NEW CONCEPTS AND APPROACHES TO THE STUDY OF COLLECTIVE SPORTS GAMES

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Review paper

Abstract
Collective sports game is a complex phenomenon and occurs by implementation of the plan. The plan applies to agents of players as holders of the activities and the structure of the environment. Therefore, we have decided that the multifaceted way, using scientific contributions to areas such as sociology, linguistics, biology, mathematics, computer science, especially in the field of artificial intelligence, robotics and philosophy shed more light on this phenomenon. With more aspects we touched on the problem of simulation. In the field of artificial intelligence, we discuss different concepts of representation of the World and place as the agent in charge of activities in it. These themes were considered for the purpose of connecting with the problem of modelling. We analyzed the development of the field of artificial intelligence with a special focus on those elements which correspond to the issue of collective sports games. We believe that systematic and competent modelling collective sports games must be significantly marked by such a level platform. Resolving this issue in the context of all areas under consideration can be directly used to solve the modelling of players, teams and matches collectives.

Key words*: agent, collective, robotics, situations and embodiment, multi-agent, swarm, simulation, artificial intelligence, emergence, plan, syntax, semantics, useful structures in the world*

Introduction

The theme that we as scientists in the field of superior collective sport occupy is to make a credible model of the game at the same time using existing knowledge of all the relevant scientific fields. This seems important because we think that in other scientific fields, there are high-quality research and solutions that are targeted and selectively directly, or with appropriate adaptations, apply for the purpose of resolving some outstanding issues in the field of sports science. The fact is that the issue of the content of collective game phenomenon highly complex and layered. Our insight and knowledge of the collective sports games imposed the themes that have been the platform for seeking appropriate solutions found in other scientific areas. In collective games, as well as the basic categories we can identify concepts player, role playing, the collective and the end game as the starting point for finding solutions in other scientific disciplines.

After a multi-faceted, we have found that similar themes successfully discussed with concrete results that are still developing in the areas of sociology, socio-biology, computer science, artificial intelligence, robotics, linguistics, mathematics and philosophy of science. Thanks to our selection and review of the results of scientific research in these fields, we consider that there is a real possibility of selective application and utilization of such knowledge, technology and tools for the transfer and use of our domain. This approach allows a better overview and thorough insight into the entire matter in the domain of sports science collective sports games but also indicates the need for amendments to approach the topic of research projects in general.

The purpose of this study, therefore, is a significant step on the way towards achieving the ultimate goal, and that is a thorough analysis of the phenomenon of collective sports games and the construction of the model that best reflects the reality of this complex system. In the field of kinesiology all that combines sub-areas of education, recreation, physical training and agonistic (competitive sports) in scientific research from the 70s to the present day in Europe, including ours, dominated by the view that the equation specifications can successfully explain every sporting activity in terms of detecting, dating, measuring and defining all the factors that are important for success, correct scientific approach, using a quantitative analytical approach and applying appropriate multivariate statistical analysis. Ultimately, the effort and the work should result in a, more or less, complex models studied sports activities, which did not happen. Obviously the problem is the complexity of sporting activities and the complexity of the procedure which should result in equations specifications sporting activities scientists in this field focused to deal with only segments of the sports that are explored (noting that similar happening in other areas, egg, economics, psychology or sociology). Exploring thus stay only in partially contributed to scientific explanations of knowledge studied sports activities. We think that it is possible and necessary a different approach in this scientific issue in the field of sports science and for these reasons and propose a new conceptual approach to the study of collective sports games which is congruent / compatible with the change of paradigm, based on a synthesis of scientific knowledge in common scientific fields.

Review of relevant research

Review of relevant research includes contributions from the fields: sociology, biology, mathematics, computer science, especially in the field of artificial intelligence, robotics and linguistics. Research in the field of sociology ambiguously associated with the phenomenon that we want to study thoroughly scientifically. The collective is possible to study as a sociological category within the sociology with the scientific approaches. Sociological debate and scientific research relevant to the problem that we want to study can be classified into three categories.

The first are the philosophical and sociological debates about strategy development and nature of sociological theory (Habermans, 1981; Luhmann, 1984, Leydesdorff, 1999). In another, papers dealing with the application and development of computer tools for simulation in the field of sociology, and in a third, work deal considering the implications of the results of applying sociological validation of simulation models to classic and inauguration of new sociological theory. Especially interesting are the discussions in sociology associated with sociological systems theory and those relating to the supposed duality of structure as a methodological basis for studying the relationship between institutional analysis and analysis of behavioural strategies.

The start of these discussions is the approach that Parsons was inaugurated back in 1937 / cybernetics, systems theory, Durkheim / (Parsons, 1937). The discussion is focused on the search for models that can offer a solution for bridging the gap between the "theory of action" and "institutional analysis" in American sociology (Giddens, 1981), ie., the gap between "action theory" and "theory of social systems" in Luhmann (1984). One aspect of the debate relates to the unit of analysis and operation social systems. For Giddens, it is important to focus on observable actions and their empirical analysis. Parsons action is taken as a unit functioning and analysis of social systems ("structural functionalism"), while Luhmann committed to the concept of "symbolic interactionism," and the unit proposes an interactive social construction of meaning.

Thus, the analysis of social structure is not based on the action, as in Parsons, but the interaction of action at the level of communication networks. Structure Action Network for the actors is latent however; a hypothetical observer can determine (Lazarsfeld & Henry, 1968). Reflective observer is able to simultaneously be more and participant events. In this context, Giddens (1976) introduced the term "double hermeneutics". The roles of observers and participants can be combined and / or vary in all possible combinations. Seen communications network in its architecture at all times contains expectations for future operations. Uncertainty related to this expectation cannot be fully observed by any participating actors. He is immersed, and because of this, for it remains latent network structure and operations, or the functioning of the network, it remains virtually. Since only partially informed, actors participate in a network, and they act according to their own plans (programs) which then modelled own observations. Distribution of events over the network is determined by the distribution of local actions or aggregates action. Expected information content network is being changed and then again available for local or partial observation agents. The system of communication and action are mutually encouraged through "structural pairing" (coupling). Therefore, social networking events and actions have two layers. At any moment, there are both network events and network perceptions of the same events. These layers are in a time of constant interaction. The dynamics and interactivity in this model is defined such that the system, which emerges, one cannot expect to fully stabilize in time and space. It follows that the system cannot be determined by a set of variables observed but only in terms of actions (operations and events).

Actors and structures are mutually determine until they interact or until a structurally matched. The event is for actors attributing as action, and for the system (network) as communication. This model of recursive type implies the possibility of reflection. In the current situation prevails acceptance approach in which the complexity of the model is updated through the reorganization of the emergent system. Constituting the meaning of emergence is just a consequence of the operation of the reorganization. When information is received internally it gets meaning it can be re-communicate and network now gets an extra layer which constitutes the distributed meaning. Since such a network contains uncertainty can be identified only by taking some perspective.

This sub-symbolic meaning can be compared with "situational meaning" to approach "symbolic interactions" of Luhmann. While in biological systems, the signal may have a function and additionally contain the information, in communication between people can distinguish between the function and meaning of the message. Human communication takes place on two levels at the same time. It is expected of the message to have a meaning and that contains information. The pairing of these two levels is not the default, but is (re)constructed and thus contains uncertainty. The two-level observer can notice only when is participant and only then is able to interact. The result of the interaction can be viewed as an event in which the actor can meaningfully communicate. The social system, due to its complexity as opposed to the formal language in which it can be described, in principle is incalculable. Events in the "living world" (life-world - Habermas, 1981) and their reflections in social communication interact in numerous ways. The association between these layers is a priori asymmetric and asynchronous.

