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Multi-level Simulator for Artificial Societies

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Abstract. The simulator presented in this paper is used for human society modelling in order to understand its specific phenomena and to predict the future evolution of large human collectivities. The present paper presents also some new and original artificial society experiments, highlighting how the artificial societies model allows collective significant behaviors to appear through simple individual rules. The artificial society concept basically consists of a "cellular" landscape that contains different resources and a population of agents grouped in social categories which have economical and political activities. The experiments were related to the real conditions of our country. This simulator create a proper environment in order to identify the causes and mechanism which influence the economical, social and political phenomena evolution from the human society: production of goods, trade, diseases' spreading / the efficiency of the immunizing methods, the impact of information in different welfare and cultural conditions of population, voting mechanisms.

Key words: artificial society, population, agents, resources, artificial intelligence, modelling.

1. Introduction

Artificial societies can be seen as a new model for social processes and/or a new paradigm of computer science. The human society is one of the most complex systems, as it is composed of individuals that are themselves complex and only partially known and understood. Social sciences are therefore very incomplete and uncertain. In the last years many researchers started to use a new approach to social sciences, using simulation models to study different essential aspects of societies. The paradigm of artificial societies harmoniously reunites and develops in a correlated manner the domains of artificial intelligence and artificial life. The research in this field is a fundamental research for the progress of knowing and modelling of a complex class of phenomena, especially phenomena of self-organising for big populations of individuals, specifically aiming the modelling of human societies.

Presented in 1996 by M. Epstein and R. Axtell [1], only in 2002 was noticed the enormous potential of the model of artificial societies as instrument for modelling the phenomena within the human societies and, especially for predicting them on short or long term basis. The model of artificial societies uses simple basic assumptions about the behaviour and evolution of collectivities, starting from simple rules that describe the behaviour of the individuals, their mutual interactions and their interactions with the ,,landscape" in which they live. Maslow stated the five levels of human needs, starting from the the lowest, survival level, and growing up until the highest, spiritual level. This model can be extended for groups of people, assuming that the different levels are related and interacting.

The most important contribution of the authors is the multi-level conception of the artificial societies simulator that included the material, economical and political levels of development. In order to develop a model more complex and elaborate, the phenomena that appear in human societies are grouped hierarchically, somehow similar to Maslow's pyramid of needs. At each level, specific rules and laws may be stated, developed and experienced in order to model real social phenomena and simulate the social dynamics. The proper rules will be used for prediction – the most important goal of each modelling and simulation approach.

2. Modeling and Simulating Human Societies

These aims may seem very difficult for all models currently used for human societies, and probably the way there will be long. However, there are many phase of the research that can be stated as partial aims. One of these is to find proper ways to model the different aspects of the human society, and the variety of human skills that influence the global evolution of the society.

This paper describes how the elementary model may be completed with simple rules, for instance, describing the production of goods and study its effect on the population dynamics. Although the model is simple, it produces a significant new behavior.

There have been many attempts to model human societies, or some of its aspects. The "classical" models are usually of one of the following types: fully numerical and non-linear equations; stochastic and statistical methods; models of the traditional operations research variety; artificial intelligence models and specifications; qualitative simulation models, multiple-agent models.

Some results of these models are [2]: "historical" simulations of not understood events like the collapse of Mayan culture; economic studies like price variations; cognitive and cultural aspects; simulations of urban movement.

Artificial life [3] and artificial intelligence [2] models and specifications have been successfully used to model simple societies and particular economic and cultural aspects. Cellular automata, as modeling tools for complex systems, have been also applied to model social processes (as for instance ant behavior), urban movement [4] and so on.

The simulation of the models is also very important, as it must offer the possibility to run different scenarios in an acceptable time. The simulation is in fact the basis of the model validation.

3. Artificial Societies – The Basic Model

The concept of artificial societies is nowadays considered by scientists as a fundamental computation paradigm, ingeniously combining the parallelism of computing methods and techniques that are specific for artificial intelligence, especially the programming based upon *intelligent agents*. The artificial societies allow the realisation of fascinating experiments regarding the evolution of *societies* of agents under different complex and dynamic conditions for modelling the social environment. Thus, it is estimated that one can model most of the social mechanisms, starting from formation and evolution of social classes and categories up to prediction with high precision of the election results, from creation and dissemination of rumours to identification of efficient measures to stop them, from generation of protest social movements to triggering and controlling the evolution of military conflagrations. Among the results already reported by the scientific literature, the most interesting are: trade modelling, modelling the migration phenomena, the adaptation to environment or the degrading of environment, evolution of prices, etc.

The new model of artificial societies, as introduced by Epstein and Axtell [1], aims to simulate human societies and to study collective (social) phenomena from bottom up. Although this is not the first attempt of this kind, it is certainly the most elaborated and successful. In this approach fundamental social structures and group behaviors emerge from individuals operating in artificial environments. Both agents (individuals) and the landscape (environment) have simple local evolution laws, thus requiring only bounded demands on each agent's information and computational capacity.

