CRUCIAL INTELLECTUAL EVENTS IN THE HISTORY OF INFORMATION SCIENCE AND TECHNOLOGY

An Intellectual Invention-Based History of Artificial Intelligence

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Abstract. Past, present and future steps in AI conceiving and implementing are sketched in our paper. We also will try to demonstrate that these steps are running from Intellimation to Automation and from Cybernation to Datamation; Sociomation – the ultimate step? Then, *the conceptual evolution* from intellimation and datamation to human-artificial cybernation is described and some contemporary automatic and cybernetic (sub) systems of thinking, acting and co-operating are outlined in the following sections of the paper. We see here cybernetics itself as a way of being, a way of making science and a way of using technology. Recent developments in artificial intelligent systems, from multi-agent systems to softbots, knowbots and social robots are envisaged. The future evolution to sociomatic systems is also questioned here, and post-diction and retro-diction, prediction and pro-action in AI development are pointed out.

INTRODUCTION
INTELLECTUAL TECHNIQUES AND INTELLECTUAL INVENTION FOR INFORMATION TECHNOLOGIES

Intellectual history, a history of fertile ideas, is a narration and interpretation of a lot of ideal structures that can begin or can be restart from any moment and from many and diverse perspectives, and that can also function as post-diction and prediction, as well as retro-diction and pro-diction.

The history of great ideas is then a possi-diction: it is possible to be made in the largest world, that of all possibilities, in any sense and with equal benefits, either if we aim to conclude about results of intellectual activity, or if we intend to animate or accelerate it to new opportunities and achievements.

A history of ideas was written in every field of intellectual history, but ideas also have a generative, structural and functional role in every current social form of activity, and mainly in the corresponding specific fields of social invention.

In our times, intellectual invention and technical means are closely intertwined and information techniques are involved in knowledge work in all its forms through information acquisition techniques, knowledge discovery techniques, learning and training techniques, professional and personal growth techniques, creative techniques, knowledge management, knowledge distribution and knowledge trade techniques.

All these techniques are intellectual techniques associated with new types of intellectual activity through which a new kind of knowledge environment is born, namely an intellectual, virtual and artificial technical environment. The present passage from knowledge flows and networks to knowledge works and groups which uses knowledge-based information systems for knowledge acquisition and for new knowledge generation leads to a new stage of science and technology development.

Intellectual invention, which results from the convergence between the two most effective human activities, namely intellectual work and technical invention, is also the generative core of science and technology. At the same time intellectual invention represents a common factor of all social forms of invention, from the invention of institutions to the invention of values. **Intellectual invention essentially means the complex work of generation and implementation of a new and fertile idea, conception or vision that set the grounds for the birth of unprecedented fields of activity, institutions or values.**

All forms of social activity, such as the artistic, scientific, moral and economical or political, include intellectual invention. Intellectual invention is also present in the technical activities and even at the highest level in the information technology development. Indeed, in all historical periods, intellectual and technical inventions were the most important means to create new, and for that matter, artificial objects, the society being the first of them. Social invention is the best illustration of the specific of human invention, which is often both individually and collaboratively made, and which is both spiritual and material, is of short or long-term utility but always of maximal social effectiveness.

Artificial cognition and artificial discovery are now in progress through new knowledge activities carried out in the new knowledge environment. By collaborative activities in professional groups and by integration of the knowledge work techniques and communication facilities offered along with the information technologies, new cultural communities with specific values are constituted in the web culture, where new, virtual needs are satisfied by virtual means. In this way, the cognitive evolution as social and cultural evolution now receives an artificial component and even a co-evolution of human and artificial intelligent systems begins.

1. STEPS IN AI CONCEIVING AND IMPLEMENTING

We will try to demonstrate that these steps are running from **Intellimation to Automation** and from **Cybernation to Datamation; Sociomation** – the ultimate step? Then, the conceptual evolution from intellimation and datamation to human-artificial cybernation is described and some contemporary automatic and cybernetic (sub) systems of thinking, acting and co-operating are outlined in the following sections of the paper. The future evolution to sociomatic systems is also here questioned.

1.1. INTELLIMATION

Here can be integrated intellectual achievements such as those initiated by scientists and philosophers who studied and launched for all the times a lot of scientific topics as those that will be further on treated.

1.1.1. Cultivated human intelligence was analyzed and teached, at the beginning, in its:
– results,
– origins,
– internal processes and evolution,
– structure (behavioral, psychic and logic), in the known scientific and esoteric intellectual traditions of Antiquity.

We can interprete these studies as expressions of the first intellectual invention period. This succession of different historical steps in the study of diverse aspects of the same general human aptitude – intelligence, makes us also able to find out an interesting and till now less observed intellectual course, that from **certitudes** to **opinions** and even from **doubts** to **paradoxes** (exprimed in the passage from dogmatism to eleatism), and then from **hypotheses** to **explanations** (genetic, structural and finalistic), like in Plato's and Aristotle's opera, while later we constate a more but not yet deeply scientific course of **typifying, analyzing** and **synthetizing activities**, which accomplish and surpass both the old speculative approach and the preceding accentuated trend to specialisation in the examination of human intellectual capabilities.

1.1.2. A second intellectual invention period begins by the research of principal features, means and instruments, as well as techniques of intellectual activity. Let see the most significant steps on this intellectual way.
– The sophists: language as technique of a techniques;
– „Old stoic" school: the first elements of logical calculus;
– Aristotle: • distinguishes maybe for the first time at a theoretical level between the intellectual and physical work;
  • describes instruments of intellectual and practical activity, and
  • makes some predictions regarding tools as those of Daedalus that will make unnecessary the work of „living tools", the slaves;
– Euclid's commentators make the synthesis of a lot of heuristic methods;
– Al Horezmī creates working algorhytms for any field of calculus (820 AD)
– Medieval mnemotechny;
– R. Lull: • the logical machine – invention of the idea to produce all the possible knowledge, by a mechanical method; "Ars Combinatoria" (1275);
  • this machine, made of paper, was effectively used for automatic but mechanical generation of religious truth;
– Pascal: • the first digital computer – Pascaline (1642, 1645);
  • his mechanical computer – 1624;
– Descartes proposes the mental experiment of the "brain in the tube";
– Kircher: the artificial universal language – "Polygraphia nova" (1663)
– Leibniz: • "Dissertatio de arte combinatoria" (1666)

– Kircher: • "Ars magna sciendi sive combinatorica" (1669); he also made
• cryptographic activities, automata, a picture-projector, as a magnetic clock and other magnificent inventions;

– Leibniz: • fulfils his promise to realize a computing machine (1671);
• develops the binar computing system (1679/1701);
• creates *characteristica generalis* (1682);
• studies mind by a large-scale model – "the mill" (see later Babbage).