For example, "situational meaning of" interaction can be changed regardless of the intentions of the participants - actors. Emergent context may be so for the actors involved to become an event. Luhmann communication is defined as the union of information, messages and understanding. This complex unity and the concept of the meaning of the constituent elements is the basis of his ideas in the theory of social systems. As understanding is necessarily reflective, its social system exists only (exclusively) on reasoning (reflexive) level. His theory of social systems is focused on the interactions between people as events. That human being is defined outside of the domain of sociology and Luhmann attributes them as a problem / topic of psychology. For Luhmann, the option that network of actors and events allows (that are not perceptible to human observer) cannot have social significance. Such events remain operational outside the welfare system. Thus this approach remains associated only with a reflective coating. Most social research develops and uses some theoretical model (egg. theory of deviant behaviour, Model class). Generally, these theories are expressed in spoken language and sometimes represent structural equations.

Recently, scientists have begun to explore the possibilities of expression theory using computer programs. The big advantage is that the social process of interest can be simulated on a computer, and in some circumstances even conduct experiments that would otherwise be impossible. The logic that is the background simulation methodology does not differ to a greater extent than those used in the statistical modelling. In statistical modelling, the model is constructed through a process of abstraction based on theories about social processes in the real world (regression equation). With the help of some statistical procedures (egg, least squares) model is used to estimate the expected values are then compared with the actual data. The main difference between the statistical model and the simulation is that the simulation should "run and run" in order to obtain the output value model, while the statistical model requires a one-time statistical analysis to generate the expected values. Generally, the model is defined by mathematical or logical specifications.

It is possible to draw conclusions about the model analytically, drawing conclusions from the specification of the model (egg performing mathematical proof). Most commonly, it is either very difficult or impossible and therefore we choose to simulate. The simulation consists in reviving (animation) model. If the model is created as a computer program, a simulation consists of the execution of such a program with some specific input values and then, observing and analyzing the output size. Paradoxically, one of the main disadvantages of simulation is that it is difficult to achieve. To create a simulation model of the necessary theoretical assumptions we need completely rethink and achieve great clarity. Each link which must be modelled accurately specified, each parameter is necessary to give value. This discipline means that you cannot be vague in what is assumed. This also means that the model is potentially open to inspection by other researchers in all details. The advantages of clarity and precision, however, have drawbacks. Simulation of complex social processes requests to the extent of a large amount of parameters and the data that it becomes difficult or even impossible to perform. The advantage of simulation is that, in certain circumstances, can provide insight into the emergence phenomenon at the macro level from the action at the micro level (Conte & Gilbert, 1995). In this way the simulation of the interaction of the individual circuits can detect a clear impact on a higher social level (egg Nowak, envisaged, 1993; Axelord, 1995). Furthermore, the problem we face in all simulations is the difficulty in validating the model. In practice, nor is it possible to explore all combinations of input values, nor is it possible to check whether outputs a large range of inputs corresponding to target, because the target may be detectable only in a very limited range of conditions.

Despite these problems, the simulation still has an important role in clarifying ideas and theories, even when you cannot spend validation. In conventional simulations the behaviour of each simulated entity is regarded as a "black box" that is, the behaviour is modelled by probabilities and does not attempt to define individual preferences, decisions or entity plans. What's more, each simulated entity is viewed separately that is, regardless of interaction with others. Interesting simulations are aimed at emulating individual cognitive processes and communication between people that use techniques from the field of artificial intelligence (AI). AI is a discipline that deals with the design and construction of computer programs with properties that are usually attributed to human intelligence. Simulations are actually based on a distributed AI. There are many such programs in which each "agent" to interact with others in a simulated environment (Bond & Gasser, 1998). Computer agent contains three components: memory, set goals, and a set of rules. Agent memory is used for the memory of past experience and on the basis of planning for the future. The purpose of the agent behaviour is determined by its objectives, which may be the simplest, such as survival in a hostile environment in which it is faced with the problem of insufficient reserves of food and energy, or more complex in terms of the conflict in deciding among alternative goals. A set of rules determines the agent's behaviour and reduced to a simple set of condition-action rules formulated. In each rule condition is compared with the contents of memory and input values from the environment observed by "sensors". If there is a match, the appropriate action is taken. It can be internal and affects only the state agent's memory, or external, that affects the environment (for example, sending messages through another agent environment). The simulation is performed in cycles within which each agent comes on the line, collecting messages sent by other agents, refresh the internal state of checking whether there is an applicable rule, and the decision on the action to be performed and, in the end, sending messages and with verification and the effect of actions on the environment. This is repeated for each agent and the cycle continues until the simulation stops or agents are all "dead". As none of the social phenomenon is not possible to explore a whole, it is the first step, usually, a selection of those aspects that are of interest. Such a selection is necessarily influenced by the theoretical conception according to which, and determines which features are important. Elections approach to the construction of models can be: AI approach, through operational research, access to systems of differential equations or approaches symbolic logic. Regardless of the chosen model it is always necessary to make a decision on the choice of the appropriate level of abstraction of models, it is important to determine the level of aggregation chosen for the research unit. For example, one can model the world economy, using the world's major centres of power, certain countries or individuals as a unit. In doing so, it is necessary to choose the form of representation model. If the model is implemented as a computer program, the decision refers to, for example, the selection of a suitable computer language. Once these decisions are made model can be constructed and performed simulations. In practice, there will always be a period of testing and gradual improvement model. The simulation will be repeated a number of times, it was assumed, each time with a slightly improved model. Finally, when the model is satisfactory, it is important to conduct an analysis of its sensitivity and fisibility.

In natural systems, there are a number of factors that affect their global dynamics. The process of induction of these factors on a number of parameters will usually result in the loss of this essential that makes this system. Differential equations for the construction of such a model, therefore, would not have easily interpretable parameters. Traditional mathematical simulation, therefore, can be used to study the internal mechanisms of functioning of natural systems. Traditional simulation describes the observed links between macro variables. They do not allow research entities that produce connections. Traditional methods (inability to connect the global with the local parameters), cannot be efficiently utilized. Differential equation, which describes the entities, cannot explain the complex interaction between local entities. To achieve good and reliable results requires simulation of behaviour of entities in the natural environment. For many natural systems can be said to consist of a number of clearly defined interrelated parts. Simulating the interactions between components can simulate the natural system as a whole.

For anything that happens in agent-based systems, it is necessary to incorporate active agents. Active agents have properties that allow them to interact with other agents with potential for action of the active agent can vary significantly. Simple reactive agents are able to 'receive' messages from others and disseminate standardized, pre-prepared answer. Others may be able to process the input values and prior demonstration of behaviour depending on the results of processing, to formulate a response. This behaviour can be guided by rules or in some other cases, more complex algorithms decision. Such, behavioural agents, generally have limited options of what is called intelligent behaviour with predefined scope and externally programmed behaviour. Work Epstein and Axtela (1998), for example, showed that embodied agents with such a 'limited intelligence' can produce complex behaviour, analogous to the natural social behaviour, from just simple local behaviour rules.

Agents in social simulations are usually defined in teleological terms. Such agents are often called 'deliberative' or 'intentional' agents. Watt (1996) found that if the "agent" starts to perform an action, and execute it, in this regard will have competence performing targeted actions such as competence and monitoring to achieve the goal. However, there are still such systems, which include agents with a pre-programmed targets and can generate unexpected behaviour on a macro level. There are so-called adaptable agents. They are able to modify some of its parameters or estimable conditions and in some cases its own set of rules. Agents, moreover, can be used for modelling the structure of higher levels, such as 'groups' and 'organization'. Cognitive agents are those who are able to adapt its own structure in order to compensate for recurring changes the environment so they are therefore treated as cognitive. Biological agents, when they are simulated on the computer, if they are designed to embody the fundamental characteristics of real biological systems, act as biological agents, and the theory of autopoesis is directly applicable to them because they are autonomous and self-producing (autopoesis – Maturana & Varela 1980). By definition, the active agents can produce behaviour. Flexible behaviour in animals extends the range of the reflexes, the lowest level, to the highest levels of learning.

