

Suggested Education for Future AGI Researchers

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The following list is a partial education plan for students interested in the research of [Artificial General Intelligence](#).

Notes:

1. The opinions expressed here are highly personal. Not only are the topics and reading materials selected according to my opinion, but also there are my own works included (they are distinguished from the others using square brackets).
2. This list is not intended to cover all relevant topics, but what I think the most important. Some crucial decisions are on what NOT to include, as well as on how to allocate time among the topics. Therefore, adding new topics into the list is not always a good idea.

Introductory Readings

The following materials can be read by anyone with a high-school education.

- [Computing machinery and intelligence](#), Alan M. Turing
- [Gödel, Escher, Bach: An Eternal Golden Braid](#), Douglas R. Hofstadter

A. Undergraduate-level Coursework

Each of the following topic can be covered by a one-semester undergraduate course, with the recommended textbook or similar materials.

1. **Discrete Mathematics**
[Discrete Mathematics and Its Applications](#), 7/E, Kenneth Rosen
2. **Probability and Statistics**
[A Modern Introduction to Probability and Statistics](#), 2/E, Dekking *et al.*
3. **Computer Programming**
[Java How to Program](#), 11/E, Deitel & Associates
4. **Data Structure and Algorithms**
[Data Structures and Algorithm Analysis in Java](#), 3/E, Mark Allen Weiss
5. **Operating System**
[Operating System Concepts](#), 9/E, Avi Silberschatz *et al.*
6. **Artificial Intelligence**
[Artificial Intelligence: Foundations of Computational Agents](#), 3/E, David Poole and Alan Mackworth
7. **Cognitive Psychology**
[Cognitive Psychology](#), 7/E, Robert J. Sternberg *et al.*

8. **Cognitive Neuroscience**
[Cognitive Neuroscience: The Biology of the Mind, 5/E](#), Michael Gazzaniga *et al.*
9. **Cognitive Linguistics**
[Cognitive Linguistics: A Complete Guide, 2/E](#), Vyvyan Evans
10. **Theory of Knowledge**
[Knowledge: A Very Short Introduction](#), Jennifer Nagel

B. Graduate-level Study

Each of the following topic can be covered by a one-semester graduate course (or upper-division undergraduate course), with the recommended textbook.

1. **Theoretical Computer Science**
[Introduction to Automata Theory, Languages, and Computation, 3/E](#), John E. Hopcroft *et al.*
2. **Philosophical Logic**
[Philosophy of Logics](#), Susan Haack
3. **Decision Theory**
[Rationality in Action: Contemporary Approaches](#), Paul K. Moser
4. **Reasoning Under Uncertainty**
[Uncertain Inference](#), Henry E. Kyburg Jr, Choh Man Teng,
5. **Machine Learning**
[Machine Learning](#), Peter Flach
6. **Categorization**
[Concepts: Core Readings](#), Eric Margolis, Stephen Laurence
7. **Memory**
[Human Memory: Theory And Practice, Revised Edition](#), A.D. Baddeley
8. **Perception and Action**
[Cognitive Robotics](#), Angelo Cangelosi, Minoru Asada
9. **Developmental Psychology**
[Theories of Developmental Psychology, 6/E](#), Patricia A. Miller
10. **Philosophy of Science**
[Philosophy of Science: The Central Issues, 2/E](#), J. A. Cover, Martin Curd

C. Readings on Advanced Topics

The following topic can be covered in graduate-level seminars using the listed materials.

1. **Research goal(s) of AI**
[From here to Human-Level AI](#), John McCarthy
[Human-level artificial intelligence? Be serious!](#), Nils J. Nilsson
[Universal Intelligence: A Definition of Machine Intelligence](#), Shane Legg, Marcus Hutter
[Position: Levels of AGI for Operationalizing Progress on the Path to AGI](#), Meredith Ringel Morris *et al.*
[\[On Defining Artificial Intelligence\]](#), Pei Wang, with [Commentaries and Author's Response](#)
2. **Limitation of AI**
[Minds, machines and Gödel](#), J. R. Lucas
[What Computers Can't Do](#), Hubert L. Dreyfus

[Minds, Brains, and Programs](#), John R. Searle

[The Emperor's New Mind](#), Roger Penrose

[\[Three Fundamental Misconceptions of Artificial Intelligence\]](#), Pei Wang]

3. Rationality

[Reasoning about a rule](#), Wason, P. C.

