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Preface

The theme of this book is the potential of new *Advanced Database Systems*. When the first of this series of conferences was held in Aberdeen, back in 1980, the potential of relational databases was clear for all to see, but commercial systems were still a few years off. At that time CODASYL and IMS reigned supreme, whilst the PC did not even exist! During the 80's, relational databases have become an industry standard, but their shortcomings have also become more obvious, many of which were foreseen. In particular, there was a serious shortcoming in data modelling constructs in order to capture complex CAD applications, and a difficulty in extending the model to include new datatypes. This led to an interest in *Object-Oriented Databases,* addressed by three papers.

Following these, we have a paper by an invited speaker *David Gradwell* on how to extend entity-relationship modelling techniques, widely used on relational databases, so that they cope with object-oriented databases. This is an important requirement for their widespread adoption.

Many people have questioned whether relational databases could meet the performance standards of finely-tuned IMS databases. Fortunately there have been developments in the UK in the use of networks of parallel processors. These have now come of age, and we have thought it right to include amongst research papers two studies of state of the art relational databases running on *Parallel Hardware* - NCR/Teradata and Meiko. These show great promise for the future, particularly with regard to the scalability of the technology and the use of faster processors. Together with these is a research paper on the use of transputer networks.

The availability of parallel hardware leads nicely into the question of the use of Distributed Systems. Our second invited speaker *Dr Michael Brodie* from GTE Labs, USA, discusses the promises for these systems, where application programs and databases cooperate together over a network. But this leads on to the awkward problem of *Legacy Systems* which are crucial to an organisation, but very hard to migrate from. How are we going to change over and get the advantages of Advanced Systems?!

One of the big problems of early database systems was the so-called impedance mismatch between them and programming languages, both in the range of data types that could be stored, and in the handling of large sets. This has led to a range of implementations coupling various new programming languages to databases - Functional, Persistent and Logic Programming. It has also led to more advanced *Conceptual Data Models* which are implemented in these languages, as described by three papers.

One particular feature of advanced data models is the need, long foreseen by Nijssen, to capture as much of the semantics of the data, including constraints and active rules, in the database. *Logic Programming* systems have been very useful for this purpose, and our final section discuss systems that use it for active rules, program transformations and constraints.

I am particularly grateful to the program committee of 16 people who picked the selection of 12 papers from 36 submitted. Although there was a wide variety of topics, it is interesting that these themes emerged so strongly for presentation at the 10th BNCOD conference. I am also very grateful for the industrial members of the program committee, who guided us in the selection of industrial papers, using slightly different criteria from the academic papers. Thus we hope that people working in industrial software development, and engineering design will find much to interest them in this book.

Acknowledgements

Finally, may I say that these proceedings represent the strength of a vigorous database community in Britain, without whose support the annual conference could not take place. I am particularly grateful for advice and support from Alex Gray, as steering committee chairman, and from Elizabeth Oxborrow and Mike Jackson who ran earlier conferences. Nearer home, I am very grateful to my co-editor Rob Lucas, to my research students, who have helped organise the conference and to the departmental secretaries Irene Kavanagh and Katie Blanchard who coped with much of the day to day work and are the unsung heroes!

Most of the work in the UK has been supported over the years by the Science and Engineering Research Council, to whom we are all grateful, and it is to be hoped that they will see the fruits of this research in these proceedings as an encouragement to them to support the proposed special initiative in Advanced Databases and Large Knowledge Bases from 1992.

April 1992

Peter M D Gray
Conference Chairman

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THE PROMISE OF DISTRIBUTED COMPUTING AND THE CHALLENGES OF LEGACY SYSTEMS

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ABSTRACT

The imminent combination of computing and telecommunications is leading to a compelling vision of world-wide computing. The vision is described in terms of next generation computing architectures, called Enterprise Information Architectures, and next generation information systems, called Intelligent and Cooperative Information Systems. Basic research directions and challenges are described as generalizations of corresponding database concepts. No matter how compelling and potentially valuable the vision may be, it is of little use until the legacy problem is solved. The problem of legacy systems migration is described, in the context of distributed computing, and is illustrated with lessons learned from actual case studies. The basic research directions and challenges are recast in the light of the reality of legacy systems. Recommendations for realizing the vision and meeting the challenges are given including the search for the elusive Killer Application.

1. World-Wide Computing

My professional goal is to contribute to making the world a better place by providing solutions to significant, real problems. As a computer science researcher this means that I want to produce the highest quality research and technology that is ultimately applicable to real problems so that the results are consistent with my beliefs. In this regard, I have very high hopes and expectations for the potential benefits of world-wide computing. The vision is that in world-wide computing the necessary computing resources (e.g., programs, information bases, information systems) can interact to cooperatively (or collaboratively) to solve problems effectively and efficiently and to do productive work. This will all happen transparently to the location or nature of the participating systems.

In this section, I describe a world-wide computing vision in terms of cooperation amongst information systems augmented by a telecommunications vision that provides communication on a scale previously unthinkable by computer scientists.

1.1. The Vision

The vision of distributed computing is compelling. It says that soon the dominant computing paradigm will involve large numbers of heterogeneous, intelligent agents distributed over large computer/communication networks. Agents may be humans, humans interacting with computers, humans working with computer support, and computer systems performing tasks without human intervention. Work will be conducted on the network in many forms. Work task definition will be centralized (e.g., a complex engineering task) and decentralized. Tasks will be executed by agents acting autonomously, cooperatively, or collaboratively, depending on the resources required to