1.2. AUTOMATION

Divine Devices are mentioned by Homer, as the Tripods of Hephaestus, and Aristotle tell us about the instruments and tools of Daedal, that work by oneself and more, he predict the possibility to grow the efficacy of human work by complex machines that will not be humanly actuated and which will make useless the work of humans as means or tools [1].

In the so-called Dark Age brilliant minds coined technical and even social inventions, such as flying machines (R. Bacon) or even logical machines (R. Lull).

The Renaissance period is full of intellectual inventions, physically realized only in our days, like the utilitarian (of industrial or personal use) or military destination machines of Leonardo da Vinci. Other intellectual creations were made in art, such as the birth of the shining sonnet [33] in the worming but anonymous south or as the development of modern tragedy in the bleak north, maybe by Fr. Bacon as Shakespeare.

As social but also only theoretical inventions we can register in these last two eras of re-building of humans, in spirit and body, collectively and individually, a lot of social constructions built as ideal models and presented as ucronias or utopias. These intellectual inventions were also described like human or geographical curiosities, not like the old platonic city, a place based only "on words" as the philosopher himself said.

We can again nominate here R. Bacon with his *Nova Atlantis* as well as T. Campanella, with his circular and more, concentric organized ideal construction. Probably similar social ideas animated some plastic representations, like those entitled as *Bononia* and sketched as stellar figures on imaginary maps, along the papal city corridors.

A very intellectual invention can be examined if we follow J. Swift in his many but less known travels in imaginary but realistic depicted countries. One of these travels led him to the Academia of Logado, where he found a **creation machine** which can make, for humans without specific competencies, like our computer, poetry, mathematics, legislation or …philosophy. This last is, only, a utopia!

In his turn, A. Kircher was not only a scientist. As Leibniz, he was a global acting creator and communicator. He had a great success not only by his de-cryptographic and cryptographic works, but he also invented an image-projector, a magnetic clock as well as a lot of more or less sophisticated automata.

Other inventors have conceived and presented diverse automatic devices or even complexes, especially with an entertainment destination. It seems that our civilization of spectacle is not the first at all; even the ancient Egyptians, the Greeks and Romans have used some religious, political or divertissement centered complex, mainly natural-laws based, artifacts.

A **machine-man** was even conceived by La Mettrie, who depicts a continuous analytic line that allows the study of human organism both as a plant-man and as a machine-man, integrated then in a cosmic and cybernetic connection. The cybernetic constitution and conduct is, in his vision, both one internal and external, individual and generic [13].

His famous idea, still picked up mainly by its spectacular feature, was preceded by that of Descartes, who elaborated a cosmological theory (which inspired, in our opinion, Kant himself)**,** that describe, in essence, a cybernetic mechanism too.

Descartes and La Mattrie have then formulated cybernetic explanations for the mode of organization and operation of the world system; thus they have integrated the cosmic universe and the human universe in the succession of the regulatory and self-regulatory forms of organization.

1.3. CYBERNATION

The idea of using or even building feed-back characterized systems is later coined by thinkers who studied and remade **the nature's scale of inventions**. On this scale even society can be seen as the highest level, but the first in the human order. Animal societies are not evolving systems or *nostratic* ensembles, even if they are at the source of human communities. They evolve only as species and are leaded, sometimes better, only by instinct.

Cybern(etiz)ation is, for now, rather an intellectual project than a practical achievement. Its theoretical foundation is however deeply accomplished. We can point out some historical and relevant illustrations and we can add a series of new but also promising definitions.

Plato formulated the well-known parable of the man at the wheel, the *kybernetes*, from here the name of cybernetics.

Ampère has studied and elaborated a *science of government* thought and described by him as a *general theory of control* or management.

The theoretical concern for the study of cybernetics and the construction of a general theory of action were then oriented in different directions and developed in mainly two autonomous cognitive and practical bodies: thus, the term cybernetics was more and more used to designate the technical branch of concerns for the growth of effectiveness in action.

Cybernetics is still further studied also as theory of action. A.A. Moles points out the importance of information theory for the present development of cybernetics, but he reminds that cybernetics aims mainly to provide the effectiveness of action [15].

We also remind what Wiener himself implicitly said, namely that the world of the action is the world of information used with a determined finality: as an *agent* can be considered entities of natural, social and technical order, and thus all sort of systems which deals with information and its communication, coordination and control.

Cybernetics functions then in nature and society. Two types of specifications are here needed: a) one theoretical and a second, b) linguistic.

a) Cybernetics *occurs* or *can be studied* and even *generated,* by technical means. Some of these means are, in our conception, mainly intellectual techniques;

b) A distinction between motion and action is necessary if we follow the exigencies of scientific and philosophical research. This difference is already made by Aristotle – see [1], and is discussed in a large variety of contemporary **pragmatic logics**, as in the present foundational **technical logics**, in its task to help in the work of AI developing.

Social cybernetics (or socio-cybernetics) is the *genus proximus* for our **intellective approach** of cybernetics.

T. Parsons, an important sociologist who is known as the author of *The Structure of Social Action,* has shown that the "pragmatic chain" can be seen as a finalistic causal link in which, depending on the result, the process of action is continued or taken again in changed conditions or even with new objectives.

We can identify here a true cybernetic connection, a value-based one, because the choice of objectives, conditions and means as the feature of the decisional process and the number of its phases are themselves results of an evaluating moment or process in the framework of action.

This evaluating process can be also studied as an action or even as an activity, in which specific and sophisticated, another types of acts or actions, assisted by peculiar methods, techniques and procedures can be used, like sociological, psycho-sociological, statistic or information techniques.

