ME 620 - Fundamentals of AI

Lecture 2: Introduction to Artificial Intelligence - II

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Intelligence requires Knowledge

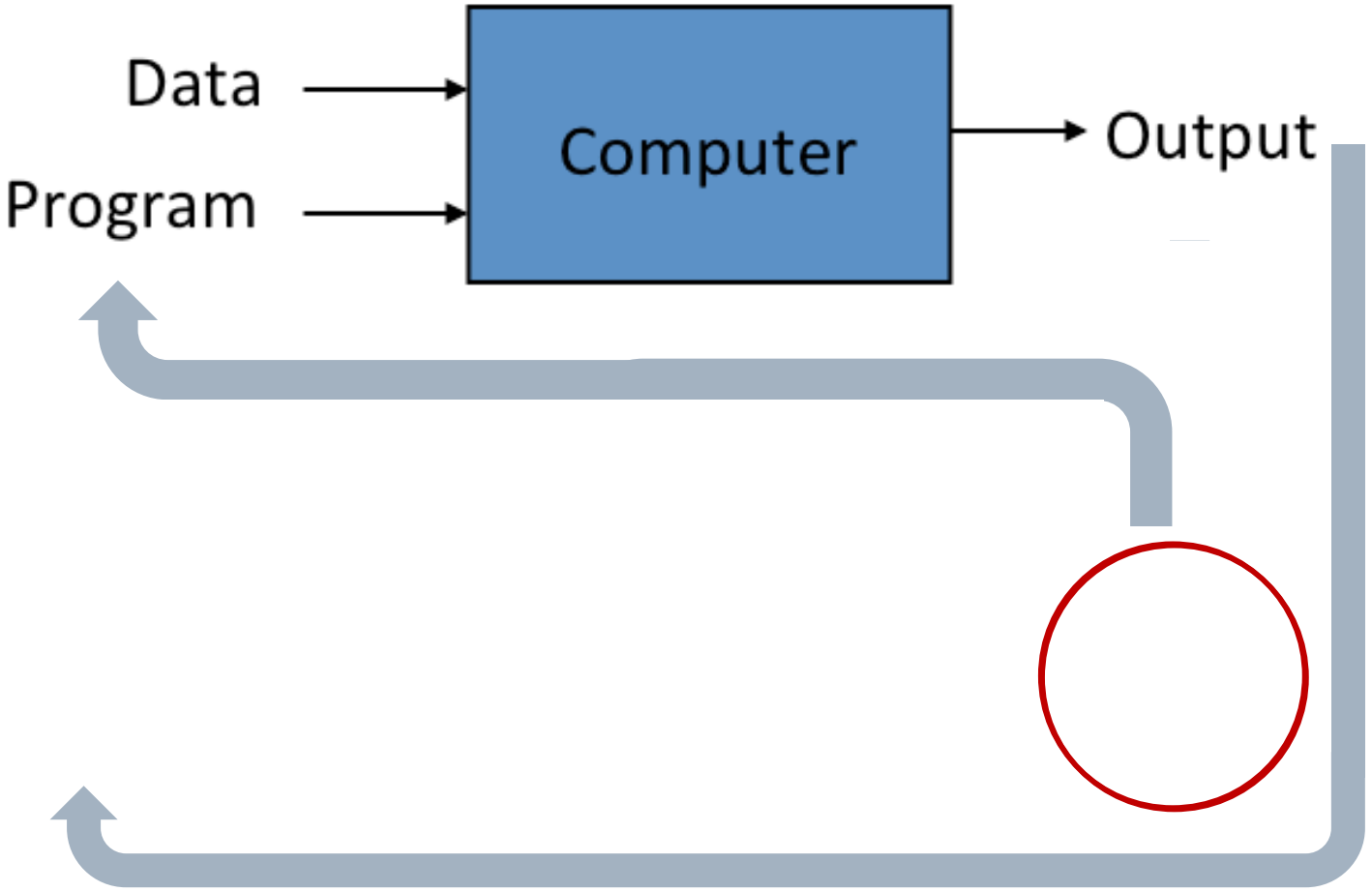
Knowledge accrues through a process of **learning.**

