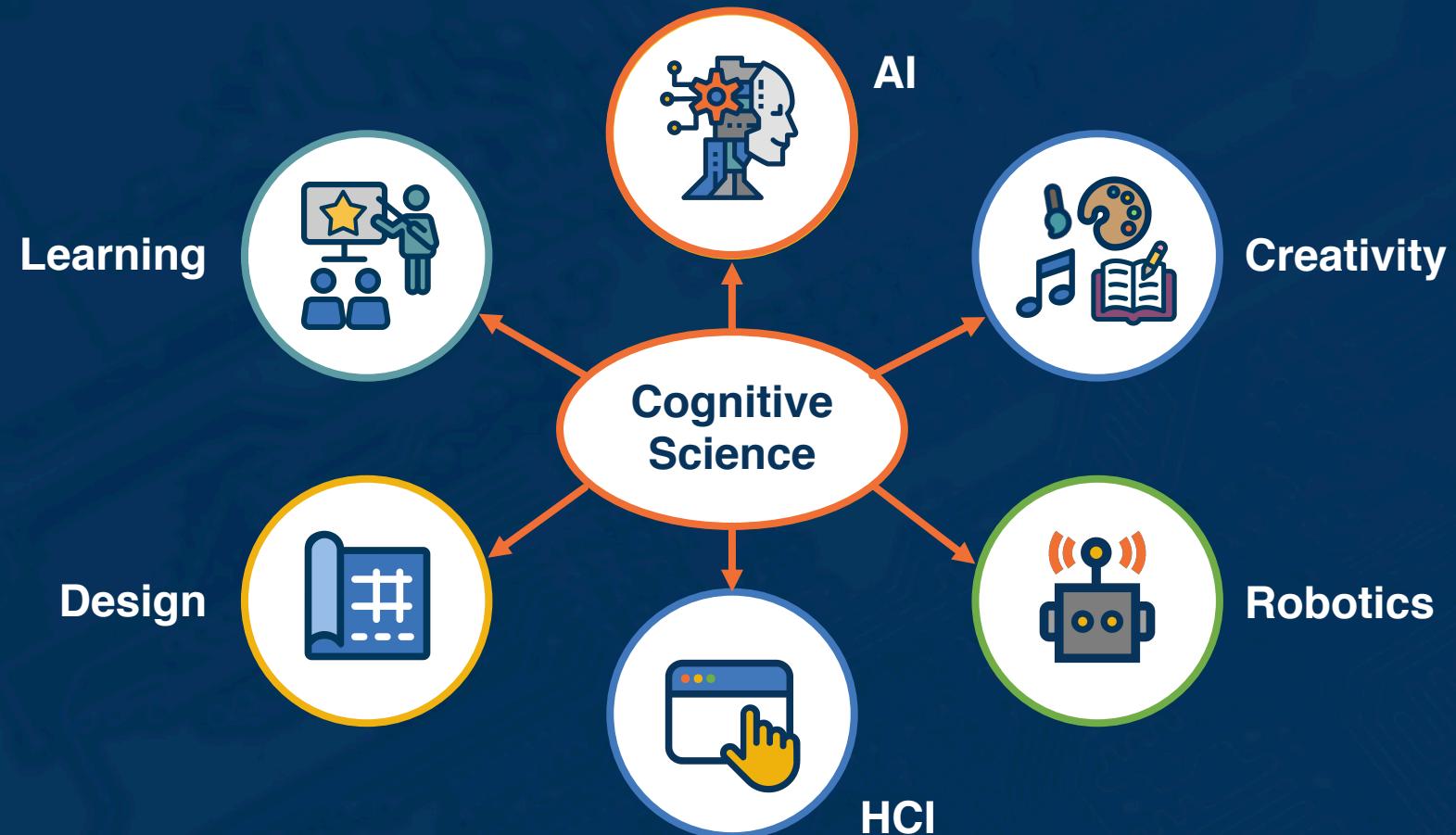
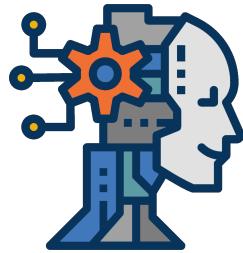




Relationship to AI



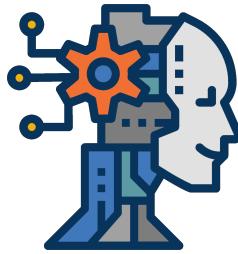
Relationships to Cognitive Science



AI (1956)

Cognitive
Science
(1974)

