CMSC 372
Artificial Intelligence

Fall 2017

Administrivia

- Instructor: Deepak Kumar
- Lectures: Mon& Wed 10:10a to 11:30a
- Labs: Fridays 10:10a to 11:30a
- Pre-requisites: CMSC B206 or H106 and CMSC B231 or permission of instructor
- Course web page: http://cs.brynmawr.edu/Courses/cs372/fall2017/

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What is AI?

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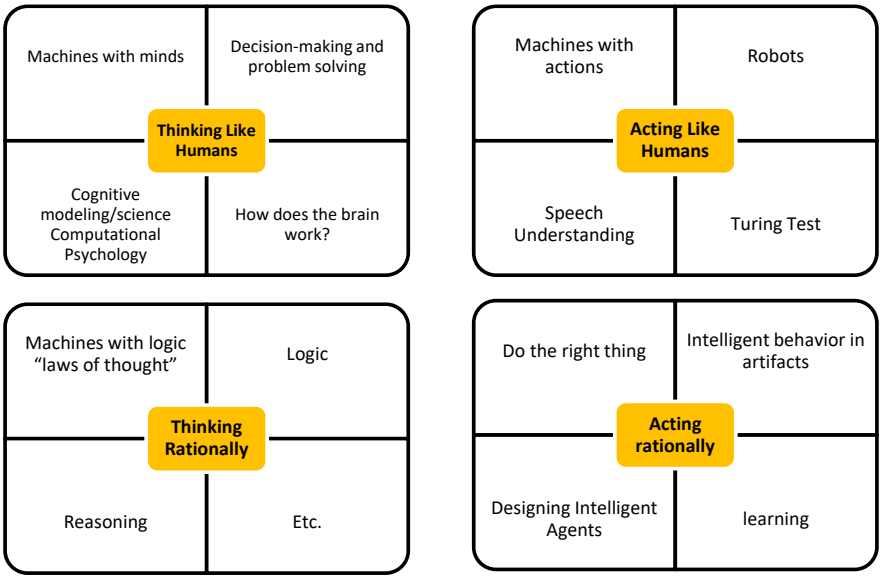

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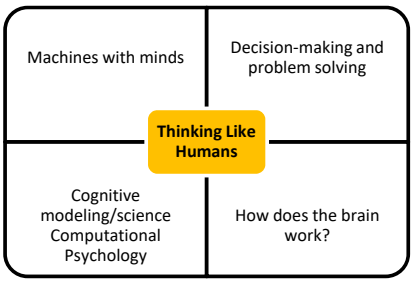

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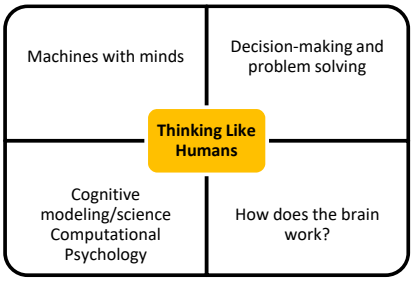

Cognitive Science

- Brain as an information processing system
- Requires theories of internal activities of the brain (level of abstraction? Knowledge or circuits?)
- How to validate?
  - Predicting and testing behavior of human subjects (top-down)
  - Theories from neurological data (bottom-up)
- Two fields: Cognitive Science & Cognitive Neuroscience

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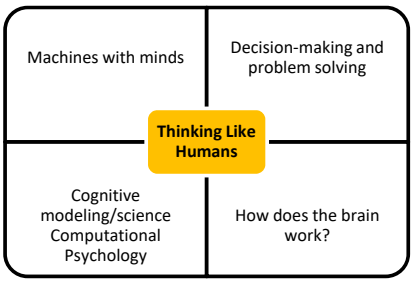

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Problem: Current theories do not explain anything resembling human-level general intelligence.