Machines need the **ability to explore the world** and **acquire the requisite knowledge** they need, for problem solving **on their own.**

Drives the idea of **Machine Learning.**

Machine Learning

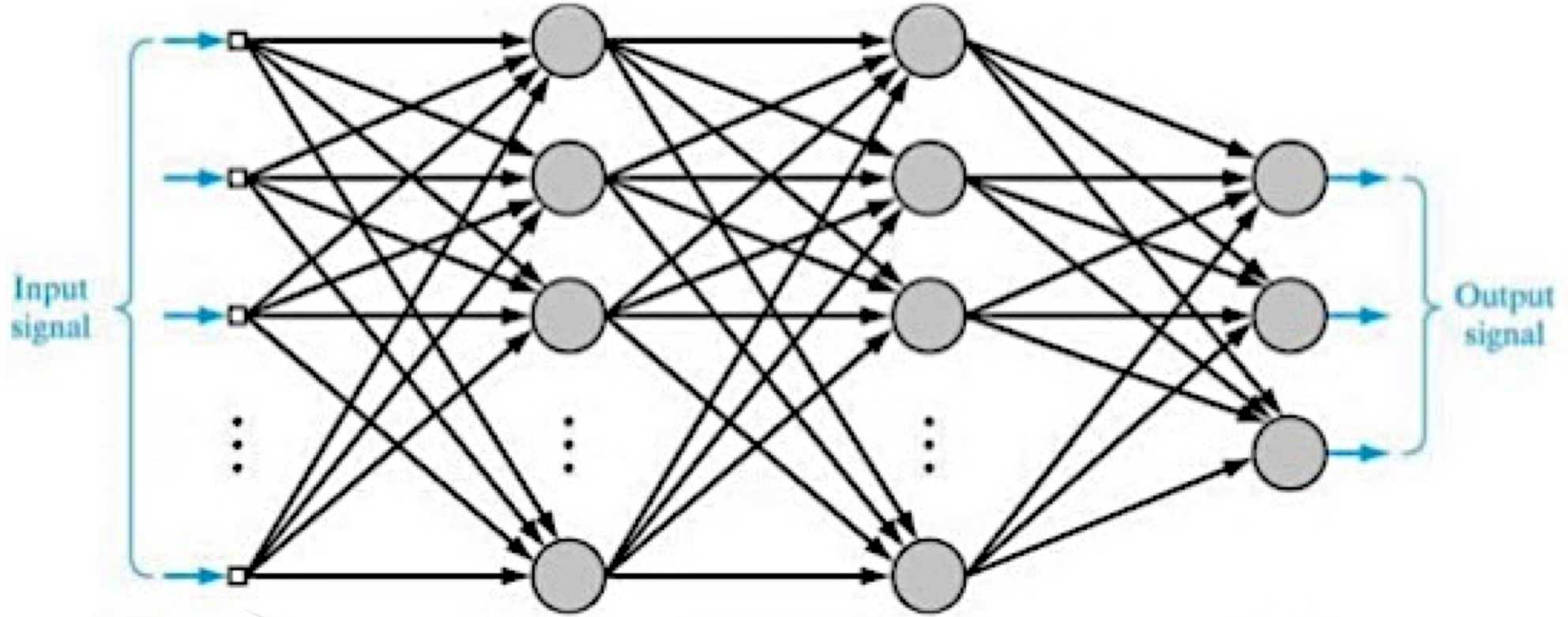
Traditional Programming



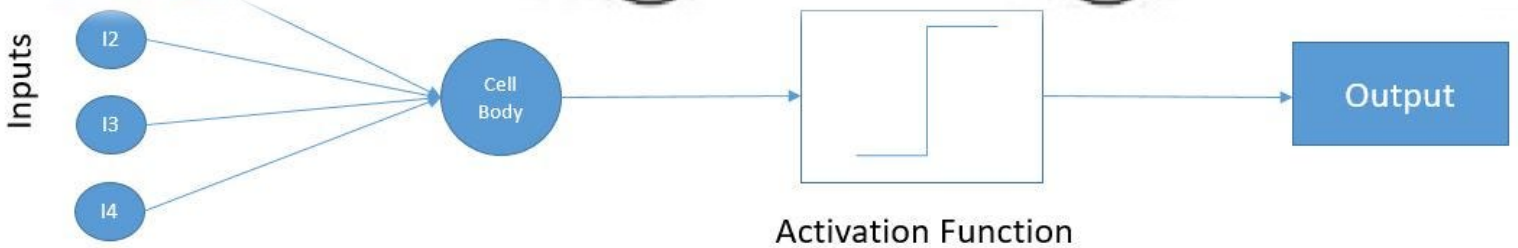
Machine Learning

Artificial Intelligence and machine learning are often used interchangeably. **Machine learning is a subset of Artificial Intelligence** and focuses on the **ability of machines to** receive a set of data and **learn** for themselves, **changing algorithms as they learn more** about the information they are processing.

