Building Intelligent Interactive Tutors
Student-centered strategies for revolutionizing e-learning

Beverly Park Woolf
Department of Computer Science,
University of Massachusetts, Amherst
For Tao Roa, Ora Ming, and Nessa Rose
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Preface

These are exciting and challenging times for education. The demands of a global society have changed the requirements for educated people; we now need to learn new skills continuously during our lifetimes, analyze quickly, make clear judgments, and exercise great creativity. We need to work both independently and in collaboration and to create engaging learning communities. Yet the current educational establishment is not up to these challenge; students work in isolation on repetitive assignments, in classes and schedules fixed in place and time. Technologic and scientific innovations promise to dramatically enhance exiting learning methods.

This book describes the use of artificial intelligence in education, a young field that explores theories about learning and builds software that delivers differential teaching, systems that adapt their teaching response after reasoning about student needs and domain knowledge. These systems support people who work alone or in collaborative inquiry. They support students to question their own knowledge, and to rapidly access and integrate global information. This book describes how to build these tutors and how to produce the best possible learning environment, whether for classroom instruction or lifelong learning.

I had two goals in writing this book. The first was to provide a readable introduction and sound foundation to the discipline so people can extract theoretical and practical knowledge from the large body of scientific journals, proceedings, and conferences in the field. The second goal was to describe a broad range of issues, ideas, and practical know-how technology to help move these systems into the industrial and commercial world. Thanks to advances in technology (computers, Internet, networks), advances in scientific progress (artificial intelligence, psychology), and improved understanding of how people learn (cognitive science, human learning), basic research in the field has expanded, and the impact of these tools on education is beginning to be felt. The field now has a supply of techniques for assessing student knowledge and adapting instruction to learning needs. Software can reason about its own teaching process, know what it is teaching, and individualize instruction.

This book is appropriate for students, researchers, and practitioners from academia, industry, and government. It is written for advanced undergraduates or graduate students from several disciplines and backgrounds, specifically computer science, linguistics, education, and psychology. Students should be able to read and critique descriptions of tools, methods, and ideas; to understand how artificial intelligence is applied (e.g., vision, natural language), and to appreciate the complexity of human learning and advances in cognitive science. Plentiful references to source literature are provided to explicate not just one approach, but as many as possible for each new concept. In a semester course, chapters might be presented weekly in parallel with recent research articles from the literature. Weekly assignments might invite students to critique the literature or laboratory activities and a final project require teams of students to develop detailed specifications for a tutor about a topic chosen by the team.
This book owes a debt of gratitude to many people. The content of the chapters has benefited from comments by reviewers and colleagues, including Ivon Arroyo, Joseph Beck, Glenn Blank, Chung Heong Gooi, Neil Heffernan, Lewis Johnson, Tanja Mitrovic, William Murray, Jeff Rickel, Amy Soller, Mia Stern, Richard Stottler, and Dan Suthers. I owe an intellectual debt to my advisors and teachers, including Michael Arbib, Paul Cohen, David McDonald, Howard Peelle, Edwina Rissland, Klaus Schultz, Elliot Soloway, and Pearl and Irving Park. Tanja Mitrovic at the University of Canterbury in Christchurch, New Zealand, provided an ideal environment and respite in which to work on this book.

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The work of the readers of this book (students, teachers, researchers, and developers) is key to the success of the field and its future development. I want to know how this book does or does not contribute to your goals. I welcome your comments and questions, and suggestions for additions and deletions. Please write to me at the e-mail below (its@cs.umass.edu) or use the e-mail link at the web site. I will carefully consider all your comments and suggestions.

Beverly Park Woolf  
Department of Computer Science  
University of Massachusetts  
Amherst, MA 01003