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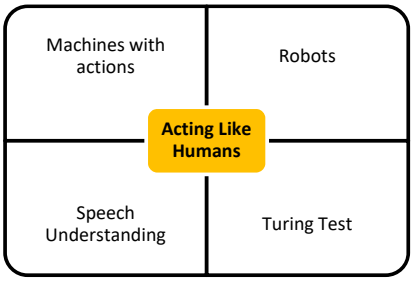

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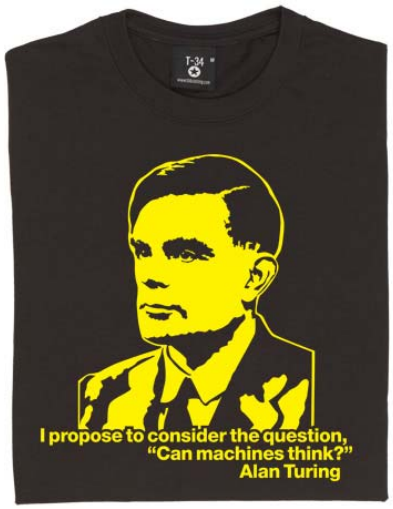
What is AI?

Machines with actions	Robots
Acting Like Humans	
Speech Understanding	Turing Test

Alan Turing (1950)

The Imitation Game



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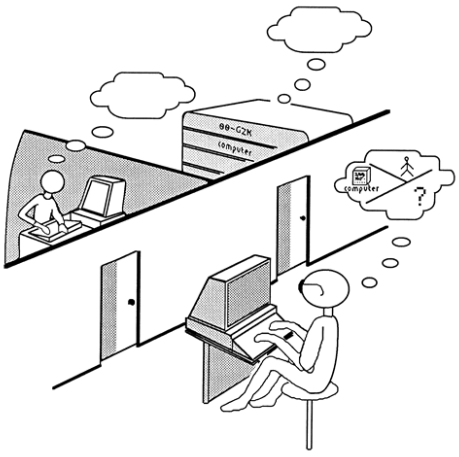

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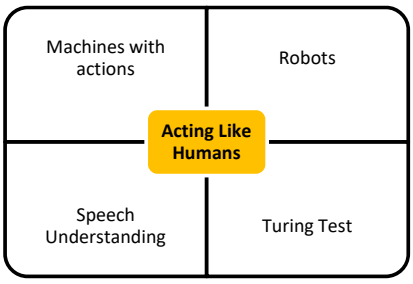

Alan Turing (1950)

The Imitation Game

The Turing Test

- Operational test for intelligent behavior
- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes.
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning
- Major subfields of AI: language processing, knowledge representation & reasoning, machine learning, vision, robotics

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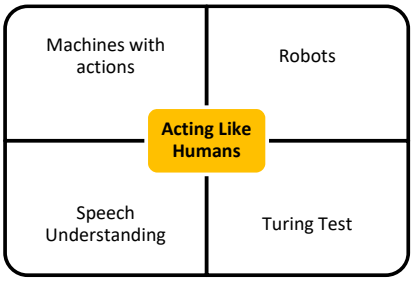

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Problem: Turing Test is not reproducible, constructive, or amenable to mathematical analysis

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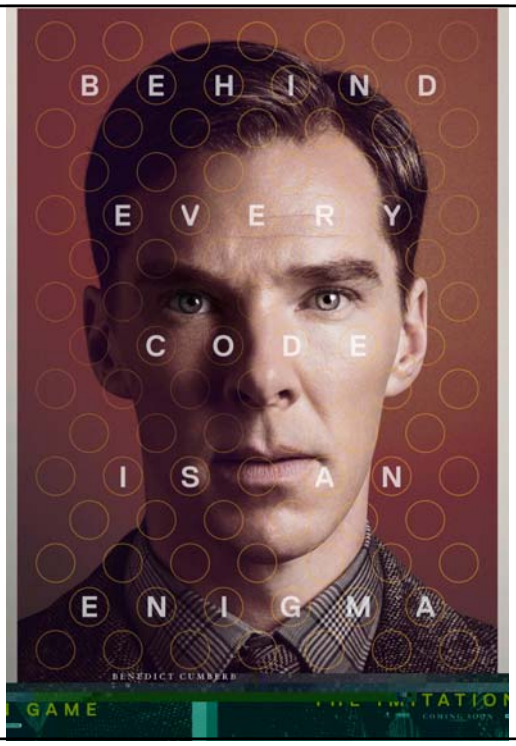
2015 Movie
The Imitation Game



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CAPTCHA?