[Judgment under uncertainty: Heuristics and biases](#), Tversky, A., Kahneman, D.

[Models of Bounded Rationality](#), Simon, H. A.

[Bounded Rationality: The Adaptive Toolbox](#), Gigerenzer, G., Selten, R.

[\[The assumptions on knowledge and resources in models of rationality\]](#), Pei Wang]

4. Symbolic vs. connectionist AI

[Computer Science as Empirical Inquiry: Symbols and Search](#), Allen Newell, Herbert A. Simon

[Waking Up From the Boolean Dream, or, Subcognition as Computation](#), Douglas Hofstadter

[On the proper treatment of connectionism](#), Paul Smolensky

[Connectionism and Cognitive Architecture: a Critical Analysis](#), Jerry A. Fodor, Zenon W. Pylyshyn

[\[Artificial General Intelligence and Classical Neural Network\]](#), Pei Wang]

5. Machine learning

[Deep Learning](#), Yann LeCun, Yoshua Bengio, Geoffrey Hinton

[Deep Learning in Neural Networks: An Overview](#), Juergen Schmidhuber

[Attention Is All You Need](#), Ashish Vaswani *et al.*

[The Bitter Lesson](#), Rich Sutton

[\[Different Conceptions of Learning: Function Approximation vs. Self-Organization\]](#), Pei Wang, Xiang Li]

6. Non-classical computation

[Thinking may be more than computing](#), Peter Kugel

[Approximate Reasoning Using Anytime Algorithms](#), Shlomo Zilberstein

[Turing's Ideas and Models of Computation](#), Eugene Eberbach *et al.*

[\[Case-by-case Problem Solving\]](#), Pei Wang]

7. Credit assignment and resource allocation

[Principles of Meta-Reasoning](#), Stuart Russell, Eric Wefald

[Manifesto for an Evolutionary Economics of Intelligence](#), Eric B. Baum

[Properties of the Bucket Brigade](#), John Holland

[The Parallel Terraced Scan: An Optimization For An Agent-Oriented Architecture](#), John Rehling, Douglas Hofstadter

[\[Problem-Solving under Insufficient Resources\]](#), Pei Wang]

8. Term logics

[Term logic](#), Wikipedia

[Charles Sanders Peirce: Logic](#), Francesco Bellucci and Ahti-Veikko Pietarinen

[An Invitation to Formal Reasoning: The Logic of Terms](#), Frederic Sommers, George Englebretsen

[\[Toward a Logic of Everyday Reasoning\]](#), Pei Wang]

9. Uncertain probabilities

[Why probability probably doesn't exist \(but it is useful to act like it does\)](#), David Spiegelhalter

[Towards a unified theory of imprecise probability](#), Peter Walley

[Probabilistic Logic Networks](#), Ben Goertzel *et al.*

[\[Confidence as Higher-Order Uncertainty\]](#), Pei Wang]

10. Non-Tarskian semantics

[Holism, Conceptual-Role Semantics, and Syntactic Semantics](#), William J. Rapaport

[Logic without Model Theory](#), Robert Kowalski
[Procedural semantics](#), Philip N. Johnson-Laird
[Contentful Mental States for Robot Baby](#), Paul R. Cohen *et al.*
[\[Experience-Grounded Semantics: A theory for intelligent systems\]](#), Pei Wang]