Regardless of whether this is a reflection or choice, the answer to each other is talking about their structural union. Structural matching is a fundamental constitutional mechanism by which social behaviour can emerge in all forms of biological agent. Some classes of agents have the ability to adapt. There are strong parallels between the variability of adaptation that is the result of genetic adaptation, and one that is the result of learned behaviour (Plotkin, 1994). The medium is the background environment or substrate social systems. The medium may include active and passive agents.

The active agents in the environment may be similar or different type from those that make up the social system. Active agents can be artificial or biological. Generally one can assume heterogeneity in populations of biological agents as the homogeneity of the population likely to artificial agents. The main characteristic of the environment is that it represents the limit of space interaction of agents in it. It has topological features and the topology can be an important factor affecting the interaction of agents. Meta-model allows interaction with respect to temporal and topological dimension. Social environments such as town and village can be modelled as agents.

Such structures can be hierarchically arranged. In social studies the primary agents will generally be 'biological' agents. Where 'social' structure should be extended to include artificial society - made of artificial agents, including new active agents expands the range. The secondary agents can be any class of agents. Systems of agents can be formed between those of the same type and of different types. When the active agents are interacting with each other they can be changed. This can result in five possible outcomes: 1) They are mutually offsetting each other; 2) One party is cancelled; 3) One party adapts to meet the other; 4) Both parties mutually adapt, or 5) Nothing happens. The only interaction that can produce social behaviour is on the fourth level. Systems which are formed on the third level will constitute the aggregate but not society. Systems formed from a variety of classes (levels) produces one of four different matrices each of which has its own characteristics.

These matrices are: passive matrix, equilibrium, the system consists only of passive agents who do nothing, passive - active matrix and active - active matrix. System with passive and active agents has the potential for dynamic behaviour, which will depend on the density of the population of agents (and thus the probability that will meet with what frequency), their action horizon, topology and parameters of the environment in which the agents are sensitive.

Computer sciences

Computer Sciences are predominantly characterized by the field of artificial intelligence - Artificial intelligence (AI). Scientific papers in the late eighties and early nineties inaugurate the new approaches in the development of this area. At that time, a new generation of researchers comes, whit prominent representatives as Agra (1987) and Brooks, (1990; 1991), and later Matarić (1994). Those researches and the changes associated with simultaneous momentum in the development of robotics and related AI. These approaches are recognised as AI behaviour based agents, multi-agent systems and swarm. The main value of this approach is a change in the definition of the concept of artificial intelligence.

Previous directions of development in this area, which are to be determined in the first appearance of the area in the late fifties (Dartmouth, 1957), characterized by the construction of AI systems "top-down" were analytically based. The problem of this approach and in some ways the ultimate extent of the possible solutions to the problem is expressed in the "frame" (frame problem) which defined McCarthy and Hayes (1972).

According to Webster's dictionary, intelligence is "the ability to learn or understand from experience, the ability to adopt and maintain knowledge, mental ability, and the ability to quickly and successfully responding to new situations, the use of skill (faculty) reason to solve problems and manage behaviour". Artificial intelligence is treated as an area of computer science and is a direct application of epistemology or theory of knowledge. Area of AI is traditionally classified into three basic categories: (1) ES or knowledge base complete with tools for their construction, (2) natural language, and (3) perceptual systems. ES (Expert Systems) are programs that contain the knowledge of people experts coded so that the computer can "understand". Mechanisms of reasoning, similar to a human, use this knowledge to solve specific problem areas. With this knowledge and encoded inference mechanism, ES and can be used to solve problems that are otherwise beyond the reach of conventional programmable computer. PS or production systems, are the most widespread method of representation of knowledge in the form of production (production rules) with the basic model rules situation - action: If (s1, s2, s3, ..., sk) then (a1, a2, a3, ... , an) Here are s1, s2, s3, ..., sk given the facts, or facts that may be the result of some other production rules, which can be brought into relation with each other by means of logical relation operators such as and, or and negation. In all cases where the outcome of relationships fact true, we conclude that both a1, a2, a3, ... are true and that the actions are performed. Such systems are called production systems - HP (Newell, 1973; Rychener, 1976; McDermott, 1978). Generally, ES (knowledge base) are determined by a set of rules, or productions, which, guided by the inference mechanism (inference engine - IE), the production of memory (PM) along with a database of current claims, called working memory (Working Memory - WM) perform competent conclusions. Each production has two parts, the left side (LHS) and right-hand side (RHS).

LHS contains a combination of structural elements that agree with WM (working memory), while the RHS contains directives for updating the contents of WM, adding or removing facts and directives. In this paper, ES interpreters, repetitive, perform the following cycle of operations: • Comparison (match) for each rule LHS compared with the current WM. Determine if the LHS satisfied with WM. Each decorated subset of WM elements that satisfies LHS rules is an instance (instatination).

All instances are numbered so as to form a set of conflict; • Select (select) from the conflict set is selected subset of instances according to some defined rules. Practically, make a choice one instance of conflict set, based on recent comparisons of WM; • Action (ACT) Execute the action specified in the RHS rules selected instances. The main advantages of expert systems are that knowledge can easily add incrementally, and the strong syntactic restrictions on the form of rules facilitates the automatic generalization of new knowledge in the fact that formal proof techniques can be used to verify the completeness and consistency of the knowledge base.

The basic components of each ES are: • Knowledge Base (KB) containing the information that experts used in the search for solutions to problems. KB is a step above conventional database (DB) and includes not only static information but also contains relational data. Here are the production rules; • Database (DB) contains facts about the problem. This is a passive area ES - easy storage for data and formulas. The information includes default and unchangeable knowledge of the problem and the area; • Working memory (WM) is used only for processing time and is the resident's room for manipulating information. KB is modified during the execution of the conclusions (IE), as the situation and data changes, collect data from the DB and the knowledge of the KB and combines them with the information provided by the user; • The mechanism of reasoning (Inference Engine) - IE, is the heart of the ES. It consists of processes which handle KB, performs analysis of hypotheses and accounts processing leading to a strategy that mimics the reasoning of experts. IE is the "thinker" of the system and provides overall control; • the interface is part of the ES for communicating with the user. The problem of changes in the real world, for yourself, it is very difficult to be solved and complex, and can be broken down into a number of other problems associated with it. In any attempt of modelling the real world, a world which is inherent in change, it should be noted that it can differentiate series, interconnected problems. These problems in AI literature are known as: (a) the frame problem - FP, (b) a bookkeeping problem and (c) the problem of qualification. FP is a general problem of representation and is still present in form searching of a complex and changing world. It is generally defined as the problem of finding a form of representation that allows a change.

The basic assumption is that the problem solver to use an internal model or symbolic representation of the problem of the world. Manipulation of the internal model, in correspondence with the actions of the real world, the problem solver can make a prediction of what will happen if performed certain actions, decide which conditions must be met in order to be able to produce a particular situation, to compare different hypothetical situation and needs.

The idea of internal representations can see a clear demarcation between epistemology and heuristics, which was introduced by McCarthy and Hayes (1969). Epistemological problem solver component models world, and heuristic solution component performs world solutions. Some problem solvers can thus rely on the very rich and accurate model of the world and they should not be too smart, because all you need to do is to consult a response model. But another problem solvers cannot rely on your mind - what you do not know can still perform - and in this way manage without explicit knowledge about the world. Research to solve problems of modelling the real world can be roughly classified into two different traditions: a) deductistic, and b) non-deductistic tradition. Although there is exchange of ideas and techniques between them, each tradition has retained its basic approach.