The model of artificial societies implies two basic components: a landscape that contains resources and a population of agents.

One of the most attractive features of this model is that it is very expressive, as it offers a natural way to model, for instance, the moving around of the agents and their gathering for resources. Artificial societies combine cellular automata and agent based modeling, the two major trends of artificial life and artificial intelligence. Cellular automata often use homogenous simple agents in simulations of ecological or social systems. The agents of the artificial societies are heterogeneous.

3.1. The Two Components of the Model: Agents and Landscape

The environment is a landscape containing resources that are distributed according to a certain topology. Thus, the environment is modeled as a lattice of sites bearing resources (practically a cellular automata) and it is a medium separate from the agents.

The agents are the people of the artificial society. Each agent has internal states and behavioral rules that can change through interaction with other agents or with the environment. Each agent need resources to survive, resources that it has to search in the landscape, eat them and consume them with a metabolic rate. In more elaborate versions of the model, such as the simulator described in this paper, each agent can also accumulate different quantities of resources and can exchange some of them with other agents. The characteristics of an agent can change in time or remain fixed. Each site has a maximum and an actual resource level (measured in “units”), together with a simple growing-back rule for this resource after one agent have consumed it. The growing-back rule can imply, for instance, that the resources regenerate with one unit per time step or that they regenerate completely in the next time step.

An example of landscape is that in Figure 1, where different levels of gray indicate different level of resource (white is for void sites, black for the richest).

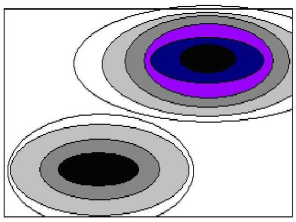


Fig. 1. Example of resources distribution in the landscape.

Each agent is characterized by a set of fixed and variable states. For a particular agent, there are some “genetic” characteristics that remain unchanged during its whole life, and there are others - wealth, for instance, and position in the landscape - that can change. At a certain moment, the agent is located in one site of the landscape. As it needs to consume grain for example, his simplest behavior can be described as searching, eating and metabolizing grain. It also can accumulate “wealth” of grain, water or other type of resources, but anyway it is continuously walking around and looking for resources.

In this simple description, there are few important characteristics of the agent:

- a level of vision (how far it can “see” around in the landscape);
- a metabolic rate (the amount of grain and/or water that it consumes in each time step).

Figure 2 illustrates the vision of an agent. Note that it can “see” around only in the four principal directions, at a maximum distance equal to its vision.

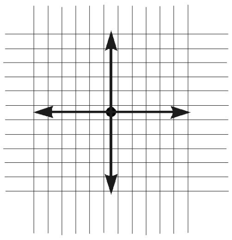


Fig. 2. The agent's vision: the agent sees only in the four principal directions.

3.2. Population Dynamics in a Simple Scenario

A typical simple experiment implies to study the movement of the agents and the global population dynamics, in the case where there are no extra-features, but only the simple "move and eat" laws.

The basic agent movement and metabolism rule is the following [1]:

- look around as far as vision permits in the four principal lattice directions and identify the unoccupied site(s) having the most grain, water or other resources;
- select the nearest site with the greatest resources value;
- move to this site;
- collect all the grain or other types of resources at this new position;
- compute the new value of the agent's wealth, adding the collected resources and subtracting the resources used for himself;
- if the wealth is less than zero, the agent dies of starvation.

The agent can also die of "old age", case in which he is replaced by a new-born agent that has the maximum life duration, vision and metabolic rate set randomly.

The experiment starts with a number of agents randomly distributed in the landscape. The evolution of the system can be divided in two distinct periods:

- the agents progressively move towards the regions in which the resources level is highest, period that is characterized by a relatively high death rate (the death being caused by starvation);
- the agents, grouped in the richest zones, continue to move around and to accumulate different types of resources; the population is now approximately constant (a very important experimental result is that this final value is correlated with the wealth distribution).

3.3. Examples of Social and Economical Phenomena Modeled with Artificial Societies

Epstein and Axtell applied agent-based computer modeling techniques to the study of the human social and economic phenomena such as trade, migration, regional and cultural group formation, combat, interaction with an environment, transmission of culture, propagation of disease, and population dynamics. In this Culture, for instance, is modeled in the landscape by means of a "culture vector" that can be modified through local interactions between neighbors, an elementary modeling of the human cultural influences by interactions between people. Although the influences are random, cultural groups emerge, in which all the members have similar cultural attributes.

Epstein and Axtell [1] consider that sexual reproduction, culture and conflict rules are enough to develop a "proto-history" on the landscape.

Agents find, consume and accumulate all types of resources and can make exchanges with their neighbors to compensate their needs. Our model for trade is slightly different.

The conclusion of the studies and simulations of the artificial societies is that important social (collective) phenomena can emerge from spatio-temporal interaction of autonomous agents operating on landscapes under simple local rules.

