EXPRESSION AND ORGANIZATION OF GEOGRAPHIC SPATIAL RELATIONS BASED ON TOPIC MAPS

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Commission IV, WG IV/3

KEY WORDS: Topic Maps, Spatial Relation, Topological Relation, Association, Topic Types, Occurrence

ABSTRACT:

Spatial Relation is one of the important components of Geographical Information Science and Spatial Database. There have been lots of researches on Spatial Relation and many different spatial relations have been proposed. The relationships among these spatial relations such as hierarchy and so on are complex and this brings some difficulties to the applications and teaching of these spatial relations. This paper summaries some common spatial relations, extracts the topic types, association types, resource types of these spatial relations using the technology of Topic Maps, and builds many different relationships among these spatial relations. Finally, this paper utilizes Java and Ontopia to build a topic map among these common spatial relations, forms a complex knowledge network of spatial relations, and realizes the effective management and retrieval of spatial relations.

1. INTRODUCTION

Tobler's First Law of Geography (TFL) thinks that: "everything is related to everything else, but near things are more related than distant things" (Tobler, 1970).In practice, in order to meet their own needs, different departments such as the government, the military, commercial enterprises describe and record the information of geographical objects and phenomena from different applications and perspectives, however it is very difficult to achieve the holographic expression of physical and humane geographical elements in a region. It is a hotspot in the field of geographic information research to establish the spatial relationships of different geographical data based on spatial relations, to effectively improve the ability to obtain valuable geographic information quickly, and to provide decision service for national economic construction. In recent years, people have made many rich achievements in the field of spatial relations. The descriptions of spatial relations are complex and diverse and there are various relationships among these description methods and models (e.g., there are some corresponding relations between four intersection model (4I), nine intersection model (9I) and CMB model of topological relation model). The ambiguity of direction concept, the hierarchical of direction relation reference system (Yan, 2002; Guo, 2007; Guo, 2014), and the localization, completeness and relativity of direction relations leads to the diversity of direction relation model and the complexity of direction relationship management. At present, the research on the spatial relations of topology, distance and direction is fragmented and it is difficult to establish connections among numerous spatial relations, which brings some difficulties for modeling, analyzing, querying of spatial data and teaching of GIS. Spatial relations are the core of complicated geographic networks and knowledge maps (Duan, 2013; Lu, 2014), in order to realize geographic knowledge maps, the first step is to build the spatial relation topic map. Topic Maps (TM) technology is a tool for building complex knowledge networks. Based on Topic Maps technology, this paper establishes a whole and united complex network of spatial relations which can integrate the knowledge of topology, direction and distance to realize the management and expression of spatial relations.

2. TOPIC MAPS(TM)

Topic Maps are the specification of organization, retrieval and navigation of semantic information on the Meta Layer (Li, 2010). Known as the global positioning system in the information world (Liu, 2012), Topic Maps is an international standard being used to express and exchange knowledge and to link knowledge with information resources, it is mainly used in the field of information management and information exchange. Topic Maps not only can reveal the interrelations between information resources and knowledge concepts, but also can locate the knowledge concept. From the perspective of distinguishing information and knowledge, the structure of topic map can be divided into upper and lower layers, namely, information resource collection layer (lower layer) and knowledge map layer (upper layer). The structure diagram is shown in Figure 1.

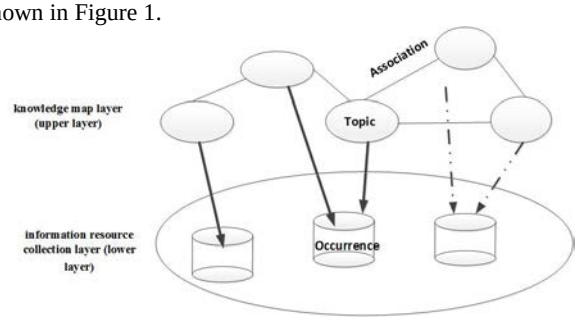

Figure 1. Two-layer structure schematic diagram of Topic Maps

Topic Maps contains three core elements: Topic, Association, and Occurrence (i.e., TAO). A topic is generally extracted after the analysis of different forms of resources according to the

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