As a preliminary conclusion, we can than say that cybernetics functions both in nature and society. From the possibilistic view of our work we also can affirm that cybernetics is not only a contemporary way of study nature, society, thinking or action, but a perennial perspective, that regards past, present and future. If we keep this perspective we can see that cybernetics is a way of being, a way of making science and a way of using technology.

Here we study mainly the intellectual means of efficient action and, particularly, the adequate intellectual techniques of effective action.

This way of thinking and acting (cognition is also a kind of action) is consonant with other present approaches of cybernetics as science and technology.

Cybernetics connected with Systemic thinking is such a research direction and is promoted by the WOSC, the World Organization of Systems and Cybernetics, which is composed of mathematicians, engineers, economists, philosophers and other categories of intellectuals from Europe, North and South America and now, from Asia. The next WOSC Congress will be held in China.

In this intellectual context new levels of Cybernetic thinking and acting were conceived and built: **Cybernetics of second and of third order**. As representatives of new order Cybernetics we can name the following well-known scholars: S.A. Umpleby (1976), Vincent Kenny and Philip Boxer (1990), Johanneson and Haunan (1994), S.A. Umpleby (1994), Marilena Lunca (1999), M. Mulej, C. Kaizer, V. Potocan (2005). Parts of our present paper can be, maybe, counted as bits of a **fourth order Cybernetics**. A recent achievement in Cybernetics can be also considered the birth of "Cybernetics of Cybernetics", which can be seen as the **Philosophy of Cybernetics**. This last assessment expresses my opinion.

Cybernetics is today conceived as the general theory concerned with the study of efficiency conditions of action and as the system of activities regarding the implementation of adequate instruments for social systems development orientation, coordination and control.

In accordance with the main necessities of our paper **cybernetics is thought as a general theory that studies the structure and dynamics of finality characterized systems.**

Other definitions of Cybernetics as outcomes of

i) systemic thinking application in the study of social phenomena and as results of

ii) cybernetic reflections on the basis of a system of philosophical principles were formulated by us in [23]. The second betwixt these last research ways [(**i**) and **ii**)] leads us to study the status and role of some *founding principles of a universal theory of evolution*, especially the principle of action and the derived principle of efficacity – see [28].

1.3.1. The present paper proposes a certain renewal of the systemic research understanding and of the cybernetic studies approaching, but in a way by which we still have to observe the internal requirements of social organization and the proper methods to deal with social facts, processes and trends. Thus we here understand **Cybernetics as the general theory of integrative systems with a finalist or directed behavior**.

Our paper refers especially to evolutive systems which can be described as developing systems.

The general theory of systems with a certain sense concerns the systems directed by a sense which can be determined or undetermined, determined from exterior or from within (self-determined), predetermined or not.

1.3.2. We have to outline here that the underlying principles of knowledge and action result not only from generalization, but also from understanding the essence of knowledge and practice, that can be synthesized in a coherent set of principles, by scientific and philosophical reflection. It is also important to study how principles of first order functions inside of systems as to describe and to use the constructive principle that acts in the process of building the system of principles itself.

Through this theoretical and methodological perspective the systemic vision and the structural methodology are not just pointed out but also applied to larger systems and even to the study of the whole existence. The systemic vision and the structural methodology are particularly useful for socio-cybernetics as for its understanding and using. **Socio-cybernetics is a complex activity of study, reflection, interaction and social intervention.** The above described both theoretical and practical orientation of cybernetics and social cybernetics express not a simple personal option but it was actually seen by us during our repeated participation in a series of international conferences and congresses of Cybernetics and Systems as in a few sociological symposia or scientific session.

1.3.3. The Principle of Action is particularly important to be analyzed, from the perspective of our paper, and the way in which this principle operates at various levels and in different areas of existence will make the object of a separate analysis.

An important role will be assigned to the study of a derived principle, namely the principle of efficiency, and to the way it operates at the distinct social levels of existence.

Cybernetics itself may be reconsidered, at this level, and **a fourth order cybernetics can be anticipated**, as representing the study of the conditions of growing the efficiency of action and the implementation of adequate instruments designed to orient, co-ordinate and control the development in social systems.

The fourth level Cybernetics passes then beyond social cognition, social attitude and social reflection (about social problem, social decision and social organization), even beyond social intervention and action; it needs – as foundation – a synthetic vision, and as source of a specific motivation, a set of prospective requisites (models, methods and techniques).

1.3.4. One of the motivations of the emergence and of the development of **socio-cybernetics** consists precisely in the necessity to scientifically ground the social evolution toward a development without a waste of resources and energy, through an increase of efficiency by resorting to universal mechanisms and principles of organization and activity, already experimented and perfected in **nature** and **technology**.

Our perspective is inspired by the mode of evolution and the efficiency models developed in **information technology**. This superior, partially artificial, type of efficiency is explained by its more recent grounding in knowledge-based technological systems and methods, and also in the understanding of the continuity between the various types of evolution as in the combination and the acceleration of the evolution types which turn out to be the most efficient.

Sociomation is preceded by Datamation, the present dominant intellectual course.

1.4. DATAMATION

1.4.1. Datamation mainly means automatic data processing, in our days, in a digital and virtual, networking and global manner.

1.4.2. In a closer actuality, **Datamation includes data, information and even knowledge searching, storing and transmission or dissemination**. On the ground of the "computing turn" of the philosophy as a whole and especially as an expression of the birth of a new philosophical branch, the **Philosophy of Computing,** as by using new methods and techniques inspired from social sciences – economy, sociology and even psychology – knowledge discovery, knowledge warehouses, stores and even knowledge markets have been developed (for more and different aspects see [25], chapter 3 "Information management" (p. 103–149) and chapter 4. "Information perspective on intellectual activity", par. 4. 3, 4. 4, 4.5 (p. 159–192), as the final figures.

Transmission of knowledge evolves now as **knowledge dissemination and sharing** and opportunities of **new knowledge generation** by knowledge flows in knowledge centers and knowledge nets are developed.

1.4.3. Knowledge Management was also born and even diversified – see [23] – by several social activities such as Business Intelligence, as well as Intelligent learning, Intelligent designing, Intelligent government, Intelligent Strategy Building, all these on the basis of an updated theory and practice of Artificial Intelligent Agent's Technology.

