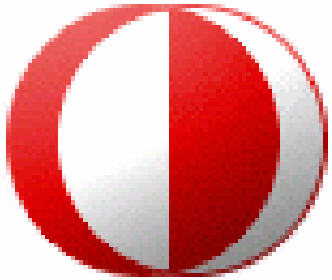


An Introduction to Artificial Intelligence

Department of Electrical and Electronics Engineering
Spring 2006
Dr. Afşar Saranlı

Thanks to Professor Andrew W. Moore (Carnegie Mellon University) http://www.cs.cmu.edu/~awm/tutorials
Also: Artificial Intelligence: A Modern Approach, 2nd Ed., Russel & Norvig

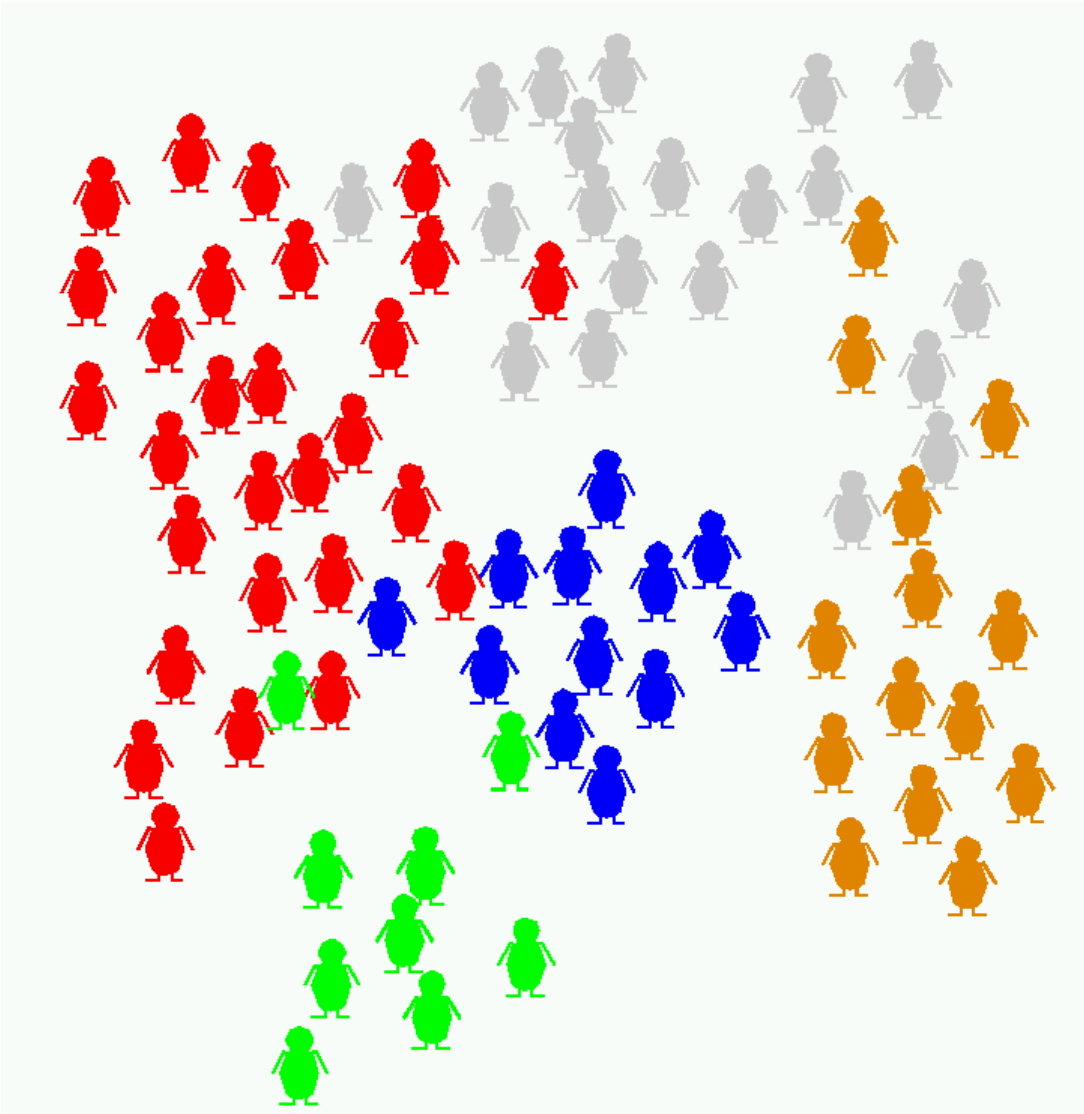
You first!! Class Brainstorming

- ***Work with your team-mate:***
- ***Q1: What is AI all about?***

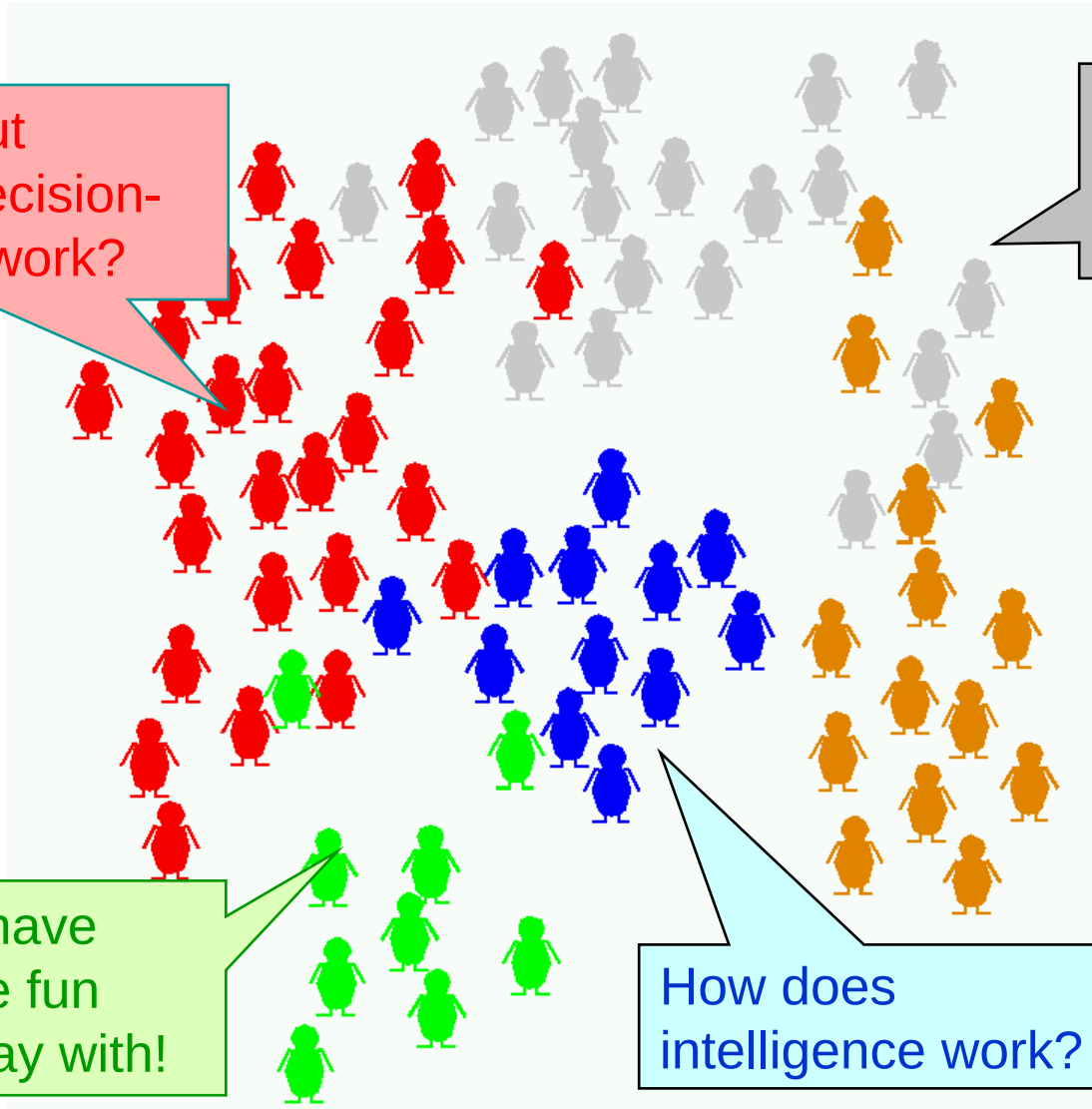
  (3+ items)
- ***Q2: Where can it be applied?***

  (3+ items)

An AI Coctail Party!



