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The Teaching of Knowledge Management Systems in Architecture: a Domain Oriented Approach

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Abstract

The teaching of artificial intelligence techniques in architecture has generally adopted a computer science oriented approach. However, most of these teaching experiment have failed to raise enthusiasm on the students or long term interest in the subject. It is argued in this paper that the main cause for this failure is due to the approach adopted. A different approach, that is, an domain oriented one will then be described as a promissing teaching strategy.

Resumo

O ensino de técnicas de inteligência artificial em arquitetura tem geralmente adotado uma abordagem voltada para a ciência da computação. Contudo, a maioria destes experimentos de ensino falharam em causar entusiasmo nos alunos ou interesse a longo prazo neste assunto. É argumentado neste artigo que a principal causa deste fracasso deve-se a abordagem adotada. Uma abordagem diferente, isto é, orientada para o domínio do conhecimento em questão será descrita como uma estratégia promissora de ensino.

Introduction

The application of artificial intelligence techniques in the field of architecture, with emphasis in knowledge-based systems, has been object of extensive research in the last twenty years. Many are the good examples of the extensive research carried out in the field such as Stiny (1980), Flemming (1987), Schmitt (1987), Oxman and Gero (1988), Mitchell (1990), Coyne et al (1990), Gero and Maher (1993) and Maher et al (1995). Several have been also the experiments in teaching those techniques to architects and students, although far less common were the cases of research undertaken in the topic of teaching in this field (for example, Oxman, 1990).

However, many of the courses dedicated to this subject have failed to cause enthusiasm on the students and to generate new long term users as well as new researchers on the topic. It is our objective to discuss some of the possible causes of such failure.

One source of problem is that most of these courses adopt an approach based on computer paradigms rather than on the architectural domain knowledge. Such courses often start by emphasising the general concepts and techniques developed in the field of artificial intelligence such as production systems, search strategies, frame systems, rule-based systems, cased-based reasoning, etc. Only later they tackle the matter of applying those concepts and techniques to architecture.

However, we believe this approach fail to demonstrate to the students, from the start, the applicability of such concepts or techniques in architectural design. Besides, the lack of proper instances in architecture makes it much more difficult for students to understand the general concepts and techniques that are being taught.

An alternative approach

We describe here a different approach in teaching knowledge management systems in architecture which focus first on the nature of architectural knowledge itself and only afterwards in computer paradigms. This course is part of a larger post-graduate programme in Computer-Aided Architectural Design run at the Faculty of Architecture and Urban Planning, University of Brasilia, Brazil, which adopts a similar overall approach. It starts by focusing on the inherent difficulties of architectural design, particularly concerning the possibility of understanding, representing and solving design problems.

It traces a distinction between classifiable and unclassifiable design precedents. It then follows by using an example, based on one particular architect (Le Corbusier) and one particular work (Chandigarh) to illustrate the objectives, the methods and difficulties of systematising architectural knowledge. Only when the student has understood the inherent problems, then the computer paradigms start being introduced. They them are asked to implement a domain of an architectural problem in a knowledge-based system shell.

The course structure and contents

The course in knowledge management systems in architectural design takes the form of three lectures, two practical seminars, and a demonstration and assessment session. These are arranged as follows:

1. In the first lecture a distinction is drawn between architectural knowledge which can be managed and other knowledge of architecture which cannot. Knowledge of the chapel of Ronchamp by Le Corbusier or Eero Sarinen's TWA Building at New York Airport, for example, cannot be systematically described. They are one-off products of an individual creative mind. The work of Le Corbusier at Chandigarh, on the other hand, can be organised systematically. The lecture shows a large number of images of the buildings on the Capitol at Chandigarh.

2. The second lecture illustrates and compares the design of the Capitol buildings at Chandigarh with some of the buildings on the Campus of the University of Brasilia. Six rules of building design are derived from this visual material. The rules are them structured into a rule tree. It is important that some of the visual material should be related to buildings with which the students are familiar.

3. Only in the third lecture the topic of artificial intelligence and expert systems are introduced. In particular, the expert system shell Cortex from Resolution Software (Mustoe, 1993) is described. An implementation of Cortex, in which the rules derived from Chandigarh are used to deduce the outline design for various types of building, is demonstrated.

4. In the first of the two practicals each student was asked to choose an aspect of architecture that interested him or her. The time was spent organising the knowledge of his or her chosen domain into a tree rule. It is difficult to obtain a structured understanding of even a small body of knowledge. It is therefore important that the attention is confined to small domains.

5. Each student was asked to make an implementation on Cortex during the second practical seminar. The quality of the implementations varied widely, but only a few weak students failed to implement their knowledge at all. Those domains in which description rather than search were required or implied were relatively unsuccessful. The unsuitability of some domains was one of the lessons to emerge from the work.

6. In the third and final practical each student was asked to use an implementation created by another. In this way they become users of an unfamiliar domain rather than implementors of knowledge that they understand. For assessment purposes it is important to observe closely the ease o difficulty with which a student's work can be used by another.

Conclusions

We have tried traditional methods of teaching knowledge management systems in architecture in the past in our school without ever being able to raise real interest in the subject from the students. However, we have noticed that the above method has generated much better results in terms of the quality of their work and long term interest in the subject.

Certain problems remain, however, as major topics of further research: many students find it difficult to distinguish between describing a knowledge domain and searching it. It also remains of difficult understanding, for some students, the transition from on type of representation to another, such as from natural language to rule-based ones and other types of representation. Further investigation should be carried out regarding better strategies and methods for explaining what an expert system is for, what it can do best, and the type of task for which is unsuitable.

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