well as the numerous examples provide excellent aids to see the classification in action. This remains a guide, however, and is it best used with the classification schedules and interpretations, which are amply cited.

Chapter 2 delineates the principles and structure of the classification, while Chapter 3 demystifies the notation. It is disappointing that the term 'reserved Cutter numbers' does not appear in the index as it did in the previous edition. The current term ' „A" and „Z" Cutter numbers' is not as user-friendly for beginners. There also is no entry for 'Biscoe date letters' or 'date letters' although both topics are discussed in the text. Chapter 4 clarifies the use of tables of general application and those of limited application.

Chapter 5, „Assigning Class Numbers", is new to this edition. It gives a much needed overview and integration of the general principles of the classification, which serve as a foundation for the explication of the individual classes in Chapter 6. Chapter 7 continues to provide a useful discussion of the classification of special types of library materials.

The *Guide* remains a useful textbook for students of the Library of Congress Classification in formal programmes. It is also an effective self-study guide for practitioners and researchers. Although no guide can provide the knowledge that can only be gained by hands-on use of a classification, *A Guide to the Library of Congress Classification* clearly illustrates the classification in use with pertinent examples which effectively lead the learner to practical understanding of the underlying principles. Lois Mai Chan has also provided an excellent tool for updating ones knowledge of current developments and changes in Library of Congress practices.

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COCHRANE, Pauline Atherton, and JOHNSON, Eric H., eds. **Visualizing subject access for 21st century information resources : papers presented at the 1997 Clinic on Library Applications of Data Processing, March 2-4,** 1997. Champaign, IL : Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign, 1998. 176 p. ISBN 0-87845-103-X.

This collection consists of 15 papers presented at the 1997 Clinic on Library Applications of Data Processing. The Webster dictionary defines the term *Clinic* as a group meeting devoted to the analysis and solution of concrete problems. The concrete problems on which the authors focus their attention here relate to subject access, to the various modes of storing information and accessing information repositories, and to modes of browsing and navigating into and among those repositories.

In "Hypostatizing data collections, especially bibliographic" Roland Hjerppe argues that presentation of data must explore all of our senses, and not only the visual one. Hypostatization led to meta-information reification, impeding the visualization of this meta-information in all its dynamic in terms of space and time. According to the author, information collections must be seen as a whole, not as gatherings of data with some resemblance.

"Simultaneous searching of distributed information and subject repositories on the WWW", by Tamas E. Doszokocs, offers a historical perspective (from 1977 to date) on the development of subject repositories. The abstract only is available in the book under review. The full text of this presentation is available at http://sis.nlm.nih.gov/~doszkocs/dpc/ sld001.htm.

In "The role of subject access in information filtering", Raya Fidel and Michael Crandall report the results of studies conducted at the Boeing Company on users' perceptions of a filtering system. Having recognized that the implementation of filtering profiles based on users' topics of interest only was not enough for filtering relevant information, the authors led their users to identify some qualitative criteria not directly related to the subject domain but related to information quality. These qualitative criteria are: style of writing, and form and nature of documents. Some of these attributes of subject matter are subjective and some objective. Objective criteria can be applied to different domains and to filter information from different repositories.

"Thesauri in a full-text world", by Jessica L. Milstead, provides a brief history of thesauri, reminding readers that, although they appeared prior to the introduction of computers in information systems, their use spread with the growth of online bibliographic databases. Originally designed to assist in subject analysis and representation, thesauri are becoming useful tools to guide users across information repositories. Milstead demonstrates that thesauri remain useful even in full-text environments. Thesauri will not disappear, but they will change to adapt to the demands arising from the new repositories and from the new modes of accessing them.

In "Dimensions and discriminability : the role of controlled vocabulary in visualizing document associations", David Dubin remarks that traditional interfaces simply list titles of documents retrieved, not revealing similarities among documents. In order to improve search results display, proposals are made for interfaces in which search outputs could be improved through visualization of associations among sets of documents retrieved. The author points out that an informative picture of docu-

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ments retrieved and of their relation to an inquiry will rely on the selection of appropriate information attributes, defined by the author as any text word or descriptor assigned to it. There are two kinds of criteria for selecting information attributes: structural and semantic. While the structural can be achieved by an automated process, the semantic still necessitates text analysis procedures. The visualization of search results must be implemented through the display of the dimensions of relations among the subjects that represent items retrieved and through a differentiation of their structural and semantic attributes.