3.4. Some Comments

According with the Maslow's Hierarchy of Need there are five levels on which we can deal with the social behaviors in order to simulate them. The first level is the level of a primitive society characterized by *consuming* and *migration* towards new resources to be consumed. The second level supposes the *production* and the *trade* with the produced things. The third level adds to the previous the *political behavior* and the *ideologies.* The fourth level keeps into account the *cultural* dimension of man. The fifth level is the level on which the *sacred* dimension must be investigated, if possible. By turn, the actor (the man) is seen as *reaper*, as *producer,* as *politician*, as *intellectual* or as *believer*.

These levels do not correspond strictly to the historical evolution of the human societies. The previous emphasized five levels are mainly useful for building models easy to be simulated. We hope that following these five steps the resulting models:

- will explain known things about the human society;
- will disclose unknown facts about the social behavior;
- and more, will be able to predict behaviors under imagined conditions.

The initial artificial society model is used only for describing the primitive behaviors of a society mainly consisting in consuming and migration. The society simulated by this model is like a monkey society, corresponding to the first previously emphasized level.

The transition from different (primitive or not-primitive) *cultures* towards the *unique civilization* is done only in the context of the production and of the trade. We believe that the production and trade must be modeled before the political, cultural or religious behaviors. This sequence is proposed only for technical reason. The actual historical process is more complicated and does not matter essentially in establishing the steps of our approach.

The preeminence of production & trade before other human behavior allows us only to build easier a gradual model for the complex behaviors of the human society. In fact, from the initial stages of the human development man was, with different weight, reaper, producer, politician, intellectual or believer. Our simplified approach takes into account only a gradual evolution of men, introducing step by step the previous emphasized human features.

Our care in developing this model is to be sure that the model does not introduce "side effects". The manner in which we "joint" different concepts and mechanisms can generate strange or doubtful behaviors.

4. Developments of the Basic Artificial Societies Model. Various Experiments

In order to carry on more complex and relevant experiments with artificial societies, the authors have developed a multi-level simulator, described in section 5. This simulator includes all basic features of the model presented in Epstein and Axell's work, but goes much further, introducing new capacities and behaviours for agents, specific features for the landscape, adapted to our country's real conditions, and a hierarchical conception of different types of social phenomena. The software was designed with a multi-granularity option for simulation phenomena from micro-level, medium-level and macro-level. At the micro-level the simulations experiments use the landscape and the agents as separate: the landscape contain natural resources (grain, water, coal and oil) and the agents are separate people men or women, child, mature or old, etc. The agents can find resources, accumulate them, consume part of them and exchange part of them with other agents. At the medium level the actors are the groups of agents and the landscape contain the same natural resources plus a new "resource" the agents. At this level the groups of agents have the same activities as the previous level (find, accumulate, consume and exchange resources) but in addition they can produce new types of products which doesn't exist in the landscape. They sell the new products with a higher price compare with the production price and in this way appear the profit and at this level is introduced the money as a parameter. The value of this parameter can be modified only from the next level, the macro-level. At the next level (macro-level) the actors are parties, institutions, banks, etc and the landscape contain some more resource the groups of agents and the money. The simulator includes hierarchical interactions between all three levels: the macro level generate the local rules of interactions between groups for the medium level, and the medium level generate the local rules of interactions between agents for the micro level. The micro level can influence the medium level when more than half of the agents acting together in one united group, etc.

4.1. The Real Landscape

The landscape introduce in the simulator was adapted to the map of our country (Romania), including real population distribution. The actual model implemented in the simulator include four types of natural resources grain, oil, coal and water each distributed in the environment according with the Romanian geographical map. The type of the landscape used in each experiment depends on the type of the phenomena which are analyzed: for economical phenomena modeling was used the geographical map, for political phenomena modeling was used the political map etc. In Fig. 3 is presented the simplified natural resources map that was used as landscape for modeling some economical phenomena.

Fig. 3. The distribution of the resources in the landscape.

4.2. The agents

The agents are separate entities men or women, with one of specific age: child, mature or old, with a specific power to work (bad, good or excellent) generated by the health status (bad, good or excellent) and the wealth (poor, medium or rich). The simulator was designed with a modular architecture in order to allow to develop the rules applied to agents or to include new features and new types of social behaviours. For instance, the simulator takes into account an exchange rate for resources exchanges with other agents. The values of the characteristics of the agents are distributed randomly: the “strongest” agents have high vision level and low metabolic rate, while the ones that have low vision level and high metabolic rate have practically few chances to survive. The exchange rate is the same for all the agents, and depends of the type of resources: it is high for oil and coal and low for water and grain adapted with the economical situation from our country Romania.