An AI Coctail Party!



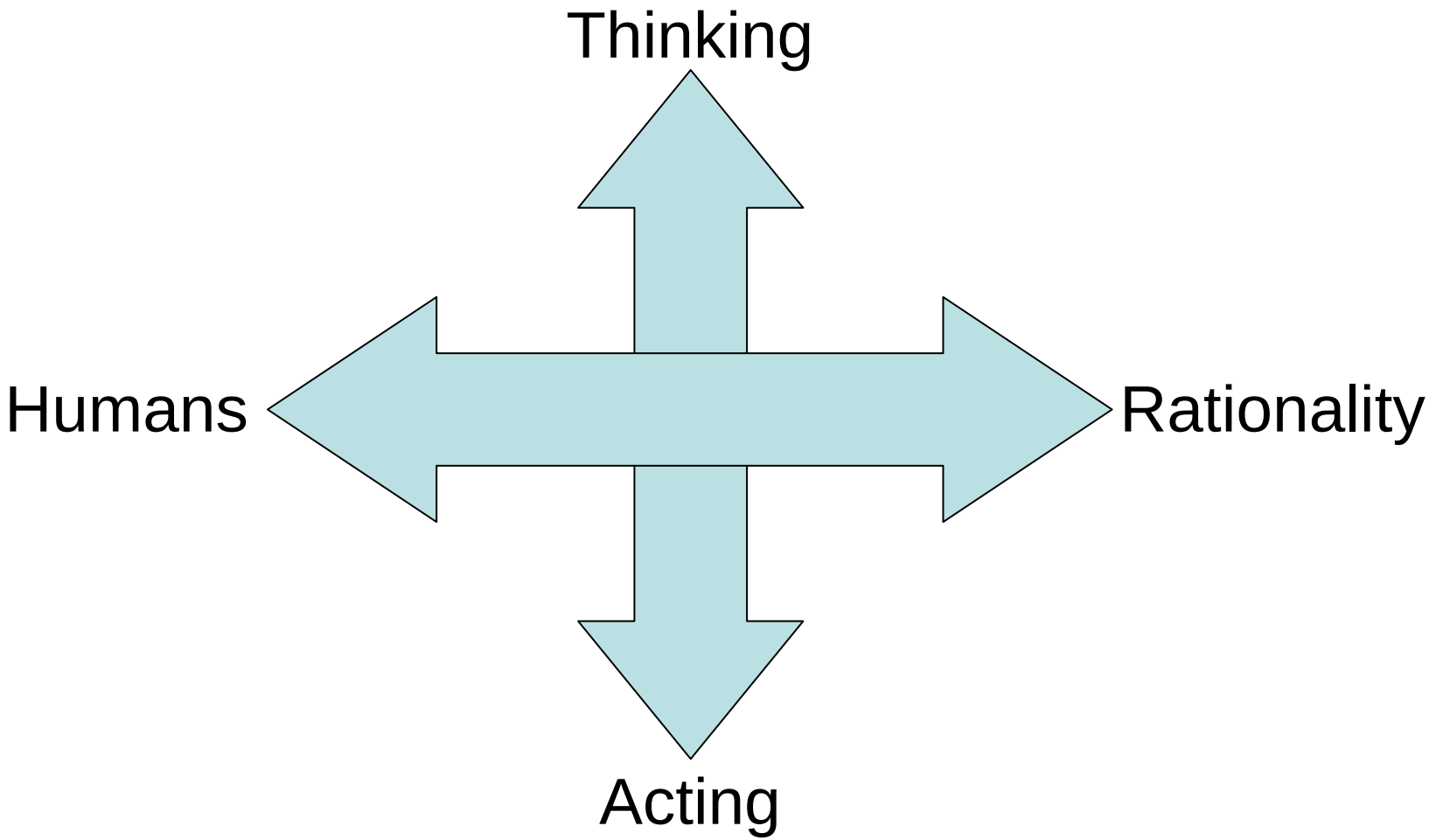
How can we put professional decision-makers out of work?

