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Agent Technology Handbook

代理技术手册

Dimitris N. Chorafas

KQML

WebBots and
Virtual Agents

Agents for Y2K

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Dimitris N. Chorafas



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PREFACE

One of the first concepts taught in a school of journalism is a working definition of *news*. An airplane's taking off and landing on schedule is not news. By contrast, an airplane that explodes after takeoff because of an act of terrorism is *breaking news*, the development of *agents* has not been breaking news yet—but they are making significant inroads with business applications, particularly in telecommunications.

Like all books aiming to provide readers with a competitive edge this text is written for people who want to be leaders in information technology. Its focus on *agents* is motivated by the fact that their usage increases the performance gap between organizations that know *how to use* information systems effectively and those that don't. Companies that fall behind do so for one of the following reasons:

- They lack appropriate human capital.
- Their culture does not permit them to get off the beaten path.

Precisely for this reason, the target of this book is business professionals: From systems administrators to network specialists and software developers. While telecommunications has been chosen as the implementation area, the text is aimed at all practitioners who want to develop new software paradigms required for advanced applications.

As the careful reader will discover, this book presupposes no knowledge of mathematics or programming practices. Its first objective is that of defining the fundamentals of new information technology. Then it moves quickly to the practical use of agents for real-life problems.

Existing theory is presented to the extent needed to understand the operation and performance of knowledge artifacts and to describe their context. But the main theme is the implementation of agents in a fast-growing information landscape. During the course of this book the reader is prompted to bring up real problems from his or her own work—and more precisely, problems that he or she wishes to solve through novel approaches.

Since technology is now such a basic ingredient of everyday life—not to mention that it serves as the nervous system of any company seeking success in the marketplace—the knowledge and appreciation of the latest

technological developments is a "must." Based on these premises, this book addresses in a comprehensive and comprehensible manner three of the key issues in information technology:

- The growing use of interactive agents
- The advantages agents provide in computer applications
- The architectural challenges agents can present and engender

Typically, the reader of this book will be the person who feels the need to update his or her skills and knowhow, and thereby to be a leader in his or her field. But, by its very nature, technological leadership is ephemeral, and this is true not only for persons and companies, it is also true for nations.

At one point in their histories, all the great civilizations—China, Egypt, Greece, and Rome, as well as Britain, France, Germany, Japan, and America—have held the contemporary state of the art in their hands. Always, their worst enemies have been misunderstanding, miscommunication, and inertia. Also a superiority complex has plagued them: "This was not invented here, so it can't be any good."

To survive in the fiercely competitive market that characterizes the global economy, we must always be ready to learn from others. We should never be satisfied with anything but the best. That is why this book is based on worldwide research, bringing to the reader's attention the best solutions and case studies.

The foregoing principles guided the effort leading to the text the reader has in his or her hands. This textbook is divided into three parts, and a total of 13 chapters.

Part 1 focuses on the concepts underpinning the development and practical implementation of *agents*. These intelligent artifacts can be seen as the new generation of expert systems—which are relatively *autonomous* and able to operate interactively from wherever they reside, in workstations, servers, and communications nodes.

The case of the new software paradigm is presented in a convincing manner in Chap. 1. A great deal is demonstrated by means of an advanced research and development project, the "Things That Think" project by the Media Laboratory of the Massachusetts Institute of Technology—and also through the ideas of Alan Kay, John von Neumann, and Alan Turing.

Chapter 2 looks at agents from a different viewpoint: the facts and opportunities they present in connection to knowledge workers. It covers virtual engineering and focuses on a major implementation example: the Mondrian project at MIT. It also examines the practical aspects of the new metaphors, particularly those related to human interfaces.

Following on the steps of these practical examples, the approach taken by Chap. 3 is more generic. The goal is to examine ways and means currently in use for exploiting intelligence and expertise. First, the notion of intelligence is defined; then its impact is analyzed all the way to deciding on the right kind of predicates to be used.

Chapter 4 is practical, providing the reader with what he or she needs to appreciate about the Knowledge Query and Manipulation Language (KQML) and Telescript. It also advises on how to morph expert systems into agents, offering examples as well as outlining the reasons underpinning this transformation.

It has been a deliberate choice in the design of this book to split the more theoretically oriented chapters into two parts and between them to insert a golden horde of practical examples on agents' implementation.

Telecommunications has been chosen as the applications landscape because:

- It is the fastest-growing field where agents are put to use.
- It is the most promising implementation domain for the coming years.