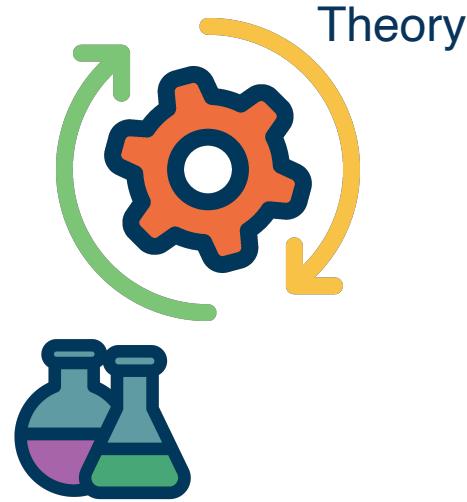




AI (1956)

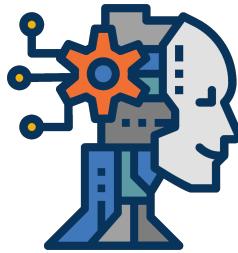


Cognitive
Science
(1974)



Experiment

Cognitive Science and AI



AI (1956)

How can we build a machine
that solves math problems the
way humans do?

How can we implement
the theories in cognitive
science?



Cognitive
Science
(1974)



Theory



Experiment

How do humans solve
math problems?

What math problems
do 4th grade students
find difficult?

Pat Langley



“Artificial Intelligence and Cognitive Systems” (2012)

Cognitive Scientist, AI Researcher

Image: <https://visca.engin.umich.edu/home/videos/pat-langley/>

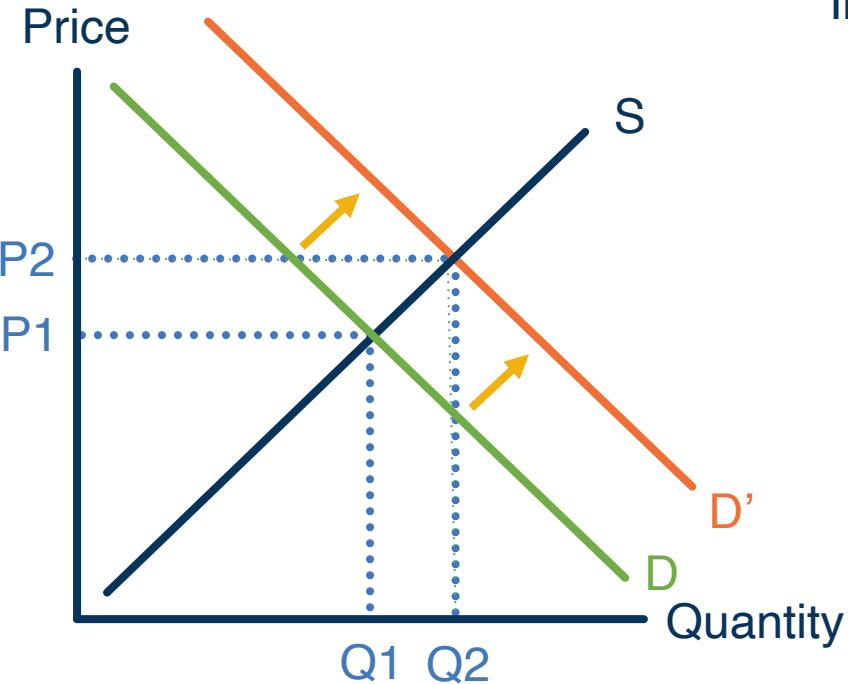


Rationality

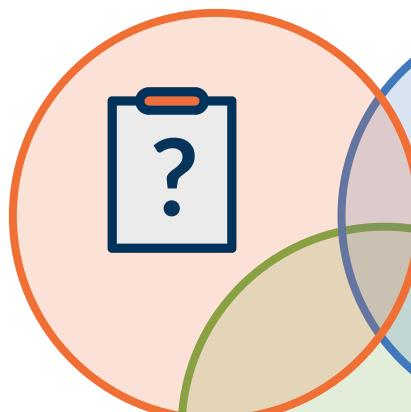


Bounded Rationality





Incomplete Information



Limited Cognitive Computation



Time constraint

Bounded Rationality: Market Economy



Rationality



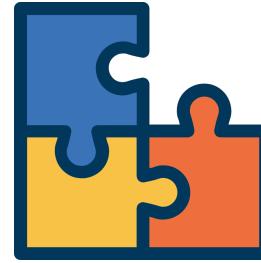
Incomplete Information



Limited Cognitive
Computation



Time Constraint



Bounded
Rationality



Satisficing



Good Enough
Decision

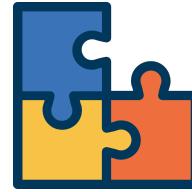
Satisficing



Optimal
Solution



Specificity



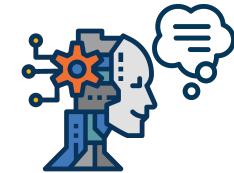
Satisficing
Solution



Generality



Doesn't explain how
behavior is produced
by the mind



Artificial General
Intelligence (AGI)