Deducts have a primary interest in modelling and opposite in heuristics. Non-deducts approach is older and has its roots in psychological-oriented approaches to AI, which implies that the most acceptable way of AI systems through the study and imitation of natural intelligence. Within this view intelligent machines simulate the brain at a high level - in terms of thinking, reasoning, etc. The human reasoning, it seems, does not depend much on deductive reasoning. In the reasoning research conducted by Newell and Simon (Human Problem Solving in 1972) and Newell, Shaw & Simon (General Problem Solver - GPS in 1960.) it is not used logic and deduction, but the reasoning called *means-end analysis*. A very simplified description of the analysis procedure is as follows: We come closer to goal with a series of steps. Each step begins with calculation of the difference between the previously achieved status and objectives. Based on the characteristics of these differences, operations that have the greatest impact on reducing the likelihood of differences have successive attempts, while some of the operations bring the system closer to the goal.

Reasoning that appears in the settlement process, mainly heuristic, type: informed guessing attempt (informed guesses), 'rule of thumb' (rules of thumb), trial and error, and the like. The approach where the problem solving free from psychological matter and inspiration, - deductive approach – logic, has a promising agent for the implementation of symbolic model of the problem of the world. The logic is a formal language with well-to-understand syntax and semantics, which makes it suitable for use on the machine. Deductistic tradition assigns greater weight capacity of the solver of problems in the modelling world, but on its epistemological power. The difficulties are of a general strategy in the expansion of ontology, so it includes egg history, intent and knowledge as entities models. Extensions of logic itself are rare. The concept deductistic paradigm, which is quite popular, the situation is "the complete state of affairs with some instant of time" (McCarthy, 1968).

The world is seen as a succession of situations, with certain set of laws of motion. Description of the situation consists of a set of first-order logic sentence. Deductive system can then be used to perform other sentences, which are also applicable to the same situation. Explicit knowledge is thus complemented by implicit knowledge. Moreover, it is understood and physical determinism: "The laws of motion of the system and determine all future situations from the given situation" (McCarthy, 1968). That means, given the laws of motion, storyline, and action, a description of the new situation that will result from the execution of the action can be deductively derived. AI as a formal discipline, there are about 30 years old. Winston (1984) characterized the goals of AI at the same time as the construction of useful intelligent systems and understanding of human intelligence.

In the history of the field of mobile robots in AI commonly referred Shakey in the late sixties to Stanford Research Institute, but other significant efforts that include, for example, CART (Moravec) at Stanford. The main characteristics of these first efforts to work with displaced (off-board) computers. Operate in almost static environments that are usually specially prepared for them. All they perceive the world around us are trying to build a 3D model of the world in which cases the planner can ignore the actual current world and on the basis of the model to make an action plan to achieve a set goal. Made plans consist of paths that would be the robot should move. All of these robots, despite significant simplifications were very slow in action. On the one hand most of the time is devoted to perceptual processing and building a model of the world, on the other hand, relatively little time was devoted to planning and carrying out the action or actions. The significance of this work consists in setting the framework for other researchers to test their ideas even without the direct use of real robots. This approach and framework Brooks called: sense-model-plan-act approach (SMPA framework). Such an approach is necessary, and set limits on the ways in which they could make the programs that control robots.

In the mid 80s many researchers are beginning discussions on the general problem of the artificial intelligence. Requirements are that intelligence has the ability to respond to changes in the environment, in which robots operate at a rate similar to that in animals and humans, and that such intelligence is able to create behaviours that are robust given the uncertain sensors and unforeseen circumstances in constantly changing world. The most important consideration of intelligence that has emerged following the above logic, the following: In everyday life, most people are not concerned with solving the problems and solve it routinely. Performances (representation) of objects in the world that agents use does not rely on semantic association with symbols that agents use, but can be determined through the interaction of the agent with the world. (Agre & Chapman 1987; 1990).

The observer may consider the agent's beliefs and goals although the agent in the work does not necessarily manipulate symbolic structured data (Rosenschein & Kaelbling 1986; 1990). In order to verify the actual idea of intelligence would be important to fully build an agent acting in a dynamic environment and uses realistic (sensors) senses. Internal models that fully represent the real-world environment is not only possible to build, but are not required to act competently agent. Many effects agent are completely separable into smaller pieces - a coherent intelligence can emerge from the active interaction of these smaller parts. Agents that are based on such ideas reached interesting levels of performance were built as easily from combination of electrical circuits with fewer timing circuitry (Brooks, 1986; 1990b; 1991). This approach and the type of work is sometimes called reactive planning, and some called it a behaviour based as computer components tend to be modules that produce behaviour. The main aspects of this approach are: a) situatedness, b) being embedded (embodiment), c) smart, d) emergence. Robots are in the real world, ie, do not deal with abstract descriptions, but the world here and now directly affects the behaviour of the system. They have the authority and direct experience world (experience the world directly).

Consequently, their actions are part of the dynamics of the world and have their own direct experience of the world retroactive. Perceive to be intelligent, but the source of intelligence is not limited to the computing machine. Intelligence also stems from the situation, the transformation of signal sensors, and physical union with the world. Intelligence system emerges from the interaction with the world and sometimes went out and indirect interactions between the components where it is sometimes difficult to point to a place or event, and argue that this is the reason some outward manifest action. Lately, authors try to integrate traditional symbolic thought and reasoning over / above (on top of) a purely reactive systems, in both the real robot and in computer simulations. The idea is that the reactive systems solve problems in real time, while the more responsible (deliberative) performed the heavier part (the hard stuff) part of the job using the traditional AI systems. The agent is used as a term denoting the holder of action and refers to the man as well as the robot or a computer program. Such as the entity realized by satisfying certain characteristics such questions: What is an agent in a given environment? Under what circumstances will achieve its objective or maintain a desired relationship with the (environment) other things (things), so in what type of environments would work? How certain aspects of the environment (topography, variability or product artefacts) affect the ability of certain agents in interactions with own properties? What forms of interaction required of an agent to use specific elements of the internal architecture (egg, memory)?

What forms of interaction allow agent learning certain skills? For these questions is not necessarily a priori put demands on architecture. Rather, the point is to understand, in the most general possible form, the connection between the properties: agents, environment and all possible forms of interaction. One theory or model cannot these requirements fully met, thus completely solve this problem. Through a lot of research in the field of computer science is only possible to transfer some intuitive understanding. Using the metaphor for this intuition is dangerous, because here the following words should be understood as a means, as a first stage, and an invitation to formulate things in a different way, through other metaphors. Most current research in AI bots can be categorized into one of three groups that differ with respect to the degree of complexity of the environment with which to cope with regard to the number of agents they employ. If we would view it in two-dimensional space in which one axis refers to the number of agents that interact, and the other to a degree of realism with which the world is modelled, then the underlying relationships can be displayed as follows: a) an agent in a relatively simple environment. Characteristics of this level models are analyzed to this degree of complexity to allow larger items level. b) relatively complex forms of interaction between several agents where interactions are mostly symbolic and poorly related to agents bodies. Here the emphasis is on the logical structure of the interaction; c) relatively simple interaction between a number of agents in more complex environments. Here is interaction dependent on the agent's embodiment (embodied). The emphasis is therefore on the order emerge from simpler forms of interaction (emergence).

Number of agents

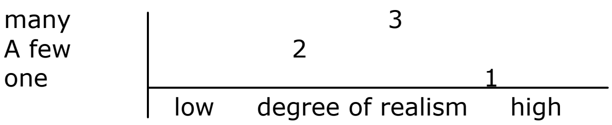

Figure 1. View of modelling the real world through the ratio of the number of agents (Y) and the degree of realism in it (X)

Computational studies of interaction of agents and environments have historically been structured in two sets of ideas; dominant tradition is targeted at planning, and the other focused on the reaction. We will mention some theoretical reflections on the problem of planning in the real world. Karl Lashley, "The problem of order and behaviour" (1951) associated with the operation of the human brain to understand the cognitive processes through the structure of language. Speaking (sentences) languages have their own formal structure of high complexity, which are the basic elements - phonemes - which follow one another so rapidly that the structure, or (sentence), you simply cannot emerge (emerge) through a simple concatenation of the concept of behavioural stimuli and responses.

