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ARTIFICIAL LIFE – APPLICATIONS AND EXPERIMENTS

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Abstract: First, artificial life (AL) is a science that seeks to help understand the phenomenon of life, being a component of biology, regarded as a scientific study of life. Existence AL points out that contemporary biology are focused only on the lives on the earth. AL branch is based on the assumption that the technology has developed sufficiently to be able to make copies of biological phenomena at hand or in artificial environments. In the worst case, there are even convinced that such a possibility worth a try.

Keywords: artificial life, artificial intelligent, applications, experiments.

1. INTRODUCTION

Artificial life (AL) is science who studying the systems created by humans who have behaviors characteristic of living systems, natural [3]. It is a science dedicated to understanding life through abstraction of the fundamental principles of dynamic biological phenomena and their recreation in other physical media - such as computers - making them accessible to new ways of experiments and tests. In addition, ways to provide new study biological phenomena associated with terrestrial life, life as we know, Artificial Life allows the field "bio-logic" possible life, life as it could be ...[5]. Of all the definitions of what might give artificial life, it's safe to say that this field as a whole represents an attempt to increase the role of synthesis in the study of biological phenomena [12]. It is an attempt to understand the biology building biological phenomena of artificial ingredients, no "break" natural forms of life in parts. It is, rather, synthetic approach, than reductionism [10]. Models of artificial life are strong enough to keep much of the complexity of living systems, even in a form more easily handled repeatedly and controlled experimental systems more precisely than the corresponding live [11]. What is actually artificial life? Sub-discipline of Complex adaptive systems. Has its roots in Artificial Intelligence. Studying the applicability of computational techniques to biological phenomena. Studying the applicability of biological techniques in computational problems. To answer the question "Can be build intelligent computers and <in life>?" must be taken into account that they must meet certain requirements: autonomy, metabolism, instinct of survival (conservation), auto reproduction, evolution and adaptation.

2. ARTIFICIAL LIFE GOALS

Traditional biology students as life-as-a-know: the chemistry of carbon chains, heredity with DNA or RNA's, Krebs cycle, etc. This happened because so far not occurred in other biological phenomena studied. AL try to discover "life-so-how-it-could-be", but there can be reached "life-so-not-as-a-know". Inherent question is: how to make the distinction between something "that-would-could-be-great-something-interesting-to-but-not-that-could-have life"? After the assessment criteria is a phenomenon that is artificially generated an instance of life-as-you-should-could-be? The first source of problems is the lack of a widely accepted definition of life. AL does not aim to create robots of human slaves in the years'50 ideas. However we define the life of the two factors that matter are: (a) there is a huge number of living creatures that live successfully, but (b) most of them do not want in our homes because of what could be on our carpets. Needs of the cockroach can not say much about the basic needs of man (although it may), but the biological perspective, this is not any less interesting attempt to build an artificial cockroach. Intellectual goals and substrates of AL and artificial intelligent (IA) are not identical, and is a great disservice if AL believes that its philosophy of philosophy IA only in conjunction with cognitive science. There are two variants for AL purposes: the "weak" and "strong". Version "poor" is based on the allegation that robots, computers and other physical experiments, if designed properly, can become powerful tools for science with which to formulate and test biological theories. According to this view, will be on equal footing with statistics, microscopic electronic or any other discipline that develops and sentence in November formalism useful in advancing biology. Version "strong" variant adds low, on the one hand, that robots, computers and other physical experiments, if designed properly, can become even living biological systems. The goal now becomes will extend the number of entities which can be considered truly organic (or living). This is the

implication that the concept of "life as could be". The biggest goal is the creation of the AL by humans of new forms of life [2].

