, intuition, i.e., intelligence. The regularities of the cognitive processes are represented as inferential strategies common to the dialog partners: inference is not just deductive, but mostly inductive.

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CONCLUSIONS

Conscience simulation demands transcending the present limits of computability, by an intensive effort on extensive research to integrate essential physical and mathematical knowledge guided by philosophical goals. Even mathematics will have to develop more philosophy-oriented to approach intuition. Simulability is computability using the power of continuum. There are positive signs for this from analog electronics, control systems, and mechatronics. Real progress towards this way of computation needs unrestricted mathematics, integrated physics and thinking by analogies. Evolution implies the separation of faith and intelligence, so we have to better understand both, integrating them to human wisdom, to be divided further to get more human. Metaphorically phrased, our searches and researches should have as axioms:

- *God is Unique*.
- *His ways are Uncountable*
- *His plans are Hierarchical.*

Philosophy is not a specialty but a human right. There have to be schools to prepare the teachers of philosophy for the other humans. These schools have to develop also respect for those that look for the Way on one of the three alternative paths that correspond to the fundamental partition (arts, science, engineering). Because recently the essential *Divide et Impera* do not *Intellige*, the only philosophers are the masters in:

- Arts – especially mathematicians, and others that, aware or not, compose mathematically
- Science – physicists, and those that do not forget their science is a chapter of physics
- Engineering – mostly those working in domains that attain the limits of the pure Reason.

Mathematics is one of the arts. The music is at least as beautiful and expressive, but mathematics does not demand an extraordinary talent, allows a reasonable dialog about it, and has well-defined reconfigurable limits of that it is aware. Mathematics has to be educated as soon as possible and has not to be confounded with its handcraft. The music gets more often out of its character. The two arts evolved together: *Johann Sebastian Bach*, *Antonio Vivaldi*, *Joseph Haydn* were musically gifted mathematicians, who preferred the liberty of the music to the bands of the Reason.

The Reason, as initial zone, makes mathematics more sure but less charming than the other arts that can refer directly to the Reality: literature, music and sculpture. The visual arts are too dependent of the Nature because seeing is the most used sense for the human natural being. The mathematics school is continuous, whereby sculpture, literature, and music can generate sooner higher singular peaks: *Michelangelo*, *Shakespeare*, *Beethoven*, by an exponential/ other highly nonlinear continuity. Arts are free. But mathematics first expressed reasonably that Reality could only be approached by Reason

Physics is the Science. The other natural and social sciences are its chapters, even if they are not yet aware of it, or just try to return to their riverbed by intermediary specialties instead of integrative bridges. As any artificial system, the society is structured on natural bases, and it develops by natural laws. The modern age forced these laws towards Reason, and recently they got out of control. The social laws got also unreasonable. Physics is essential for the constructive reconfiguration of the Faith.

Engineering is most frequently both art and science, and is as important as arts and sciences in the fundamental partition of the Reality needed for evolution. However, it is more dangerous than its alternative approaches, of which it has to be strictly bridled. Reasons are twofold: Its result, called *technology*, is defined by its complement – so it is not superior to this. It does not impose spiritual proximity between the creator and the user – so it can be applied in a complete different scope than it was generated. However, any engineering is the homonymous complement of a special science that collaborates with mathematics, therefore, integrated sciences into physics and mathematics remaining among arts solve the case.

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MARIA NICULIU is MA (European Intercultural Communication Strategies) and MS (Mechanics Engineering). Her MA thesis (2011) is about *Von intensiv zu nachhaltig* – from intensive to sustainable. She graduated the Faculty of Literatures and Foreign Languages, German/ French/ Dutch - Bucharest University (2009) with a paper on *Sprachenvielfalt und Mehrsprachigkeit, was taugt die Europäische Union als Standort der Mehrsprachigkeit* - Multilinguism and what makes the European Union as model for a multilingual society. After the MS from the Faculty of Mechanics Engineering of University *Politehnica* of Bucharest (1987), she enriched her technical and economical background - member of the Romanian Authorized Accountants and Financial Experts (2008), and directed her interests towards a multicultural approach of the European social and economical evolutions, based on linguistic and behavior simulation.

TUDOR NICULIU is Professor at the Electronics, Telecommunications, and Information Technology Faculty of the *Politehnica* University in Bucharest, and Senior Researcher at the Center for New Electronic Architectures of the Romanian Academy. He is looking for hierarchical integration of different domains, to understand intelligence by simulating it, and to apply it to intelligent simulation. Since 1991, he teaches and researches at the same institution, PhD 1995, MS 1985. Before, he was Senior Researcher at the R&D Institute for Electronic Components in Bucharest, researching and designing hierarchical simulation of analog integrated circuits. He studied Mathematics at University of Bucharest (MA 1994). He published 12 books, 25 journal articles, and 69 international conference papers. He is IEEE Senior Member of CAS, Computer, and SMC Societies, as Fellow of International Institute for Advanced Studies in Systems Research & Cybernetics.