Well then, according to Lashley, it follows that the brain must be able to generate these structures on the basis of their internal resources. Moreover, Lashley proposed understanding of human actions on the basis of language model. In today's dictionary AI that could be translated in a way that the brain generates a series of primitive actions applied and stored habitual schemes. Unclear is the idea of "determining tendencies of intent" that Lashley abstract analogy explains that the semantic content expressed by the word / sentence (utterance) because it replaces the simple meaning of the target will be reached at the end of the sequence of actions in the sentence sequence. Another effect is a computer model of problem solving that are suggested in their research Newell and Simona (There are / can be observed similarity with Lashley). The process of searching through / in the space of possible sequences of "operator", some of which correspond to the desired / target situation and that it can accept, in terms of steps towards closing, as a solution to the problem or achieve the ultimate goal. The meaning of "nested search space" goes well with formal hierarchical decomposition of the complex action which is already found in linguistics. Every sentence (utterance) has the grammatical structure that can be drawn (show) as a hierarchical phrase tree, where lexical units (phonemes) have a hierarchical structure of syllabus and phonemes.

Miller et al. (1960) in 'Plans and structure of behaviour' combine these contributions in the first synthesis of computational theory of planning, and provide first recognized definition of the plan. The plan is a hierarchical process in the body that allows you to control the order in which the sequence of operations to be performed. The plan here is not symbolic mental structure but "Hierarchy Process" determined so that it can be structured in serial behaviours of the organism (in terms of Lashleyev). There are two basic concept of the plan. The plan indicates a relatively fixed repertoire of commonly used structures action, and a library of plans. Plans are hierarchical in its structure and can be stacked as parts of larger structures.

Meaning plan represents a hierarchical structure or process that provides a sort of ongoing transcription in the total behaviour of the organism. In this context, the interesting and revolutionary Chomsky 's standpoint in linguistics and his "theory of generative grammar" is in the opposition between the methodology that applies only to research the legality of observed fact and one that uses the observed facts as indications of hidden and those who have underlying those principles. Its revolutionary point of view twice as interesting in the field of linguistics speed is part of a wider conflict, and secondly, it uses the results of the language to try to develop anti-behaviouristic and anti-empiric conclusions about the nature of the human mind that go beyond the boundaries of linguistics (Chomsky, 1969 by Searle, 1982).

The course of any match in team sports it is possible to describe the sequence of simple sentences spoken language. In this context, the match could well be described as a story (the opening, the plot, the epilogue). So we have a very interesting and Chomsky (1957) because the syntax and semantic sense of it, we can get the tools and platform for a different analysis and views on the game compared to today's approaches. For Chomsky, syntax is directly related to the organization and architecture of the human brain that is genetically determined. The problem of semantics is still with Chomsky is not resolved and is subject to debate and attempts to further scientific contributions of various linguistic schools. Complexity theory is applied in the fields of natural, social and human sciences in different and sometimes contradictory ways. Advocates of this theory, a 'theory sorts of things', attributed to its use of the possibilities and explanations of various subjects such as biological evolution, the state of mind, weather, earthquakes, social changes, price trends and other (Waldrop, 1992). Some ascribe to this theory the value of a new paradigm that is emerging as a challenge to traditional Newtonian show the world (Thom, 1975; Capra, 1996).

Complexity theory deals with the problem of how to fully landscaped complex system spontaneously emerge from the chaotic situation. In this way, complexity theory is actually a meta-theory is a theory that combines disaster and chaos. Around the same time, the two sides of the world, there are two similar theories. One theory is catastrophe (Thom, 1971) and other is chaos (Gleick, 1987). As a mathematical formalism, catastrophe theory deals with sudden changes from one minimum potential state of stable equilibrium to another. An example of such a catastrophic event, for example, is saying 'last drop in the cup’. So when a small, almost insignificant contribution is important, catastrophic, it changes the state of the system. The theory deals with the disaster of the system state changes from one stable state to another, while chaos explores the unstable state of the system. Chaotic systems are sets of subsystems that are flexible because they can be quickly and unpredictably switch between different states. Nevertheless, although chaotic systems can be unpredictable, they are deterministic. This can be done based on the fact that two identical systems with the same initial conditions to produce the same results. Classic and typical example of a chaotic system are weather conditions, which, despite many efforts modelling is still not possible to predict for periods longer than a few days, sometimes a few hours. Complex systems are not only complicated static objects, but non-linearity, spontaneous and self-organizing systems (Waldrop, 1992). Such spontaneous emergence of new forms of self-organization and emergence called complexity. What theory of complexity makes it unique is its ability to take into account the structure, coherence, and self-organization of such systems.

Adjustment (adaptation) is one of the main properties of complex systems. Complexity theory is therefore concerned with adaptation and awareness of the changing circumstances and accordingly to the production of new solutions (Alen, 1994). Instead of just passively respond to events, complex systems, they interact with their environment. For processes with increasing complexity and emersion spontaneous organization is a fundamental concept of the agent. In theory, the complexity of systems is seen as a network simultaneously and in parallel active agents. Sam agents should be understood as comprising a plurality of how individuals and collectives. In this way, agents can be as individuals and families, or, for example, cities, provinces and states, all depending on how that our level of observation. Irrespective of the level, such an environment is the product of interactions of agents in a given system. The system consists of the constant action of one agent and the corresponding reactions of others. Therefore, the environment is always dynamic. However, in order to achieve coherence and behavioural adaptation is necessary that the agents themselves are dispersed, ie, decentralised. In complexity theory is of central importance to the coherent behaviour can arise only as a result of constant competition and cooperation of agents themselves given environment (Waldrop, 1992). In any complex adaptive system can be many organizational levels. A single agent in one variety will be so only building block from which it is built on the following second level. For example in collective sports games, one player will at one level of observation to be an agent, while the next several such agents - players seem new agent that can be for example a subgroup for his role in the game, such as defenders, while all agents in the following subgroups for her roles seem agent collective team. It should especially see the importance of some characteristics of adaptation.

Complex systems continuously and in accordance with the learned lessons revise and reformat your building blocks on each level and in a similar way as it happens with modification, reorganization and adaptation in the evolutionary process. As it Waldrop (1992) observed, was that these cells, neurons, body, politics or the economy, the processes of learning, development and adaptation are the same at all levels of the organization. In general it can be concluded that complexity theory as its subject looks unpredictable and creative emergence of order out of the chaotic situation in the natural biological, cultural, social, and other systems. Adaptive self-organization occurs in the population through the exchange and interaction of independent agents through competition and cooperation which lead them to a state of increasing interdependence and which eventually results emersion of new structures. This emergence of new structures in addition to rising levels of complexity and sets the foundation for establishing a new level of complexity.

Computer theory of action has at least two main objectives. First, explain how the action has a structure like the one belonging, and second, to explain how the action is chosen so that it is appropriate for the given circumstances where it is used. In 80s team research focuses on the construction process of the plan, assuming that the performance is a relatively simple matter. In the late 80s began to move the focus of research in the classical problem of the construction plan in a formal way and explore mathematical issues that require formalization of the plan (Chapman, 1987; Gupta & Nau 1992). This theoretical circumstance is resolved mid-'80s introduction of new terms "situational action" and "reactive planning".