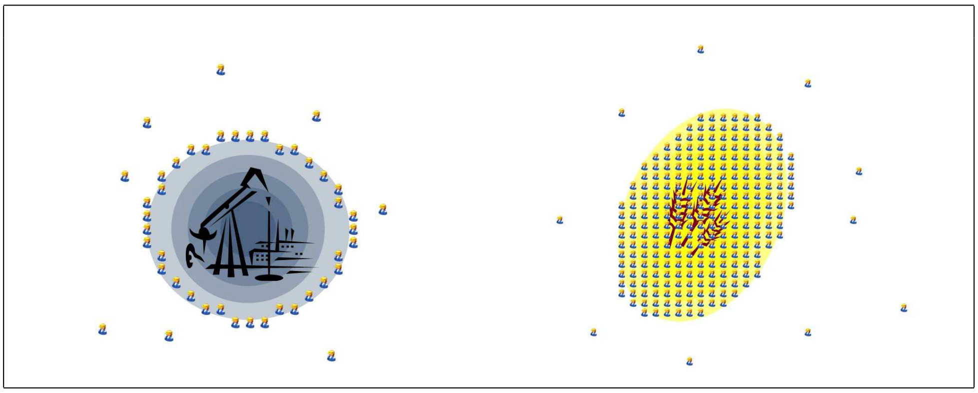


Fig. 4. The agents working to collect natural resources.

4.3. The Model for Production and Trade in the Artificial Society Context

This section describes a new experiment on the artificial societies' economical landscape. The aim of this experiment is to illustrate how a simple new feature can affect the collective behavior (see also [5]). The *wealth* of one agent, defined as the quantity of accumulated grain, oil, coal or water, plays the central role in the model for production and trade. The wealth is evaluated in money only in the medium and macro level.

4.4. The Mechanisms for Production and Trade

Somehow resembling to what happens in a proto-society, the richest groups of agents start to *produce* new products which not exist in the landscape: drugs in order to increase the health of the agents and the period of their life. The richest groups of agents can transform a part of their accumulated natural resources in drugs. The production cost is the amount of natural resources consumed for each unity of vitamin produced. Producers can sell this product to the other non-producers agents or groups of agents at a cost considerably greater than the production cost: this is *trade*. It is done on the basis of a request mechanism: if the agent can afford to buy "drugs" (his wealth is greater than a fixed value named "poverty threshold"), it looks around to see if there is somebody selling drugs. If there is, it buys as much as it can afford (or the other offers) and consumes all the drugs immediately. Drugs effect is the following: they improve the agents' health skills for a certain period of time. The drugs are useful if that area some of the agents are infected with some infectious diseases. Practically, the infected agents can't move and after a specific number of steps they will die. The mechanisms for production and trade are included in the simple agents' acting algorithm, after the final calculation of the wealth value.

4.5. Conditions of the Experiment

The experiment takes place in a landscape of 5000×5000 sites with the resource distribution in Fig. 4. The resources of the sites regenerate with one unit each time step.

The particular values are the following:

- an initial population of 400.000 agents;
- there is an initial wealth distribution in the range (10,20);
- the metabolic rate is in the interval (1,4), initially randomly distributed;
- the wealth necessary to become a producer is 60 resource units;
- one drugs is produced at cost 1 and sold at cost 5;
- the "poverty threshold" is 20 units.

For one time step, the agents act in a random order. Initial positions of agents, their wealth and all genetic treats are randomly distributed within the appropriate intervals.

The aim of the experiment is to measure the evolution of number of agents and wealth distribution in time, in order to compare the results with the same measurements, on the same population and under the same initial conditions, without vitamin production.

Note: the conditions of the experiment keep as close as possible to Epstein and Axtell's simplest sugarscape, in order to have a reference. Simulations were made with a C++ program; producers belong to a subclass of the general agent class.

The complete sequence for one time step is the following: all the agents act in a random order (changed at each iteration) and then the resources of the sugarscape are updated according to the growing-back rule.

4.6. Experimental Results For Production and Trade

The experiment intends to study the differences between the evolution of a simple artificial society, and an artificial society that includes the model of an infectious disease. The graphics presented here illustrate a typical case from the many different experiments we made.

To have a concrete measurement of our results, we compare the following:

- population dynamics in a case of an infectious disease without drugs;
- population dynamics in a case of an infectious disease with drugs introduced early;
- population dynamics in a case of an infectious disease with drugs introduced later.

4.7. Population Dynamics in the case of an infectious disease

In the experiment of an infectious disease the global population dynamics imply the continuous decreasing of the number of agents. When the infectious disease appears many agents die, but if the proper drugs are introduced the situation become better. Assuming the existence and production of an eficient drug for the specific disease (that is not quite the case in real life), these drugs will help stop the disease, with a big benefit for their producers.

Figure 5 compares the population dynamics for three running of the program:

a) in the case of one infectious disease without drugs;

b) in the case of one infectious disease and drugs are introduced early;

c) in the case of one infectious disease and drugs are introduced later.