How can we actually apply this profitably?

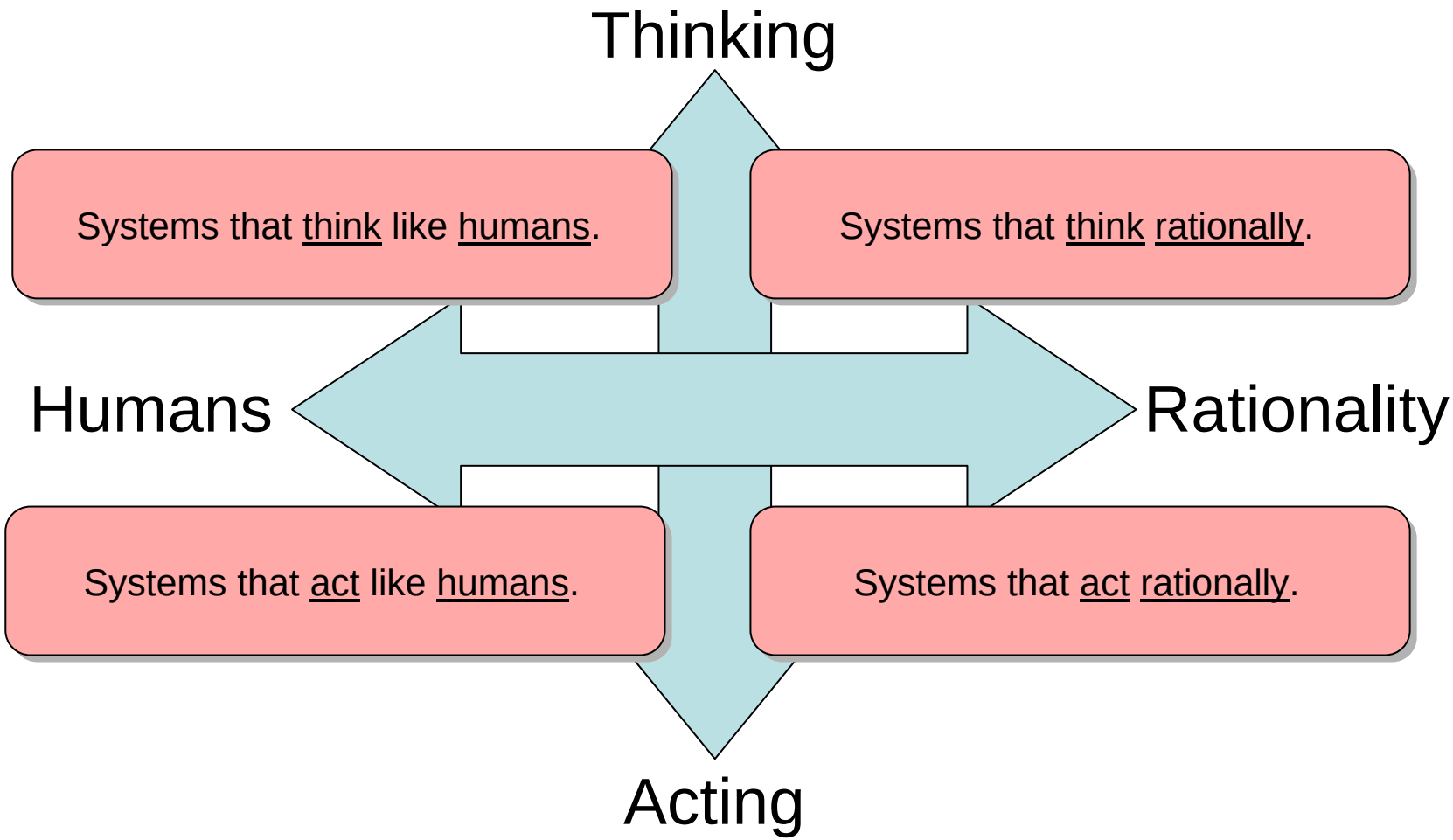
These people have produced some fun questions to play with!

