Advances in Decision-Theoretic AI: Limited Rationality and Abstract Search

by

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S.B., Symbolic Systems
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Submitted to the Department of Electrical Engineering
and Computer Science in partial fulfillment
of the requirements for the degree of

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Abstract

This thesis reports on the current state of ongoing research by the author and others investigating the use of decision theory—its principles, methods, and philosophy—in Artificial Intelligence. Most of the research discussed in this thesis concerns decision problems arising within the context of Computer Game-Playing domains, although we discuss applications in other areas such as Clinical Decision-Making and Planning as well. We discuss in detail several AI techniques that use decision-theoretic methods, offer some initial experimental tests of their underlying hypotheses, and present work on some new decision-theoretic techniques under development by the author.

We also discuss some attempts, by the author and others, to transcend a few of the limitations of the earlier approaches, and of traditional decision theory, and synthesize broader, more powerful theories of abstract reasoning and limited rationality that can be applied to solve decision problems more effectively. These attempts have not yet achieved conclusive success. We discuss the most promising of the current avenues of research, and propose some possible new directions for future work.

Thesis Supervisor:

Dr. Jon Doyle
Principal Research Scientist, Laboratory for Computer Science

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