From our research perspective an important and promising way of the Philosophy of science and technology was thus opened: that of the **Philosophy of Artificial Intelligence**, which can be integrated in the Philosophy of Computing.

In our representation, **Philosophy of Artificial Intelligence has to study** *inter alia* **the emergent and new knowledge forms, inclusively artificial knowledge forms.**

New forms of knowledge were born or are coming into being. Their apparition often needs **new forms of knowledge processing** and **knowledge structuring** but primarily, new intellectual processes and structures and, as a consequence, adequate means and forms of human agent's cultivation and education.

Such **new kinds of knowledge** are the *fuzzy knowledge,* the *fractal knowledge,* the *network knowledge,* the *global knowledge* and the *projective knowledge* as well as the *inter-theoretical* and *integrative knowledge* and even the *artificial knowledge.*

The generation of new and more and more complex forms of knowledge, such as the *fractal network knowledge* is now possible. If we accept the existence of real widespread fractal network structures, as those signaled by J.D. Barrow in his book *The Artful Universe* (2005), we also have to admit and conceive, as well as to use an adequate form of knowledge.

Under these conditions, a diversification and a new hierarchy of knowledge forms are constituted and each of the new forms of knowledge is also specified by new means and by (intellectual) instruments.

To know on the web means, for example, to use some means of knowledge acquisition as well as text mining instruments, collocation detectors, means for semantic search and semantic classifiers as well as syntactic or semantic annotators, summarizers. See [31] to find the Romanian contributors in this area of AI research.

Knowledge based products are now distributed by a virtual market where intellectual producers can sell their virtual products (e.g. *IQ Port* on the web), knowledge and virtual proximity groups are formed for research, design or business and are organized in virtual communities.

1.4.4. The present stage, one superior to the precedent, in the intellectual history, is that in which technology is not only *with* knowledge dealing, but in which we have a technology conceived and built *around* knowledge – and we are speaking here even about theoretical knowledge – a **knowledge based AI technology**. This is then a technology that integrates, sustains and generates new knowledge, **with or without human intervention**.

1.5. SOCIOMATION

1.5.1. Sociomatic systems

From the class of the systems with sense, especially **the evolving systems which can be described as developing systems are studied**.

Social evolution itself can be natural, artificial and mixed, in its each component dimension: biotic, mental, cognitive and spiritual.

The natural and artificial co-existent, co-generative and co-functional forms of being are studied and their co-evolution is described for a both scientific and philosophical foundation of sociomation.

Socio-technical aspects of natural and artificial evolution are studied and instruments of social interaction and intervention, offered by the information technology, are considered.

Artificial conscience is even anticipated by M. Draganescu in many of his works, but artificial conscience is derived from a natural, cosmic disponibility and tendency, in his genuine philosophical creation, that confirms Isabelle Stengers in her reflections about the history of science, which is conceived not as a sum of results, of equations and principles, but as a collection of adventures which permeat to comprehend these results themselves as passion generated singularities.

Concerned about what the future of humankind and of science especially will be, M. Draganescu finds a solid backing in the thinking of a romanian specialist in biology and medicine, Gr. Popa, who foreseen, in 1940, that the faith of individuals and countries will be decided by their capability to master the means of transforming man and society. See [8], p. 23. As a prominent cultural personality, the scientist also outlines that these means are provided by science.

1.5.2. Sociomation is another possible level of cybernation, anticipated and described by us in a paper prepared for the 2008 Cybernetics and Systems Conference held in Vienna.

Social and even technical system's evolution has been until now either completely spontaneous or politically directed: it was determined with the help of a co-system of the global social system and not consciously or from within determined.

Nowadays some social sub-systems and systems have the possibility to behave as a **cybernetic system, namely as a self-determined system.**

In terms of social action and conduct, **sociomatic conduct can be described as an automatic, efficient and project guided conduct**. Not only in the general history, but in the intellectual history too, this kind of conduct is still absent or shabbily represented, mainly because of the lack of a satisfactory effectiveness level of human activity. The 11th chapter of our book *Philosophy of Technical Culture* (2000) p. 378–418 is assigned to efficiency problems.

Advanced technical systems can function as models for the development of social systems.

Such kind of technical systems have some characteristics of natural intelligent systems and some new properties, such as those outlined in Pană, [23], [24].

These properties can be modeled and used to design and develop some emerging sub-systems or some privileged tendencies of the social system.

The present European project includes, for example, **the conceptual model of a knowledge society.**

Progresses in complex artificial entities conceiving, developing and implementing need interdisciplinary teams involved in both theoretical and practical activities.

1.5.3. A Binary, technological and sociological, perspective

The sociomatic study of human relations, processes and evolutions, proposed by us, can be developed both in theoretical and practical directions. New and important aspects of a sociomatic vision and action can be thus expressions of

i) invention of artificial social agents;

ii) intelligent natural and artificial agent's co-evolution.

We note here that we can speak about an artificial cognition and action and more, about artificial discovery and invention.

It is also implied here the idea that artificial agents can be and are used as social agents. A recent but abundant literature is now available on this theme.

Co-evolution of human and artificial intelligent agent's is an issue coined and dwelled on by us at a conference on Computing and Philosophy – Pana, [20]. For a clear and exhaustive definition and classification of artificial agents see Draganescu, [7].

The artificial social agents as the organized and efficient collective human agents can be named and studied as sociomatic systems of micro and macro-social order.

We can then also conclude, **from the perspective of the History and Philosophy of Artificial Intelligence**, that **socio-technical systems can be developed as sociomatic systems.**

A lot of fundamental and applicative research directions in multi-agent systems were thoroughly studied and developed by Romanian specialists such as Dobrescu *et al*. [6], Barbat *et al*. [4], [5] or Negulescu *et al*. [17]. We can also note several inter-disciplinary and multi-disciplinary, sociological, philosophical, linguistic or technological approaches and, among them, some ethical Pana, [19] and [24], Barbat *et al*. [3].

These singular or collaborative but inter- or multi-disciplinary works are important for a sociomatic perspective, which subsumes both the technical and social and humanistic perspective.

A model of social organization and evolution as a whole can be accounted as the very sociomatic process, a mega-process because of its complexity and less because of its magnitude.