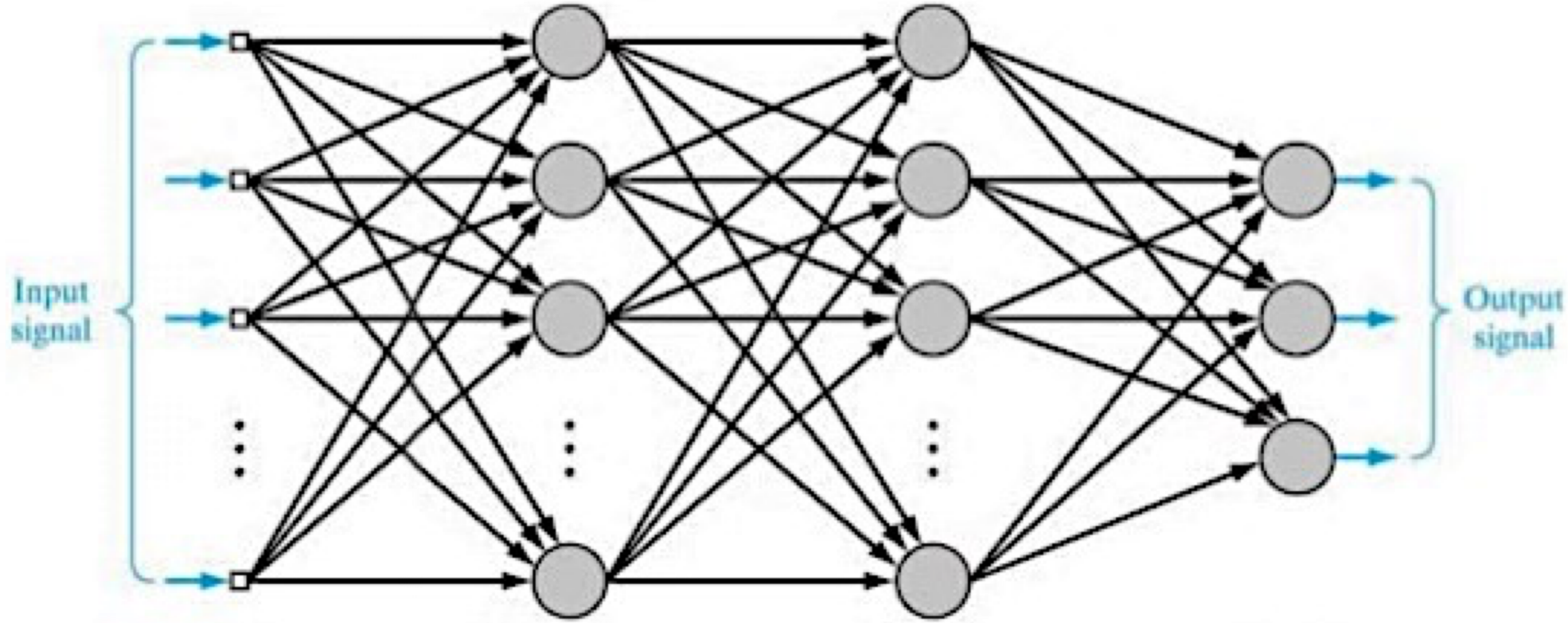
Artificial Neural Networks



Artific ational intelli ems.



Deep Learning



Deep Learning which uses either deep architectures of learning or