COMPUTER SUPPORTED COOPERATIVE WORK

John H. Connolly
and Ernest A. Edmonds (Eds.)

# CSCW and Artificial Intelligence

## CSCW 与人工智能

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John H. Connolly, PhD
Department of Computer Studies
University of Technology
Loughborough
Leicestershire LE11 3TU, UK

Ernest A. Edmonds, PhD
Department of Computer Studies
University of Technology
Loughborough
Leicestershire LE11 3TU, UK

*Series Editors*

Dan Diaper, PhD
Department of Computer Science
University of Liverpool
PO Box 147, Liverpool L69 3BX, UK

Colston Sanger
GID Ltd
69 King's Road
Haslemere, Surrey GU27 2QG, UK

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# *Preface*

Computing, despite the relative brevity of its history, has already evolved into a subject in which a fairly large number of subdisciplines can be identified. Moreover, there has been a noticeable tendency for the different branches of the subject each to develop its own intellectual culture, tradition and momentum. This is not, of course, to suggest that any individual subdiscipline has become a watertight compartment or that developments in one branch of the subject have tended to take place in total isolation from developments in other related areas. Nevertheless, it does mean that a deliberate effort is required in order to bring different subdisciplines together in a fruitful and beneficial manner.

Artificial Intelligence (AI) and Computer Supported Cooperative Work (CSCW) jointly constitute a good example of two branches of computing that have emerged separately and given rise to largely distinct research communities and initiatives. On the one hand, the history of AI can be traced back to the 1950s, the term "Artificial Intelligence" being generally attributed to John McCarthy, who first used it in print in 1956. "Computer Supported Cooperative Work", on the other hand, is a term of more recent coinage, having been devised by Irene Greif and Paul Cashman in 1984.

CSCW is generally associated with, or included within, the broader area of Human–Computer Interaction (HCI). This is right and proper, since CSCW involves communicating via a user interface with a process mediated by that interface. In CSCW, of course, the process concerned is not the operation of a computer program but the communicative activity of another human being in cooperating towards the achievement of some common goal; hence the distinctive nature and character of CSCW in comparison with other branches of computing.

In recent years, AI has come to play an increasingly important role within conventional HCI, with the notion of intelligent user interfaces coming into prominence; see, for example, Sullivan

and Tyler (1991), Gray et al. (1993). So far, however, in the CSCW literature only scant attention has been paid to the use of AI techniques. Thus, it is opportune to offer the present book as the first to be devoted to the task of exploring in detail the ways in which AI may contribute to CSCW.

One of the key features of this book is its multidisciplinary nature, with technological, organizational, psychological, linguistic and semiotic perspectives all being represented. This multidisciplinarity is inherent in the subject matter of the book, and is therefore entirely appropriate.

A concept that has emerged as central in discussion of AI in relation to HCI is that of the "agent". This notion features in every one of the eleven chapters of this book. The reader should note, however, that not all authors use the term "agent" in exactly the same way. Some apply the term to any entity, human or automatic, that is capable of taking an initiative, whereas others restrict its use to computer-based processes that act on behalf of human users or other software processes. (The sense in which each author in the present volume employs the term is made clear in the relevant chapters.) Despite this terminological variation, however, the core notion of an intelligent system possessed of the ability to carry out useful tasks without slavish prompting by another is common to most concepts of "agent", and will be seen to recur throughout the book.

Intercommunication among agents, too, is an important theme, which is addressed by several authors. Its relevance stems from the fact that CSCW is a field in which the application of Distributed Artificial Intelligence (DAI) readily suggests itself.

The chapters that follow are all revised versions of papers presented at a seminar organized by the UK Department of Trade and Industry CSCW Special Interest Group at Kingsgate House, London, on 30 June 1992. The eleven contributions will now be briefly introduced.