How does intelligence work?

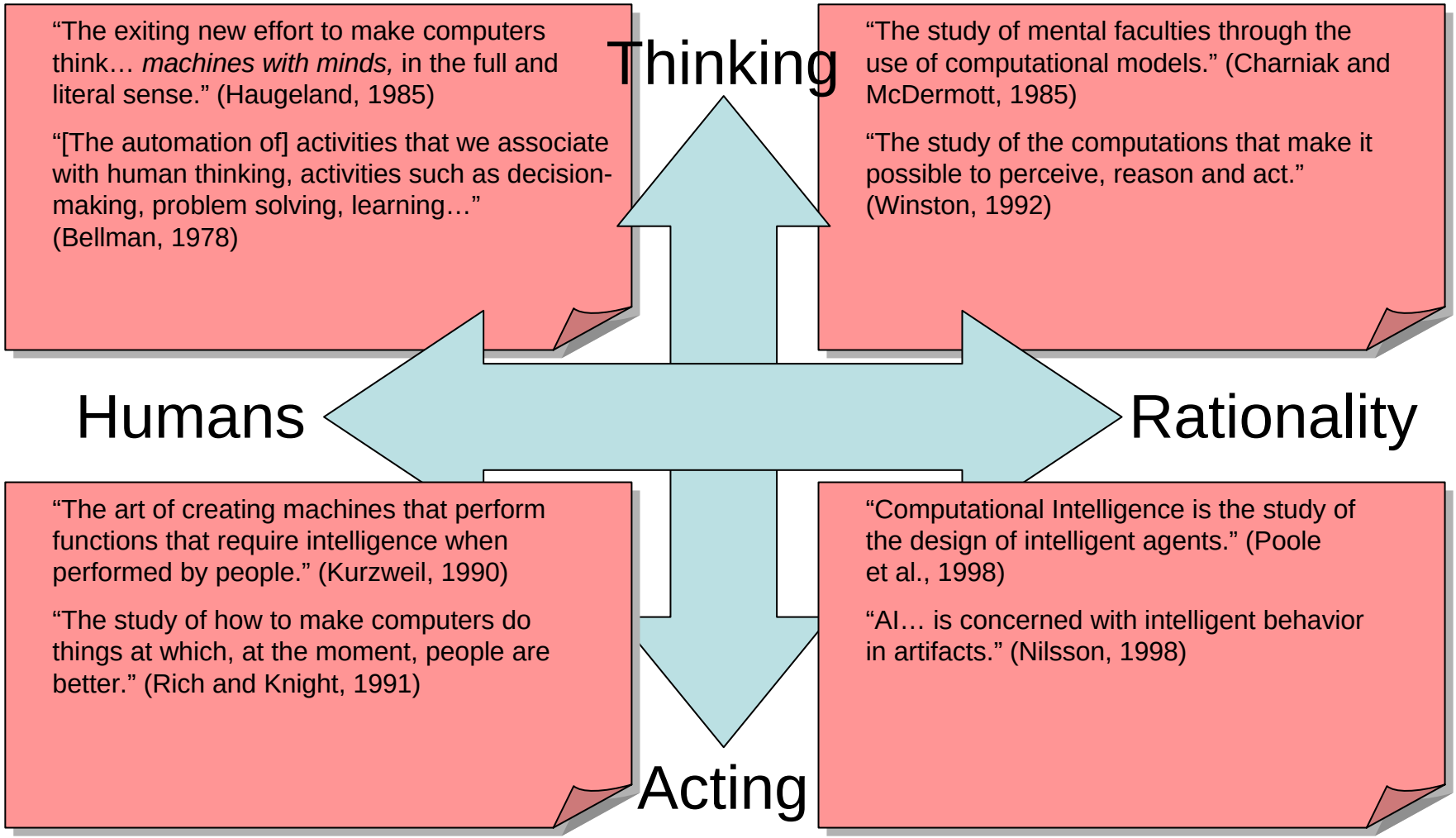
What is Artificial Intelligence?