3. THE RELATIONSHIP BETWEEN AL AND IA

Another issue raised is the relationship between life and thought; between AL and "cousin", the artificial intelligence. Elliot Sober suggest that this affinity can be characterized by analogy: AL is for biology what is artificial intelligence to psychology. Both depend heavily on computational models. Both attempt, through synthesis, to amend the traditional fields of study, analyzed the biology and psychology. AL aims to create biological entities "made man", while artificial intelligence tends to psychological entities created by man. In both, a role it has very presumption that the attempt to create artificial copies of natural phenomena, these phenomena will be better understood. At the same time, it is important to note that there are significant differences between the two. First, while artificial intelligence is shaped by a single instance of nature - people adults, artificial life is a source of "inspiration" throughout the biological world. Interest in shaping the reproduction: There are a variety of systems that can be taken into account. Reproduction in nature has many forms: cell division, burgeoning, sex, etc. in these broad categories into more strategy. Among sexual strategies: some animals protect their eggs and chickens, while others allow their offspring want to chance. Some animals have only a few survivors, while others, millions etc. Although not observed that it would be an advantage, certainly is a difference between IA and AL that will have many more events on which to investigate and to explain [5]. Secondly, another difference between biology and psychology is that psychological explanation is not only the behavior of psychological systems. One of the reasons that psychology is so difficult that it is studied to investigate a person - at least for men - in the third person as a phenomenon to be explained.

3.1. Relations between natural and artificial

To explore possible relationships between artificial entities and natural labeling are considered example, a schematic diagram of a device is a complex analysis of the electronic capabilities of the device as a whole but also each of its components. This schematic diagram may be an abstract but accurate description of any appliances or electronic components, whether made up of diodes, transistors and integrated circuits. Even if they can be made from many materials, they have the same organization and the same functional description. It may be said about them that are isomorphic functional foods. On these labels are (or should) past natural ingredients and artificial that the product contains. Identification of natural ingredients is quite simple. These are derived from natural food sources (plants, animals and minerals) without significant changes in their chemical composition. Have their origins and natural compounds are produced in a natural way. Artificial ingredients can be categorized into two main groups. One containing the artificial substances obtained the greatest extent in unnatural ways, but whose chemical composition resulting in very much resembles the natural. The other contains those substances created entirely in stilted, but whose chemical composition is almost no longer anything in common with the natural substance. Next, we define "artificial" substances of the second class, and the first "natural identical".

3.2. Types of relations between artificial and natural

Using the example above, there are three ways of identifying and natural artificiality: entities may be related genetically (that have a common origin), entities may be functionally related (that have common properties when they are described at a certain level of abstraction) and entities may be related makeup (contain similar parts arranged in a similar manner).

1. *Genetic relationship.* Two genetically related entities have a history or a common origin. For example, states that the human finger is in a gene related to that of a chimpanzee, but both differ from the finger of a panda bear. Fingers of a human and chimpanzee were originally a bone of the finger, while finger panda bear hand wrist stemming from a progenitor that has nothing to do with man or a chimpanzee.

2. *Functional relationship.* Two functionally related entities have in common a similar abstract description. According to Cummins (1980): "Schematic diagrams of the electronics provides a clear illustration of the functional review. What each symbol represents an object with certain physical properties, a schematic diagram of a device is a complex analysis of the electronic properties of the device as a whole. An analysis also allows an explanation of the behavior. In this case, program is given by the wires connecting the components."

3. *Compositional relationship.* If 2 entities are made of the same "material" in ways similar, one can say that between them there is a compositional. Both criteria (joint composition and organization) are required to be a compositional similarity.

4. APPLICATIONS, PROJECTS AND EXPERIMENTS

4.1. Robotics evolutionist and neuroethological

Robots are only some of the art products to be created, developed and controlled by man or could develop and control