hierarchical learning approaches is a class of ML. Uses Deep Neural Networks.

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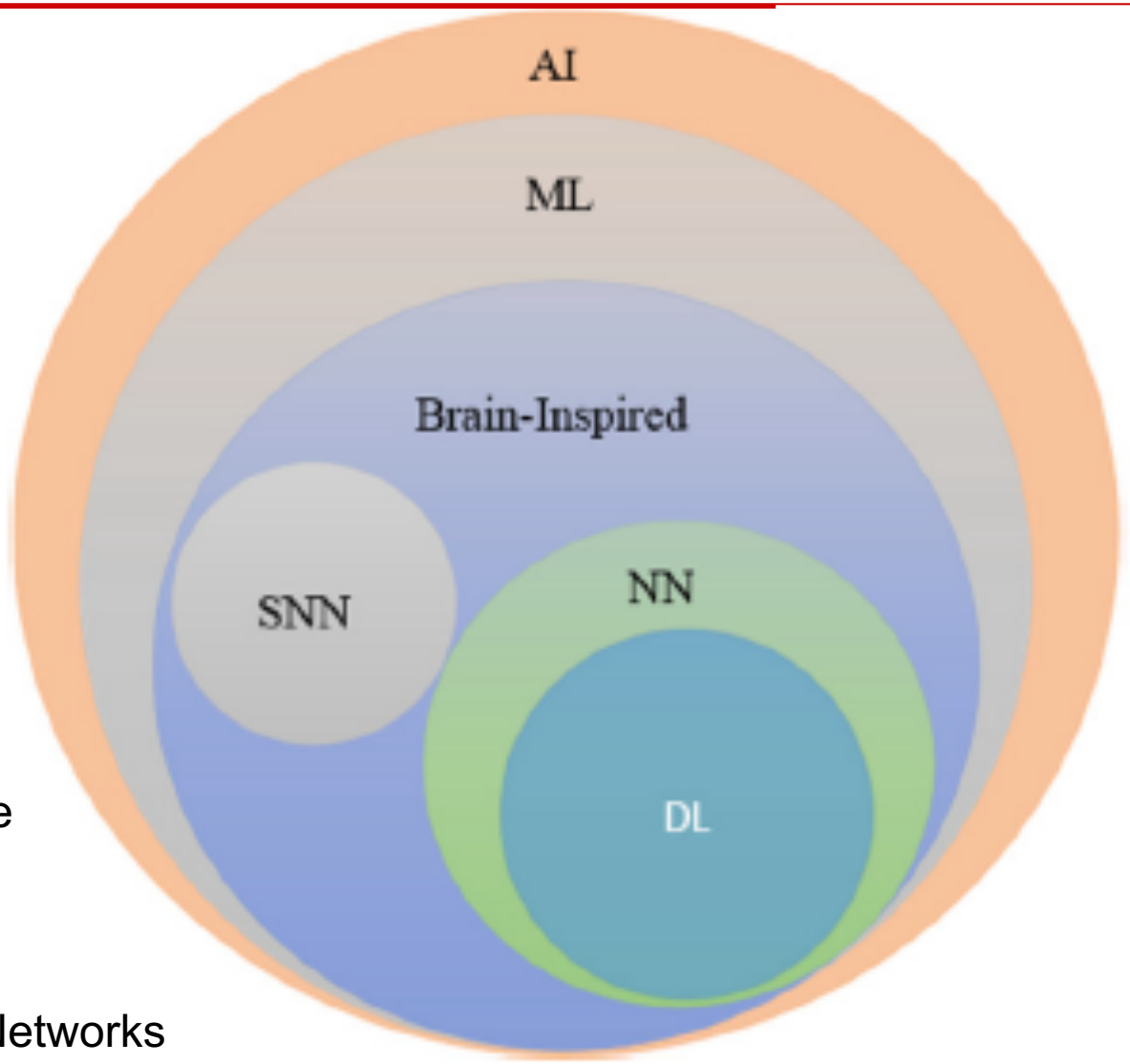
The Taxonomy of AI



