Specifying Geographic Information - Ontology, Knowledge Representation, and Formal Constraints - DTU Orbit (28/12/2018)

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This thesis deals with the specification of geographic information. On the basis of the role of geographic information as an infrastructure element, a method is developed for the making of specifications which are well-structured and ensure the connection between the data collections being part of a joint infrastructure. The motivation for the presented work is to meet the need for topical geographic information at any time, so that the requirements for data content and quality are fulfilled, and the information can thus form actively part of the task performance in public administration as well as in the private sector. The theoretical background is the establishment of a representational system, which ontologically comprises a representation of notions in the "real world" and notions which include the representation of these. Thus, the thesis leans towards a traditional division between modeling of domains and conceptualization of these. The thesis contributes a formalization of what is understood by domain models and conceptual models, when the focus is on geographic information. Moreover, it is shown how specifications for geographic information are related to this representational system. The starting point of the thesis is an analysis mapping the elements in a specification for geographic information. The basis of this empirical investigation is TOP10DK's data content specification, version 3.2 of the National Survey and Cadastre. The basic idea is to view a specification as a collection of requirements and rules, building on terms from the domain and concept ontologies. In combination with the theoretical basis the analysis is used for developing an underlying model of notions, which defines the individual elements in a specification and the relations between them. In the chapters of the thesis this underlying model is extended to include a number of components, which each contribute to the model being able to form the basis of a strong and productive specification tool for the making and maintenance of specifications for geographic information. These components among others include description of quality requirements and formalization of rules, so that they can be used for verification of produced information. An essential contribution is a formal specification language dedicated to the formulation of formal rules to be observed by the information. The language is based on a formal semantic model which makes translation into other languages possible. In the thesis it is shown how statements can be translated into SQL and thus form the basis of direct implementation in the production environments where the geographic information is procured. To be able to describe requirements for the quality of geographic information is an essential part of a specification. The thesis contributes a structure of quality descriptions by introducing two notions: "Acceptable Quality Levels" (AQL) and "Quality Element Requirements" (QER), which designate respectively the minimum quality requirements for information produced according to a given specification and the requirements for the quality parameters used to describe this information. The two notions are incorporated and related to the developed system of notions for specification for geographic information. It is an important part of an infrastructure for geographic information that there is a connection between the individual data collections. This thesis argues for ensuring the connection by first and foremost describing these as an integrated part of the specification work. The thesis contributes a model which describes relations and dependencies by writing specifications in the context of one or more other specifications. As an illustration of the applications of specifications written in the developed specification language, a concept is developed in the thesis to make possible a decentralized collection and distribution of information about changes to be used for updating geographic information.

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