Coevolutionary strategies in MultiAgent systems. An approach using socionatural realistic environments.

Master Thesis

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Abstract

The aim of this master thesis is the development of a multiagent model for a simulation of two populations whose interactions are strongly influenced by a realistic landscape. This research will be in line with Consolider-Simulpast (www.simulpast.es), an interdisciplinary project aimed to create simulations designed to be used in archaeological studies of human-environment interaction, decision-making processes and coevolutionary/competition behaviours of past societies. The work plan will be focused on the development of first-stage models for two societies in the age of agriculture spreading surpasing the hunting and foraging way of living. The simulation will involve a climate engine for seasonality depending primarily on variable rainfall rate. Landscape information will be created from satellite image rasters. Constants, and variable relationship shall be modelled from measures and interviews with the experts. Data analysis tasks will be undertaken to validate the models and detect patterns in the archaeological record. Furthermore a comparison will be stablished between the classical simple models used in social simulation[1][2][8] and more advanced approaches.

Contents

Chapter 1

Introduction

1.1 Description

Problem, Gujarat, Archeology

1.2 Motivation

interaction society vs envirm

niche construction theory

1.3 Simulation

1.4 Question

Do AI techniques contribute to better simulation results?

Classic Simple Agent approach vs Rich Agents

Did Gujarat extreme enviromental conditions delayed the HG disappearence?

Chapter 2

Methodology

2.1 Intro

Dynamic systems tied to time. Non reducible to a formula, so the system must be replicated in a abstract calculus framework. methodology with integration of system state, time component and repeatable experimentation for behaviour induction : simulation

simulation : virtual experimentation in computers for a posteriori analisys of the dynamics.

the system is reproduced in a model. The framework of the simulation reproduces the conditions for the experiments and iterates the changes of the system over time.

The use of agent-based modelling and simulation techniques in the social sciences has flourished in the recent decades. The main reason is that the object of study in these disciplines, human society present or past, is difficult to analyze through classical analytical techniques. Population dynamics and structures are inhrently complex. Thus, other methodological techniques need to be found to more adequately study this field. In this context, agent-based modelling is encouraging the introduction of computer simulations to examine behavioural patterns in complex systems. Simulation provides a tool to artificially examine socities, where a big number of actors with decision capacity coexist and interact.

2.2 Conceptual Framework

2.2.1 Evolution

Configurations c1,...,cn. Strategies σ_1,...,σ_n. Along time we study adaptation of different strategies.

2.2.2 Coevolution

Retro feedback of the different actors inside the evolution phenomena. Everybody conditions the othe with its outcomes and success/fail in the evolution of its adaptation

drive.

Evolutionary Genetic Programming?

2.3 ABMs

2.3.1 Intro

2.3.2 ABM justification

2.3.3 Platforms / Software packages

NetLogo...

Pandora/Cassandra

2.4 Intelligent agents

2.4.1 Planners, ...

Chapter 3

SugarScape vs Advanced Sugarscape

3.1 What is SugarScape?

3.2 Added advanced features

Same deduced trends and emerging dynamics

Realistic Adaptability to Parameter Perturbations

3.3 Solving critics against classic SugarScape

3.4 Experiments

3.4.1 Initial Conditions

Montecarlo?

Emergence of stationary state; initial state := stationary state

3.4.2 Experiment features

Description

Hypothesis

Assumptions

Config

Results

Validation

Chapter 4

Gujarat Case Modelization

4.1 Introduction

Northern Gujarat is a marginal environment between the Thar Desert and the more fertile area of Saurashtra. This region is an ecotone, characterized by the seasonal influence of the monsoon where contrasting ecological niches are in tension and small climatic shifts can generate significant environmental changes, eventually affecting resource availability. Archaeological evidence points to the presence and possible coexistence in the area of groups of people with different resource management strategies and mobility behaviors: hunter-gatherers (HG); agropastoralists (AP); urban Harappans (UH). The aim of this study is to model resource management and decision making among hunter-gatherer groups in this region to explore adaptive trajectories and performance in relation to a) environmental variability and b) the appearance of other specialized groups . What factors play a role in HG persistence or disappearance in arid margins? Is the advent of agro-pastoral behaviour a big enough change to explain the disappearance of HG behaviour? What happens when there is an external influence, such as that by UH? Does climate change affect HG behaviour?

4.1.1 Hypotheses

In our starting hypothesis HG groups are adapted to marked seasonality (due to monsoon) in the arid margins of northern Gujarat. We intend to explore HG resilience considering: a) the appearance of AP, b) the appearance of an external attractor (UH) and c) climate change. We define resilience as the ability of the system to maintain its identity in the face of internal change and external perturbation (Carpenter 2001).

4.1.2 Aims and objectives

4.1.3 Knowledge Elicitation & Brainstorming

Interviews

ECOTONO (journal club)

ODD

4.2 Physical World / Environment

4.2.1 Statistical Modelling

Data Sources

Resource Pipeline

4.3 Antrophological Model

4.3.1 The Model

Knowledge Represent

Arithmetics, logics, probab models,... which & why

Decission Process

Hypothesis:richer agents

UPF hand to hand work:UCT algorithm

Methods

¿state of the art?

Social Network

¿state of the art?

Design

Organisational level design

Social structure

Interaction structure

Communicative structure

Normative structure

Coordination level design

Action model

Task model

Agent model

Plan model

4.4 Experiments

4.4.1 Initial Conditions

Montecarlo?

Emergence of stationary state; initial state := stationary state

4.4.2 Experiment features

Description

Hypothesis

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Results

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Chapter 5

Conclusion

5.1 Achieved Objectives

5.2 Achieved Objectives

5.3 Comparison AI - Simple

5.4 Difficulties & Issues

5.5 Publications/CAA

5.6 Future Issues

Chapter 6

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