These systems fill "hole" in the existing system of ideas about planning and thus reopening the second half of Miller-accessories problems (Test Operate Test Exit). Thus, the emphasis is on interaction with the environment and the role of close ties to organized activities between <perception-action>. When we have an agent that interacts with its environment is interesting and important to ask the question: Why do we think it will work? Most often this is trying to prove to the AI, the argument about the correspondence between the internal representations of the external world. In short, this argument is the induction of type a) implies that the agent has the proper knowledge of the world in the initial state, and then, b) if we can show that the accuracy of the knowledge to be preserved from one action to another unitary, it follows that agent's knowledge of the world as long as you stay properly taking action. The approach to checking the functioning method of correspondence it is the so-called frame problem (McCarty, Heys, ...). In this problem, the question is, assuming that the agent correctly anticipates what the world will be up at some point in time, how can infer what the world will be after the action is executed or, more precisely, for which the agent's beliefs can be assumed that will correspond to the actual state of the world after the action is performed. The second approach, the method of convergence relies on the principle of fairness, however, differs in that it focuses on the agent's behaviour, not on the possible internal states. This approach therefore puts in relation the agent and its environment. It can be said that the convergence wider accentuated range of problems (general category), which is a special case includes correspondence (semantic). Since the agent is finally being in a complex world, it will probably happen that will occasionally make a mistake, a mistake in the belief (mistaken beliefs). Nevertheless, it is possible (or expected) to show that the agent will still accomplish your goal. In the design of an agent that operates in an abstract environment and territories, as well as search space (symbolic bases) and that there is no authority (either a simulated or material) in any real sense, it can be easy to ignore the distinction between what the agent knows about the situation and knows what its designer.

The distinction designer-agent is not always present. When a designer is an agent method of correspondence, the agent is important to maintain a sufficient knowledge of their environment to be able to perform a proof that I do what is expected of him. For an agent is not necessarily that can perform this evidence as sufficient, but that the designer spent such evidence in a general form above. The essence of the method of correspondence is that the agent knows the facts that allow its mission fails.

When an agent designed according to the principle of convergence of such an agent can be said to have knowledge (or even no) but this knowledge is not necessary to show the convergence. For example, an agent who relies on his mission to set the landmarks will have more trouble if these landmarks are sparse in the area, however, if the designer knows that in this area landmarks are properly installed, it is possible to show that the agent will get to the default location, and regardless of whether I'm sure of it or not. This simple example highlights the question of the connection between a set of knowledge agent and designers, and it becomes particularly interesting when their (agent-designer) know different. Discrimination of this knowledge becomes necessary due to a sharp conceptual separation agent and designers because they allow the formation of special agent 'relationship with the environment when the agent has the authority (is not abstract) and is in the physical environment and interact with a variety of environment artefacts. In general, the fact that the agent has the authority and is in the interaction with the physical world has a vital role in computer theory of action, knowledge, perception and learning. For the most part it stems from the fact that embodied agents have direct access only to a limited one, and a relatively small part of the real world. So characteristic is that the agent interacts with a local situation is located at a specific location in space, facing in a certain direction and its surroundings are certain artefacts.

This material embodiment of the action makes real important distinction between the view from above (aerial) ("bird's-eye view) and the view from the bottom (" bottom view ") (ground view). The designer may have a position views from above and therefore can have a better and broader insight into the situation than is embodied agent may have turned in one direction. Agent's knowledge and / or ignorance is structured phenomenon and the designer's job is to understand these structures. For example, an agent can be found in the situation that all the time running in circles and that's what he does not know. There is then the job of designers to solve the problem and avoid such a possibility. Agent will, for example, be in a position to constantly losing its things, but if the designer can implement that "socks always be found as long as you are left where they belong and where they belong," this problem will be rectified.

Simon (1957) observed many ways and means through which social organization compensates for the shortcomings of their members ("limited rationality"). Balancing work of many workers in large organizations, as noted by Simon, compensates for the limited capacity of working individuals. The division of labour and allocation of specialized tasks to individuals compensates for their limited ability to learn and perform new tasks. The course of structured information through the organization compensates limited knowledge and precise formation of the organization, together with accurate classification of individual tasks, compensating individual limited ability to make decisions. Simon believes, therefore, that the hierarchical structure of the bureaucracy compensates individual limited ability of individuals / bureaucrats in realizing their own potential.

Therefore, "the structure of the world compensates for the weakness of the cognitive architecture": according to Simon, "Administrative behaviour". Talking about the weaknesses of the architecture can be said that some of them are the result of weaknesses in the design, or they can be derived from the weakness of all known architecture, or may be inherent computational limitations arising from unsolvable (undecidable) problems. Perhaps, however, on the other hand, it is crucial the critical scarcity of research and the relative lack of concepts for discussion architecture "useful structure in the world." Emphasis some, once the prevailing concepts of looking at the environment as "uncertain", "complex", "variable" and the like, made it impossible to say anything general about the environment that describes only these negative attributes. Observing thus, follows that the most environments are unbearable and without the possibility of survival of all organisms that are above a certain primitive level of organization. Relying on a classical approach to planning that increase the complexity quickly becomes difficult arable and when planning formalism reveals (and registered) new and emerging complexity.

Therefore, it was imperative to discover a kind of properties of a given world and the agent's interactions with that world that will survive in it seem bearable. It is important to note that the question is where structures come. Are they simply properties representational schemes that can be chosen among many possible (logic, mathematics or philosophy)? The general conclusion still can be done, if they try to find structure in the world that best suit the strengths and weaknesses and architecture. Or, if on architecture agent encounters a problem, let's look can you find a structure that will help compensate for weaknesses. Of course, it is possible that the architecture itself has an inherent weakness that can be corrected, but in general, however, it can be concluded that the emphasis on looking for a structure to be more important and more Illuminating.

In many works, attempts were made to these structures, but in terms of general orientation can enumerate some basic categories that might be useful in searching for such structures. Agre in his work "Dynamics structures everyday life" (1989) argues that the contingency is central feature of everyday activities and improvisation central kinds of human activity. In this context, for any kind of action and a man and an agent in simulated conditions is of crucial importance as various artefacts, signs, physical dynamics, customs, and practical limitations, learning situations, mutual adjustment, inertia, locality, stabilization and geometry. Spotting these structures have a direct incentive and are the trigger for the selection and implementation of previously learned routine. Therefore, according to Agre live in a complex world is reduced to the identification of known structures which will trigger a learned routine.

Illustration on that (according to Agre, 19 -): • Knowledge of artefacts simplifies the process of decision-making agents, for example, agents known as buildings, streets, clothing or furniture; • Knowledge of the characters in the world who study unusual is important. You need to know what they are saying and who are assumed knowledge for their understanding; • Physical dynamics agent informs what the rhythms are established in certain categories of physical interaction with the environment. What are the properties of these interactions are conserved or remain invariant. Under what conditions and why attractors converge or remain within the set framework; • Traditions are the conventions that agents worldwide respect if the agent relies on it to respect these and other agents to simplify their reasoning and thus the action; • Practical limitations are related to the execution order of actions which are dictated purely for physical convenience and practicality. For example, the case must be opened to remove something from it. First, dress pants and shoes. Unable to take anything if you are not close to her; • Situations of learning are those which requires the agent to do something new. Do these situations reliable performance? Did anyone or anything ensure that the agent uses reasoning that becomes incrementally more complex than it was earlier? Where and how an agent can get help? • Mutual adjustment consists in the fact that it is determined whether there is some pressure for incremental adaptation of various entities to one another. Examples may include evolutionary adaptation, or the accumulation of common knowledge in joint activities. Each of these cases has its particular logic and its way of adoption or adaptation; • Inertia talking about whether there is a limit of possible changes in the size of the important things in the world and that it guarantees that a dangerous situation to be detected before they cause permanent damage; •

Locality defines whether the effects of actions affect only a relatively small part of the world are limited.

