User Role in Problem Solving with Distributed Artificial Intelligent Systems

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Abstract. This paper considers user interaction with Distributed Artificial Intelligence (DAI) systems from the perspective that end users primarily use DAI systems for problem solving and decision making tasks. Initially, human problem solving is considered using the framework provided by Newell and Simon, then pertinent factors from group problem solving are detailed and a classification of user-DAI system interaction is proposed. The role of the user in relation to a variety of systems and to DAI systems in particular is then discussed. Finally a variety of user roles with DAI systems are presented through different scenarios, created from the problem solving characteristics identified earlier. These scenarios are then further detailed with the use of an application from the Electricity Supply Industry. The paper concludes with the identification that the ideal user-DAI interaction platform, is one in which the user exists as a partially integrated entity.

1. Introduction

Until recently the majority of research in Distributed Artificial Intelligence (DAI) focused on architectural factors, relating to aspects such as communication, control and agent structures, see [1], with little consideration being given to user-related issues. Now, however, as DAI research matures and DAI systems begin to emerge from research laboratories, for example with experimental prototypes for applications [2] and large scale pre-industrial projects such as ARCHON [3], user interaction with such systems must be considered.

A wide range of DAI systems exist, from those consisting of fine-grained agents, for example the Eco problem solving approach [4], to those which consist of several coarse grained expert system style agents, for example CooperA [5]. The research reported here focuses on this latter class of system. Such systems follow the Scientific Community metaphor [6] and consist of discrete agents with complementary areas of expertise. Such agents adopt behaviour patterns which are intelligent, and in the solution of problems, cooperation mechanisms are used.

For any DAI system, there are a variety of different classes of user, ranging from those involved in development, such as the Knowledge Engineer and agent developers, to those who are involved with the use of these systems, for example the Organisation and end users. Here, we concentrate on primary end users, who are defined as users who use the system frequently and directly [7]. DAI system end users are comparable to users of other intelligent systems, and like these, they require advice and information regarding a decision making or problem solving activity. It can be assumed that whilst they will have some computer literacy, they will essentially...
consider the system as a tool and have little technical knowledge regarding computer systems, nor will they intend to submit to any form of intensive technical training before using the system. DAI systems now under production, for example those within the ARCHON project, aim to support such primary end users and to provide them with facilities which enhance and improve their work-task capability.

This paper focuses on how to provide an interaction situation which is beneficial to both the user and the system in the solution of complex problems. This issue is tackled through considering human problem solving and user role to determine the context of the user in relation to a DAI system.

2. Problem Solving

The aim of this section is to determine how humans act within a problem solving situation, and to attempt to apply factors from this to how a user will interact with a DAI system to solve problems. Thus, it provides an analysis of the user in relation to a DAI system within a problem solving activity. This section is divided into a number of areas, firstly a consideration of a problem solving situation, secondly problem solving within a group environment, and finally a classification of problem solving is proposed.

2.1 The Problem Solving Situation

Newell and Simon [8] defined a problem situation as:

"A person is confronted with a problem when he wants something and does not know immediately what he can perform to get it ... To have a problem implies (at least) that certain information is given to the problem solver: information about what is desired, under what conditions, by means of what tools and operations, starting with what initial information and with access to what resources. The problem solver has an interpretation of this information."

In terms of this definition three areas of importance become apparent, the first two dimensions were identified by Newell and Simon in their Information Processing theory. The final dimension that of problem representation is noted throughout the problem solving literature, for example see [9].

1) Demands of the Task Environment

The structure of the environment can affect a person's ability to understand and solve a problem. A problem solver exists within the task environment primarily to solve the task under consideration and thus, the task determines the problem solver's perception of the environment. The complexity of a task is reduced if its environment is conducive to the nature of the task. Further, the task environment can be considered to provide an external representation of the task.

2) The Psychology of the Subject

The psychology of the subject determines an internal representation of the task environment or problem space. The problem space refers to the psychological environment in which the problem solving activity takes place.

3) The Representation of the Problem

The representation of the problem is fundamental to the problem solving activity. The outcome of the initial stage of problem solving provides a representation of the problem, as seen by the problem solver. Representation of the problem throughout its solution is significant, this occurs on both a physical and conceptual