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Foreword

The Database and Expert Systems Applications (DEXA) Conferences are traditionally thought as a wide platform for the exchange of ideas, experience and opinions among theoreticians and practitioners active in the areas of database and artificial intelligence technologies and coming from all over the world.

Despite the applications aspect occurring in the name of the conference, the Program Committee arranged – as it has become tradition – the necessary balance between theoretical and practical points of view.

This volume contains the best 78 contributed papers which have been carefully selected during a tight reviewing process involving comments of many international experts by the Program Committee from a total of 269 submissions. The scope of the papers in this proceedings covers the real hot topics in both the areas of database and AI systems. The database sessions are primarily devoted to *object-oriented data modeling*, *distributed databases*, *active database aspects*, *database optimization*, and *performance evaluation*; among the specialized systems *spatial* and *geographic databases* have been stressed. Artificial Intelligence is represented in particular by papers on *expert systems applications*, *knowledge engineering* and *distributed AI systems*. While some of the topics, as for example *hypertext/hypermedia* and *user interfaces*, are important for both database and AI systems, some fields, in particular *software engineering* and *legal systems*, are even aimed at integrating the results achieved in both fields.

DEXA'93 is the 4th conference in the line and has some new features. After Vienna (1990), Berlin (1991), and Valencia (1992), this conference takes place in the capital of an East-European country, thus providing an ideal forum for the advancement of the East-West scientific cooperation.

This conference is the first organized in cooperation with the IEEE Computer Society; this is an important feature confirming that the DEXA Conferences have gained a certain recognition among many international database and AI events. All the individuals involved in the preparation of this conference consider this fact as a great honour.

We would like to express our thanks to all institutions actively supporting this event, namely to

Research Institute for Applied Knowledge Processing (FAW), Linz
Czech Technical University, Prague
IEEE Computer Society
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We also would express our thanks to all members of the Program Committee and the Organizing Committee as well as to all referees supporting the selection of the contributions with valuable evaluations often given on short notice.

Vienna, Prague, Linz
June 1993

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Information Handling – A Challenge for Databases and Expert Systems

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Abstract The increasing availability of a broad range of information types like textual documents, audio and video data, and hyper-linked information structures imply a need to reformulate the task of information handling systems. An integrated heterogeneous information pool of interlinked multimedia data forms the center of such a system. In order to create and utilize this pool components involving many interoperating humans and also active (intelligent) system support are needed. In this paper we focus on the acquisition, offer, and retrieval of information performed around this pool of multimedia data. We discuss requirements, approaches and (partial) solutions in areas like storage, information modelling, semi-automatic acquisition, retrieval and visualization of multimedia data, and sketch implemented systems that integrate some of these aspects. The discussions will identify needs and show techniques to embed expert system functionality into each single step of the process of information handling. An integrated prototype, which is currently under development at GMD-IPSI, will be outlined at the end of this paper.

1 Introduction

In former times, the materialization of verbal knowledge in books, and then the creation of public libraries, started new eras in information handling and in interhuman communication. Nowadays, knowledge is more and more stored in electronic libraries and made available through information servers in networks. The necessity of being 'up to date' and the immense growth of electronic information require on-line access to the data. Furthermore, the central storage of information and its replicability create new means of information delivery. Broadcasting through a network is the fastest way to provide many people with actual information. This requires adequate representation of all potential information. Not only size and structure of the data items increase. New media like video or audio, for example, provide a new quality of stored data, because they add temporal aspects to all tasks that are performed around a database.

Taking all these demands into account, the challenges to database development can be sketched as:

- appropriate modelling of multimedia data
- effective storage and retrieval of mass data
- synchronization and real-time assertions for temporal data
- automatic acquisition of external data

- unified modelling layer for a simple access to all kinds of data
- integration of network services into information management systems

All these new requirements go beyond the capabilities of traditional database management systems. Most of the tasks are already solved, as long as they are viewed separately. E.g., CAD/CAM applications and desktop publishing programs are publicly available. But the integration of all these requirements into a new database concept remains to be done. The object-oriented paradigm of database design seems to be a good basis for this integration. Thus, the major goal of database development can be summarized as:

Databases must efficiently store all kinds of data and provide integrated and unified manipulation methods.