Intelligent systems are sensitive, cognitive, active and co-operative systems. This definition of intelligent systems is made by us as a conclusion of such kind of inter-disciplinary and multi-disciplinary studies, often prolonged in inter-cultural studies, such as those present in our book *The Technical Culture*, where we have described the specific of technical culture among other cultural fields.

The past, but mainly the future of intelligent systems will constitute themes for our last paragraph. We will turn our attention both on natural and technical as well as mixed intelligent systems.

2. POSSIDICTION: POSTDICTION, RETRODICTION, PREDICTION AND PRODICTION IN THE AI RESEARCH FIELD

A society is the whole of its past, present and future.

Human action too, has the same temporal dimensions. A prominent psihologist, J. Piaget, known mainly, as we know, by his contributions in the area of Psychology of Intelligence, asserted that the human brain itself has a distinct function for anticipation, named just the anticipative function.

The term *possidiction* was already used in the field of social prediction, but only as a diferit name for the same human attitude and the same scientific research. We enlarge here and in the same time we specify the significance of the term, from a philosophical and then from an integrative approach.

Possidiction is the general activity to describe, to evaluate and to predict social evolution in each of its potential direction.

We have now to precise what we are understanding by post-diction and retro-diction and by prediction and pro-action. By chance, we have here, as already prepared instruments, chapters of our own book about *Infinity, Possibility, Predictibility* (2009). But we have to apply now these instruments to the process of AI development as a field of cultural evolution and, more precisely, as a direction of scientific and technological evolution.

2.1. POSTDICTION AND PREDICTION IN DIFFERENT CULTURAL DOMAINS

In a research field, such as history, we can have both post-diction and retro-diction. Our position can be determined by **a)** our conception on history, but in the same time, by **b)** the social perception and practice as well as by **c)** our own cultural, social or even political attitude and every time but especially nowadays, by **d)** the present consequences of some recent important events.

In the history and philosophy of science and technology can co-exist and co-evolve similar historiographical options.

According to these main options, history can be seen as **postdiction** and then, as registering of significant social, cultural, scientific or political events. Each cultural field has its own history and even histories: history of science, history and histories of art, of politics and technology.

Retrodiction is seen as

– the possibility to re-construct the succesion of social and cultural events from the perspective of a conception or vision about history;
– a narration of these events by the angle of incidence of the social and personal effects of a recent important event, or even
– a presentation of an event or process from a group or individual position, interest or preference.

But history is often re-scribed from both these perspectives.

It means that each of the resulted versions is or can be inaccurate?

We also can constate that we need to rescribe history by various causes not only by motives. These later cannot be always blamed and even evited, by example when we need to correct or to complete it. But we have to modify not history but its registering and then its evaluation, interpretation as its foreseeable evolution.

This both theoretical and practical problem is avoidable if we use the term “possidiction”, even if, as we know, social processes, as complex phenomena, are irreversible, even it they can follow many, divergent or convergent, directions .

As an additional argument we have Hempel's specification about **the similar structure of postdiction and prediction,** which can be assimilated, in our vision**, as kinds of explication**, beside of the genetic explication, the explication by laws, as by the functional or motivational explications.

An other strong enough argument for **demonstrate the validity and value of prediction** is that faced with post-diction and retro-diction, prediction can be **cognition and action**, and not only a cognition form or way. Prediction is then pro-active.

Prediction then can be seen as an even more *productive* and *powerful* cognition and action way than post-diction or retro-diction.

Even as cognition, prediction can help us to decide in conditions of incertainty or singulararity and can enable us to solve future problems before their apparition.

With its specific power, prediction can determine present actions with the aim to realize a model of future.

2.2. ROMANIAN FOUNDATIONAL AND CONSTRUCTIVE CONTRIBUTIONS IN AI

As we already have shown, the early automatic machines with functions of human intelligence were mechanical and exclusively algorithmic. In his exhaustive and comprehensive book dedicated to the history of Romanian and world engineering, and its social influence, Şt. Iancu follows separately the evolution of the physical support of artificial intelligence – the information and communication technology – and the development of artificial intelligence from an idea to a scientific concept [11].

This volume is also a history of technical sciences and even a history of the connected fundamental sciences. Its author shows that the roots of Romanian AI research were fed by Mathematics as well as by Electronics. Because of its scientific and even cultural foundation, the Romanian AI research field registered a lot of achievements and Romania was the 5^{th} country in the hierarchy of the first generation computers conception and construction and the 11^{th} in the second generation computers original designing and fabrication. See especially [11], pp. 251–254.

As foundational works for the AI research field in Romania Şt. Iancu indicates monographs and studies of S. Marcus, Gr. Moisil, Erika Nistor or Minerva Bocşa, as a synthetic volume edited by the Romanian Academy. Mariana Beliş is distinguished as the author of a theory of learning. Practical achievements in automatic translation, realized in 1959 – yes, you have well read – by Erika Nistor (Timişoara) and in voice recognition as well as in a speaking machine construction, carried out by E. Nicolau, I. Weber and St. Gavăț in Bucharest (1963), are pointed out. Mariana Beliş, who built an automatic device for written language recognition is once again brought into perspective.

Fundamental works of the Romanian school of mathematics, computer science and technology also come from Cluj, especially from the Numerical

Computing Institute (1957–1975) organized by T. Popoviciu, who held new ground breaking courses and wrote books of Numeric Analysis and Real Analysis. Lectures on Computer Science and Programming languages were early given in this university center and a lot of young specialists were here educated, even by important guiding activities like the Seminar of Approximation Theory with applications in Numerical Analysis, initiated in 1946. Eight international scientific events were organized (1957–1975). As technical products of this Romanian school we can set off, with the kind support of a few participants at these creative processes, as professor N. Bulz, achievements as MARICA (1959), DACICC 1 (1961) and DACICC 2 (1969).

MARICA (Arithmetical Machine with Relays of the Computing Institute of Academy) constitutes the first Romanian computer built by electromagnetic relays and is the result of an experiment realized as an application of the Automaic Mechanisms Theory elaborated by Gr. Moisil at the University of Bucharest.

The first electronic computer built in Romania was CIFA-1, the computer of Nuclear Physics Institute of Bucharest, designed by engineer V. Toma, who presented its project in 1955 at an international symposium held in Dresden. The device was put into service in 1957. This first generation electronic computer, with electronic tubs and with magnetic roll based memory was reproduced and developed later for Romanian and Bulgarian computing centres of academic or even industrial interests.

