
A Knowledge-based Creation of Mathematical Programming for GIS Problem Solving

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Abstract

The present biggest challenge to Geographical Information System (GIS) is to design model for theme analyzing. Many real applications of GIS need more functions in analysis and decision-making than in data management and visualization. While confronted with an application like planning a new metro line in a city, the typical GIS cannot accomplish it by itself, unless some human experts or artificial intelligence (AI) technology are involved. Many applications of GIS are essentially models for analyzing under different themes, and they are examples of problem solving in AI. Therefore many theories and technologies from AI can be embedded in GIS to strengthen its ability of automatic analysis. Since mathematical programming is a kind of powerful tool to provide feasible if not optimal solutions for problems under some constraint conditions. And many applications of GIS happen to be in a category of optimization, as they can usually be approximated accurately with some mathematical models. However, two questions arise, the first one is what objective function and constraints constitute a mathematical programming should be, and the second one is how an improved GIS can acquire those mathematical expressions. So a knowledge-based subsystem should be included in the hybrid system for the sake of integrating a mathematical programming for a GIS application. This problem is multi-dimensional and so some novel knowledge processing methods, namely, knowledge dependence, knowledge transition and knowledge reference, have to be studied. In this paper, a knowledge-based system represented by frame- and reference-based approach will be illustrated. Examples are used to demonstrate in detail the necessary steps to create a mathematical programming, and a real application based on the proposed approach on planning a new metro line will also be presented.

Keywords

Artificial intelligence, GIS, automatic programming