- **C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers and **H**umans **A**part

- A “reverse Turing Test”?

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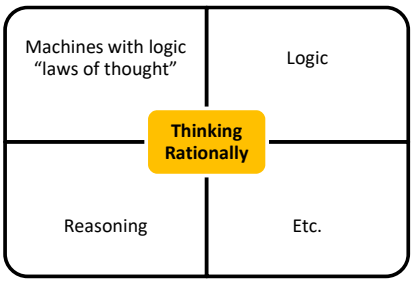

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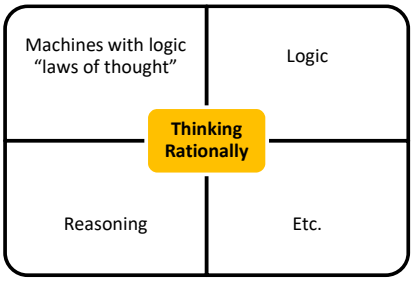

Reasoning with Logic

- Aristotle: What are correct arguments/thought processes?
- Formal Logics:

Socrates is human.
All humans are mortal.
Therefore Socrates is mortal.

- Laws of thought govern the operation of the mind.

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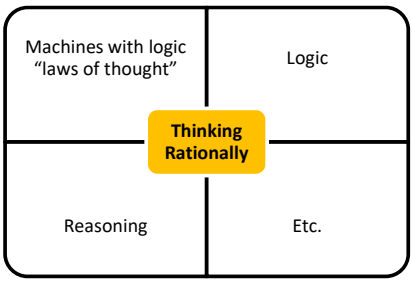

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Problem: Not all intelligent behavior is mediated by logical deliberation. Not easy to formalize informal knowledge. E.g. Most students might be sleepy.

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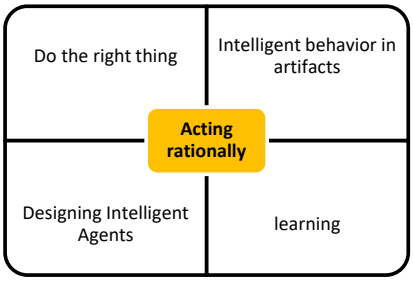

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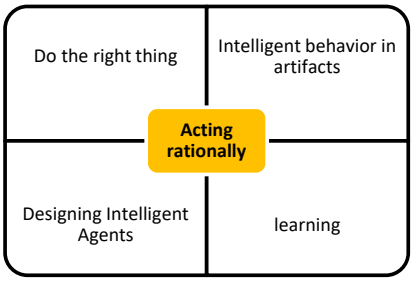

Rational Behavior

- Do the right thing.
- That which is expected to maximize goal achievement, given available information.
- Doesn't necessarily involve 'thinking'. E.g. blinking reflex.
- Any thinking there is, should be in service of rational action.
- Design Rational Agents.

$$f: P^* \rightarrow A$$

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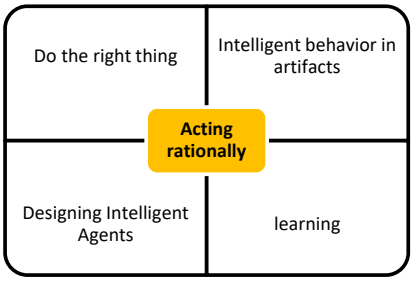

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$$f: P^* \rightarrow A$$

Problem: Computational limitations make perfect rationality unachievable. So, design best program for given computational resources.

