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Agent Reproduction In Artificial Society and Reproductive Schemes

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Abstract: creating agents that are capable of emulating the same kind of socio-cultural dynamics found in human interaction remains one of the hardest challenges of artificial intelligence. this problem becomes important when we consider embodied agents that are meant to interact with humans in a believable and empathic manner. our application context is an artificial society, i.e., the whole work will be a simulation of a social system which is not possible experimentally in a real world. In this paper we also study various reproductive schemes in an evolving population of agents. we classify reproduction schemes in temporal and spatial terms, that is , by distinguishing when and where agents reproduce.

Keywords: agent reproduction, artificial society, agents, virtual environment.

I. INTRODUCTION

Reproduction (or procreation)[4] is the biological process by which new "offspring" individual organisms are produced from their "parents". reproduction is a fundamental feature of all known living organisms: each individual organism exist as the result of reproduction. the known methods of reproduction are broadly grouped into two main types: sexual and asexual. In **Asexual reproduction,** an individual can reproduce without involvement with another individual of that species. The division of a bacterial cell into two daughter cells is an example of asexual reproduction. Asexual reproduction is not, however, limited to single-celled organisms. most plants have the ability to reproduced asexually and ant species Mycocepururs smithy is thought to reproduce entirely by asexual means. **Sexual reproduction** typically requires the involvement of two individuals or genes, one each from opposite type of sex[4].

In this paper we aim to identify and take the first step to create a conceptual model for social behaviour in virtual agents . there are no theoretical bounds to the level of social complexity that we want to represent in our model. however, the model should be as simple as possible, but still rich enough to allow for short emergent interactions between agents with different cultural configurations. Through these simple interactions, people will be able to see the effect of culture on behaviour[10]. The research theme of this paper is decribed by the term: Emergent collective intelligence(ECI).the end goal of ECI research is to combine and exceed achievements in multi-agent systems [1], swarm intelligent [5], and evolutionary computation [12] research via developing synthetic methodologies such that groups of computationally complex agents produced desired emergent collective behaviours resulting from the bottom-up development of certain individual properties and social interactions. This paper investigate certain technical aspects of artificial evolution as means of achievement adaptability at the local level and desired emergent behaviour at the global level. Our experiments are conducted in a straightforward artificial society[2]. This society consists of a collective of a agents that lives off harvesting sugar resources in the environment. In some situations, agents may be forced to harvest sugar together with other agents. Each agents is able to communicate information about the amount of sugar at its location and many also receive such information from other agents.

II. ARTIFICIAL SOCIETY

Our research can be positioned in a broader context, that of artificial societies. We let artificial societies be agent based models of social processes [7]. This definition brings it with some notion of agents (the "people" of the artificial society), simulation (models are computationally executed to explore social phenomena) and social structures (the behavior of a group of interacting individuals) according to Epstein and Axtell[7] [2] . An artificial society consists of three basic ingredients:

I) Agents:

Agents are the "people" of artificial societies who acts on behalf of a user. Each agent has internal states and behavioral rules. Some states are fixed for the agent's life, while others change through interaction with other agents or with the external environment. An agent's sex, metabolic rate, and vision are fixed for life.

However, individual economic preferences, wealth, cultural identity, and health can all change as agents move around and interact.

These movements, interactions, changes of state all depend on rules of behavior for the agents and the space[2].

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Figure-1 shows the control loop[2] of agent that how agents can move, harvest, talk to other agents and reproduce.

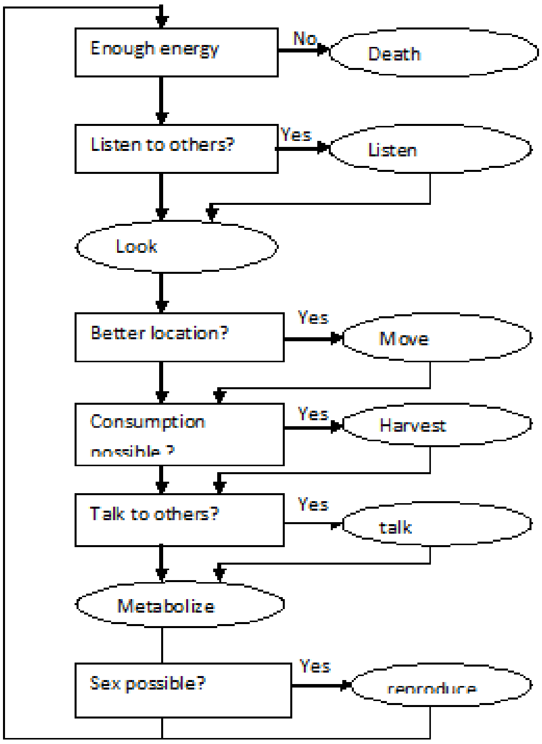

Fig 1. Agents control loop

II) Environment:
Life in an artificial society unfolds in an environment of some sort. However, the environment, the medium over which agents interact, can be a more abstract structure, such as a communication network whose very connection geometry may change over time. The point is that the "environment" is a medium separate from the agents, on which the agents operate and with which they interact.