What is Artificial Intelligence?



What is Artificial Intelligence?



"The exiting new effort to make computers think… *machines with minds,* in the full and literal sense." (Haugeland, 1985)

"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning…" (Bellman, 1978)

"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)

"The study of the computations that make it possible to perceive, reason and act." (Winston, 1992)

"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)

"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)

"Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998)

"AI… is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

What is Artificial Intelligence?

- **Acting Humanly: *The Turing Test approach,***
  - **Alan Turing, 1950: A test to assess intelligence,**
  - **Principle: To be Indistinguishable from a human on a written question/answer session.**
  - **To pass the test, a machine would need:**
    - ***Natural language processing,***
    - ***Knowledge representation,***
    - ***Automated reasoning,***
    - ***Machine learning***

Total Turing Test:
- ***(Computer vision)***
- ***(Robotics)***

What is Artificial Intelligence?

- **Thinking Humanly: *The cognitive modeling approach,***
  - **Tries to get inside the workings of human minds,**
  - **Self observation + psychological experimentation,**
  - **Develop a theory of the mind,**
  - **<u>Build a computer program to represent it</u>.**

  - ***Cognitive Science*: Computer models from AI + experimental techniques from Psychology.**

What is Artificial Intelligence?

- **Thinking rationally: *The "laws of thought" approach,***
  - **Ideas from Aristotle initiated the field called *Logic*.**
  - **A precise notation for all kinds of things in the world and the relations between them.**
  - **Logicist tradition in AI hopes to h**
    programs to create intell

- Not easy to represent informal knowledge,
- What if knowledge is not 100% certain?
- May not be computationally tractable!

What is Artificial Intelligence?

- **Acting Rationally: *The rational agent approach,***
  - **Tries to act to achieve the best outcome, or… the best expected outcome when there is uncertainty.**
  - **If computer programs, other attributes, such as:**
    - ✓ **Operating under autonomous control,**
    - ✓ **Perceive the environment,**
    - ✓ **Persist over prolonged time,**
    - ✓ **Adapt to change**

Why do AI research?

The old fashioned answer:

To make systems that behave like the brain behaves.

Systems that think like humans!!
(also Systems that act like humans)

