

# 0.1

## A Brief Introduction to AI

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**informatics**

## INTELLIGENCE

*noun* 1. the ability to learn, understand and think in a logical way about things; the ability to do this well

But in AI we use...

## METAPHOR

- not a literal description of a property that humans and machines share
- but a task-defined competence which systems can manifest.

## CLEVER HANS



[Wikipedia entry on Clever Hans](#)

## WHAT IS AI?

Systems that think like humans

Systems that think rationally

Systems that act like humans

Systems that act rationally

INTELLIGENCE  $\neq$  RATIONALITY

## ACTING HUMANLY · THE TURING TEST

*Computing machinery and intelligence* (Alan Turing, 1950)

**Can machines think? → Can machines behave intelligently?**

Imitation game: operational test for intelligent behaviour

- + suggested major components of AI  
*(knowledge, reasoning, language understanding, learning)*  
anticipated all major arguments against AI of the next 60 years
- not reproducible, constructive, or amenable to mathematical analysis

► The Turing test: Can a computer pass for a human?

The *cognitive revolution* in the 1960s: information-processing psychology replaced behaviourism.

Scientific theories of internal activities of the brain:

- Level of abstraction: **knowledge** vs. **circuits**
- Validation via
  1. predicting and testing behaviour of humans
  2. identification from neurological data

Cognitive science & cognitive neuroscience – distinct from AI

Aristotle's syllogisms: correct arguments/thought processes

### LOGIC

**notation and rules of derivation** for thoughts

- not all intelligent behaviour is mediated by logical deliberation
  - not easy to state informal knowledge in the formal terms required by logical notation
  - limited computational resources

## ACTING RATIONALLY · RATIONAL AGENTS

**Rational behaviour** = doing the right thing

- *the right thing* = that which is expected to maximize goal achievement, given the available information
- does not necessarily involve thinking (e.g. blinking reflex)

### RATIONAL AGENTS

**Agent** = entity that perceives and acts.

- computational limitations make perfect rationality unachievable.

## PRE-HISTORY

## PHILOSOPHY



Aristotle



Descartes



Russell



Wittgenstein



Carnap

## PRE-HISTORY

## MATHEMATICS



Boole



Frege



Tarski



Gödel



Turing



Cardano



Bayes

## PRE-HISTORY

### ECONOMICS

Decision theory

### NEUROSCIENCE

How do brains process information?

### PSYCHOLOGY

How do humans and animals think and act?

### LINGUISTICS

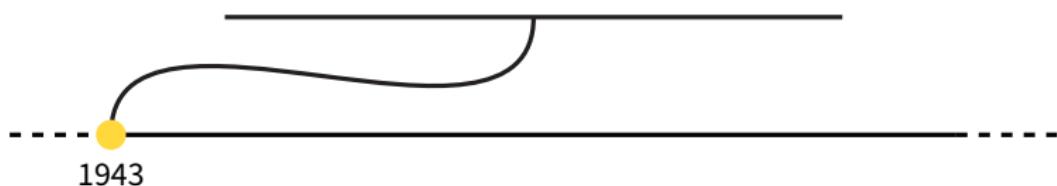
How does language relate to thought?

## TIMELINE



Warren McCulloch & Walter Pitts

*model of artificial neurons*



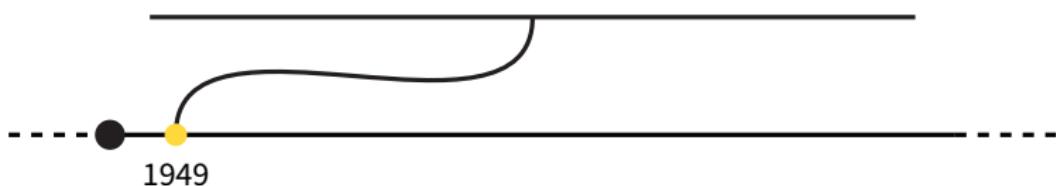
1943

## TIMELINE



Donald Hebb

*Hebbian learning: updating rule for modifying the connection strengths between neurons*