themselves autonomously? Traditional robotics, which uses the techniques of planning your schedule for the robots, deals with the first part of the question, while the approach made by the Robotics and Autonomous suggest the second hypothesis is a possibility. Robots built according to the latter should be adapted in environments that are uncertain and incomplete information and media are constantly changing. To achieve this end were identified at least two techniques. One is based on imitating the process of learning a unitary body naturally. The other, called Robotics evolutionist is based on phylogenetic evolution of reproduction populations of robots. Robotics evolutionist process that allows a simulated evolution to create robots that can adapt. Applying the selective reproduction of a population of robots, the simulated evolution is directly inspired by evolutionist theory of Darwin. Genetic algorithms can be used to achieve control systems autonomous robots. However, this approach is very limited because we have very much time to develop the whole population of robots. An approximation to the simulations, in which most of the evolution takes place in a simulator, dramatically reduces the time required. It is expected a decrease in performance in the transfer of control of the robot in a real simulator. This can avoid leaving the machine to build autonomous simulator and to continue the process of evolution in the physical world. While Robotics evolutionist uses to create automatic control systems, neuro-ethological Robotics can be used to check the control systems are known (or predetermined). Based on records neuropsychological or compartmental, biology and neuroethological have made different assumptions about the different control systems live. In this context, the neuroethological Robotics provides an area where it is possible to empirically test these hypotheses by their implementation on real robots. One example is the formation of cognitive maps in rats in experiments labyrinth [6]. Contrary to the conclusions reached by biology, implementations and experiments on a small robot (Khepera) have shown that it is not necessary to form a cognitive map to meet the requirements of "surfing" through the maze can be made with a simple reactive control system.

4.2. Evolution multipliable parallel programs

An older issue of mathematics (to write a program that reproduces) leads to an "infinite regress." A test in a hypothetical programming language [8]:

Program copy: `print("Program copy"); print(" print("Program copy")"); print(" print(" print("Program copy")")")`.
 Solution for infinite regression was found with occurrence of von Neumann architecture. The basic idea: the program stored in computer memory, a program has access to memory where it is stored, suppose you have an instruction that MEM is a memory location that instruction is executed in time. A program that is viable and auto reproduce is as follows (Fig. 1):

```

1 Program copy
2 L=MEM+1
3 print("Program copy")
4 print("L=MEM+1")
5 LOOP until line[L]="end"
6 print(line[L])
7 L=L+1
8 print("end")
9 end
  
```

Figure 1: The program.

In the program, information is used in two ways: the instructions to be executed and instructions for the data. Can make an analogy with the DNA: the DNA is a concatenation of nucleotides and DNA encodes the enzyme that performs the multiplication. The environment is called COSMOS (Self-replicating Competitive Multi-cellular Organisms in Software). It is somewhat like Tierra system, developed by Tom Ray, but is especially focused on the evolution of parallel programs (biological analogy being multi-cellular organisms). COSMOS uses the distributed memory model of MIMD parallelism. Processes ("cells") containing software ("body") multi-process (multi-cellular) can communicate with each other only through the "message passing". In this inter-cellular communication, each cell has only access read/write within its own borders.

4.3. Tierra, Artificial Painter and Soar

Tierra is Thomas Ray's attempt to create an artificial ecosystem by using the computer. It contains little strings of code ("codelets") capable of self-reproducing. Everything they do is to create copies of their deal until all the memory which was allocated by the operating system. In the regular operating system destroys the part of children, thus releasing a portion of memory. Multiplication of "codelets" is imperfect, leading to the variations of the population of "codelets". Some of them multiply better than others and the result is an ecosystem evolutionist string code multipliable whose limits can not be known. But this is the correct virtual simulation? Strings of code are only Tierra code and we all know any code that needs interpretation. There is no actual copying, but only a simulation of multiplication. You should note that the computational structures, unlike the typical artificial intelligence, you always kept somewhere. These "codelets" are actually physical samples voltage (high or low, 0 or 1) of the computer. When a string of code manages successfully to increase not only lead to changing the world of symbols and computational code, but also to change the physical

world. Much the same question can be done and if virus when a virus infest a partition, not only changes in computational and change but the physical content on disk. Techniques can be used to achieve useful images in the artistic design. Evolution paintings are based on aesthetic evaluation of several images on the screen of the user. The "Artificial Painter" is the original techniques of bio-picture, like the Computer Tomography (computed tomography - CT), through issuance of positron tomography (Positron Emission tomography - PET) and single neuronal recordings (Single Neuron Records - SNR). The latter applies in this case, the artificial neural networks. Thus, the multitude of images produced, the user can select a number to reproduce and reach the desired result.

