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MULTI-AGENT SYSTEMS IN THE HARVEST PROGNOSIS

Laura Ciocoiu, Cristian Paraschiv, and Dragoş Barbu

Abstract: The paper presents a case study of geo-monitoring a region consisting in the capturing and encoding of human expertise into a knowledge-based system. As soon as the maps have been processed, the data patterns are detected using knowledge-based agents for the harvest prognosis.

Keywords: data mining, topological maps, GIS, knowledge based agents, Model Based Reasoning

Introduction

The process of geo-monitoring a region needs to use knowledge-based systems as a resource for aiding the specialists and the people in achieving their objectives. The model design process represents, in fact, the transferring of human experience in monitoring into an *interactive model.* Knowledge about process of the geo-monitoring of a region (e.g. map interpretation, statistics methods, strategies, etc) is represented by models that refer to observable features and significance.

So, the model designer has an inference network for the reasoning process; following the initial design of a model, the evaluation techniques are used to assess it in order to extent it; so, there are identified specific parts of the model that should be modified and the priorities of these modifications should be recorded. Besides the way of the geo-monitoring a region for a number of subjects, this process is in an on-going change (interference of Internet knowledge, including the artificial intelligence elements).

Area Monitoring

The aim of this work is to present a case study for capturing and encoding human expertise in geo-monitoring a region into a knowledge-based system. The main goals of weather and geo-monitoring of a region involving the environmental preservation are: modelling of liquid flows of rivers, harvest prognosis, riverbed degradation (utilization of hydropower potential) such some snapshots of our site “Geo-monitoring of a region” **http://inteligent-agents.ici.ro/gis/**

After the pre-processing operation of the topological and lithographic maps, knowledge about the process of the geo-monitoring of a region (e.g. statistics methods, strategies, etc) is represented by models that refer to observable features and significance.

The prognosis of harvest is realized on the base of geographical data such as using knowledge based modelling (hierarchical tree of classes and method definition, FBS decomposition, agent cooperation)

Harvest Prediction

This tool uses the knowledge engineering concepts such as *function-behaviour relationships, intelligent agents definitions* for creating a complex database for geo-monitoring a region.

Knowledge Representation is based on Model Based Reasoning (MBR) for an intuitive functional description, which is concerned with the design knowledge and geo-monitoring actions. The Functional-Behaviour-Structure (FBS) modelling consists of recursively decomposition of the functions into sub functions using a catalogue to look up the *most appropriate functional element* that means a component or a set of components that perform a function. Functional reasoning adds functional concepts into functional hierarchy and uses *a Casual Process description* with Casual Functional representation. The tool uses shared knowledge bases where the knowledge is represented as classes, objects and rules.

Function-Behaviour-State/Structure Modeller supports functional design (functional knowledge decomposition and function modelling) that means the defining of *function-behaviour* and *behaviour-state (structure)* relationships, causal decomposition (hierarchies constructed from the *function viewpoint*), construction of behaviour network, behaviour simulation, evaluation.

Knowledge Representation consists of constructing Function Knowledge Base and Behavior Knowledge Base based on model-based reasoning permit to generate a lot of alternatives, some of them “the best” for this process.

The process of geo-monitoring a region is simulated by constructing the Intelligent Agents referring to collaboration/ communication facilities. So, this model supports multiagents that generate partial results, data dependencies and conflicts among them.

Due to the complexity of application, in the ‘Harvest prediction’ process, along with the GIS software, a Knowledge-based System is used. First of all, there are defined superclasses **geographical features, geological structure, soil type, seed type, improvements, rainfall** with their attributes and instances. Also, some special data structures and classes had to be defined such as **Harvest, Basic Tilling, Auxiliary tilling, Soil Maintenance, Crop, Plant, Plant Control, Plant Maintenance**. External parameters (geographical position, climate), soil and seed, with their attributes (type, treatment, history, period) and their methods (work, evolution) are considered. The goal is quality and quantity of the crop. Each class represents an intelligent agent; the agents communicate each other in order to solve the conflicts.

For example, for a plain region with the quantity of the rainfall satisfactory and treatment, the harvest is expected to increase with 20%, according to the rules of the model.

The interpretation of the output data. We make the classes *geographical features*, **rainfall** and **soil type**, which have the greatest influence on the harvest evolution. The most important class is *geographical features,* which determines the quantity of the rainfall and the type of the soil.

For the moment the model implementation is made for a few numbers of classes and rules. We intend to improve the algorithm to include additional classes and methods.

Conclusions and Future Trends

Collaborative efforts in artificial intelligence, statistics, and databases have been made in order to model the phenomena and to be a support of decision-making.

The digital geographic databases are simple representation of geographic knowledge at the level of basic geometric, topological and measurement constraints. Knowledge-based GIS attempts to build higher-level geographic knowledge into digital geographic databases for analysing complex phenomena. Geographic knowledge discovery is a source for knowledge-based GIS and intelligent analysis.

For the next work we intend to develop our application by map interpretation and information extraction, environmental features defining (e.g. inductive learning techniques and neural networks to classify and map soil types, mapping vegetation types), extracting patterns, creating the geographical database.

Acknowledgement

This Technical Report was made by a team from National Institute for Research and Development in Informatics, on September, 2003, under INTAS Project no. 397: "**Data Mining Technologies and Image Processing: Theory and Applications**" coordinated by Lappeenranta University of Technology, Finland.

We want to thank the team leader dr.mat. Angela Ionita, Deputy Director of RACAI, for her work and assistance during this period.

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