III) Rules:
Finally, there are rules of behaviour for the agents and for sites of the environment. A simple movement rule for agents might be: Look around as far as you can, find the site richest in food, go there and eat the food. Such a rule couples the agents to their environment. One could think of this as an agent-environment rule. In turn, every site of the landscape could be coupled to its neighbours by cellular automata rules. For example, the rate of resource growth at a site could be a function of the resource levels at neighbouring sites. This would be an environment-environment rule. Finally, there are rules governing agent-agent interactions- mating rules, combat rules, or trade rules, for example[7].

Some local rules for environment:
Sugarscape:
Our experiment takes place in a specific artificial world. This world is based on standard SUGARSCAPE (Epstein and Axtell 1996) model [3].

In our model, autonomous agents inhabit this sugarscape and constantly collect and consume sugar. We therefore need to postulate a rule for how the sugar regenerates- how it grows back after it is harvested by the agents. Various rules are possible.2 For instance, sugar could grow back instantly to its capacity. Or it could grow back at a rate of one unit per time step.

Or it could grow back at different rates in different regions of the sugarscape. Or the growback rate might be made to depend on the sugar level of neighbouring sites. We will examine several of these possibilities . To begin, however, we stipulate that at each lattice point the sugarscape obeys the following simple rule:

Sugarscape grow back rule G: At each lattice position, sugar grows back at a rate of α units per time interval up to the capacity at that position. The rule can be stated formally. Call the current resource (sugar) level r and the capacity c . Then the new resource level r '+1, is given by $r'+1= \min(r'+\alpha,c)$.

Agent movement rule M :
- Look out as far as vision permits in the four principal lattice directions and identify the unoccupied site(s) having the most sugar;
- If the greatest sugar value appears on multiple sites then select the nearest one;
- Move to this site;
- Collect all the sugar at this new position.

III. AGENT REPRODUCTION

A reproduction based agents does not moves by itself but it reproduces child agents in adjacent locations. When one parent agent reproduces multiple child agents, it is propagates and a algorithm is equal to a branching algorithm. An agent creates child agent only ones in first time frame. Most of agents in multi-agent system are based on reproduction based agents[8]. Reproduction takes place by crossover applied to two parents yielding the child, followed by a mutation operation on the child. The talk and listen genes express probabilities and are formally real valued numbers between 0 and 1. The value of a gene in child is determined by recombination.

The preferences for listening and talking are both inherited from the wealthiest parent (the one with most sugar). Finally, the child receives from each of the parents half of their sugar (here sugar is described as wealth of agents). The child inherits each of the values for vision, age of death, metabolism, and child bearing independently from one of the parents without change as by uniform crossover. After mating, each agent has a so-called recovery period, which is the number of cycles after mating that an agent cannot mate[3].

To illustrate the process of reproduction, consider the following example. Two agents are next to each other-one with 24 sugar units, a listen preference of 0.7 and talk preference 0.55; the other has 16 sugar units, a listen preference of 0.6 and a talk preference of 0.5. A child of these two agents gets its listen and talk preference from the first agent (0.7 and 0.55 respectively). Its initial sugar amount is the sum of half of the sugar amounts of each of the parents, thus 12 from first parent and 8 from second parent-its initial sugar amount is thus 20[3].

IV. PREREQUISITES FOR AGENT REPRODUCTION

Reproduction is not subject to individual decisions, nor is there any mate selection. If all conditions are satisfy for two agents, they will always mate and generate offspring. These conditions [2] are that:

1) Two agents are on the same location (vertically or horizontally not diagonally).
2) It is required that genders must be different.
3) The sugar level of both the genders are above the reproduction threshold.
4) Both agents are in the fertile age range.
5) There must be vacant cell present in the vicinity for placing the offspring.

V. REPRODUCTIVE SCHEMES

In this section we study various reproduction schemes in an evolving population of agents. Reproduction schemes distinguish that when and where agents reproduce[6][11]. We classified reproduction schemes mainly in two terms:

i. Temporal
ii. Spatial

In terms of **temporal reproduction**, agents reproduce only at the end of their lifetime (which is also known as "SREL" serial reproduction at the end of life time) or multiple times during their life time (which is also known as "MRDL" multiple reproduction during the agent's life time). In terms of **spatial reproduction,** we distinguished locally restricted reproduction (agents reproduce only with agents in adjacent positions) and panmictic reproduction (when an agent can reproduce with any other agent in the environment). The precondition for locally restricted reproduction is that there must at least one potential partner agent in the same grid- cell or an adjacent grid-cell.

VI. CONCLUSION

in this paper, a survey on agent reproduction in an artificial society and reproductive schemes. We analysed that how actually agents meet and produced new offspring in an artificial society. The feature of artificial agent societies makes our work very useful to perform social simulation and to experiment with artificial social evolution which is impossible in real world.

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