DACICC-1 (Automatic Computing Device of the Computing Institute of Cluj), created in 1961, was a second generation computer if we consider its technical infra-structure (it was completely transistorized). As a soft product, it was conceived and organized in mnemonic program structures, built on the basis of mathematical modeling methods.

Another Romanian performance was MECIPT-1 (Electronic Computing Machine of the Polytechnical Institute of Timişoara), a computer with electonic tubes and memory on magnetic roll, designed and built in three years (1959–1961) but finalized in the next eight years. As D. Farkaş and Şt. Măruşter specify in their presentation “MECIPT-1 A page of history”, 1961 was the year of finishing the hardware of computer (central unit, memory, peripheral devices, etc.). Rudiments of the operating micro-system were built in several years (1961-1969), with components such as an I/O supervisor (input both for numerical data and programs, output for numerical data); Translators and Compilers (both for a specific assembly language and for a high level language like FORTRAN) and a Mathematical library. In 1968 was designed and achieved one of the first translators for a specific assembly language in our country, named *Autocod*, by a team with D. Farkaş as the main designer. The initial team included a mathematician, an engineer and a technician; the leader of team was I. Kaufmann, mathematician and lecturer at the West University of Timişoara. MECIPT-1 was utilized mainly in designing and research works: most of the calculus for the cupola of National Exposition Center from Bucharest, for Vidraru dam, "Iron gates" on Danube; the water network of Arad; the design calculus for power machines (UCM Reşiţa); computing the gravitational anomalies in the Petroşani basin for geological prospecting.

DACICC-200 (1969) had the capacity to realize 200,000 arithmetical operations/ second, a performance at that time. From the technical perspective, DACICC-200 belongs to the second generation of computers too, but contains many concepts and elements of the third generation: the length of words was of 32 bits, and the memory was organized in octets, addressable by parity control. It also disposed of a hardware system for the treatment of discontinuities as of a series of parallel execution mechanisms of operations, such as those of instruction preparation and execution etc. From the software perspective, with the DACICC-200 appears, for the first time in our country, the notion of operating system in the case of an original conception computer. The operating system of DACICC-200 contained a monitor which realized the administration of peripherals, the treatment of discontinuities as the administration of the multitasking work regime. The system also included a FORTRAN compiler, assemblers for two programming languages (PAS and MOL), a feeder and a library.

The study of human intelligence, even if sometimes shadowed by spectacular technical achievements that attract and retain our attention, as the research of natural intelligence, at its different levels, never ceased but, unfortunately, it

• was always partially oriented and
• tends to be more and more specified.

We consider that a very holistic approach is necessary to innovate in this domain at the highest level. As an attempt to come near to an adequate foundation of the AI project we have sketched [18] an Integrative Model of Brain, Mind, Cognition and Conscience.

In a chapter earlier dedicated to describe the present achievements in AI development we investigated the relations between cognition and computing, emotion and computing as between creation and computing [25]. **Our synthetic opinion about these pairs of structures, processes and activities may be exprimed in the appreciation that human intelligence can and will be efficiently assisted by artificial intelligence.**

Computing machines with programs and programmers in a present-day meaning were designed by Babbage with Byron (Lovelace). The first one was actually both a theoretical model and an engineering design: the *differential engine,* which was deeply mechanical but based on the rule of finite differences in complex equations solving by reiterated addition. The engine was designed to use the then digits and conditional algorithms. It was also conceived to function on the basis of data and instructions and by using the energy of steam, the most advanced technology form in their days. The second version of the project was the *analytic* *engine*, that was equipped with an input device, a memory and an output device; its functioning model was made in 1999, at the Smithsonian Museum.

The Turing Machine – the universal computing machine – is also named “the ideal machine”, because it is

– an abstract model of a computing system;
– a program, a complete algorithm and a machine which transforms a list of symbols by operations in an other list;
– a “mental experiment to decide in a logical problem”.

We can say that Turing’s machine was the first GOFAI project (GOFAI is the acronyme for “Good Old-Fashioned Artificial Intelligence” – the initial, “strong” AI research programme).

Artificial Intelligence research projects evoluated to LAI (“Light Artificial Intelligence”), because they have become less and less ambitious and now are aiming to make intelligence forms similar with those of insects and birds, but these projects are still more advanced, because they combine diverse intelligence technologies, when the initial, more ambitious projects aimed to imitate or even to get ahead of human intelligence, conceived only as an abstract, mathematical intelligence.

2.3. PRESENT DEVELOPMENTS AND PERSPECTIVES IN THE AI RESEARCH FIELD

The stage what the AI reserach field has reached is that of the turning toward the concrete, by inquiries as the

– study of simpler intelligence forms;
– analyse and reproduction of the former life forms;
– re-building in the revers order the scale of natural evolution;
– re-evaluation of elementary vital behavior forms, like those of fish shoal or of bird flock.

Another group of research themes is that consacred to human language and human senses (as those visual, auditory or tactile) with the aim of use, to correct or to supply them by artificial recognition, rendition and reconstruction Robotic entities with specialized functions and facilities are conceived and designed. Humans acting in special contexts such scientific or medical, as in conflict situations are equipped with devices that ensure ultra-human, infra-red, ultra-sound or anti-agression capabilities; human-artificial entities co-ordination and co-operation become possible by automatic control and by diverse forms of conditioning.

The traditional aim to grow and to adequate the computing function of the “artificial brain” is till followed but by a variety of ways and not only by human mind modeling. Besides of artificial neural networks, which have a considerable role in different kinds of recognition as in complex practical problem solving situations, another supercomputing ways are now conceived, and for the moment more theoretically developed, such as the cuantum computing or the molecular or DNA computing.

Cuantum computing is mainly based on the property of coherent super-position peculiar to microparticles, that to be simultaneously in all the possible combinations. Faced to the known *bit* with the two 0 and 1 states, the *qubit* or cuantum bit, with the $|1\rangle$ and $|0\rangle$ states, is a multi-level system that can be configured in any super-position $|\psi\rangle$ of the two co-existent states:

$$|\psi\rangle = c_0 |0\rangle + c_1 |0\rangle$$

where the coefficient $c_1$can vary and indicates the probability of the qubit to be in a certain state. This is not equal to say that this coefficient has a value between 0 and 1, as in the analogical oe even digital systems, but it means that the information unit can be simultaneously both in the state 1 and 0. Here we found the base of the anticipated computing power of the cuantum computing systems, still unrealized because of some present technical limits, such as the efficient control of cuantum phenomena. See [25] for other details.