"An overview of results from Rutgers' investigations of interactive information retrieval", authored by Nicholas J. Belkin, presents an overview of the various investigations led by the Information Interaction Laboratory at the Rutgers' School of Communication, Information and Library Studies. Previous and current research projects focus on the individual's interactions with information, observing, analysing and comparing information-seeking behaviour, and proposing alternatives for information seeking strategies in advanced information retrieval systems.

Bryce L. Allen describes an experiment designed to investigate the effects of different cognitive abilities on the use of both conceptual and spatial representations of information in "Visualization and cognitive abilities". Spatial and conceptual representations are cognitive facilities through which people learn. Hence, they could be used for subject access to information. Traditional approaches have used conceptual representations. The author's proposal is to make more use of spatial facilities, exploring more fully the spatial possibility of displaying conceptual structures in order to identify more clearly clusters of documents.

In "Using IODyne : illustrations and examples", Eric H. Johnson presents an Internet client program that allows one to retrieve information by combining information objects which are abstract representations of bibliographic data, including full-text search terms allowing simultaneous connection to multiple servers. Abstract representations means that regardless of the bibliographic server one is connected to, he will always do the same kind of search in the same way. The idea is to retrieve by moving information objects among different information spaces and combining information objects in various ways in these spaces.

"OCLC investigates using classification tools to organize Internet data", by Diane Vizine-Goetz, suggests that the Dewey Decimal Classification (DDC) is a powerful tool for navigation because it makes possible a visualization of subjects in their context.

As Bob Zich argues in "Visualizing digital libraries", with digital information, navigation and searching are definitively entwined. Up to now, the presentation of search results has been linear. In his opinion, digital libraries must go beyond words and use other resources such as colour and sound to stress some words or cluster.

In "Information analysis in the net : the interspace of the twenty-first century", Bruce R. Schatz affirms that one must now focus on the processes of communicating and sharing information as much as on information itself. This author believes that we are shifting from large information repositories to very small groups gathered around a common area of interest. He proposes the telesophy system, which means knowledge at a distance: telesophy was to be the universal system connecting the world's knowledge and the world's people. In Schatz's opinion, the interspace of the next century will be the more or less formal sharing of data, results, literature, news, etc., among communities of users that will build themselves small specialized spaces. In the new interspace, users are authors, computers are publishers. As a result, the future is not a net but a cross-correlation of multiple sources.

According to Elizabeth D. Liddy in "Natural language processing for information retrieval and knowledge discovery", a full natural language processing system extracts meaning from text at all levels of language. These levels are: the morphological, the lexical, the syntactic, the semantic, the discourse, the pragmatic. The author stresses that the larger the size of the unit analysed, the fewer the rules to rely on. Liddy deals with NLP in the retrieval realm as well as in the knowledge discovery realm. The knowledge discovery realm is defined as the area of research and development involved with the computational process of extracting useful information from massive volumes of digital data; its goal is to map large quantities of low-level data into a more abstract form in order to extract knowledge automatically.

"Building and accessing vocabulary resources for networked resource discovery and navigation", by Joseph A. Busch, provides an overview of the Getty vocabularies resources, describing their structure as well as their cooperative model of maintenance. These vocabularies are: *Art & Architecture Thesaurus, Union List of Artist Names* and *Thesaurus of Geographic Names*.

An abstract of Suzanne Wilson Higgins' presentation at the Clinic, "Using electronic services to become an internetworked business : Blackwell's electronic journal navigatorCone agent's experience", describes how the role of the information intermediary (the subscription agent) is being affected by communication technology, getting it into an internetworked business.