Since the concept of the agent is of such significance in the present book, we have chosen to introduce the book with a chapter by Michael Smyth, entitled "Towards a Cooperative Software Agent", which begins with an outline history of the term "agent" and its usage in both AI and HCI. Smyth then proceeds to examine another crucial concept in CSCW, namely "cooperation", and discusses how this relates to the behaviour of agents. Finally, he describes an implemented system in which both key concepts (agents and cooperation) have been realized.

Both agents and their intercommunication are discussed in Chapter 2, by Rachel Jones and Ernest Edmonds, "A Framework for Negotiation". This contribution deals with the issue of designing knowledge-based CSCW systems aimed at supporting a geographically distributed group of users engaged in negotiating solutions to problems. The CSCW system makes available to the group computer-based tools that support the decision making activity. The authors offer a theoretical framework to assist in the design of this kind of system. The framework involves the recognition of several different types of agent, in addition to other knowledge-based components, and the provision of the necessary communication channels to sustain their interaction.

Interaction among agents is also a central issue in the chapter by Alan Dix, Janet Finlay and Jonathan Hassell, "Environments for Cooperating Agents: Designing the Interface as Medium". The main thrust of this contribution is that the user interface should be seen as the medium via which agents can communicate with one another and act upon the passive elements (or objects) within the system. This view has the interesting consequence of providing a means of reconciling consistency with adaptivity in the interface: adaptivity is made the remit of agents, while the interface itself is made to offer a stable environment for human–computer interaction. The application of such ideas to CSCW areas such as conferencing is also discussed.

Providing for interaction among agents within a system inevitably raises the question of appropriate architectures. This issue is addressed by Douglas McGregor, Craig Renfrew and Iain MacLeod in their chapter, "Domain Knowledge Agents for Information Retrieval". Taking as their field of application the problems experienced by engineers in finding the information they require in documents such as journals or compendia of standards, the authors identify three different types of agent which together may assist users in the task of retrieving relevant information. Moreover, the agent architecture proposed in this chapter has the advantage not only of providing for the retrieval of such information but also enabling it to be shared among different users.

The next chapter, "Autonomous Agents in the Support of Cooperative Authorship" by Geof Staniford and Paul Dunne, again deals with system architecture, but this time in relation to the writing rather than the reading of documents. A vital aspect of the contribution of these authors is the presentation of a graph-based formalism for specifying architectural design

of systems which, like the one described in this chapter, incorporate intercommunicating agents.

The following chapter, by Gregory O'Hare, Paul Dongha, Linda Macaulay and Steve Viller, is entitled "Agency within CSCW: Towards the Development of Active Cooperating Working Environments", and is concerned with the cooperative capture of system requirements by geographically distributed, multidisciplinary teams of people. The authors propose an agent-based system to support this cooperative requirements capture process. Once again, system architecture figures among the topics discussed. Another important consideration is the social dynamics of the team members during the cooperative process, and the system is designed to help manage these.

Team problem solving and its support by means of a computing system is also the concern of John Gammack and Robert Stephens in their chapter, "A Model for Supporting Interacting Knowledge Sources". They offer a formal model, both for representing expert knowledge relevant to the solution of problems in a domain such as metallurgical quality control and for describing the interactions among team members during the problem solving process.

The description of interactions is also a central issue in David Benyon's chapter, "A Functional Model of Interacting Systems: A Semiotic Approach", in which a model of interaction that provides a basis for understanding the prerequisites for and the process of communication among agents is proposed. This model, being semiotically founded, embodies a view of communication as the exchange of meaningful and structured signals, which have to be interpreted in relation to their context.

Context is also a vital consideration in Stefan Kirn's contribution, entitled "Supporting Human Experts' Collaborative Work: Modelling Organizational Context Knowledge in Cooperative Information Systems". In this chapter, the author demonstrates why a knowledge of the organizational context of tasks is required for an effective computer-based system that supports collaborative work among human users. The application domain around which discussion revolves is that of cooperative expert systems in banking.