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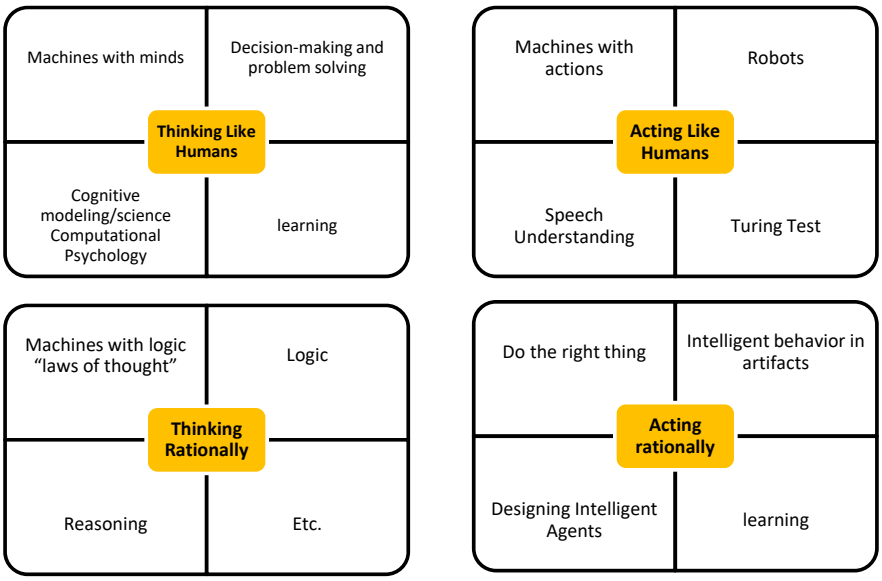

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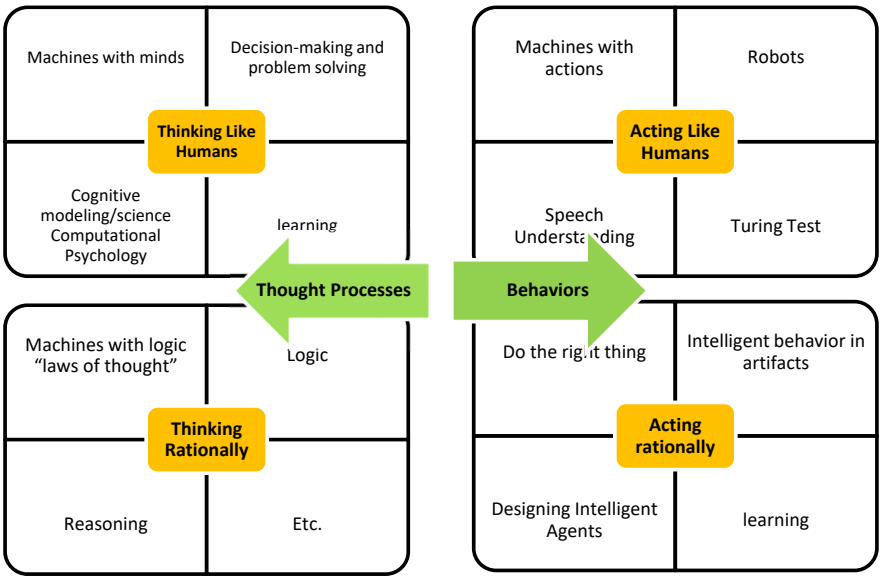

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RoboCup – Robot World Cup

"By the middle of the 21st century, a team of fully autonomous humanoid robot soccer players shall win a soccer game, complying with the official rules of FIFA, against the winner of the most recent World Cup."

From: http://www.robocup.org/

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“AI Beats FIFA 2052 Champs!”

- What would it take to beat the FIFA World Cup 2052 champions?

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“AI Beats Jeopardy! Champion!”