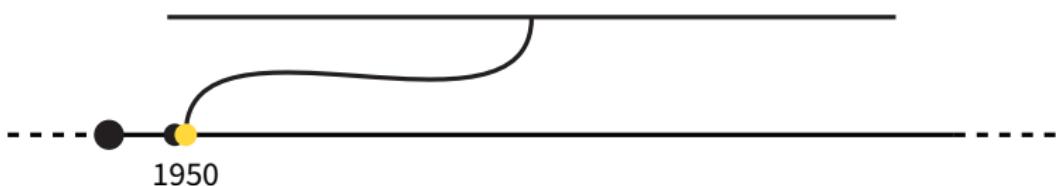
## TIMELINE



Alan Turing

*Computing Machinery and Intelligence*

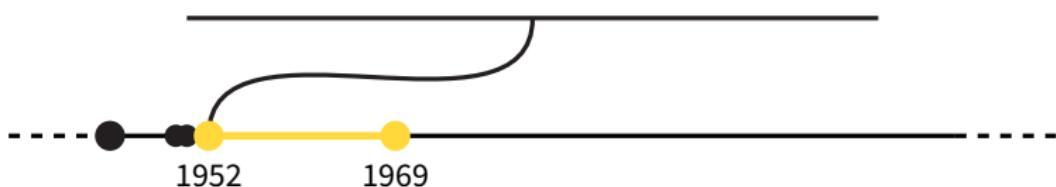
*The Turing Test*



## TIMELINE

**Look, Ma, no hands! era**

*microworlds, General Problem Solver,  
Logic Theorist, Geometry Theorem Prover*

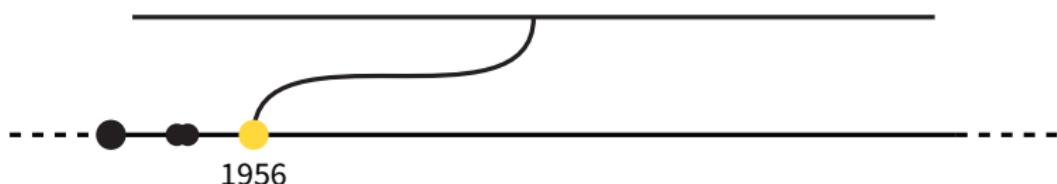


## TIMELINE



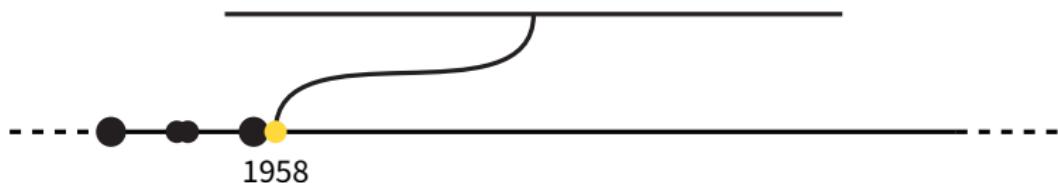
### The birth of AI

*Dartmouth workshop: John McCarthy, Marvin Minsky,  
Claude Shannon, Nathaniel Rochester*