A further dimension to the treatment of communication in the present volume is provided by John Connolly's chapter, "Artificial Intelligence and Computer Supported Cooperative Working in International Contexts". Drawing where appropriate on concepts from linguistics, the author outlines various kinds of problems that can arise when geographically distributed users with different national/cultural backgrounds attempt to

engage in CSCW. He then suggests ways in which AI may be employed in order to reduce the difficulties involved.

The book ends with a somewhat cautionary chapter by David Jennings, "On the Definition and Desirability of Autonomous User Agents in CSCW". The author points out that practitioners of different academic disciplines may have rather different ideas of what an "agent" is, and that this fact represents an obstacle to the idea of taking agents as the basis for user interface design. Instead, he argues, the task and other aspects of the context in which the group work is to be carried out should determine whether agents should be incorporated and what intelligence they should manifest.

It will thus be evident that the application of AI to CSCW is an area in which a multiplicity of approaches exist and controversy is to be expected. Many questions are unanswered, and even unasked. However, it is clear from this volume that a number of central issues remain. Understanding the human users' tasks, capabilities and preferences must be high on any research agenda. Of particular concern is the scope that can be offered to autonomous system agents while generating real benefit to users. The resolution of an agreed set of underlying architectural concepts is also important for the enabling and encouraging of research in the application of AI to CSCW. It is hoped that the present volume will serve as a stimulus to further investigation of the field and to further enlightening debate.

Loughborough
1993

John Connolly
Ernest Edmonds

# Contributors

David Benyon

Computing Department, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK

John H. Connolly

LUTCHI Research Centre, Department of Computer Studies, Loughborough University of Technology, Loughborough LE11 3TU, UK

Alan Dix

Department of Computer Science, University of York, Heslington, York YO1 5DD, UK

Paul Dongha

Department of Computation, UMIST, PO Box 88, Manchester M60 1QD, UK

Paul E.S. Dunne

Department of Computer Science, University of Liverpool, Chadwick Building, PO Box 147, Liverpool L69 3BX, UK

Ernest A. Edmonds

LUTCHI Research Centre, Department of Computer Studies, Loughborough University of Technology, Loughborough LE11 3TU, UK

Janet Finlay

Department of Computing and Mathematics, University of Huddersfield, Queensgate, Huddersfield HD1 3DH, UK

John G. Gammack

Department of Computing and Information Systems, University of Paisley, High Street, Paisley PA1 2BE, UK

Jonathan Hassell

Department of Computer Science, University of York, Heslington, York YO1 5DD, UK

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David Jennings

Occupational Psychology Branch, Employment Service, B3 Porterbrook House, Pear Street, Sheffield S11 8JF, UK

Rachel Jones

LUTCHI Research Centre, Department of Computer Studies, Loughborough University of Technology, Loughborough LE11 3TU, UK

Stefan Kirn

Westfaelische Wilhelms-Universität Münster, Institut für Wirtschaftsinformatik, Grevener Strasse 91, D-4400 Münster, Germany

Linda A. Macaulay

Department of Computation, UMIST, PO Box 88, Manchester M60 1QD, UK

Iain A. MacLeod

Department of Civil Engineering, University of Strathclyde, 26 Richmond Street, Glasgow G1 1XH, UK

Douglas R. McGregor

Department of Computer Science, University of Strathclyde, 26 Richmond Street, Glasgow G1 1XH, UK

Gregory M.P. O'Hare

Department of Computation, UMIST, PO Box 88, Manchester M60 1QD, UK

Craig R. Renfrew

Department of Computer Science, University of Strathclyde, 26 Richmond Street, Glasgow G1 1XH, UK

Michael Smyth

LUTCHI Research Centre, Department of Computer Studies, Loughborough University of Technology, Loughborough LE11 3TU, UK

Geof Staniford

Department of Computer Science, University of Liverpool, Chadwick Building, PO Box 147, Liverpool L69 3BX, UK

Robert A. Stephens

Faculty of Computer Studies and Mathematics, University of the West of England, Bristol BS16 1QY, UK

Steve Viller

Department of Computation, UMIST, PO Box 88, Manchester M60 1QD, UK

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