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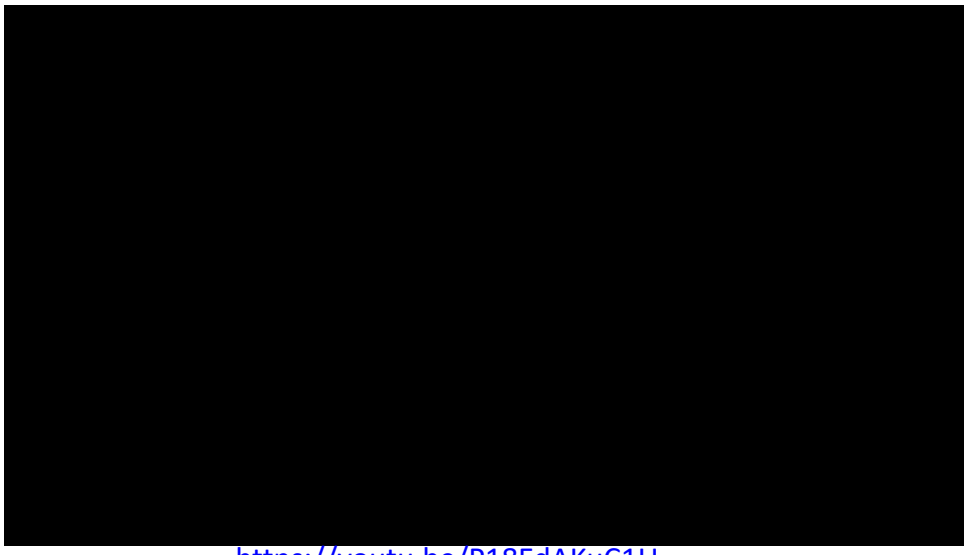
Watson: Jeopardy!



https://youtu.be/P18EdAKuC1U

February 2011

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Answer: Deepak Kumar

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Watson/Jeopardy set at CHM

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What is AI?

Is intelligence computable?

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What is AI?

Is intelligence computable?

Physical Symbol System Hypothesis
"a physical symbol system [such as a digital computer, for example] has the necessary and sufficient means for intelligent action."

-: Newell & Simon, 1976

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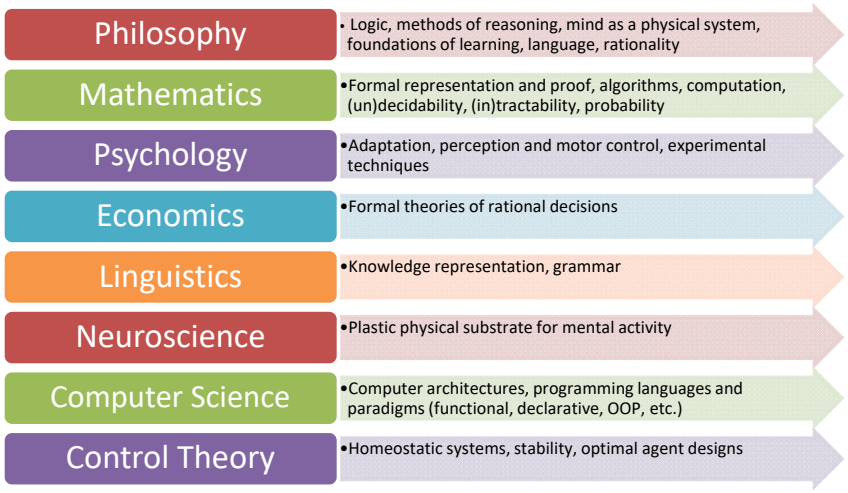
Prehistory of AI



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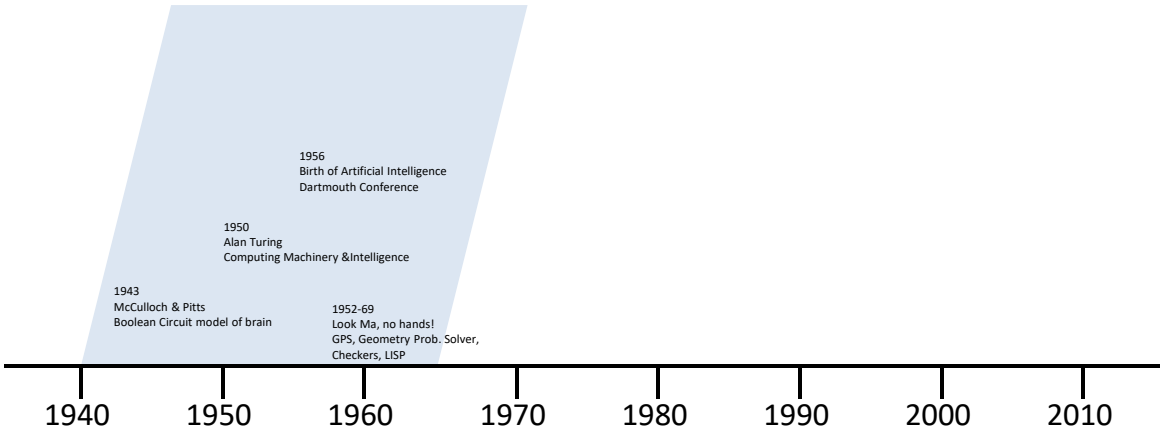
Landmarks in AI History