Soar is a general cognitive architecture for developing systems that have an intelligent behaviour, realized as a production system. It was created in collaboration between several researchers from various institutions, among them: Allen Newell, John Laird and Paul Rosenbloom [3]. Is based on two previous models: GPS (Newell & Simon) and GOMS (Card, Moran & Newell). As the sun can simulate actual answers and responses in time. The main idea is to Soar an area of problems: all are forms of cognitive task of the search. Unit and the memory is procedural, there is no distinction between procedural memory and declarative. Chunking's (grouping of information based on links between them and their eyes as a whole) is the basic mechanism for learning and representing the conversion of the Act to resolve the problem in long term memory. Newell said that Soar suggest a new method of reconstruction of memory. Soar involves a wide range of different types and stages of learning: operators (created, call), control of search (the selection of operators, planning), slabs declarative (recognition / recall) and task links (space to identify problems, hypotheses/ consequences). Researchers from all over the world, both in the field of artificial intelligence and cognitive sciences will use Soar. Purpose and applications: Newell has positioned Sun at the base of a unified theory of knowledge and showed how it explains a very large range, results and events of the past [4]. For example, he provides interpretations for response times for the task's word learning, for the reasons for mental models and acquisition of skills. In addition, however, have developed versions of the Sun behave as intelligent systems for computers and configure formulate algorithms. Sample problem [9]: (case study): given item, become familiar (recognition space problems)

Operator: Recognizes the next item and fail if does not recognize "the sudden" coming in stalemate

Goal: learn to recognize sub item

Give a name (recognition item) and Start Chunking to give a name if the item is recognized

Test: giving an item If chunking is initiated the item receives a name and is recognized

If not, the item is not recognized

What must be noted in this example is the recognition that the Sun as an activity to solve a problem in trying to identify components of a recurring item and create a deadlock situation when a failure occurs. Principles:

1. Learning is a direct consequence of activities with purpose, some knowledge is gained to meet these goals (needs);
2. The requirement of learning occurs with a rate constant equal to the rate of occurrence of deadlock in troubleshooting (average 0.5 chunk /second);
3. Transfer occurs between identical elements and is dedicated (cf. His Thorndike). Transfer can be generalized to work if the abstract;
4. Repetition helps the learning process and lead to an active processing (eg the instantiation chunking).
5. Chunking the underlying organizational memory.

Soar is expected to be used to: meet the full range of tasks that organizations expect from an intelligent agent: the banal routines to very difficult routines (problems with "open end" means and methods used to resolve procedural or episodic) and interact with the outside world. In other words, it is expected to meet all the requirements necessary for an intelligent agent. The last phase in the intelligence judgments of completion, which would involve the ability to use all existing knowledge to solve any task that appears in the system. Unfortunately, the complexity of finding the appropriate knowledge to make this almost impossible to be fulfilled because of the volume of information undergo exponential growth, your task is the most diverse and the requirements for response time of the system are very high. What can be achieved today is an approximation of complete judgments. Sun intelligent agent design can be regarded as an investigation of such approximations. Here are the principles underlying the design of the sun and fulfilling approximation rational behavior. Number of distinct architectural mechanisms should be minimized. Soar exist in a single framework for all task and subtask's sites, one representation of permanent knowledge, a single representation of temporary knowledge, one mechanism for generating goals and a single mechanism for learning. All decisions are made by combining the relevant knowledge at the time. In Soar, every decision is based on current interpretation of sensory data, memory work, created to solve the problems earlier and found relevant information in permanent memory. Decisions are never precompiled in uninterrupted sequence.