AI: Artificial Intelligence
ML: Machine Learning
NN: Neural Networks
DL: Deep Learning
SNN: Spiking Neural Networks

Weak vs. Strong AI

Weak AI aims at building machines that act intelligently, without taking a position on whether or not the machines actually are intelligent.

Strong AI is the field devoted to building persons!

Charniak and McDermott (1985) concede in their classic introduction to AI that we are very far from achieving strong AI.

Weak vs. Strong AI

The ultimate goal of AI, which we are very far from achieving, is to build a person, or, more humbly, an animal.

Charniak & McDermott 1985

Charniak and McDermott don't say that the ultimate goal is to build something that appears to be a person. Their brand of AI is so-called strong AI, an ambitious form of the field aptly summed up by Haugeland.

Weak vs. Strong AI

The fundamental goal [of AI research] is not merely to mimic intelligence or produce some clever fake. Not at all. AI wants only the genuine article: machines with minds, in the full and literal sense. This is not science fiction, but real science, based on a theoretical conception as deep as it is daring: namely, we are, at root, computers ourselves.

Haugeland 1985

What is involved?

Interaction with the real world i.e., perceive, understand, and act. For example: a. speech recognition and b. image understanding.

Reasoning and planning involving a. modeling the external world b. planning and decision making and c. deal with unexpected problems and uncertainties.

Learning and Adaptation through Internal models being always updated such as a baby learning to categorize and recognize animals

What is involved?

Philosophy	Logic, Methods of reasoning, Mind as physical system, Foundations of Learning / Language Rationality.
Mathematics	Formal representation and Proof Theory Algorithms: computation – Decidability / Tractability
Statistics/ Probability	Modeling uncertainty, Learning from data
Economics	Utility, Decision Theory

What is involved?

Neuroscience	Neurons as information processing units.
Psychology/ Cognitive Science	How do people behave, perceive, process cognitive information, represent knowledge
Computer Engg.	Building fast computers
Control theory	Design systems that maximize an objective function over time
Linguistics	Knowledge Representation, Grammars

History of AI

1943: early beginnings

- McCulloch & Pitts: Boolean circuit model of brain

1950s: initial promise

- Turing's "Computing Machinery and Intelligence"
- Samuel's checkers program
  - First program of Machine Learning
- Early AI programs
  - Newell & Simon's Logic Theorist

History of AI

1955-65: Great enthusiasm!

- Dartmouth meeting
  - "Artificial Intelligence" name adopted
- Newell and Simon: GPS, general problem solver
- Gelertner: Geometry Theorem Prover
- McCarthy: invention of LISP

1966—73: Reality dawns

- Realization that many AI problems are intractable
- Limitations of existing neural network methods identified

History of AI

1969—85: Adding domain knowledge

- Development of knowledge-based systems
- Success of rule-based expert systems,
  - E.g., DENDRAL, MYCIN
  - But were brittle and did not scale well in practice

1986 onwards : Rise of machine learning

- Neural networks return to popularity
- Major advances in machine learning
  - Algorithms and Applications