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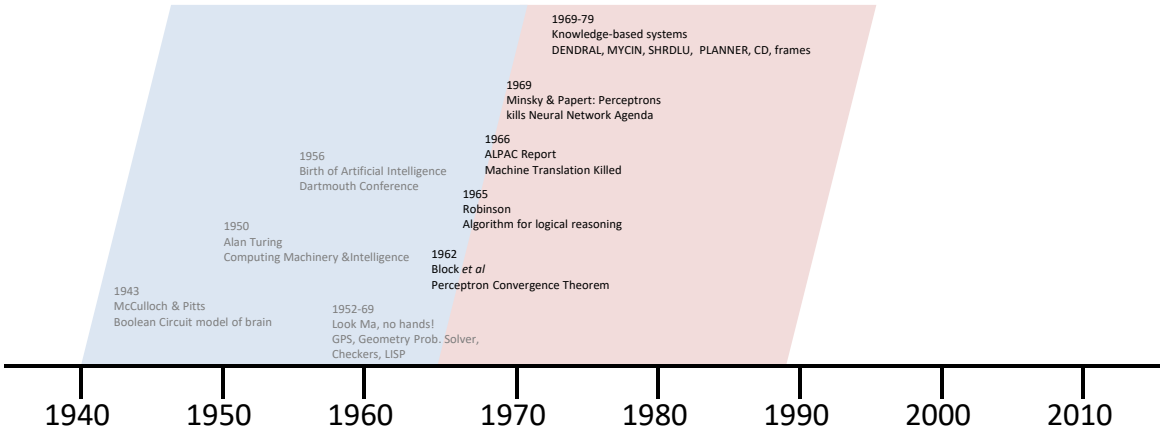

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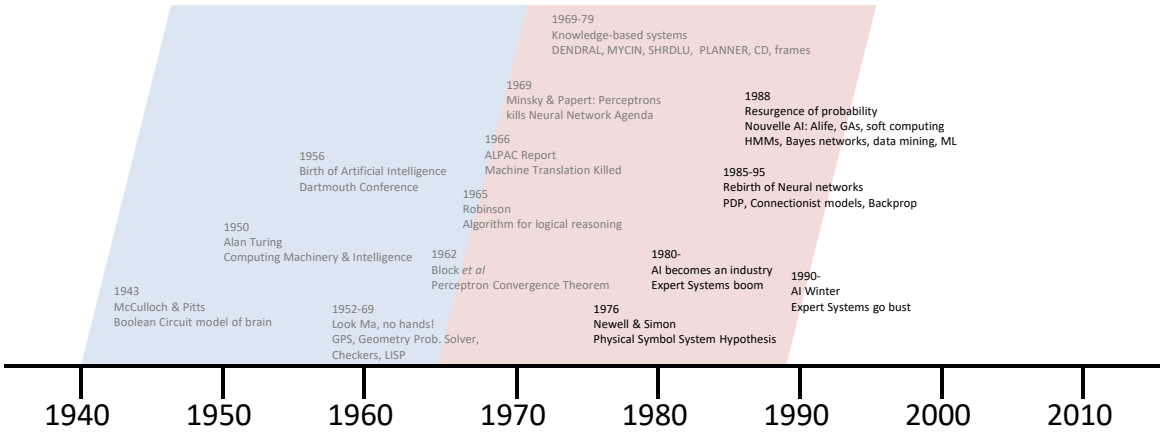