4.4. Swarm, Framsticks and Golem

Swarm is a software package developed at the Institute of Santa Fe, for multi-agent simulation of complex systems [9]. Viewed individually, some ants are simple insects with limited memory and whose activity has a random component. However, as community, a few ants running task complicated sites with a high level of consistency. Among them: forming bridges, building and maintaining a heap, cooperation when the weights went higher, finding the shortest way from the anthill to food, adjusting the temperature of the heap in high grades and preferential exploitation of the most rich sources of food. Swarm intelligence is used in combination with very good choice of the road from ants to solve the problem of the shortest routes (Fig. 2). Ants have a very interesting way to carry food to the anthill. When you go to the

food source, they emit some pheromones incentives are very strong [1]. When pheromones feel, the way ants are concerned. Level indicates how many ants pheromones went on that route lately. It can happen to experience a food source close to the hill and in this case, even if the level is lower pheromones, appear another route. It is not known exactly how strong are and how long does pheromones nor is dispersion ants (how often an ant go after ants eat and sometimes must use a route until it becomes "knowledge").

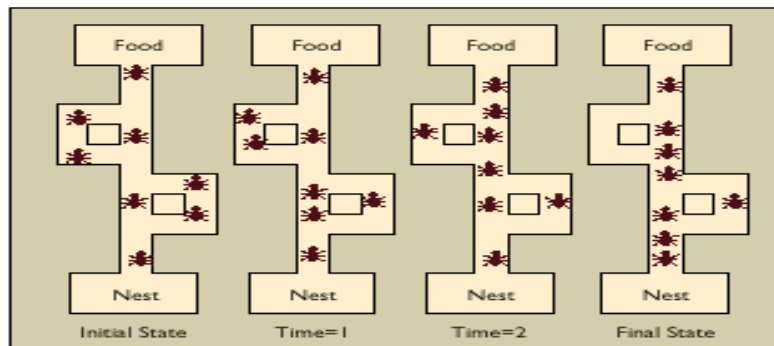


Figure 2: Example - Swarm intelligence.

Routing using swarm intelligence: artificial system consists of three types of agents: explorers, locators and defalcators. Explorers found the remains of the explorers left pheromone before. Locators crossing the path established by explorers and allocate bandwidth for the links on the path. When the path is not needed, a cross defalcators and dislocate bandwidth. The system works like this: at a given node reaches an application. The application is either a point-to-point (P2P) or a point-to-multipoint (P2M). P2P applications are creating a new species of ants (agents) that is sent to the network. P2M requests are n agents in November. These explorers running the following algorithm (Fig. 3):

```

1. Initializing
   set t:=0; for each corner (i, j) set an initial value  $T_{ij}(t)$ =intensity of all
   place m ants on the source node explorers, we generate a certain frequency
2. Set s:=1 {tabu list index}
   for k:=1 to m do placing the start node ants KTH in tabuk (s).
3. Repeat until you reach your destination: Set s:=s+1
   for k:=1 to m do node j to choose to move with the probability  $p_{ijk}(t)$ 
   kth ant moves to node j recalculates the route cost:  $rk=rk+c(i, j)$ 
   if ( $rk > rmax$ ) kill explorer k
   insert node j in tabuk(s) destination to go to 4.
4. While s>1 cross edge (i, j)
    $T(i, j)=T(i, j)+a$ ; s:=s-1
5. Source node to execute:
   if (path=pathBuffer*d) create and send a new allocated
   if  $t > Tmax$  create and send a new explorer

```

Figure 3: The algorithm.

Explorers are to create a certain frequency and continue to create and explore throughout the application. In this way it is possible to recover in case of running aground. When explorers reached their destination, returning on the route and found a mark with pheromone. By returning to the core source is deciding whether to send or not allocated. This decision is taken based on the previously allocated paths m allocated. If p% of agents follows the same path, the path is stored and creates a new allocated which is sent to the network to allocate bandwidth [4].