Gerry McKiernan describes a clearinghouse of selected projects, research, products and services that apply information visualization technologies to access Web and non-Web resources. Only an abstract of "The big picture (sm) : visual browsing in the Web and Non-Web data

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bases" is presented here. The full text of this communication is available at:
http://www.public.iastate.edu/~CYBERSTACKS/DPC97.htm.

This collection of papers presents different views regarding subject access and its future. All of them contribute to information science theory by helping prepare the ground for accompanying changes in modes of communicating and storing knowledge.

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GANTER, Bernhard, and WILLE, Rudolf. Formal Concept Analysis : Mathematical Foundations. Berlin : Springer-Verlag, 1999. 284 p. ISBN 3-540-62771-5.

Formal concept analysis is a theory of conceptual data analysis and knowledge processing. A concept is formalized as an element of a mathematical lattice. Formal concept analysis is thus a field of applied mathematics and competes with and is related to other formalisms in the area of knowledge representation, such as the relational database model and conceptual graphs.

In formal concept analysis, a formal context consists of a set of data considered to be objects, a set of data considered to be attributes and a relation between. A context is graphically represented by a cross table that has a row for each object, a column for each attribute and a cross for each element of the relation. From a context, a set of concepts is derived. Among the concepts, a subconcept-superconcept relation holds. Together with that relation the set of concepts forms a so-called concept lattice. An advantage of this data analysis approach is that conceptual hierarchies can be graphically represented via lattices and that a large inventory of mathematical operations, such as operations for constructing, combining and decomposing contexts and lattices, can be utilized for studying data. Furthermore, dependencies and implications among attributes are visualised in the lattice modelling. Formal concept analysis can therefore incorporate reasoning procedures and be extended to a conceptual logic.

As stated in the preface, this volume covers solely the mathematical foundations of formal concept analysis. A detailed representation of applications and methods and of philosophical and other non-mathematical foundations is left for future volumes. Furthermore, conceptual logic which has been greatly elaborated in the years since the publication of the first German edition of this book in 1996 is also left for future volumes, with the exception of attribute implications and dependencies which are covered in chapter two.

This is the first comprehensive publication on the mathematical foundations of formal concept analysis. Although the book is self-contained because chapter zero explains all necessary order-theoretical mathematical terms, the book is not aimed at a general audience; readers should have a strong mathematical background to fully appreciate its content. On the other hand, readers who are not mathematicians but are already familiar with formal concept analysis may find chapters one and two, which comprise one third of the book, very helpful as a source of definitions, hints, lists of scales, and examples. The book contains an extensive bibliography and every chapter ends with a section called "Hints and References" that gives detailed information on where the results of each chapter were first published and hints for further readings.

The first chapter defines formal contexts, concepts, concept lattices, and clarification and reduction of contexts. Lattices of the reduced or clarified version of a context have the same lattice structure as the original lattice and can often be used to define or check mathematical properties of concept lattices. Another technical aid is provided by arrow relations that can be inserted into a context. Contexts and lattices in formal concept analysis can be infinitely large. Many theorems, however, hold only for subsets of contexts and lattices that have additional properties, such as doubly foundedness. Many-valued contexts are contexts that contain a third set, a set of values, such that at most one value is assigned to each object-attribute pair. Relational database tables can be interpreted as many-valued contexts. These contexts must be scaled into single-valued contexts. The last two sections of the first chapter describe the process of scaling, a list of standard scales, and simple methods for constructing contexts from other contexts.

The second chapter provides an explanation of methods for manually deriving all concepts of a context and for manually drawing easily-readable lattice diagrams using the geometrical method. Software tools for formal concept analysis exist that automate these methods. These tools are often based on an algorithm for generating concepts that produces the concepts in their lectic order and an algorithm for generating preliminary versions of diagrams that are then interactively refined. Nested line diagrams are described as a method of reducing the visual complexity of lattice diagrams. Implications among attributes lead to the notion of an attribute logic. A basis is defined for the set of attribute implications of a lattice. By means of attribute exploration, sets of implications that are complete and non-redundant can be generated even for an incomplete initial context. For this procedure a computer program questions a user

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