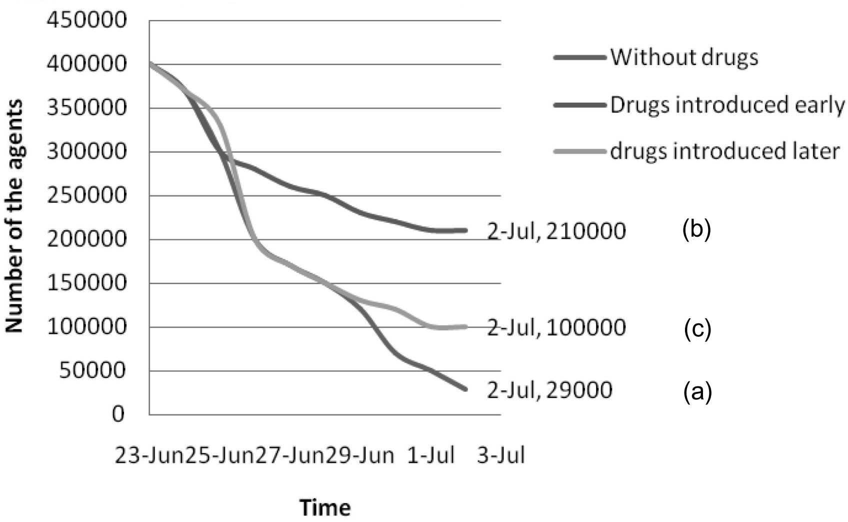


Fig. 5. Population dynamics: the evolution of the number of agents in time: a) without drugs, b) with drugs introduced early and c) with drugs introduced later.

4.8. Explanation: Population Dynamics and wealth distribution for productions of drugs

In the experiment presented the production and trade of the drugs imply that a small number of agents become rich and these agents will be not affected by the infectious diseases, and in the same time most of the agents must work all their life to buy drugs in order to be alive and remain poor.

The effects of the drugs production and trade on the population dynamics can be resumed as follows:

- the drugs modify the dynamics of the agents in the landscape and also the population dynamics;
- the effects of the drugs on the population dynamics trigger the emergences of the social classes.

Figure 6 gives the typical wealth histogram in the two cases, after 500 time steps. The second graphic has a "gap" between poor and rich agents that is typical for the experiments with production and trade.

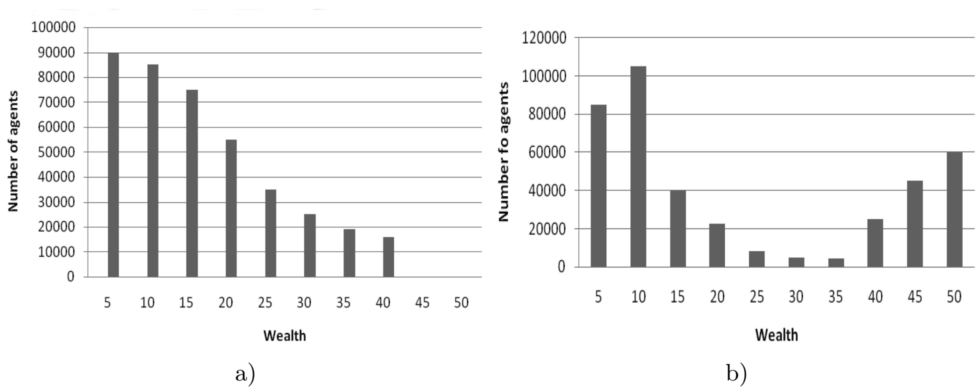


Fig. 6. Typical wealth histograms for simple landscape (a) and production experiment (b). Note the clear "class" formation.

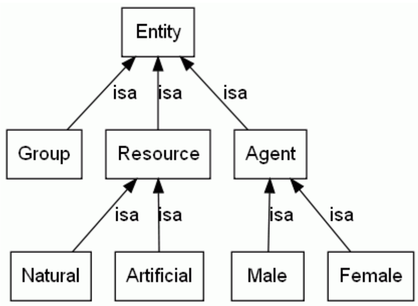
The effect of the production and trade mechanisms can be resumed as follows:

- producers become richer and richer as time goes by;
- the agents in the medium wealth category are maintained at the "poverty threshold";
- for the poor, nothing changes.

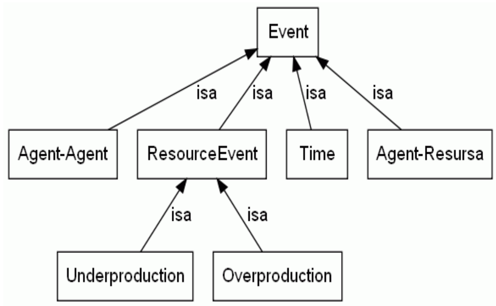
The crucial new phenomenon that appears is social class formation (after the agents' wealth). Producer's number remains unchanged, as the medium class agents cannot reach the required wealth to become producers.