11. Sensorimotor and cognition

[Intelligence without representation](#), Rodney A. Brooks
[How the Body Shapes the Way We Think: A New View of Intelligence](#), Rolf Pfeifer, Josh C. Bongard
[The symbol grounding problem](#), Stevan Harnad
[Perceptual symbol systems](#), Lawrence W. Barsalou
[The Ecological Approach to Visual Perception](#), James J. Gibson
[Action in Perception](#), Alva Nöe
[\[Perception from an AGI Perspective\]](#), Pei Wang, Patrick Hammer]

12. Analogy and metaphor

[The Analogical Mind](#), Dedre Gentner *et al.*
[Fluid Concepts and Creative Analogies](#), Douglas Hofstadter, FARG
[Metaphors We Live By](#), George Lakoff, Mark Johnson
[Case-Based Reasoning: Experiences, Lessons, & Future Directions](#), David B. Leake
[\[Analogy in a general-purpose reasoning system\]](#), Pei Wang]

13. Animal cognition

[Animal Minds: Beyond Cognition to Consciousness](#), Donald R. Griffin
[The Thinking Ape: Evolutionary Origins of Intelligence](#), Richard Byrne
[What is learning? On the nature and merits of a functional definition of learning](#), Jan De Houwer *et al.*
[Empirical Studies in Machine Psychology](#), Robert Johansson
[\[Issues in Temporal and Causal Inference\]](#), Pei Wang, Patrick Hammer]

14. Planning and decision making

[Robot's Dilemma Revisited: The Frame Problem in Artificial Intelligence](#), Zenon W. Pylyshyn
[Some Philosophical Problems from the Standpoint of Artificial Intelligence](#), John McCarthy, Patrick J. Hayes
[Reasoning about plans](#), James F. Allen *et al.*
[Reinforcement Learning: An Introduction](#), Richard S. Sutton and Andrew G. Barto
[\[Assumptions of decision-making models in AGI\]](#), Pei Wang, Patrick Hammer]

15. Motivation and emotion

[Human Motivation](#), David C. McClelland
[The Functional Autonomy of Motives](#), Gordon W. Allport
[Cognition and Motivation in Emotion](#), Richard S. Lazarus
[Who Needs Emotions?: The Brain Meets the Robot](#), Jean-Marc Fellous, Michael A. Arbib
[\[Motivation Management in AGI Systems, The Emotional Mechanisms in NARS\]](#), Pei Wang *et al.*]

16. Cognitive linguistics

[Cognitive Linguistics: Basic Readings](#), Dirk Geeraerts
[Language, Thought, and Logic](#), John M. Ellis
[\[Natural Language Processing by Reasoning and Learning\]](#), Pei Wang]

17. Self and Consciousness

[What is consciousness, and could machines have it?](#), Stanislas Dehaene *et al.*
[A Cognitive Theory of Consciousness](#), Bernard Baars
[Consciousness, Intentionality, and Causality](#), Walter J. Freeman

[Metacognition in computation: A selected research review](#), Michael T. Cox

[\[A Constructive Explanation of Consciousness\]](#), Pei Wang]

18. **Cognitive architecture**

[Unified Theories of Cognition](#), Allen Newell

[An Integrated Theory of the Mind](#), John R. Anderson, et al.

[40 years of cognitive architectures: core cognitive abilities and practical applications](#), Iuliia

Kotseruba, John K. Tsotsos

[\[Intelligence: From Definition to Design\]](#), Pei Wang]

19. **Robotics**

[An Introduction to AI Robotics](#), Robin R. Murphy

[Prospects for Human Level Intelligence for Humanoid Robots](#), Rodney A. Brooks

[Autonomous Mental Development by Robots and Animals](#), Juyang Weng et al.

[\[Solving a Problem With or Without a Program\]](#), Pei Wang]

20. **Agent and multi-agent system**

[The Society of Mind](#), Marvin Minsky

[Agent Technology: Foundations, Applications, and Markets](#), Nicholas R. Jennings, Michael J. Wooldridge

[Agent AI: Surveying the Horizons of Multimodal Interaction](#), Zane Durante *et al.*

[Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence](#), Gerhard Weiss

[\[From NARS to a Thinking Machine\]](#), Pei Wang]