

Workshop on Using Knowledge in its Context

Report of the Program Committee

This workshop will be held at Chambéry (France) on the 28th of August 1993, just before the Thirteenth International Joint Conference on Artificial Intelligence. The paper describes the current state of the discussion by electronic mail between the participants one month before the one-day workshop. For this reason, ideas that are presented in this paper belong to participants of the workshop. Hereafter, we present how the workshop has been organized, the main topics that have been proposed for discussion before the workshop to participants, and the early results of our discussion.

1. Introduction

Advances in multidisciplinary research are leading towards a new generation of Intelligent Assistant Systems (IASs) which are context-sensitive. It is hypothesized that 'knowledge' has a contextual component. If its importance is acknowledged, contextual component is rarely represented explicitly in available knowledge representations, and not used in subsequent processing of knowledge. There is a gap between what is known and what is done. Thus, acquisition, representation and exploitation of knowledge in context would have a major contribution in knowledge representation, knowledge acquisition, explanation, maintenance, documentation, learning, human-computer communication and validation/verification. A computational capability to understand, represent and reason about context will be very valuable and of immense benefit to many AI problems.

2. Workshop organisation

The call for papers focussed on computational principles and mechanisms for eliciting, modelling, and using the contextual aspect of knowledge, as well as techniques and tools for building context-sensitive systems. The problem was addressed through questions relevant to the notion of context such as: What is context? How can the notion of context be modeled? How can context be encapsulated in representation formalisms? What are the cognitive aspects linked to the notion of context? How does context influence human dialogues and how can it be taken into account in IASs? How to exploit the notion of context in human-computer interaction (assistance to user, explanations, etc.)? What is the role of the notion of context in a computer-supported cooperative work?

Deadlines were set very early for the workshop. It was planned that participants should interact by electronic mail before the workshop to devote the whole one-day workshop to presentation of synthetic or controversial viewpoints on topics selected on the basis of the received papers. For reaching this goal, proceedings have been sent three months before the workshop. Also, an electronic book--using hypertext techniques--would present results of the discussion held during the workshop.

Thirteen papers have been selected. Participants come from different disciplines such as, cognitive science, knowledge representation, knowledge acquisition, explanations, knowledge assimilation, human computer interaction and navigation.

3. Proposed topics for discussion before the workshop

On the basis of the received papers, the Program Committee selected four topics on context: its position, its elements, its representation, its use(s).

1) Position of context: This aspect concerns what context is with respect to other entities like situation, behavior, point of view, relationships among agents, discourse, dialogue, application-dependency. Is context a process or a state? Three examples illustrate this topic. In explanation, the use of the context would permit tailoring a system answer to a user, including various information pieces. In knowledge acquisition, the explicit use of the context may limit the domain of validity of the acquired knowledge

and indicate its correct moment of use. In diagnosis, the explicit use of the context may limit the search to a small set of assumptions.

2) Elements of the context: This aspect deals with various things like objects of the domain and the task at hand, but it also concerns the organization(s) of the elements, the mechanisms for managing them, the way in which these elements either are at domain knowledge level or can manage domain knowledge at a more abstract level. Moreover, it would be interesting to determine what really are the dimensions of the context such as time, space (itself multi-dimensional), variables of the system (some could be dependent on user profiles or models...), etc. Is it sufficient to add a time dimension to take into account the context? Does context simplify the building of knowledge bases? Is context nested in chunks of knowledge or, conversely, are chunks of knowledge nested in context(s)? Is context an object of the domain? Can we decontextualize knowledge?

3) Representation of the context: First, there is a need to study how the way to represent context depends on the choice that is made of a representation formalism. Some of the participants think that logic is the "right" formalism, others think that conceptual graphs are better. There are other formalisms of representation that are candidates too. What are the possible formalisms that allow explicit representation of context? What are the advantages and drawbacks of each? For a given formalism, which aspects of context are easy or difficult to represent? What kinds of reasoning using context are then allowed? What are the comparison criteria of two formalisms with respect to context? Such questions are important because it seems necessary to specify the position of the definition of what a context is with respect to the formalism of representation that is used. Indeed, studies show how context is represented in various formalisms (characteristics, advantages, disadvantages, etc.). However, there is no attempt to merge all these descriptions at a "conceptual level."

4) The uses of context: A priori, there seem to be two uses of context: one for an internal management of knowledge pieces and the other one for communication management with a user. Which representation formalisms allow reasoning in context? How must we use context to extract and present the relevant pieces of knowledge? Is context more important in some domains (e.g., linguistics) than in other ones? Is activity a process of contextualization?