## TIMELINE

Design of high-level language Lisp

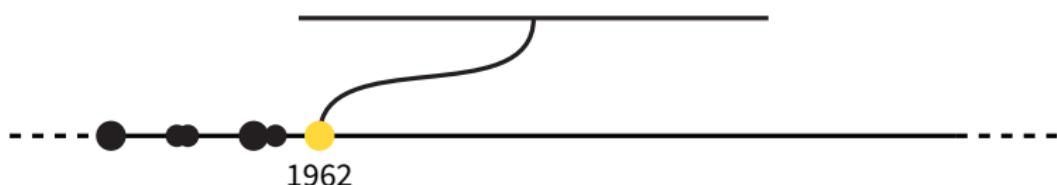


## TIMELINE



Frank Rosenblatt

*perceptrons*

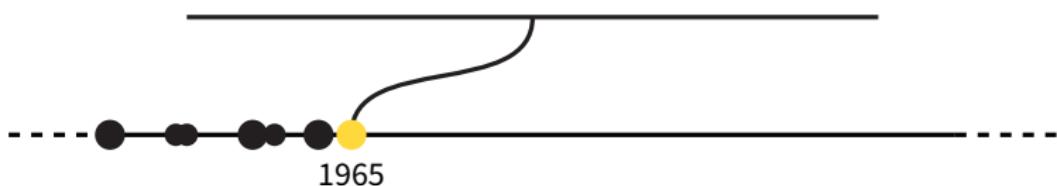


## TIMELINE



John Alan Robinson

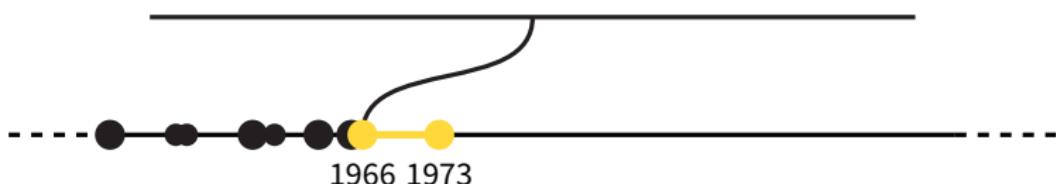
*resolution: a complete theorem-proving  
algorithm for first-order logic*



## TIMELINE

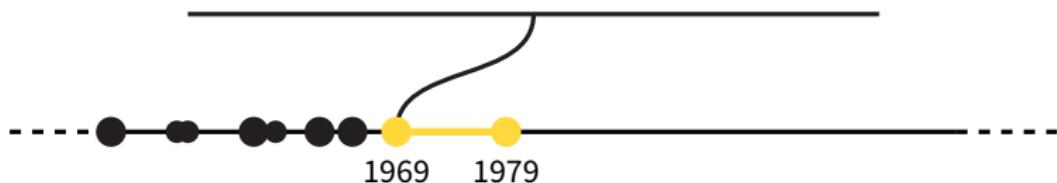
A dose of reality: computational complexity