The goal of this project (Framsticks) is to study the process of evolution in an artificial world, simulated on the computer. It is hoped that, just as in the real world, despite the lack of cleanup and the mechanisms evolutionist base will lead to the creation of "artificial bodies" becoming more efficient, ever more adapted conditions of "world artificial. The results of these experiments led to the development of animal models of computer-controlled (in films like "King John", "Batman forever" and many commercial advertisements), and more sophisticated models include creatures with learning skills and self-overcoming. Artificial bodies can be trained to avoid obstacles, seek energy points, to pursue certain goals, to get rid of enemies, etc.. Such experiments are directly related to control robots. Often, development is the improvement in controlling the establishment of better adapted organisms. Evolution is directly related to genetic algorithms and works in the same way. In nature, organism's morphology is determined by genes and they, in conjunction with other mechanisms (such as learning) support the development and do so efficiently. And in this life simulator all genes are those that describe the entire structure of a body. Total freedom in creating genotypes is in fact empowered to do things of any complexity.

Framsticks is a simulation of three-dimensional life. Both the physical structure of creatures and control systems are evolved. Evolutionist algorithms are used to Selection, Mutation and Crossover. Are used for simulation of finite

element methods. Both are possible developments (developments) spontaneous and direct. This system uses the framework of the standard EA operators to develop 3D equipped with neural networks. Proved to be an attractive tool for those who want to learn about how the techniques work evolutionist optimization. You can simulate various types of experiments, including simple optimization (algorithms with evolutionist), co-evolution, evolution and ultimate spontaneous open populations with different genetic background, mapping the different genotypes and fenotipuri and modeling of species and ecosystems. More time, people use the computer to simulate nature. In addition, "worlds" artificial enables studying signs of life that have nothing to do with protein. A field-life studying "life as it could be based on understanding the principles underlying the existence of real world. As the planes using the same principles as the birds, but have fixed wings, artificial life forms may have the same principles, but have the same implementation. Any feature of living systems may seem Fabulous field until it is understood. Stored energy, autonomous movement, and even communication between animals are not some miracle, even the toys are copied using the batteries, motor and electronic chips. Complex organic forms are used to replicate a set of arbitrary, but full of chemical reactions auto catalyzed. Golem project (Genetically Organized Lifelike Electro Mechanics) consisted of a series of experiments in which electro-mechanical systems evolve to simple machines with loco motor physical possibilities. Similar biological life forms whose structure and function exploit the behaviors permitted by the chemical and mechanical in their lives, artificial creatures and use them to their environment: thermoplastic, motors, artificial neurons. The autonomy of design and implementation is achieved using evolution in a simulation of a physical universe along with the limited technology of rapid construction. It is the first project led to the creation of robots by robots.

5. CONCLUSION

The objective of this paper is to study the process of evolution in an artificial world simulated on the computer. Biological life has control of its own sense of reproductive autonomy and the design and implementation is key, which was not yet understood and reproduced artificially. At present the construction of a robot is an enormous expense, both in financial terms and time. Many times people have used the computer to simulate nature. Such research is also wide scope of "artificial life". No matter if the environment is an artificial world, inside a virtual computer: philosophers have never yet come to the conclusion that our world is a real, however, examine the biology still alive... . In addition, artificial worlds allow studying signs of life that have nothing to do with protein. Scientists studying artificial life focus on various fields and serve many purposes. Rules of simulated worlds should not be like the real, but such models seem more interesting (and may be because there can be "face to face" reality simulation results). Developments in computers are based on the evolutionist theory of Darwin: in a competitive environment will survive only the strongest, genes "good" of the survivors of their survivors be transmitted occasionally occurring genetic mutations. Currently developing an environment that facilitates learning patterns of evolution in a system of entities multipliable in competition for resources. In this environment: CPU time and memory required self-copying. While it can be seen that those programs that manage to make children more quickly become more resulting in a process of evolution. Programs of this system may be analogous to biological organisms from unicellular vending geological period. Instructions in the program "genotype" of (type or genetically) which is interpreted in terms of behavior during the program - "phenotype".

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