It rapidly appeared that one can not consider one of these topics independently of the others. Moreover, it is also difficult to speak of context independently of its uses. A third difficulty was that participants are interested by the notion of context in very different domains (logic, communication, knowledge acquisition, explanation, diagnosis, etc.). Thus, we have limited our ambition, beginning by clarifying the basic definitions and highlighting alternatives. We could try to arrive at a condensed view of the ideas and insights that we will develop. We present hereafter the result of the interaction of participants by e-mail. The conclusion of the one-day workshop would be the subject of another paper.

4. Some results of participants' interactions

Cognitive processes are contextual: they depend on the environment, or context, inside which they are carried on. Indeed, this is a problem in knowledge acquisition: The knowledge is acquired without its context of validity. An explicit representation of contextual knowledge is essential for knowledge acquisition and for reducing conflicting information.

It also is important to establish context in reasoning (e.g., for explaining), and for obtaining relevant interpretations on observations and events. Note that interpretation transforms data into information in a given context (data contextualization). One advantage to make explicit context in a representation is the capability of inference within and among contexts, making explicit the change in the reasoning across contexts. Context-sensitive reasoning may be seen as a generalized form of case-based reasoning.

Intelligent behavior is constrained by context too. Context modulates behavior by affecting the actions used to achieve goals as well as the timing and manner of those actions. Contextual information (e.g., applicability conditions, preconditions, filter conditions) helps the agent to focus its attention on appropriate goals to achieve in the current situation and speed up problem solving behavior.

The elements that play a role in determining the context are: The problem-solving memory (task, methods, results expected, content of the knowledge base and its representation, the system); The participants (expertise, beliefs, goals and plans); The mode of interaction (single vs. multiple participants, medium, feedback); The dialogue memory (communicative goals, rhetorical means, already shared knowledge); the environmental situation (general knowledge about the world, psychosocial situation). Making explicit such an implicit knowledge in the current interaction would permit to assimilate these contextual components to dynamic "knowledge bases." Contextual components change in time by elaboration and shift. Thus, it is important to consider the two aspects of contextual knowledge: (1) a static aspect (knowledge that remains constant throughout the interaction); (2) a dynamic aspect (knowledge which changes throughout the interaction).

There are several notions of "context," each of which is associated with different uses: context in natural language; context as a set of assumptions for reasoning; context in situated action and cognition (indexicality, background conditions, cultural background). However, it is not yet clear whether contexts are used differently across uses. One problem is that there are many instances of papers discussing aspects of context that are different. It seems difficult now to merge all considerations on the notion of context at a 'conceptual level' because one must first define what we want to do with context. Thus, the analysis of the different notions of context is a prerequisite to answering this question.

Thus, the context in which interaction occurs--the current context--changes in time and is multi-dimensional. Indeed, all communication assumes a context. It is not the unique difficulty: The current context is sometimes considered as an instance of a class of contexts. For instance, there are the context of the application and those of the user. Current context has been presented as the physical/real memory, and other contexts as virtual memory. A central issue associated with the notion of context is the study of the relations between contexts and their organization. Using a contextual representation gives us much greater control over the knowledge. Indeed, making explicit context in representations may facilitate the expression of the control in knowledge bases. It will be really relevant if contextual knowledge may be integrated into problem solving.

Different representation formalisms attempt to express context: extended logic, Sowa's conceptual graphs, etc. Some ones are discussed in the participants' papers. One of the main focuses concerns the means to link contexts and concepts. For instance, one of the workshop participants relates concepts through context relations. These are higher-order relations that constrain the interpretations of all other relation types in the framework and delimit the "scope" of the description of a concept in the network. They specify conditions in which the description of the denoted concept is valid, and allow this description to vary, if necessary, from the basic entity. In this sense, the context relation induces a "context network"--a hyper-network--among all concepts defined in the knowledge base. However, it is not yet clear whether the notion of context is independent of the representation formalism, and how to represent contexts.

5. Conclusion

Context is something that is ill-defined and no-one really knows what context is. This is one of the main messages coming through all the submitted papers and if one does any reading in this area, it is the view that quickly appears. One of the goals of the workshop will be to clarify some basic definitions of the context and point out alternatives. This would be done if we could condense the ideas and insights on this topic to explicate the essential things on context.

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The proceedings are available from the chairperson of the workshop (Research Report 93/13 of LAFORIA).