The use of agents in networks, mobile computing, security, reliability, and diagnostics is the theme of Part 2. Chapter 5 looks at agents as the new catalyst of telecommunications solutions. The pioneering restructuring of ISO's Open Systems Interconnection (OSI) cannot be done without agents—as the reader will see in this chapter through practical examples.

The use of agents in connection to security is the point of attention of Chap. 6. Examples are taken from the Internet as well as from other public networks and from private communications solutions. Emphasis is placed on mission-critical applications as well as on nonlinear, nontraditional approaches to security.

Because most of the important projects being developed today involve software-hardware codesign, the role of agents in this domain is considered in detail in Chap. 7. One of the subjects that are examined is the support that the Internet Protocol, version 6 (IPv6), can give to security. Another topic included in this chapter is the impact of competitive access providers to the international telecommunications market.

Chapter 8 addresses agents in connection with network reliability, diagnostics, and maintenance. Here again, the emphasis is on practical applications: the benefits agents provide through the exploitation of the intelligence they possess, the fact that they act as vehicles for other func-

tions, and their ability to communicate with other agents and with end users, thereby enhancing system dependability.

Agents represent the true automation of programming products. This is the theme of Part 3. The five chapters of this part examine how the reader can develop his or her own agents, the concepts that will assist him or her in this effort, the more attractive domains regarding business applications, and what he or she must consider to maximize the effect of his or her investment.

Chapter 9 explains through practical examples and quotations the culture that is necessary in developing agents. "The information revolution has changed our perception of wealth. We originally said that land was wealth. Then we thought it was industrial production. Now we realize it's intellectual capital," suggests Walter Wriston, former CEO of Citibank.

Returning to the fundamentals, Chap. 10 focuses on the support to mission-critical applications provided by intelligent software. It considers organizational issues, mathematical notions, and applications requirements. It also explains how and why the knowledge artifacts must be proactive. Marketing operations are taken as an implementation example.

Chapter 11 elaborates on the concepts that enter into the development and use of autonomous agents, demonstrating how they can be used to shrink time-to-market requirements. Examples are taken from a banking environment, specifically loans and investment advice, and merchandizing. Another case study looks at the use of agents in personal communications.

Chapter 12 summarizes the agent story, and at the same time it introduces some other applications in which the use of agents can be of service, such as further uses of morphism and patterning. One of the applications examples is telemedicine; another is value analysis. Chapter 11 also addresses the issues associated with the productization of agents.

The issues connected to a business architecture that can accommodate and make good use of agents and multiagents are the theme of Chap. 12. This text covers primitives and facilitators for the Internet and intranet solutions, reviews the role of Uniform Resource Locators (URLs), and takes the year 2000 and European Monetary Unit (EMU) problems as practical examples of a domain where agent technology can be quite helpful.

Professionals, companies, and nations that over the years declined in their standing did so because they allowed their technological advantage to wither away. As their competitive position slipped from leadership in research, development, and implementation (RD&I), they also surren-

dered other forms of leadership. Professionals lost their employment, companies dropped behind their competition, and nations were no longer the world players that they used to be.

While high technology will not necessarily guarantee success, lack of it is the best prescription for failure. This is a factual statement, documented through many examples from manufacturing, merchandizing, and banking—as well as from very competitive interdisciplinary sectors such as telecommunications.

This book is intended for anyone who is interested in the use of advanced technology in his or her daily business. Readership includes engineers, managers, marketing people, computer scientists, and those interested in planning, designing, and operating networks.

The book is also addressed to science students and students in information technology. The 13 chapters this book contains provide a preview of the direction software technology will be taking in the next few years.

Let me close by expressing my appreciation to everyone who contributed to the research, and therefore to making this book successful. A complete list of companies, senior executives, and computer specialists is found in the acknowledgments. Particular mention should be made of the advice by Anthony J. Zawilski for his many useful suggestions in restructuring this text, and of the assistance provided by Ulrich Rimensberger in connection to KQML and the Year 2000 Problem. I am indebted to John Wyzalek and Steven Elliot for having seen this book through production, to Paul Sobel for supervising the editing work, and to Eva-Maria Binder for the artwork, the typing of the manuscript, and the index.

DR. DIMITRIS N. CHORAFAIS

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PART

Concepts Underpinning the Development and Use of Agents



CHAPTER

1

The New Software Paradigm “Things That Think”

“Come to me for advice, if that’s what you want, but don’t come to me for a decision,” Amadeo P. Giannini, the man who made Bank of America, was saying to his assistants. Suspicious of those who seemed overly eager to agree with him, he would shout: “Are you yessing me?”

*Felice A. Bonadio, *A. P. Giannini, Banker of America*, University of California Press, Berkeley, 1994.