5. The Simulator Architecture

The entities necessary to the simulator determined during the analysis stage are: members (also called agents), resources and groups. The agent is the atomic element that consumes the resources having the purpose of living and moving in the simulated environment. The agents can be grouped with the purpose of better fulfilling their needs and faster evolving. The evolution of entities' attributes is ensured by genetic algorithms and is adjusted with fuzzy rules specific to the actions being performed. The action is a reaction to an event. Events are triggered when certain local or global states/stages are reached for the simulated system. An event is triggered by the encounter of two agents and when an agent discovers an accessible resource. Resources represent the elements required by the agents to live and to maintain the current living standards. Resources can be natural (when found in the explored environment) or artificial (when produced by agents). Natural resources have certain regeneration depending on their type and artificial resources have a certain production speed. Production deficit and excess determine the necessity of product exchange between agent groups or the listing at the stock exchange. Direct trade between agents is based on direct negotiation and the stock exchange is based on an auction. Large quantities are always traded through the stock exchange.



a)



b)

Fig. 7. a) The application active elements (Entity) are partitioned among many categories: Resource, Group and Agent. Resource can be Natural or Artificial, and Agent can be Male or Female b) The events that appear inside application are triggered by the meeting between two agents or by an agent and a resource, after a preestablished period of time or after acquiring a preestablished value by a resource (minimal for UnderProduction or maximal for OverProduction).

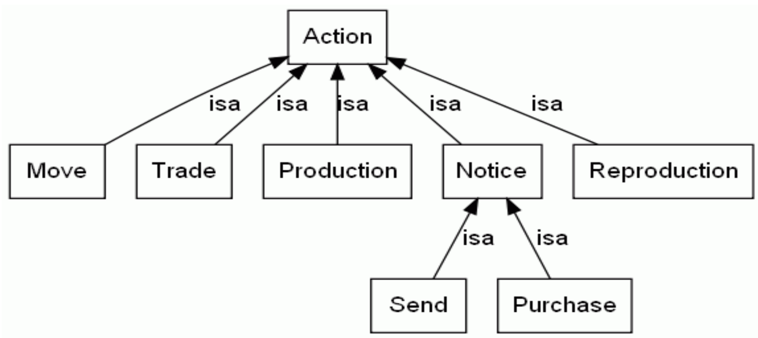


Fig. 8. The actions are divided among few categories (movement, exchanges, production, biological reproduction, sales notifications – Sale or acquiring notifications – Purchase) and shows the methods used when an event occurs.

5.1. Agents and groups

As man is a social being, an agent can only exist in a group. Individual agents are represented through groups with a single agent. An agent can be part of multiple groups and a group can contain multiple agents simultaneously. Managing the multitude of agents and groups implies frequent updates on the relations between agents and groups. In order to reduce the processing time rare matrix were used where the membership groups are stored in double linked lists on both horizontal and vertical. These have the advantage that the update takes a processing time of: O(1). The search operation is not necessary as it was incorporated in the evolution process of the simulators' entities.

The agent's attributes are: its level, the genetic inheritance, the skill and the group participation quota. The genetic inheritance influences the adaptation degree of the agent to different tasks that are performed. The skill is the current capability to adapt to the task performed. The group participation quota is an abstract value (equivalent to money) and represents the individual's intake to the group as a result of the actions performed. An agent does not hold resources. The agent's level is determined by the accessed resource types and also determines the resources needed in order to maintain this level. The agent's sex is an arbitrary value established at the creation time. Each agent can exist a certain number of cycles, with maximum and minimum values, depending on the genetic inheritance and its skill.

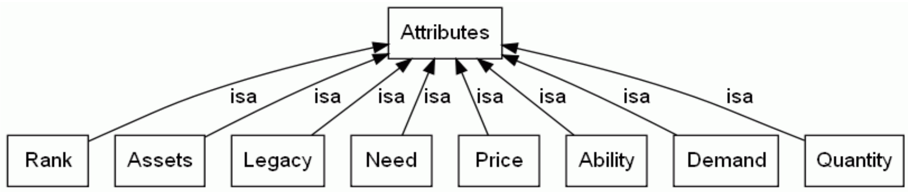


Fig. 9. An entity from inside application is characterized with the attributes above. Each entity uses just a part from all of them, for each function in part.

The group's attributes are formed by resources that it can make available to its members, proportional to their quota. Each contribution from an agent updates its respective quota and reduces the other agents' quota. The resource combination in a group determines the level of that group. The evolution of the group's individual members towards the group level is based on their participation. The relationship between the number of agents in a group, the group's resources and the group's level (and its members) determines the wealth degree: poor, average, rich. Only the rich members (as in the agent level) can go to a superior level. The cost of a superior level of the agents is given by the quantity of resources necessary in each cycle. The wealth level is determined by the number of cycles in which an agent can exist based on its participation to different groups.

The agent's affiliation is determined by the group's needs and the agent's abilities. The need is given by the deficit of a certain resource and determines its wish to include a member with a high ability in collecting the resources that are in deficit.

Each resource of a group can be catalogued as: insufficient, poor, normal, sufficient, excess.