History of AI

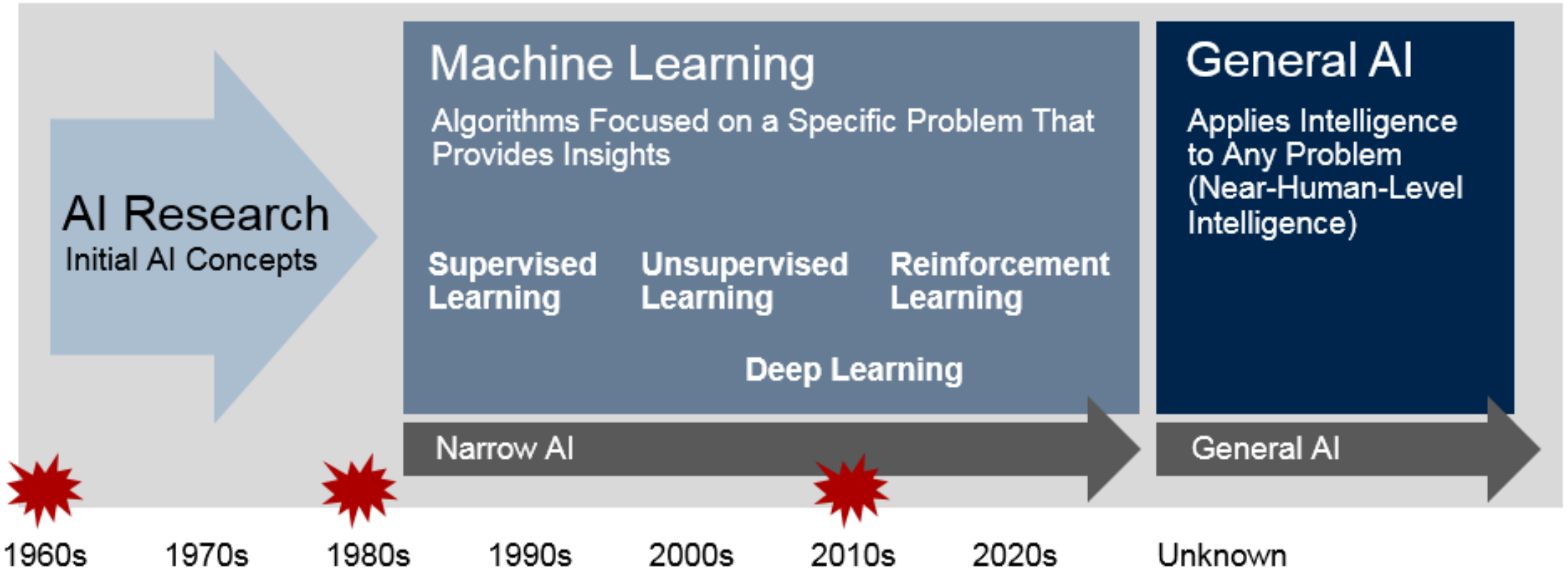
Beginning 1990: Role of uncertainty

- Bayesian networks
  - knowledge representation framework

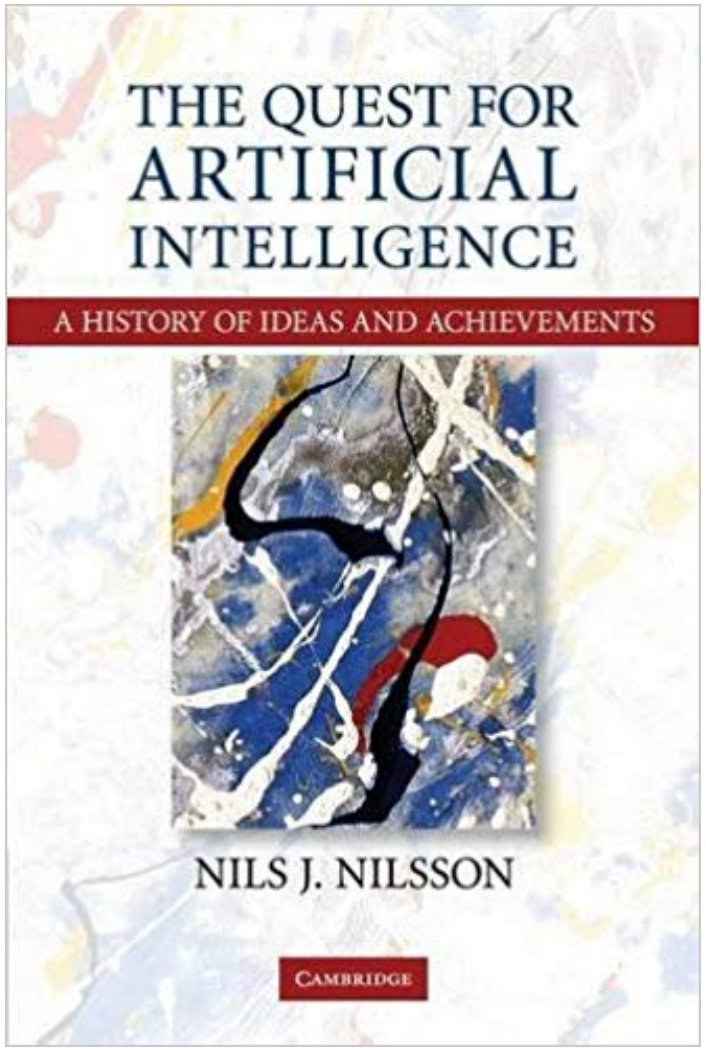
Beginning 1995: AI as Science

- Integration of learning, reasoning, knowledge representation
- AI methods used
  - vision, language, data mining, etc