*Minsky and Papert's book Perceptrons (1969)*

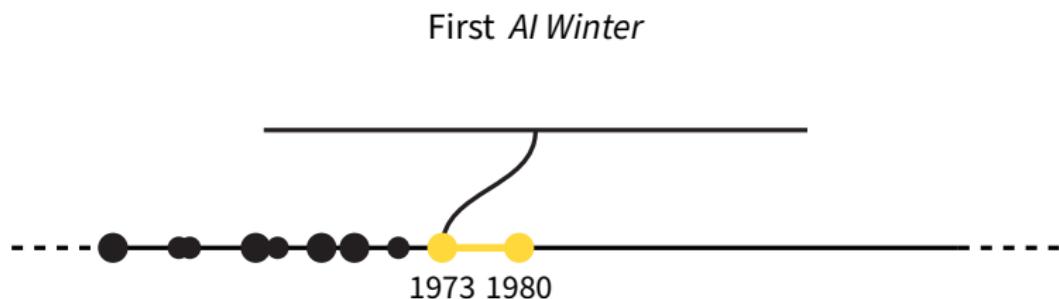


## TIMELINE

Early knowledge-based systems

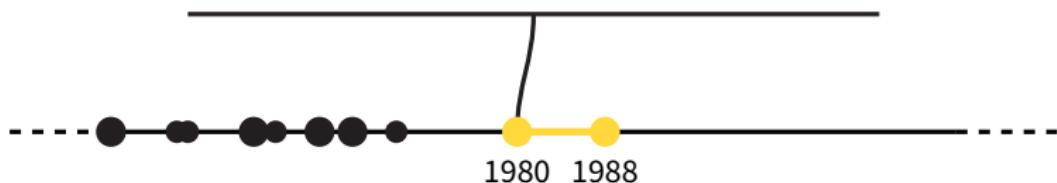


## TIMELINE



## TIMELINE

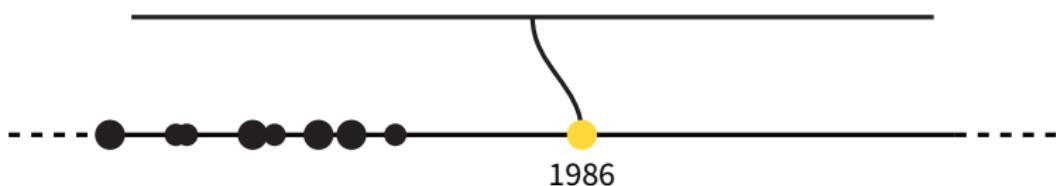
Expert systems industry



## TIMELINE

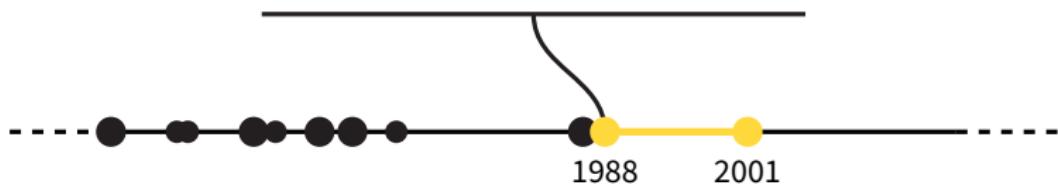
The return of neural networks

*reinvention of back-propagation learning algorithm*



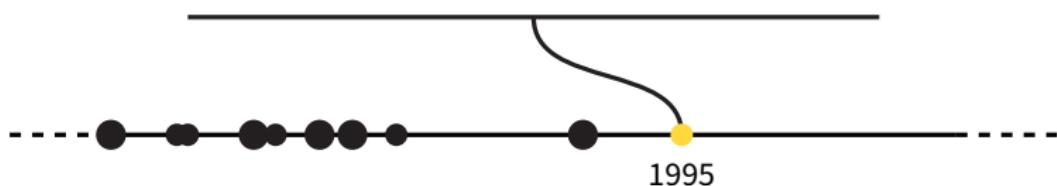
## TIMELINE

Second *AI Winter*



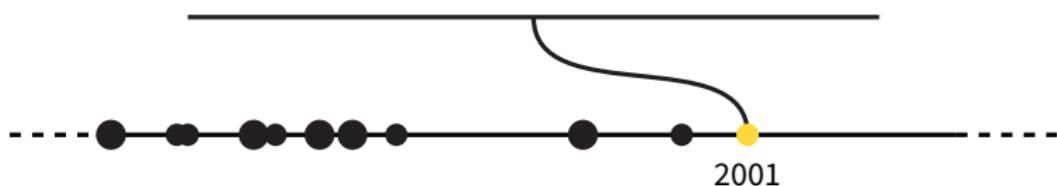
## TIMELINE

The emergence of intelligent agents

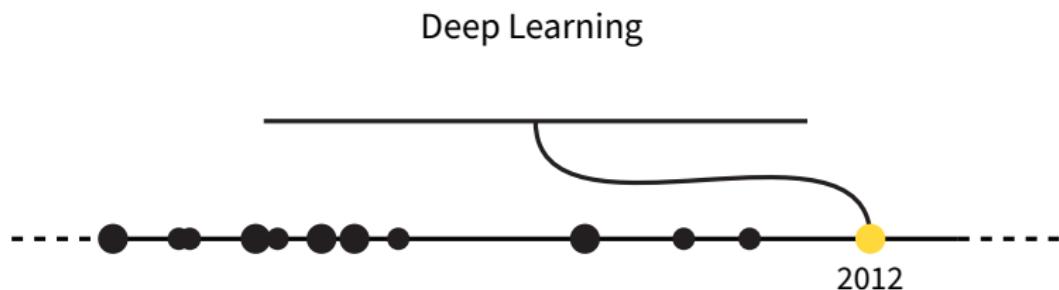


## TIMELINE

The availability of very large data sets



## TIMELINE



### ❓ Which of the following tasks can be now solved by computers?

- Discovering and proving new mathematical theorems
- Writing an intentionally funny story
- Giving competent legal advice in a specialized area of law
- Translating spoken English into spoken Swedish in real time
- Driving in the center of Cairo, Egypt / Tempe, Arizona
- Performing a complex surgical operation
- Playing a decent game of bridge / Catan / table tennis
- Doing the Twist

## WHERE TO NOW?

- Is the Turing Test still relevant?

Human-level AI

Artificial General Intelligence

Efficiency

Security

Fairness

Explainability

Friendly AI

- Symbolic AI + Connectionist AI = ❤