

AI: An Overview

Dr. Gene B. Chase, August 30, 2006

A year spent in artificial intelligence is enough to make one believe in God.

—Alan Perlis, as cited at

<http://www-pu.informatik.uni-tuebingen.de/users/klaeren/epigrams.html>

I. Definitions of AI

A. Kinds of definitions

1. External, functional in the sense of how it functions in the larger world
 - a. Automobile is transportation, investment, and status symbol.
 - b. Computer program: implementation
2. Internal, component-wise
 - a. Automobile has engine, alternator, transmission, brakes, ...
 - b. Computer program: interface

B. AI under these two kinds of definitions

1. Externally, AI is—

Overlap of at least Psychology (e.g. learning), Linguistics, Engineering (e.g. robotics, control theory, operations research), Computer Science, Mathematics (e.g. logic, statistics), and Philosophy.

2. Internally, AI is—

- a. Planning (goal-directed behavior)
- b. Search (early focus historically; tell story of Marvin Minsky's first homework assignment, one of the two father's of AI)
- c. Knowledge representation (Doesn't Database Concepts do that too? Yes!)
 - Mathematical modeling more broadly
 - Natural language modeling
 - Computer Vision [contrast with Computer Graphics]
- d. Lisp or Prolog programming

C. Contrasting Strong AI and Weak AI positions (p. 947)

1. Strong AI

AI is the study of things that a computer does that if a human were to do them, they would be considered intelligence. AI is the study of intelligent machines. Minds as “white boxes” into which we can look to model our machines after minds. A mechanistic philosophical commitment might say more strongly mind is machine. “Computers are minds made out of silicon.”

2. Weak AI

AI is the study of building a computer in such a way as to perform tasks that humans perform that require intelligence, whether or not the machine accomplishes the task in the way that the human does. The mind is a black box. Minimal philosophical commitments.

D. Connectionist versus Symbolic AI

1. Symbolic AI: concerned with logic, discrete and not continuous variables.

Functionalism: a Strong AI position which attempts to model mental states. (p. 954)

(Here “functional” also means as in A.1 above “modeling [mental states] without looking under the hood.”)

2. Connectionist: concerned with probability, continuous variables.

Biological naturalism: a Strong AI position which attempts to model neurons. (p. 954)

- E. The definition that makes AI the most interesting course to teach:
AI is the bleeding edge of Computer Science.
Example: OOP used to be in AI, but is now in Computer Programming I.
Long division was graduate study in the Middle Ages.
- F. The “neats” versus the “scruffies.” (p. 25 n.1)

II. History

- A. First conference. Marvin Minsky & John McCarthy et al. organized at Dartmouth, 1956.
- B. First programming language, Lisp: McCarthy, 1958.
- C. First textbook. Minsky’s *Semantic Information Processing*, 1968, collection of dissertations of Minsky’s graduate students.
- D. First success in creating new science. METADENDRAL, 1978, found rules about how molecules would break into pieces in a mass spectrometer (p. 686).

III. Cross-fertilization examples

- A. AI gave Psychology testable cognitive models in psychology (John Robert Anderson’s HAM)
- B. The relationship between Artificial Intelligence and Data Structures and Algorithms:
 - 1. In 1976, Niklaus Wirth wrote the book (Prentice-Hall) entitled:

Algorithms + Data Structures = Programs

- 2. Then in 1979, Robert Kowalski wrote an article (*CACM*, 22, 7, July 1979) entitled:

Algorithm = Logic + Control

(See pp. 289 and 407)

- C. Rational decision-making (p. 465)

Decision theory = Probability theory + Utility theory

- 1. Optimal behavior: maximizing something
 - a. Calculus (the derivatives half of the subject)
 - b. Linear and non-linear programming, game theory
 - c. Maximum expected value in Statistics
- 2. Therefore add to the fields from which AI borrows the following: Economics, Management, and Diagnosis (the last is not really a field, but I’m thinking of medical diagnosis or automobile diagnosis).