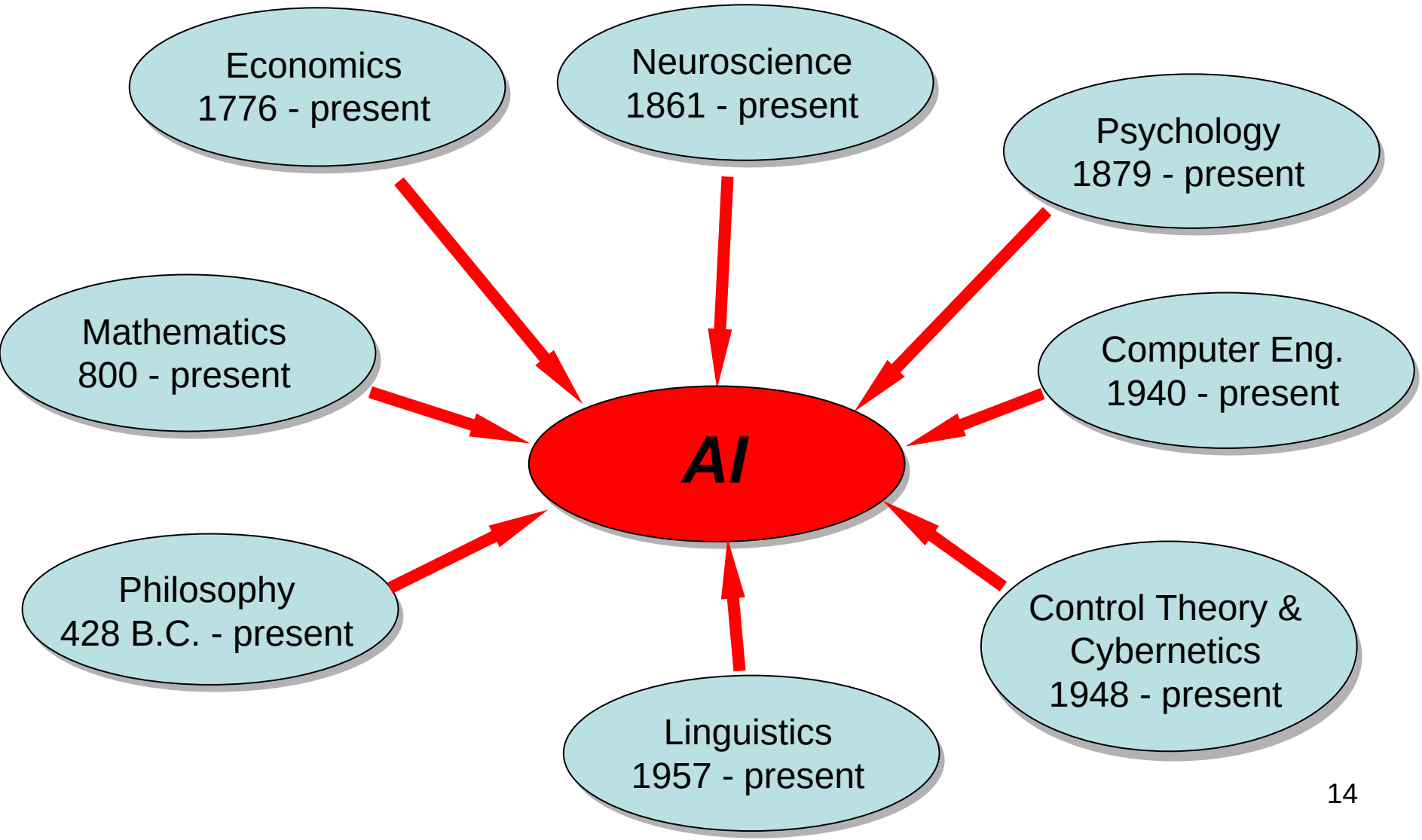
Why do AI research?

The new fashioned answer:

To make systems that behave like the brain <u>should</u> behave.

Systems that <u>act</u> <u>rationally</u>!!

Foundations of Artificial Intelligence



“Natural” and “Algorithmic" AI

“Natural AI” questions.....

- **Can we make something that is as intelligent as a human?**
- **Can we make something that is as intelligent as a bee?**
- **Can we get something that is really evolutionary and self improving and autonomous and flexible....?**

“Algorithmic AI” questions.....

- **Can we save this plant $20million a year by improved pattern recognition?**
- **Can we save this bank $50million a year by auto fraud detection?**
- **Can we start a new industry of handwriting recognition / automated negotiation / helpdesks / ....?**

“Natural” and “Algorithmic" AI

Natural AI

Typical Paper Title:

Effective Learning Requires Neuronal Remodeling of Hebbian Synapses **-- Gal Chechik, Isaac Meilijson, Eytan Ruppin,**

Lee, T.S. (2000) **Neural Processes Underlying Attentive Perceptual Organization .** *To appear in Perceptual Organization in Vision: Behavioral and Neural Perspectives Ed. M. Behrmann, C. Olson and R. Kimchi, Lawrence Erlbaum Associates.*

“Natural” and “Algorithmic" AI

Algorithmic AI

Example Paper titles

Andrew W. Moore, **The Anchors Hierarchy: Using the Triangle Inequality to Survive High Dimensional Data,** *In proceedings of UAI-2000: The Sixteenth Conference on Uncertainty in Artificial Intelligence*

D. Fox, W. Burgard, and S. Thrun. **Markov localization for mobile robots in dynamic environments.** *Journal of Artificial Intelligence, 11:391--427, 1999.*

