EXPERIENCE, MEMORY, AND REASONING

Edited by

Janet L. Kolodner
Christopher K. Riesbeck

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Preface

Several years ago, during a reunion banquet at the national Artificial Intelligence conference in Washington, DC, some of us were commiserating over the fact that the national and international AI conference had grown too big. The largeness and diversity of the conferences made it hard to do two things: to learn in detail about what others were doing and to present our own work at a satisfying level of detail. It seemed obvious that the thing to do was to begin having a series of smaller, more intimate thematic workshops devoted to presenting research ideas in detail.

The First Annual Workshop on Theoretical Issues in Conceptual Information Processing (TICIP) grew out of that. It was held in Atlanta, Georgia in March 1984 and included 50 people with roughly the same world view. In particular, all of us were interested in content-based theories of conceptual information processing. Despite this, our call for papers for the workshop elicited papers on a wide variety of topics: learning, parsing, creativity, problem solving, representation, and memory organization are just some of the topics that were discussed. Although topics were diverse, everyone was interested in a set of basic issues: What do people know? How do they use that knowledge to reason?

What we didn't know before we set up the workshop was that a majority of the papers would converge on a theme: the relationships between memory, experience, and reasoning. It has long been acknowledged that reasoning depends on heuristics or knowledge gleaned through experience. Thus, one relationship between reasoning and experience is already well-defined. We now add memory to the duo of experience and reasoning. How does memory fit in? The knowledge coming from experience that is used for reasoning must

be gleaned from an accumulation of many experiences. Those experiences do not necessarily come in the right order for learning. Yet, we, as people, learn from experience anyway. A memory stores experiences to allow learning to happen on the basis of several experiences. Furthermore, reasoning capabilities evolve as new knowledge is learned.

In addition, heuristic knowledge compiled from many experiences is not the only way we use experience in reasoning. Often, a *particular* previous experience acts as a guide in allowing us to construct a solution to a new problem. If we are *reminded* of a previous case similar to one we are trying to solve, we can use it as a guideline for solving the new one. Memory also stores experience, then, to be recalled to guide later processing. When we consider the role of a memory holding experiences, we also begin considering additional reasoning processes, namely those that consider previous individual cases to make new decisions. The name that has been coined for this view of intelligence is *memory-based reasoning.*

The chapters in this collection are based on presentations made at the First Annual TICIP Workshop. Each chapter addresses some issue associated with the relationships between memory, experience and reasoning. In considering representation, for example, the representation of episodes (experiences) is a major issue, as is their organization in a long-term memory for experience. Chapters in the understanding section consider the relationships between understanding processes and the memory store, including how we can expect knowledge to be organized in that store for access by understanding processes, how it can be updated as part of the understanding process, and what new processing considerations become important when we look at understanding in its relationship to memory. In the hypothesis generation section, a framework explicitly citing the relationships between problem solving, learning, and memory processes is presented, and other chapters explore issues associated with explaining why things have happened and justifying decisions, two reasoning processes that depend heavily on experience.

This book presents a first view of the issues associated with memory-based reasoning. There is much research currently being done along the lines presented in this book, both by those whose chapters are in this book and by others. This book presents an introduction to what we believe will prove to be an important approach to unraveling the mysteries of cognition and AI.

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Christopher K. Riesbeck

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1 Introduction

The chapters in this volume, though different in topic, style, and even scientific discipline, all share a common theme: that knowledge is first and foremost the product of experience. This obvious truth about human knowledge has significant ramifications for artificial intelligence (AI) and cognitive science. It means that to understand human knowledge and how it is organized and applied, we have to understand how it was acquired. It means that to claim that a representation of knowledge is adequate, we have to show how that knowledge could be learned and how it could be updated in the face of new experience.

KNOWLEDGE AND AI

The importance of knowledge for intelligence is one of AI's few consensual beliefs. Knowledge, in large quantities organized into usable chunks, is an essential ingredient of a great deal of intelligent behavior. How to chunk knowledge about the world to make it usable for reasoning is an unavoidable problem in AI research. The real world is full of objects and tableaux that have no identifying labels to help the visitor. To understand the world, we must carry around in our heads a field guide, a guide so large that the quality of its index is a major factor in the usefulness of the guide.

The metaphor is incomplete, however, until we make one further point: the guide is really a notebook that each of us writes and maintains. We are born with pencil and paper and have to take it from there. As a result, we each have a different field guide, in our own handwriting, with illegible scribbles, mistakes, corrections, and redundancies, and at no point can we stop and say that the book is complete.