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Book Review

The Web Resource Space Model, H. Zhuge. Springer (2007)

What is the Web Resource Space Model?

The major Web search engines such as Google and Yahoo can tell us that Professor Zhuge initiated a promising research area – the Web Resource Space Model. It is a semantic data model for specifying, storing, managing and locating contents of Web resources through appropriate classifications. An *n*-dimensional space represents *n* kinds of classification methods. Selecting one coordinate at every dimension can uniquely locate a point, a set of resources of the same category. A resource space focuses on contents and resources can take any form.

Different from ordinary distance space from linear dimensions, a resource space is a multi-dimensional classification space where dimensions are discrete and every coordinate can be a tree structure. A point in the space can be a set of resources, a semantic link or a resource space.

A brief introduction to the main content of this book

Chapter 1 introduces the Resource Space Model from the methodology point of view. It introduces the study and design of the Resource Space Model including the Resource Space's essential definitions and characteristics, definitions of operations, the normal form theory, the integrity theory, the query language and the development method.

Chapter 2 presents a semantic overlay integrating normalization with autonomy. The author pointed out that normalization and autonomy are two aspirations of realizing an ideal semantic data model for the Web. Integrating the Resource Space Model and the Semantic Link Network (an extension of the hyperlink network) is a good way to construct a semantic overlay with the characteristics of normalization and autonomy to support intelligent services. A resource belonging to a point can link to other resources belonging to other points or resource spaces. The advantage is that not only interested resources can be located but also relevant resources can be found through these links.

Chapter 3 studies the expressiveness of query languages for the Resource Space Model. It answers how many operations are complete or necessary. The author finds out a set of complete operations and a set of complete and necessary operations for querying resource spaces. This is very useful in the design and analysis of resource space query languages.

Chapter 4 presents Resource Space Model's Algebra and Calculus, the basis of the model's query language. The author proves the equivalence of the resource space algebra and the resource space calculus, and shows that the Resource Space Model has powerful expressive capability by transforming relational table into resource space. This is a very important result.

Chapter 5 studies the searching complexity of the Web Resource Space Model. Given a resource space, it is important for us to know the relationship between the searching efficiency and its dimensions as well as the relationship between the searching efficiency and the coordinates at every axis. The author also studies the relationship between the searching complexity and the distribution of coordinates at every axis. The results are significant for designing and analyzing resource spaces.

Chapter 6 presents the storage mechanism. The resource space's multi-dimensional discrete nature differs from one-dimensional index of relational table and multi-dimensional indexing approaches. To achieve efficient resource operations like insertion, deletion and search, the author proposes an approach to store resources with similar classification semantics nearby in disk. The semantic distance between concepts at one axis is defined as the length of their shortest path in the concept tree of that axis so that semantic-close resources can be stored in neighborhoods.

Chapter 7 presents a new decentralized resource sharing approach by transforming an *n*-dimensional resource space into a partition tree and integrating the resource space with the unstructured P2P. Peers are classified into communities belonging to the leaves of the partition tree. Each peer maintains neighbors with a hierarchical structure, where the number of levels a peer maintains depends on the depth that the peer lies in the partition tree. The classification semantics of the partition tree are used to improve the P2P performance because a peer could get the satisfied answers with high

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probability by interacting more frequently with the peers of the same community sharing common interests.

Chapter 8 presents the structured P2P Resource Space Model, which divides the topological space of the resource space into independent zones. Each node in the P2P network manages one zone. Each node maintains the information of its neighbor nodes for routing. The routing process adopts a greedy method to forward the message to the destination. Nodes in the structured P2P Resource Space Model are self-organized into an overlay that represents the resource space. No super node is needed in this overlay. This improves the scalability of the P2P network.

Chapter 9 presents the Probabilistic Resource Space by generalizing the original Resource Space Model where a resource clearly belongs to a class or not. Assigning each resource a probabilistic membership function at each axis, a resource can be mapped onto a probabilistic Resource Space Model. Therefore, the normal form theory, integrity constraint theory and operation of the Resource Space Model are extended under the probabilistic model.

Comment

Different from the relational databases, multi-dimensional database and data grid, the Resource Space Model focuses on how to establish an appropriate classification system and normalize it to effectively organize and manage versatile Web resources regardless of their forms and locations. It brings a fresh idea into the research of Web information management with a complete theory, model and methodology. The model will play a very important role in managing resources of the Web. This book forms an important contribution to the field of Web information management. It is very worth reading for researchers of the Web, Semantic Web, and decentralized information management.

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