

Contents

1. Introduction	1
<i>Pei Wang and Ben Goertzel</i>	
1.1 The Matter of Artificial General Intelligence	1
1.2 The Matter of Theoretical Foundation	3
1.3 The Matter of Objective	4
1.4 The Matter of Approach	5
1.5 Challenges at the Heart of the Matter	6
1.6 Summary	7
Bibliography	8
2. Artificial Intelligence and Cognitive Modeling Have the Same Problem	11
<i>Nicholas L. Cassimatis</i>	
2.1 The Intelligence Problem	11
2.2 Existing Methods and Standards are not Sufficient	13
2.3 Cognitive Modeling: The Model Fit Imperative	16
2.4 Artificial Intelligence and Cognitive Modeling Can Help Each Other	21
2.5 Conclusions	24
Bibliography	24
3. The Piaget-MacGuyver Room	25
<i>Selmer Bringsjord and John Licato</i>	
3.1 Introduction	25
3.2 More on Psychometric AGI	28
3.3 Descartes' Two Tests	34
3.4 Piaget's View of Thinking & The Magnet Test	35
3.5 The LISA model	38
3.6 Analogico-Deductive Reasoning in the Magnet Test	39
3.7 Next Steps	45
Bibliography	46

4. Beyond the Octopus: From General Intelligence toward a Human-like Mind	49
<i>Sam S. Adams and Steve Burbeck</i>	
4.1 Introduction	49
4.2 Octopus Intelligence	50
4.3 A “Ladder” of Intelligence	53
4.4 Linguistic Grounding	55
4.5 Implications of the Ladder for AGI	57
4.6 Conclusion	63
Bibliography	64
5. One Decade of Universal Artificial Intelligence	67
<i>Marcus Hutter</i>	
5.1 Introduction	68
5.2 The AGI Problem	70
5.3 Universal Artificial Intelligence	74
5.4 Facets of Intelligence	77
5.5 Social Questions	79
5.6 State of the Art	81
5.7 Discussion	83
Bibliography	84
6. Deep Reinforcement Learning as Foundation for Artificial General Intelligence	89
<i>Itamar Arel</i>	
6.1 Introduction: Decomposing the AGI Problem	89
6.2 Deep Learning Architectures	91
6.3 Scaling Decision Making under Uncertainty	94
6.4 Neuromorphic Devices Scaling AGI	99
6.5 Conclusions and Outlook	101
Bibliography	102
7. The LIDA Model as a Foundational Architecture for AGI	103
<i>Usef Faghihi and Stan Franklin</i>	
7.1 Introduction	103
7.2 Why the LIDA Model May Be Suitable for AGI	104
7.3 LIDA Architecture	105
7.4 Cognitive Architectures, Features and the LIDA Model	108
7.5 Discussion, Conclusions	117
Bibliography	118

8. The Architecture of Human-Like General Intelligence 123

Ben Goertzel, M. Iklé, and J. Wigmore

8.1	Introduction	123
8.2	Key Ingredients of the Integrative Human-Like Cognitive Architecture Diagram . .	125
8.3	An Architecture Diagram for Human-Like General Intelligence	128
8.4	Interpretation and Application of the Integrative Diagram	136
8.5	Cognitive Synergy	138
8.6	Why Is It So Hard to Measure Partial Progress Toward Human-Level AGI?	140
8.7	Conclusion	143
	Bibliography	144

9. A New Constructivist AI 145

Kristinn R. Thórisson

9.1	Introduction	145
9.2	The Nature of (General) Intelligence	147
9.3	Constructionist AI: A Critical Look	151
9.4	The Call for a New Methodology	156
9.5	Towards a New Constructivist AI	158
9.6	Conclusions	167
	Bibliography	169

10. Towards an Actual Gödel Machine Implementation 173

Bas R. Steunebrink and Jürgen Schmidhuber

10.1	Introduction	173
10.2	The Gödel Machine Concept	175
10.3	The Theoretical Foundations of Self-Reflective Systems	178
10.4	Nested Meta-Circular Evaluators	184
10.5	A Functional Self-Reflective System	186
10.6	Discussion	191
	Appendix: Details of Notation Used	192
	Bibliography	194

11. Artificial General Intelligence Begins with Recognition 197

Tsvi Achler

11.1	Introduction	197
11.2	Evaluating Flexibility	200
11.3	Evaluation of Flexibility	209
11.4	Summary	215
	Bibliography	216

12. Theory Blending as a Framework for Creativity in Systems for General Intelligence 219

Maricarmen Martinez et al.

12.1	Introduction	219
12.2	Productivity and Cognitive Mechanisms	221
12.3	Cross-Domain Reasoning	222
12.4	Basic Foundations of Theory Blending	226
12.5	The Complex Plane: A Challenging Historical Example	228
12.6	Outlook for Next Generation General Intelligent Systems	233
12.7	Conclusions	238
	Bibliography	238

13. Modeling Emotion and Affect 241

Joscha Bach

13.1	Introduction	241
13.2	Emotion and Affect	244
13.3	Affective States Emerging from Cognitive Modulation	246
13.4	Higher-Level Emotions Emerging from Directing Valenced Affects	250
13.5	Generating Relevance: the Motivational System	252
13.6	Motive Selection	257
13.7	Putting it All Together	259
	Bibliography	261

14. AGI and Machine Consciousness 263

Antonio Chella and Riccardo Manzotti

14.1	Introduction	263
14.2	Consciousness	264
14.3	Machine Consciousness	267
14.4	Agent's Body	270
14.5	Interactions with the Environment	271
14.6	Time	273
14.7	Free Will	274
14.8	Experience	275
14.9	Creativity	277
14.10	Conclusions	279
	Bibliography	280

15. Human and Machine Consciousness as a Boundary Effect in the Concept Analysis Mechanism 283

Richard Loosemore

15.1	Introduction	283
15.2	The Nature of Explanation	288
15.3	The Real Meaning of Meaning	297
15.4	Some Falsifiable Predictions	301
15.5	Conclusion	303
	Bibliography	304

16. Theories of Artificial Intelligence	305
<i>Pei Wang</i>	
16.1 The Problem of AI Theory	305
16.2 Nature and Content of AI Theories	308
16.3 Desired Properties of a Theory	312
16.4 Relations among the Properties	317
16.5 Issues on the Properties	318
16.6 Conclusion	320
Bibliography	321
Index	325