Biological or DNA computing uses as memory units DNA molecules of variable dimensions. Inputs and outputs are constituted by DNA chains and by re-combinations of genetic sequences fundamental operations can be effectuated. Other data about this kind of computers may found in our abowe indicated book [25].

A limit of molecular computing is done by the requirement to produce a specific DNA molecule (the equivalent of a conventional cip) for every single problem. The major advantage is that this type of computer simultaneously processes all the possible solutions of the given problem and a single step of a biochemical operation can be arranged so that it will affect billions of DNA chains.

This kind of machine is preferable for its global efficiency, done by the simultaneous work of all "processors", even if each of processes is slower than the electronic information processing. The main disadvantage is done by the increased imprecision of the result, but this only means that this kind of computer has to be used to solve the type of problem in which it is efficient.

It was already designed and realized the first "living" computer made up of artificially produced proteins associated with polymers. Such computers are now in use and have many different destinations. On the basis of these practical results computer scientists and technologists also appreciate that biology will be the higher way to obtain not only the artificial brain, but an entire artificial nervous system; they also appreciate that the way to build artificial intelligence is only opened and not ended by electronics.

Other fruitful research directions in AI are opened by the scientific computing which is directly addressed to human intellectual faculties as an adequate instrument and as an unlimited workplace. Problem solving, validity verification, theorem demonstrating and even experiments performing in physics or chemistry are such scientific activities.

Practical reasoning strucures and processes are modeled in ethical studies or decision making procedures are applied in management fields on the basis of

Business Intelligence programs. Knowledge Management techniques are used by knowbots or webbots in the virtual *workplaces* and new knowledge is generated by humans in new *thinkplaces* on the Web.

Artificial Intelligence as a platform and as a technique developed for human intelligence supporting and enhancing needs a few pre-conditions. Among others, it supposes not so much new and more effective instrumental infrastructures and techniques, but an improvement of the information perspective on the intellectual activity.

As the last but one step in the study and development of both human and artificial intelligence we can consider their co-evolution.

The last stage to go over will be, in our opinion, that of learning, using and enhancing efficient intellectual work structures and processes by all kind of human and artificial cognitive and active agents in their common tasks achievement.

Centered on the perspectives of AI development, St. Iancu studies in [10] first the necessary conditions of this process: assimilation of new technologies which will conduce to innovation; promotion of an efficient and general use of ICT; ensuring of a fair competitivity of concurent technologies in a normative technological environment.

In the same study, the author, an inventor and a personality of the history and philosophy of science and technology, as well as a specialist in the domain of intellectual property, outlines the principles of the novelty generation by middle- and long-term oriented invention management and examines the main directions of technical invention in the fields of ICT and AI, and then marks the transformation of information technology in a meta-technology.

We also have to distinguish here an other contribution in the field of the history of science and technology, by which Vl. Ţicovschi, a winner of the Romanian Academy Prize, who has analysed the factors as the features of technological transfer under the conditions of globalization, in his work [32], has allowed a clear and fertile classification and a precise evaluation of the present state of things in science and technology.

But permanent changes are also to be emphasized mainly in AI research orientation. Probably the most significant movement in the field, from the perspective of a social and cultural approach, is the comprehensive and reflexive inclusion of social goals among the aims of technical development.

This new orientation has two main directions, in our vision:

a) a more concrete and immediate component, with another four distinct objectives, that of

   a.a. developing artificial social agents to offer accurate, specialized, efficient and interesting public services as to

   a.b. provide a permanent and close help for disadvantaged persons, and to

   a.c. improve man-machine interaction; to a.d. develop a society of intelligent agents which can assist humans in various types of work, such as knowledge work and creation work but also in designing, “healthing”, life conditions preserving, entertaining etc.

These types of agents can be knowbots, softbots but also medical or industrial robots.

b) a long-term oriented and visionary direction, with scientific and cultural aims, but each of them, creation-oriented.

This later set of objectives is characteristic for the book of Wierzbicki and Nakamori [34] which can also be viewed as an AI research field “revisited”. AI itself becomes Computational Intelligence and the goal of research itself is changed: it is now **to elaborate concepts and ideas** leading to the “cultural platform” of the “Civilization Era”, as a vision that shows “what problems of humanity we have to solve”. But the main goal of authors is to unite **knowledge** and **creation** in a new creative space with the coordinates done by: 1. Systems Science, 2. Creation Models and 3. Computational Intelligence. The concept of Creative Environment is elaborated by micro- and macro-theories of **knowledge creation**.

2.4. PRE- AND PRO-DICTION. EUROSCIENCE AND EUROTECHNIQUE ISSUES

As we have seen, post-diction and retro-diction are, and have to be, actually, possidiction. If we are able to conceive the whole set of possibilities and to establish their hierarchy leading off with the highest one, we have the opportunity to represent and to evaluate more accurately but also more motivating the picture of future development of science and technology. Prediction is pro-action, we also have argued.

What we constate:

– Impressive technical, economic and intellectual resources are used for trifling problems solving;
– Important problems remain unsolved because of insufficient or inadequate theoretucal foundation;
– We still have theoretical or practical problems which are not included among those considered as solvable;
– A lot of theoretical problems are evaluated as unsolvable;
– New scientific fields are promoted, such as Earth science or Life science that need and encourage multi- and interdisciplinary scientific work and projects;
– Social sciences and philosophy are marginalized: they are classified in a secondary group by UNESCO and placed on a modest place in this group.

But Philosophy and Social Sciences are concerned with fundamental human needs and values that can actually orient all the human action, inclusively that scientific and technological.

European research descends from the scholastic intellectual tradition, which was one

– theoretical
– abstract and
– speculative.

The applicative tendencies were either programmatic and prospective, as those dued to Roger and Fr. Bacon, or subordinated to some esoteric and even occult expectations, often related not only with spiritual, but also with mercantile interests.