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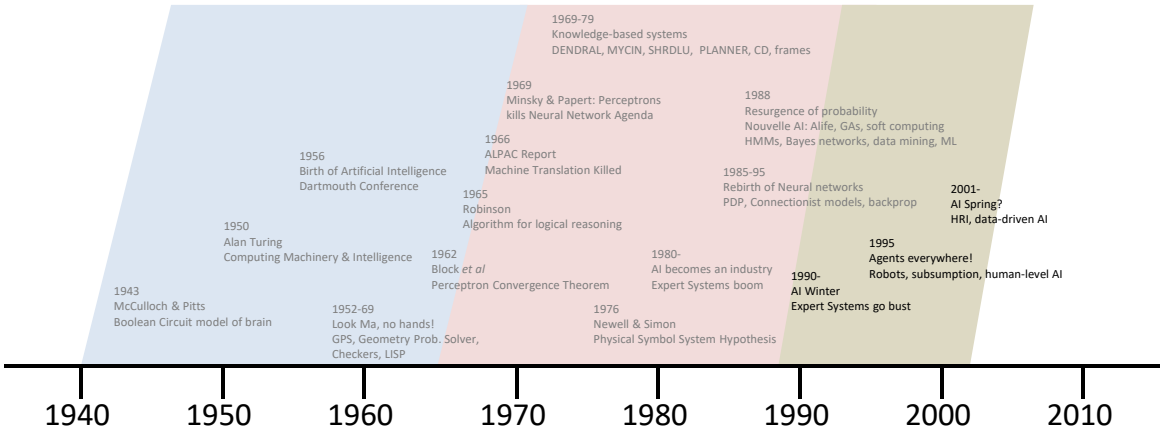

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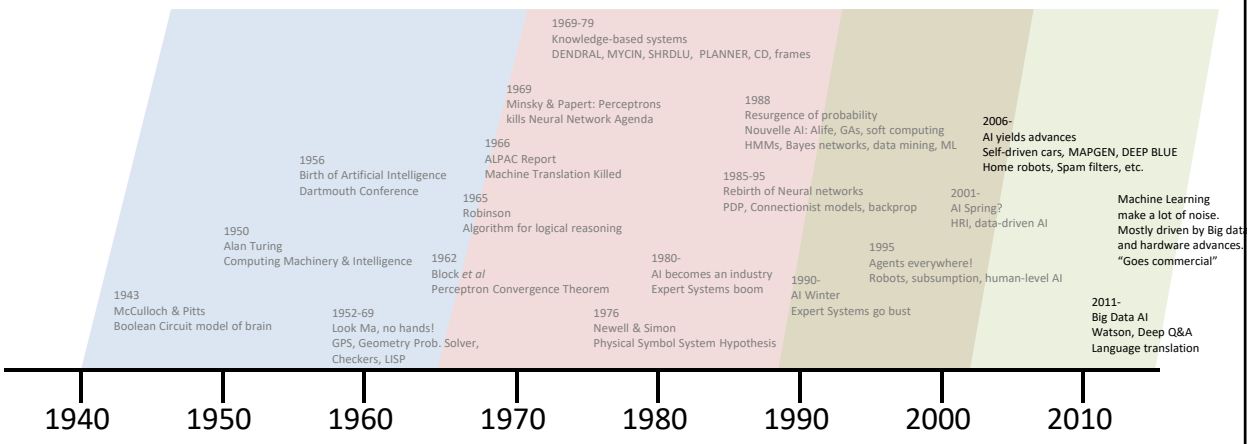

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Agenda

- What is AI? History, Foundations, Examples: Overview
- Intelligent Agents
- Problem Solving Using Classical Search Techniques
- Beyond Classical Search
- Adversarial Search & Game Playing
- Constraint Satisfaction Problems
- Knowledge Representation & Reasoning (KRR)
- First Order Logic & Inference
- Classical Planning
- Planning & Acting in the Real World
- Other topics depending upon time...

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Acknowledgements

- Much of the content in this presentation is based on Chapter 1, *Artificial Intelligence: A Modern Approach*, by Russell & Norvig, Third Edition, Prentice Hall, 2010.

- This presentation is being made available by Deepak Kumar for any and all educational purposes. Please feel free to use, modify, or distribute. Powerpoint file(s) are available upon request by writing to dkumar@cs.brynmawr.edu

- Prepared in January 2015, updated September 2017.

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