History of AI



Annotated Bibliography



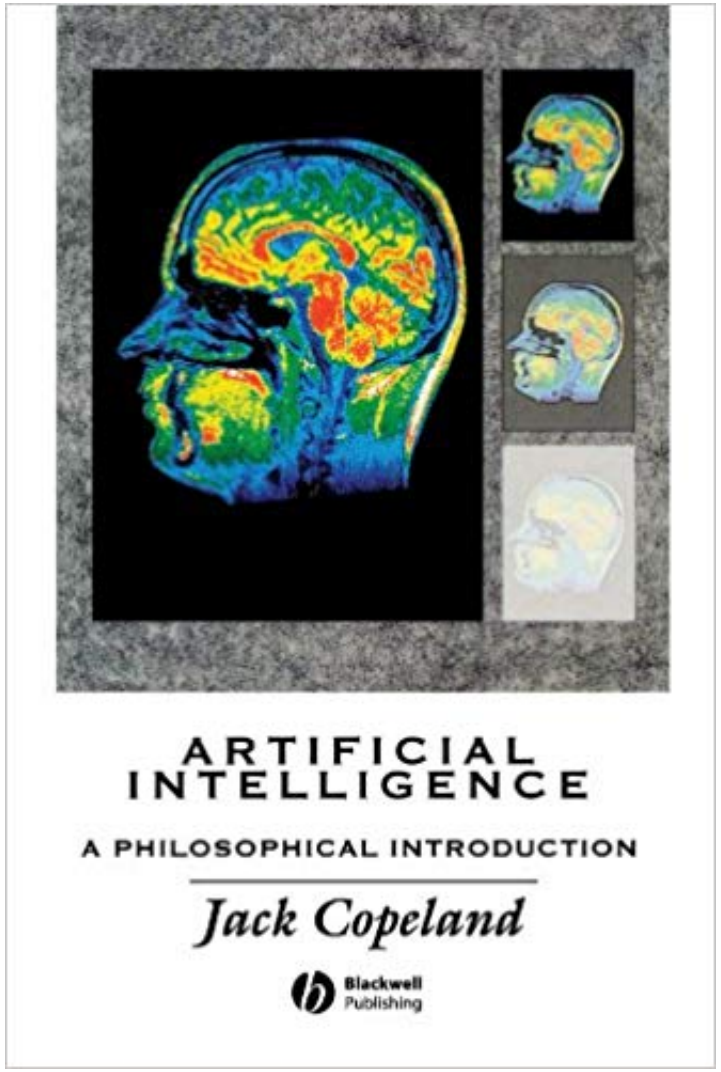
The Quest for Artificial Intelligence

Nils J. Nilsson

Cambridge, 2009

End-of-chapter notes with citations to important materials will be of great use to AI scholars and researchers. This book traces the history of a field that has captivated the imaginations of scientists, philosophers, and writers for centuries.

Annotated Bibliography



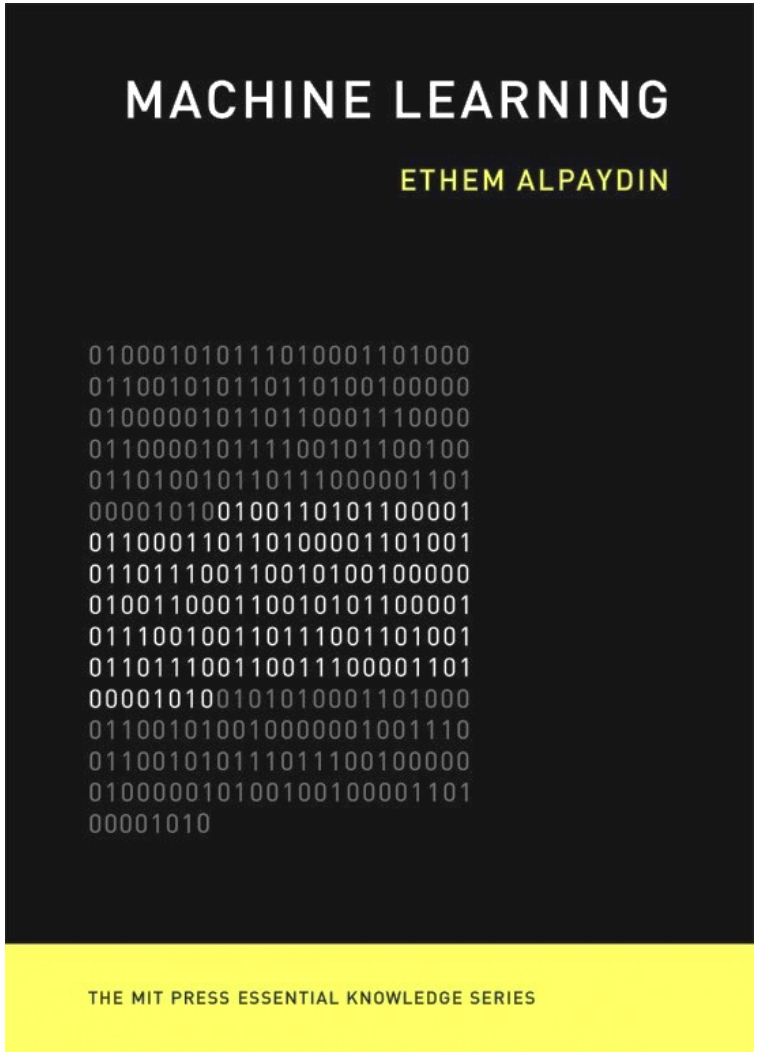
Artificial Intelligence: A Philosophical Introduction

Jack Copeland

Backwell, 1993

The book reviews the progress made in AI since the inception of the field in 1956. Copeland goes on to analyze what those working in AI must achieve before they can claim to have built a thinking machine!

Annotated Bibliography



Machine Learning: The New AI

Ethem Alpaydin

MIT Press, 2016

A concise overview of machine learning — computer programs that learn from data — which underlies applications that include recommendation systems, face recognition, and driverless cars.