Traditional retrieval systems are designed for effectiveness in searching and finding single records or simple sets of data in large but poorly structured databases. This becomes obvious if one takes a closer look at the quality measures that have been formulated several decades ago and are still in use. *Recall* (the ratio of relevant documents retrieved) and *precision* (the degree of 'noise' in the result set) are purely quantitative rules of success.

The new and promising results in information acquisition and storage imply a need to develop new paradigms for the design and construction of intelligent multimedia information systems. New challenges for information handling systems – to provide access to complex information structures and to support users in preparation of large and rich structured data – have to be adopted in two domains. On the one hand there is a need to build new kinds of general purpose retrieval tools. On the other hand existing applications have to incorporate novel information structures without loosing their acquainted usage. These future systems have to address more qualitative goals like:

- mediation of dependencies of information, not leaving users alone in 'hyperspace',
- visualization of complex information structures and
- integration of several types of media within one unique metaphor of man-machine interaction.

New theories and technologies that have been developed in the area of information retrieval to reach these design goals should be transferred to existing applications in the domain of databases and information systems (e.g. business and engineering systems, bulletin boards, library systems, or electronic newspapers). These systems should be endowed with components capable to handle new electronic media like video, audio, interactive maps and pictures to overcome the existing paradigm of pure information managing. This integration leads to promising approaches like

- presenting data as instantiations of concepts and ideas, i.e., cooperation of users and machines via active media and
- intensifying the productivity of the human mind (by abstracting from physical or spatial aspects of information storage and retrieval and offering cognitive models of the underlying information sources)

The formulation of clear and procedural design guidelines for information handling systems and the development of active multimedia systems in the way sketched here is a

long-range goal. Research at GMD–IPSI and other locations has started to tackle certain aspects. The overall goal is the development of fully functional prototypes which can mutually be combined to integrate the benefits of distinct research areas.

The big amount of automatic processing and the high degree of user interaction reveal a big need of integrating techniques from the area of knowledge processing to allow information handling systems to take decisions and to guide the user in his or her tasks. Instead of providing stand-alone expert systems, active system support is achieved by embedding knowledge based assistance components into the system.

In the following we will take a look at different aspects of information handling. Section 2 presents an overview of the whole 'process of information handling'. The single steps in the information flow from information sources to terminal applications are depicted and related to each other. Section 3 sheds some light on information acquisition and storage mechanisms appearing in that environment. Structural enrichment, schema integration and concepts for modelling videos are the selected topics. New developments in retrieval techniques are presented in section 4. Multimodal dialogues and interface mechanisms to heterogeneous databases lead up to virtual-reality visualizations of complex data. The last section of this paper will then be used to present the MultiMedia Forum, an integrated information system prototype under development at GMD–IPSI.

2 The Process of Information Handling

The main functionality of an information handling system is the acquisition and maintenance of data together with a support of appropriate retrieval mechanisms. This overall scope can be divided into two general parts, that can be roughly entitled as *import* (*acquisition* and *creation*) and *export* (*offer* and *retrieval*). The import part is responsible for populating the information base. It acquires data from many different sources and has to prepare it for appropriate usage. The second part is concerned with all aspects of retrieval of this data and the presentation of the results to the user. In addition to query mechanisms and visualization techniques, it may provide sophisticated user guidance to assist the user in his or her search for the desired information. Both tasks have to be based on a common metaphor for the handled data. An appropriate modelling is necessary to connect these two parts through the shared information base.

Figure 1 shows further refinements of this whole process of information handling. The graphic mirrors the information flow from the information sources to the terminal application programs and the user. Interconnections between the different actions, like cooperating editors and cycles (e.g. storage of retrieved or edited data) are not taken into account. In the following, we will take a look at the different parts of the information processing task.

2.1 Information Acquisition

Information Import. When an information system has to be built up, it has to be filled with data. The information to be gathered in this state of information handling is of diverse nature and comes in many different structures from many different sources. In addition to existing internal and external databases with more or less structured data, information can reside in simple text files, in expert systems, or in on-line databases