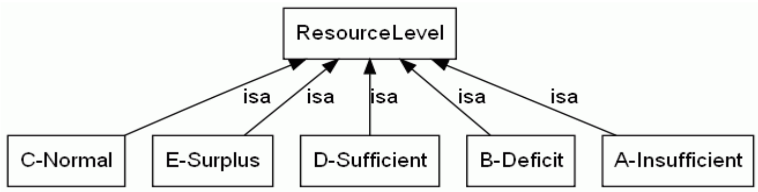


Fig. 10. The level of resources is classified in one of disjunctives categories: Insufficient < Deficit < Normal < Sufficient < Surplus.

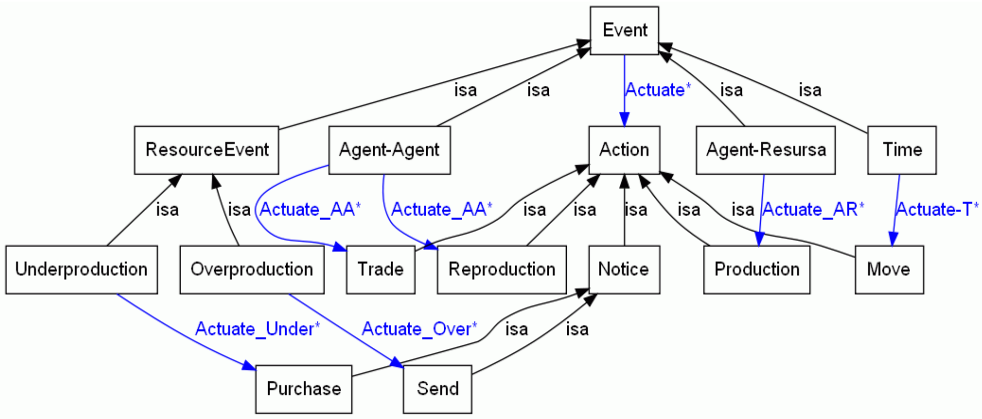


Fig. 11. In the graph above are found the combined taxonomics for the events and actions and the relationship between them: <Event, Actuate, Action>.

5.2. Resources and Landscapes

Between resources exists a dependency relationship. A resource can be collected or produces if there are available other resources and, sometimes, by consuming other resources. The tree dependency between resources is the key to the whole application. By constructing the structure tree is modeled the real world – that will be simulated.

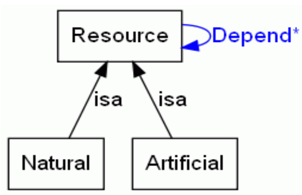


Fig. 12. One resource can depend by the existence of other resources. The relationship is one of type <Resource, Depend, Resource>.

5.3. The graphic interface of the multilevel simulator

The graphic interface of the simulator contain: central area for the landscape evolution, separate areas for graphical results of simulations from each level: micro-level (left-down-corner), medium-level(left-middle-part), macro-level(upper part) and a separate area for the evolution of the resources (right part).

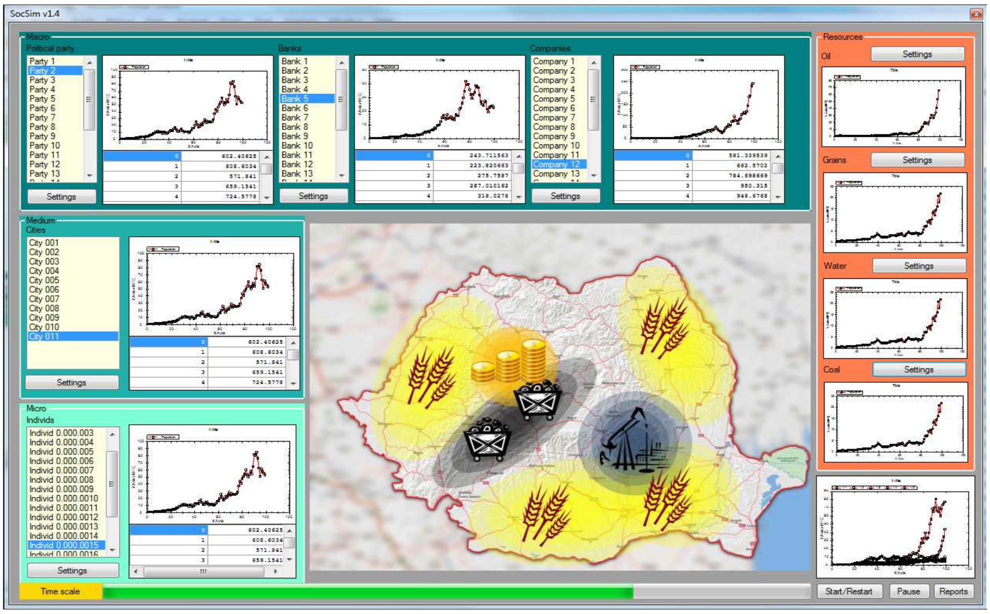


Fig. 13. The graphic interface of the simulator with natural resources landscape.