Such locality can be given the physical distance, but also the causal proximity, there is always the question of whether it provides verifiable limits of the possible damage and that error can produce; • Stabilization indicates the actions that the agent undertakes to ensure that the world keep the computer useful properties. In this geometry talking about the properties of the physical environment that limit the complexity of reasoning required to perform an action or for learning and whether there are in fact useful meanings for the terms "diameter", "bottleneck", "critical path", "climbing", etc.; • Structures in the world can be viewed from different perspectives.

We need to distinguish the use of such structure in the world when it is used from a position above "bird" or below "frog" perspective; Agent's understanding of the environment does not have to correspond with the designer. Agents can have a subset of the designer's understanding of the world or some simplifications or even can slowly discover that understanding only by adding the process of abstraction. Clear distinction between the view from above and below will help the designer to have access to a broader range of design options that are compatible with the designer's understanding of the world of agents. The focus on the structure of the world and on a consistent characterization of the interaction has a further advantage. The discovery of the structure of the world and the properties of the interaction are of particular importance for possible radical changes in architecture. Various research projects can use the unparalleled vocabulary, but each project can learn from the way others move forward or backward in the agent's design, architecture and structure of the world and study the properties of the interaction. In the history of AI, Newell and Simon, they embarked on a struggle against behaviourism. There are also other authors, such as Lashley whose ideas were highly influential in the development of AI. In order to counteract this was a strong distinction was emphasized cognition that occurs in the agent and the world located outside it. Therefore, research agent's interaction with the environment may sound like a representation of behaviourism.

Sure, it's easy to fall into the idea of behavioural types, such as stimulus-response sequences, which Lashley countered in his work on the structure of serial behaviour. The concept of "unit of analysis", borrowed from sociology to establish relations within which research is conducted. The focus of research is on the interaction between agents and their environment. For this purpose it is necessary to define a concept that crosses a line between what is outside and what is inside. The world is what the agent sees the inside but also what is out there and the interaction of these two factors determines the behaviour. In the study in AI it is important to develop the concept and to determine the unit of analysis concerning the interaction, rather than the simple sum of the agent and the world as two separate entities. Interaction as the unit of analysis is stronger than simply summarize and requires that at least some of the fundamental concepts are defined in terms of interactions and properties. Let us clarify this logic example. Controller associated with the refinery will receive, through its sensors, for a number of input values and produce a range of output values. Long-term follow-up of these sizes can reveal that converge to some values, and to enter into oscillation with an amplitude and frequency. Does the controller produce this behaviour? Do you have a problem with the installation? Of course, the behaviour is the result of interaction between the two. It simply means that the structure of behaviour "located" on the interaction of the controller and the plant, not on one or the other separately. The coach of a team in a collective sport (controller) in a multi-year work with the team controls the effects produced by the actors played (players - sport mode). Long-term follow-up will reveal that the behaviour of some converging values (results) and that the team has a certain oscillation amplitude and frequency. Do you coach produces this behaviour? Do you have a problem with a team? The behaviour is actually the result of the interaction of both. It is obvious that the structure of behaviour "located" in the interaction coaches and teammates and not on one or the other separately. The challenge of research in this area is reflected in the development of principles that allows reasoned discussion about the properties of the interaction, as well as the reasons that determine how to design the agent's architecture.

This enables us sophisticated reformulation insight into the "structure in the world." The point is not that the world has the structure itself, but rather that the world has a structure that affects the operation of a particular agent. This property links an agent and the world rather than the world itself. The unit of analysis is not a tool (in the case of adapting tools people) rather than the usual method of using tools to interact with the world. Culture forms a realization of interaction and they in turn provide guidance and leadership in the process of adaptation to our complex world. Computational studies provide promising tools for the analysis of these settings. It is necessary to identify and understand the role of indexing and objective forms of representation. ("a few blocks ahead," as opposed to "latitude and longitude 41 13'). Indexing team, the causal and epistemological sense, it is more related to the actual circumstances of a particular place with one hand, while on the other hand is not suitable for other purposes, such as the distribution of knowledge about space and time and agents in remote locations or unknown locations. In the study of complex systems computer programs play an increasing role. Computer simulation as an experimental tool used in parallel with the physical-based measuring instruments. Models, derived as programs on your computer, giving many advantages over traditional methods of experiment.

In the early development of a given scientific field scientists typically construct experimental measurement devices. Standardization of measuring instruments is not just a matter of convention, but also needs ensuring repeatability of experiments and compare the results of experiments of different researchers. Modeling formalism based on the collective of independent agents interacts, which is realized through discrete events. In general, this approach is not dependent on the domain, such as special physical environment, physical phenomena, and the team of agents or structures their interactions. They both can be used in chemistry, economics, physics, ecology, political science, sociology, anthropology, or kinesiology. The basic unit is a simulation agent. Acting agent in the system is any entity that can produce events that affect it or the other agents. The simulation consists of a group which may be more interdependent agents. This approach to simulation of discrete interactions between agents differs from the continuous simulation to simulate the phenomena of the values that variables take on the system of differential equations. Agents define the basic objects or components of the simulation. The sequence of events direct object determines the process that occurs over time. Some actions of objects occur in a given moment.

Time flows as a result of the order of events in successive times. The schedule is a data structure that consists of action and the order in which they should be executed. Passage of time in the model is determined by completing the event in a sequence. Simulation is the process of construction of abstract model which is represented by a system in the real world. All substantive aspects of systematic simulation model are described as a series of equations and / or relations. Simulation is used for analysis and evaluation. The model is used instead of experimenting in the real world, which is often not feasible. Simulation is a tool of description so that allows experimentation on the model rather than on the system in the real world.

The reasons for the use of abstract, realized on a computer simulation model, created when the system does not yet exist or is experimenting with the existing system too expensive, that is, experimenting with the system is not appropriate for any reason. The system in the real world, acting on the basis of a random process called stochastic unlike deterministic systems. For a system that does not vary in time is said to be static, as opposed to those that are changing over time and dynamically. There are three basic types of simulation. These are: • statistical simulation can be used to simulate a system having the characteristics that are static and stochastic. They are used in risk analysis, where the consequences of making the wrong decision can result in very large losses for the purpose of risk analysis and evaluation of the benefits of making certain decisions; • Continuous simulation is used when the system is characterized as a dynamic whether deterministic or stochastic. This simulation is often used when the system occurs or operated feedback; • Discrete simulation is used to simulate the real system that, at a given level of precision, can represent a series of discrete events. In the simulation of such systems are described changes that each discrete event over time is entered into the state system. Such systems for its dynamic characteristics are almost always stochastic. Model simulation of discrete events implies that events are changing the state of the system and to occur at discrete time points. Each point in time at which the event occurs is called the beat of time (in beats). The measurement time is achieved by choosing an appropriate unit given system and can be whichever seconds, day, year, etc. The duration of simulation refers to the time that flows in the model, but the time it takes to perform a simulation on a computer in principle multiple shorter, so that in a few minutes to several hours of computer time performed in the model.

The simulation time depends mainly on the computer only on the number of events that need to be done. Simulation is considered complete if satisfy some of the conditions: no more events to be executed, the execution time for the next event exceed the maximum total time set for completion of the entire simulation or appeared to be some terminating event. Basic concepts that are encountered in these simulations are: a) the entities are objects or individuals whose activities simulate. Each entity is characterized in that it can be individually identified some of its particular attributes. One of the attributes of entities is timing, which is given as a number that determines the time of the next event. There are two types of entities; permanent - created at the beginning of the simulation and are present until the end, and temporary or transient entities that are created and last only when and as needed; b) Resources in the process simulations have their own special attributes, but they appear as restrictions on the activities of the entities. In the process of structuring a simulation model for each object must be determined whether there will be an entity or resource; c) Class objects must be described as entities in cases when objects must be identified individually or have attributes, and when they are the main objects involved in other, independent activities, and should have the time in the entity; d) The attributes of entities are given as information that can be a full number or a real number, the value of some nominal variables, a relatively complex set of data, or simply a logical value. The set of entities that are characterized by the same attributes make the class, and the attributes that distinguish them from other classes of entities is said to have class attributes; e) event occurs at a particular point in time when something happens with the entity. There are two basic types of events. The first is limited or planned event that is predictable and can be planned.

