Chapter XI
Social Modeller:
The Use of Expert Systems in Archaeology

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INTRODUCTION

Computer applications and especially artificial intelligence (AI) in archaeology is a scientific field that emerged in the late 1970s. This fact came in response to several simultaneous needs, opportunities and interests that result from the systematic development of methodologies relative to excavating, recording and restoration of findings, and also the increasing amount of information gathered in excavation areas. One of the first uses of artificial intelligence on a practical level was the coupling of expert archaeological knowledge with computer-based applications such as expert systems (ES), in order to simulate archaeologist's reasoning for a specific problem. Nowadays, the evolvement of the Internet provides a novel platform convenient for the development of new intelligent software and for offering valuable services in archaeology (Gardin, 1988; Huggett & Ross, 2004; Huggett & Ryan, 1994; & Wilcock, 1985, 1990).

Archaeology is a problem-oriented discipline, which tries to solve questions such as "What social action has caused the material effect that we are observing?" The goal of archaeology is to discover what cannot be seen in terms of what is actually seen (Barcelo, 2004). Answers are unobservable social causes, such as actions and processes, related to observable elements, such as items found in excavation areas. Problem solving can be conceptualized as a form of learning, because it can be defined as the acquisition of knowledge (decision rules) that derives from existing data (facts) and is inserted in an intelligent information system. The prerequisite of building an information system is the existence of a formal and systematic knowledge relative to a very narrow subject that will be encapsulated in an expert system (Huggett, 1985). In this chapter, we present a rule-based system implemented as a service that offers to experts and nonexperts the ability to formulate, organize, initialize and test hypothetical social scenarios, based on items that were gathered and facts that were concluded from excavation areas. The presented tool is called ArchES and is part of the Social Modeller module of the SeeArchWeb project (URL: http://www.seearchweb.net).

Expert systems are "software systems (or subsystems) that simulate as closely as possible the output of a highly knowledgeable and experienced human functioning in a problem-solving mode within a specific problem domain" (Lane, 1986). Expert systems were found to be ideal for integrating different programs in a domain, resulting in the development of decision support systems. Decision support systems integrate heuristic knowledge-based inference, description of scenarios and situations using a network of frames, objects or scripts, conventional programs and databases (Jackson, 1999; Liebowitz, 1997; Smith & Kandel, 1993; Waterman, 1986). The process of building an expert system typically involves a special form of interaction between the expert-system builder (knowledge engineer) and the expert in the specific area (domain expert). The knowledge engineer extracts from the domain expert strategies and rules for solving the problem. Extracting information (knowledge) is usually in the form of facts and rules.

For example (Barcelo, 2001):

Facts:
- Site x has pottery.
- Pottery is of type A.

Rules:
- IF site x has pottery
- AND pottery is of type A
- THEN site x chronology is 5th century.

Facts and rules may not always be true/false with absolute certainty. A degree of certainty/uncertainty is commonly used, to express the validity of a fact or the accuracy of the rule. The collection of the domain knowledge is called knowledge base, while the problem-solving tool that is based on knowledge emulates human capabilities to arrive at a conclusion by reasoning is called inference engine.

THE SOCIAL MODELLER TOOL

SeeArchWeb is a MINERVA project that aims to develop and present a new instructional approach for the subject domain of Archaeology based on networked technologies. The project emphasizes on a pilot study for the prehistoric archaeology of southeastern Europe. In order to accomplish this aim, the SeeArchWeb infrastructure has four parts:

- The Web Course module which is the basic learning resource for use by students, teachers and lecturers.
- The Social Modeller module that provides the users (learners, social scientists and archaeologists) with a new instrument for analysis, comparison and testing of hypothetical social scenarios.
- The Excavation Cataloguer module which is a standardized digital database used as a storage of archaeological excavation data.
- The Educational and Community Resources module which presents to the general public resources about the archaeology of southeastern Europe through the development of a current fund of archaeological community related information.

ArchES, the social modeller tool, is a novel instrument that formulates and tests hypothetical social scenarios provided by the expert archaeologist. ArchES analyses different variables as social factors in southeastern Europe in the past, as well as the present. The social modeller use knowledge management techniques to analyse large amounts of information available through the Excavation Cataloguer Module database. The detailed defining of the social values provides a better understanding of past processes and offers benefits such as more inclusive understanding of the region today.