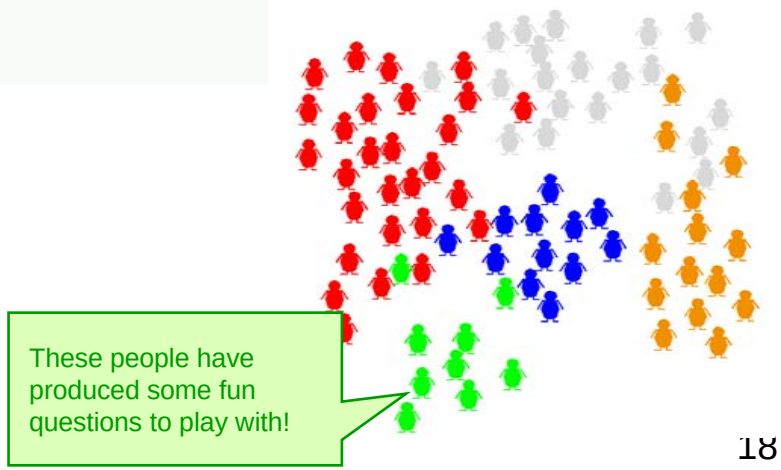
“Theoretical” AI

Theoretical AI

Typical paper titles:

Reasoning in Expressive Description Logics with Fixpoints based on Automata on Infinite Trees, ***Diego Calvanese, Giuseppe De Giacomo, and Maurizio Lenzerini***

Ordered Binary Decision Diagrams and Minimal Trellises, ***John Lafferty and Alexander Vardy.*** *IEEE Trans. Computers, Vol. 48, No. 9, pp. 971-986, Sept., 1999.*

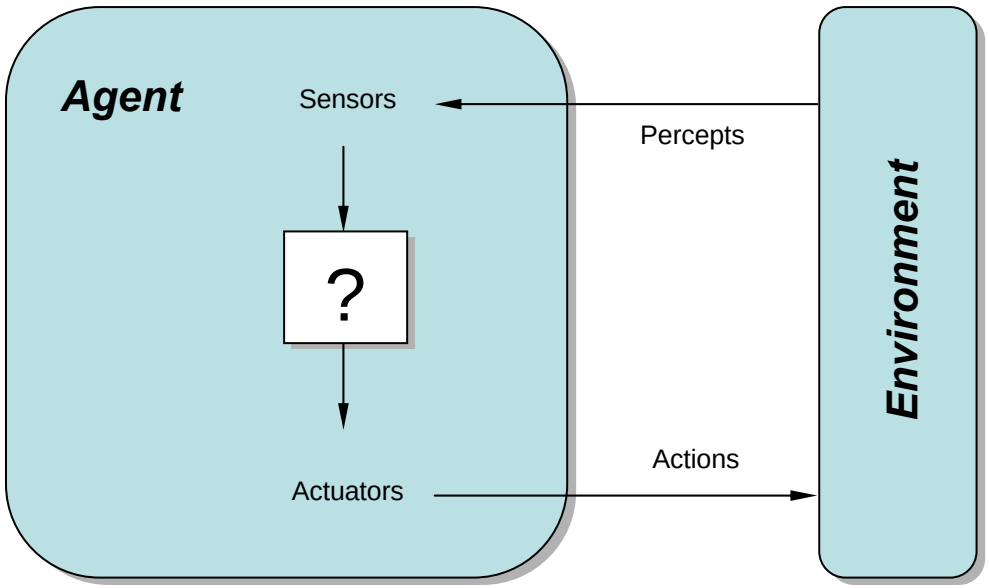


Buzzwords associated with AI over time

- **1970s: Artificial Intelligence**
- **1980s: Knowledge Based Systems, Fuzzy Logic, Satificing**
- **1990s: Neural Networks, Cased-Based Reasoning, Genetic Algorithms, Distributed AI**
- **2000s: Agents, Evolutionary Systems**
- **Bayes, Markov, Nash!**

Next week: The Intelligent Agent

- **The Intelligent Agent approach.**



Challenge!

Example of human intelligence:

How to perform academic research?
(Develop an algorithm for it)