6. Experiments. Political and Economical Dynamics in the Artificial Romanian Society

We have realized macro experiments with many different values for economical and political phenomena from the Romanian society. The necessary work for this experiments includes first to collect the real data regarding the population, resources, groups, institutions, companies and political parties distribution and past evolution and second to identify the inner mechanisms of the most important economical, social and political events and phenomena. After these the authors designed the local rules and algorithms libraries for each level in order to obtain the same evolution of the phenomena in the artificial societies with the real society. We obtain in this stage of our research work the following results wich include also the evolution from the last few years and a possible future evolution of the phenomena from Romanian society:

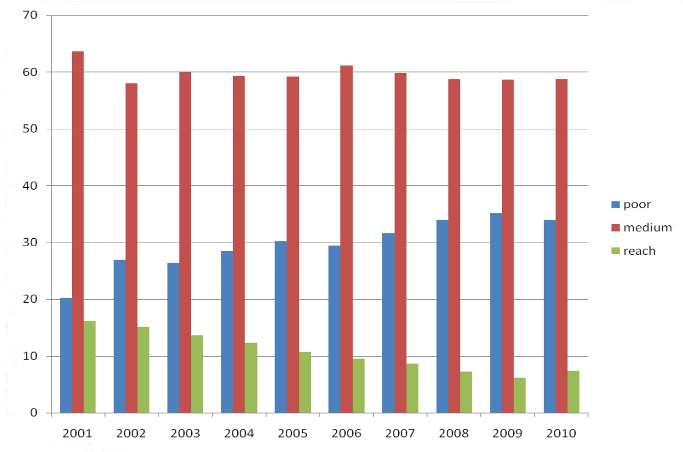


Fig. 14. The social categories modelling (using the wealth criteria) in Romanian society.

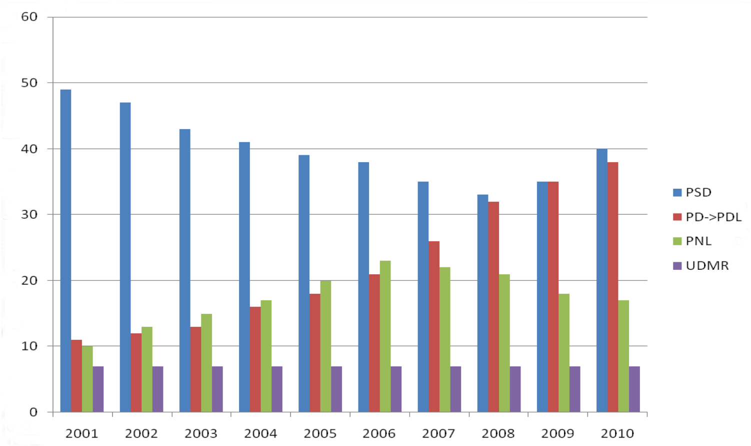


Fig. 15. The Romanian parties evolution and prediction.

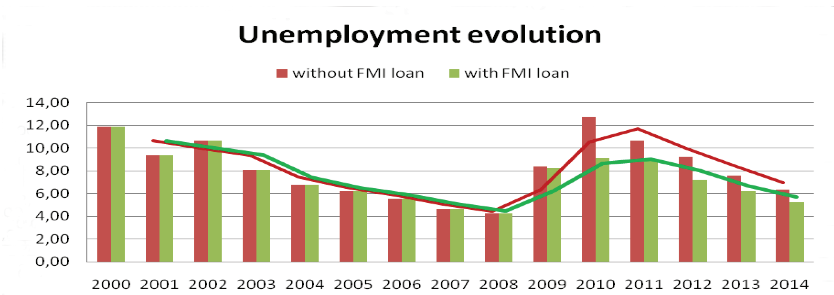


Fig. 16. The unemployment evolution simulation and prediction in Romanian economy.

6.1. Interpretation and Comments

The economical aspects above can be interpreted in the context of a human society, for instance this way: there are some products which make people's life longer and easier and these products have a good effect on the global dynamics of population. Unfortunately, people consume these "good and necessary" products even if they do not really need them. As a result, producers become richer and richer while people with medium wealth spend their resources on futile things. The poor are just poor all the time.

The political aspects can be interpreted in the actual crisis context that the majority of poor and medium wealth people will start to appreciate more the left wing parties because the continuous decreasing in the real landscape of the financial resource: money.

7. Conclusion

The approach of artificial societies models is characterized mainly by the gradually building of the model, starting from a simple basic structure and adding progressively new features, aspects and mechanisms. Therefore, an important direction of research is to find ways to model the different aspects of human societies. The simulator developed by the authors aims to cover the first three levels of social phenomena, including the bottom, survival level, the economical and even the political level. The original hierarchical structuring of groups of agents leads to a powerful tool than can be applied to predict very interesting aspects of real time Romanian society, with the condition that most appropriate and significant features are quantified and took into account.

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