The second is a conditional event whose occurrence depending on the satisfaction of certain conditions. Time occurrence of events planned enrolled in clock entities. Entity in the simulation can be located in one of the following three states: busy, waiting or idle. The entity is employed if the planned his appearance in a limited event. All entities that are pending satisfaction of certain conditions are in the queue. Idle state is all present in the model entities that are neither employed nor in standby mode. An entity that is in the state of employment of the activity; f) Activities usually start and end with some contingent planned event. The perpetrator is in the mathematical modelling of the mechanism of the flow of time, which has the task of moving the simulation time to the time of the next phase of beats or control and occurrence of events in the correct order; g) check the list of future events. It can be defined either as a list of entities that determine the next event or a list of events that identify the entities that appear in this event, and arranged according to the times of the classes of entities.

To make the simulation could begin in the calendar must be at least one entity. The next phase of the clock or the executor is activated according to the calendar until the simulation is not completed. Those agents are implemented as objects. The modelling is common, not universal, talk to live agents in the environment. However, the environment can also be viewed as an agent. Field playground in front of the goal collective sports game is the only instance of a general definition of the object agent's playground. Schedule of activities of agents determines how the system simulated time and consists of creating a set of actions with specifying their regulation or order. In order to observe what is happening with the model in the simulation it is necessary to provide tools for data collection. These "observers" are also agents and may be paid to certain aspects of the behaviour of agents, groups or models. One can record the spatial characteristics (postures), a second set of activities of agents or groups.

Therefore this tool for tracking and I can be a group or collective agents. In principle, can be determined by different observers and thus observe the behaviour of the different aspects of the same model. An interesting and useful for us an example application of the considered theories, approaches and solutions is RoboCup initiative. This initiative aims to promote wider field of artificial intelligence (AI) and robotics. It consists in the proposal of a common platform that will allow evaluation of different options or performance, algorithms, theory and architecture of the robot. Also would allow, and integrated towards a specific project implementation robot oriented education. This initiative has already been achieved in the very beginning, animation, formed a large number of international projects which included twenty countries and over a thousand researchers.

The primary function of the RoboCup Federation, a non-profit organization, the organization's annual conference and competition in promoting and encouraging contacts and exchanges among researchers. Team participants are mostly representations of university laboratories and corporate research groups. Robotic competition in football matches consist of autonomous agents robots as players. Players in robotic soccer - the robots must, as well as when it comes to people, to recognize objects in real time, to move in a dynamic environment, to track the paths of movement of moving objects, collaborate with your teammates and hit the ball in the right direction.

All these tasks require these robot autonomy, efficiency, cooperation and intelligence / wit. In order to play acceptably well is necessary the use of a wide range of technologies forming part of a complex system that provides sensations, thought, and action. Sophisticated behaviour is accomplished using modelling multi-agent system. This event occurred about two decades and efficient ways uses in various fields, ranging from the modelling of biological systems, in real-world applications, such as egg military applications, the network of social agents, command and control structures, and more recently in the applications out to the party. Systems of agents that include several agents who collaboratively achieve a common goal are considered multi-agent teams - teams. The structures of these teams have a common purpose and who share common plans rely on negotiation and contracting to allow the initiation and implementation of the common plan.

Conclusion

In this paper, a selective review of research by the criterion of correspondence with the content of collective phenomena in the field of sports games has been made. This view contains contributions from the fields: philosophy, sociology, and biology, and mathematics, computer science, especially in the field of artificial intelligence, robotics and linguistics. Deliberate the scope of this paper is omitted field of kinesiology and scientific research and methodological approaches because these issues will be addressed in a separate paper. Sociology has become a topic because the collective is a sociological category. In this context, we gave targeted insight into the basic sociological theories associated with the concepts and methodologies.

Sociology was further interesting for us because it first introduced computational tools to simulate the phenomenon of collectively. Significant achievements in science almost always initiate a philosophical discussion. They are always interesting because they provide insight with a wider horizon which then generates a level of debate and understanding that connects those areas which make a link with sport science, therefore, our primary area of interest.

In the domain of mathematics there were of interest fields of mathematical simulation in which the collective game are described by the system of equations or relationships. Computer science because of its importance and impact on all other areas show the fastest development trends and the biggest investment. From this area particularly interesting to us is the field of artificial intelligence, and within that, with a pronounced interest, robotics. The fact that the players in the collective, and so a collective act intelligently, as we intend to thoroughly explore, motivated us to investigate particularly good scientific achievements in the field of AI. That's why we created a targeted selection of topics that are analyzed: the agent as an abstraction that is used to describe the activities of the holder, the issue of the plan and the planning, design agent that is bound frog and bird perspective in addressing the problem, the field of expert systems, the problem of modelling the real world we have given the insight into the long broaches and more enduring themes related to changes in the real world (box, records, qualifications). Of interest for future research might be to us, and the area of robotics. We gave a brief insight into the historical trends of development and design of robots and robot behaviour as a group or collective. From the time they are connected and some topics in biology that were the direct inspiration for solving the problem robotics. These biological issues are particularly important because they relate to collectives where they studied social insects (ants and bees), animals that live in herds or packs, the behaviour of birds and fish (at strengthening the study of phenomena) and bacteria which corresponded to robotics.

Chomsky's contribution to linguistics in domain of syntax and semantics definitely corresponded to the area you're exploring because the competition in team sports often describe attributes or sentences because sports collective in competition always passes three phases (introduction, plot and epilogue), which is identical to the structure of the literary work. It should be noted that in relation to linguistics rules and division of roles directly associated with Chomsky's syntax and semantics of the developments and understanding of the game in the game.

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NOVI KONCEPTI I PRISTUPI U PRUČAVANJU KOLEKTIVNIH SPORTSKIH IGARA

Sažetak
Kolektivna sportska igra je kompleksan fenomen a odvija se provođenjem plana. Plan se odnosi na agente-igrače kao nositelje aktivnosti i na strukturu okoline. Zbog toga smo se odlučili da na višestran način, korištenjem znanstvenih doprinosa područja kao što su sociologija, lingvistika, biologija, matematika, računalne znanosti, posebno u području umjetne inteligencije, robotike i filozofije rasvijetlimo ovaj fenomen. Sa više aspekata dotakli smo se problema simulacije. Iz područja umjetne inteligencije razmatrali smo različite koncepcije reprezentacije svijeta i mjesto agenta kao nositelja aktivnosti u njemu. Ove teme razmatrane su u svrhu povezivanja sa problematikom modeliranja. Analiziran je razvoj područja umjetne inteligencije sa posebnim fokusiranjem na one momente koji korespondiraju sa problematikom kolektivnih sportskih igara. Mišljenja smo da sustavno i kompetentno modeliranje kolektivnih sportskih igara mora biti značajno obilježeno ovakvom razinom platforme. Rješavanja ove problematike u kontekstu sa svim razmatranim područjima moguće je direktno iskoristiti za rješavanje modeliranja igrača, kolektiva ekipe i utakmice.

Ključne riječi*: agent, kolektiv, robotika, uronjenost i utjelovljenost, multi-agent, swarm, simulacija, umjetna inteligencija, emergencija, plan, sintaksa, semantika, ograničena racionalnost*

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