This research trend was re-oriented toward practical problems and toward efficacy by Pascal, Descartes, Leibniz, Kant, Saint Simon, Comte, Odobleja and Wiener.

2.5. THE FUTURE OF EUROSCIENCE AND EUROTECHNOLOGY WILL BE DETERMINED BY THE FUTURE OF EDUCATION

We can constate and anticipate a few evolution ways of artificial intelligent systems:

A. Simulation of natural evolution of populations (ecosystems, mutations, viruses, selection;)
B. Technically directed evoluion ("oriented" by tehnologists),
C. Self-structuringin in pre-determinate contexts (engineers will create only the favourising conditions);
D. Evolution by learning within the framework of different kind of cultural processes (like children).

All these human or technical achievements are or will be realized in new conditions, in which

- the "pozitive sense of existence was lost". But can we name a sense of existence?
- scientists are seen as mentors, trainers and guides;
- their anticipations are pessimistic, they formulates warnings and imperatives (Drăgănescu, Hawking);
- scientific and academic associations and organizations elaborate strategies and are building models;
- these anticipation forms are based on axiomes such as:
  - "The present millenium is the age of biology";
  - "Robots will grow like animals";
  - Humans will evolve as robots;
- different models of development of science and of the intellectual history, in general, are:
  - accredited: Comte (a system of positive approach of all activity fields), or

   - proposed, such as the pulsatil model of development, used in various cultural fields – that mythical, philosophical, mathematical, physical and even astronomical;
- we have now the complex and evolutive, theoretical and paractical, model of globalization.

In this theoretical and practical context, patriarchs of the scientific and technological culture as M. Draganescu warn that „the Romanian state cannot turn out from the research system" without important and long-term consequences [8] and the present and future social role of learning is put again in discussion by M. Malita, the historical promoter of the no limits learning, brings up-to-date the double helix of learning and work [12].

New an old specialists in Computer Science and Technology are also preoccupied about *Improving the Performance of Universities in Transitional Economies* (Y. Prytula, S. Umpleby, Ivan Franko National University, Lvov, Ukraine) and topics as *Universities and a* "*Sustainable Spirit*" *– Bridging the Gap between Vision and Action* are promoted by other scholars (F. Risopoulos, University of Graz, Austria). Such academic debates are taking place as parts of international conferences like THE 19^{th} EUROPEAN MEETING ON CYBERNETICS AND SYSTEMS RESEARCH, Vienna, 2008.

Scientific and technological aspects of social change are investigated in other papers presented at the same conference, as *On Modeling Social and Technological Change: An Attempt* (K.-H. Simon, University of Kassel, Germany) and very new AI anticipations or even projects are conceived as that entitled *Connecting Freud and Minsky: the* "*Pleasure Pump*" *as an Emotion Machine* (J. Kelemen, Silesian University, Opava, Czech Republic) or as that concerned with *Emotion Adaptive Dialogue Management in Human-Machine Interaction* (M. Gnjatovic, D. Roesner, O. von Guericke, University Magdeburg, Germany).

All kind of work are changed by ICT past and present developments. The managers of industrial processes think, for an example, that the most important elements of the organization are the computers. Some sociologists [35] points out that this sort of managers are using informatization with the aim to limit their own dependence upon the personal aptitudes and skills of (intellectual or unskilled) workers.

Informatization is further on considered as important for documentation and communication, by M. Malita, but the scientist who is the initiator of no limits learning also outlines a deeply shared present idea: "*Anticipation, not adaptation* ...". Consequently, the same author brings in, among other modules of an efficient educational system, a set of prospective modules [12].

An efficient school can fill up the gap between instruction and education, research and industry and, mainly, between truth as product of science and other values, preserved by social structures and developed by cultural work.

CONCLUSIONS AND/AS PREVISIONS

We tried here a multisided but integrative, multileveled and, at the same time, unitary approach, able to

a) model the place and role of the technical factors that penetrate and influence all social organization levels and that have their own complex structure and feature, and to

b) explain the most complex and difficult to run system, that social, as well as social evolution, not only by complex technical processes, means and products, but by a more complex self-determination process, a process that I am naming *sociomation*.

Sociomation is then a quasi-automatic or automatic process but not a spontaneous one; it can be a very well, intellectually and spiritually managed system, a system managed even by some intellectual techniques.

Artificial Intelligent systems are sensitive, cognitive, active and co-operative systems.

We can record or anticipate different ways of artificial intelligent agent's evolution, but human evolution is connected with or is even part of this evolution.

Possidiction is the general activity to describe, to interprete and to evaluate, and to predict social evolution, in any direction.

Progresses in complex artificial entities conceiving, developing and implementing need interdisciplinary teams involved in both theoretical and practical activities.

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The history of science and technology (HST) is a field of history which examines how understanding of the natural world (science) and ability to manipulate it (technology) have changed over the centuries. This academic discipline also studies the cultural, economic, and political impacts of scientific innovation. Histories of science were originally written by practicing and retired scientists, starting primarily with William Whewell, as a way to communicate the virtues of science to the public. In If you were asked to name the top three events in the history of computer technology (or the history of what came to be known as the IT industry), which ones would you choose? Hereâ€™s my very short listÂ March 1989: Tim Berners-Lee circulated â€œInformation management: A proposalâ€ at CERN in which he outlined a global hypertext system. [Note: if round numbers are your passion, you may optâ€"without changing the substance of this condensed historyâ€"for the ENIAC proposal of April 1943, Ethernet in 1973, and CERN making the World Wide Web available to the world free of charge in April 1993, so that 2013 marks the 70th, 40th, and 20th anniversaries of these events.] Why bother at all to look back? Follow the fascinating story of science as it unfolds in the 20th century. Discover the most significant developments in anthropology, archaeology, history, linguistics, sociology, political science, economics, psychology, and cognitive science.Â Modern science is a cultural phenomenon that has an inside, intellectual dimension, and an outside, social relationship dimension. Concepts change: The terms space, time, matter, energy, the universe, Earth, gene, language, economy, culture, and society no longer mean what they did a century ago. Reality is ultimately describable in terms of information, relationships, and processes. The course is organized into five major themes: matter and energy, the universe, Earth, life, and humanity.