Task-specific vs. General Intelligence



High-Level Cognition

1950's:

- ◆ High-level Human Intelligence
- ◆ e.g., multi-step reasoning, language understanding

Now:

- ◆ From understanding language to text classification
- ◆ Short term practical gains in narrowly defined tasks but no insight into human intelligence



Structured Knowledge

1950's:

- ◆ Represent and organize knowledge
- ◆ e.g., symbolic structures

Now:

- ◆ Increased popularity of statistical and probabilistic methods
- ◆ Great performance but remarkable drop in representational power



Systems-Level Research

1950's:

- ◆ Comprehensive theories of the mind
- ◆ e.g., cognitive architectures

Now:

- ◆ Researchers shifted focus to algorithms, not systems
- ◆ Decreased interest in systems-level accounts, fragmentation of AI into disconnected subfields



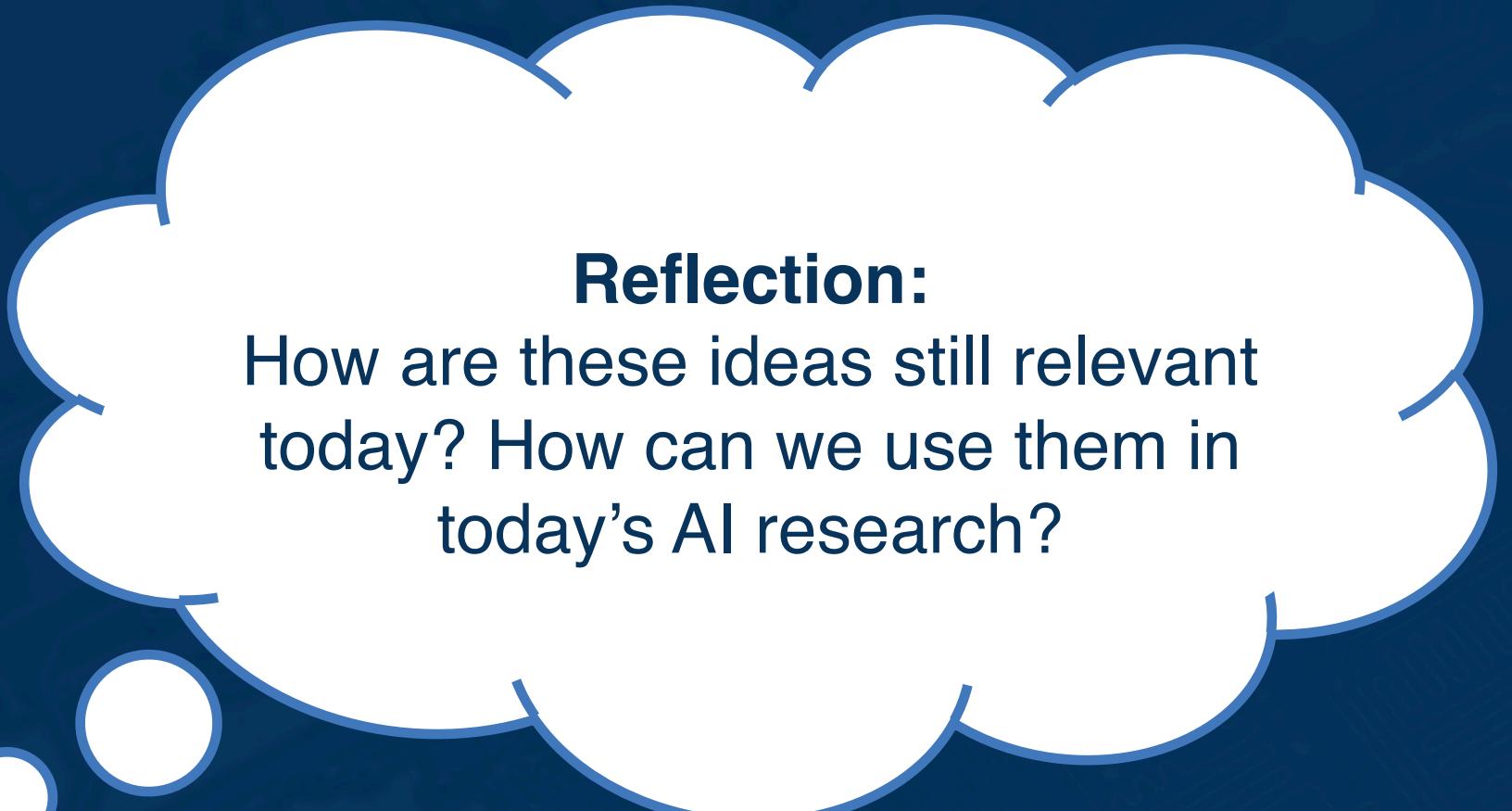
Heuristics and Satisficing

1950's:

- ◆ Search method that use "heuristic"
- ◆ Used to tackle difficult and challenging problems

Now:

- ◆ Notion that mathematical formulations provide guarantee of behavior
- ◆ Rise of statistical approaches

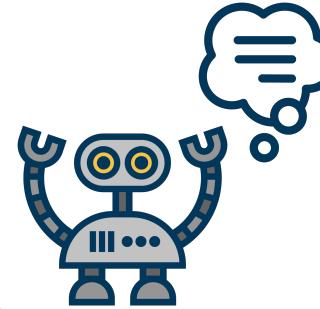


Reflection:
How are these ideas still relevant
today? How can we use them in
today's AI research?

AI Research



Engineering AI



Cognitive AI

Best
Solution



Human
Intelligence



What data needs
to be collected

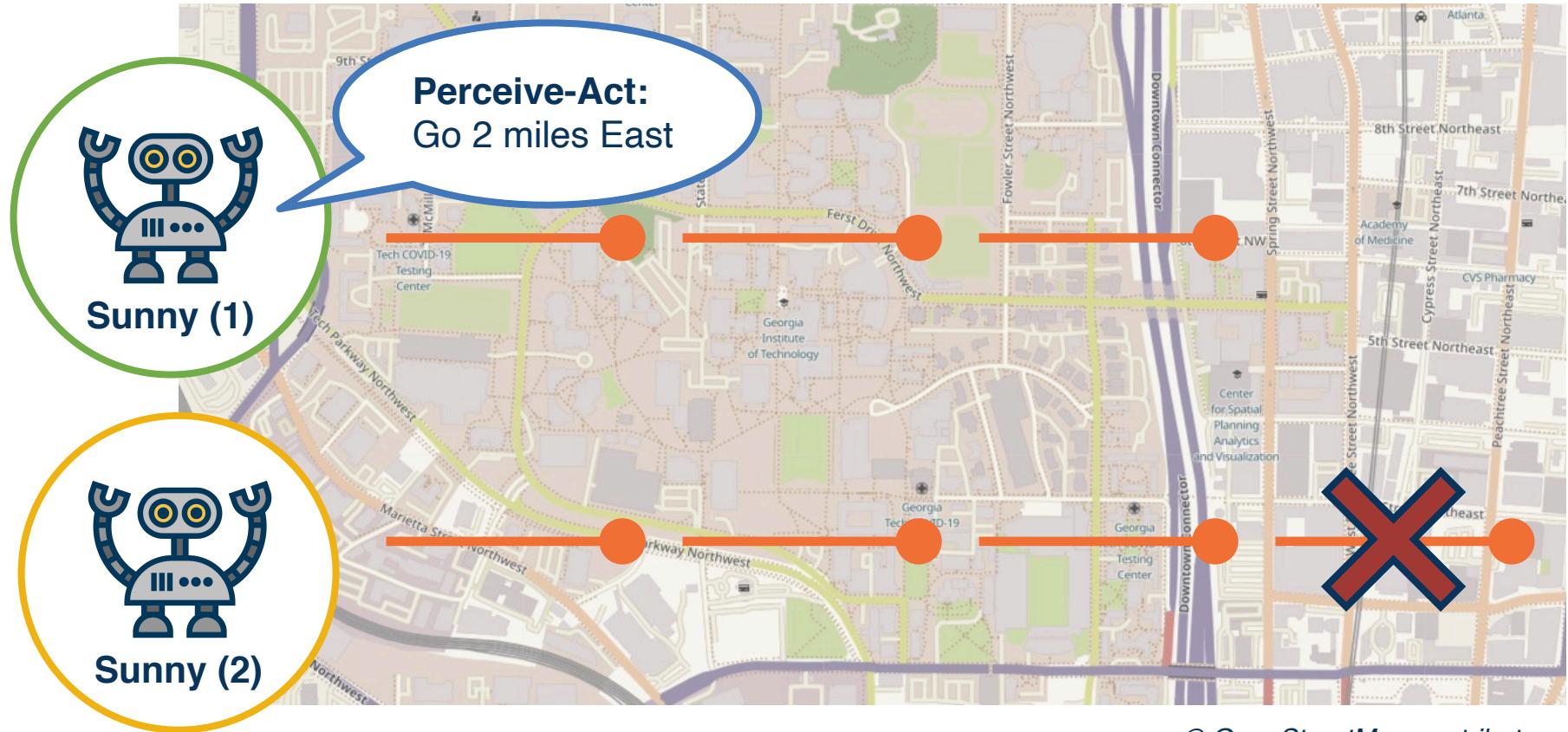


Representation and
organization of
knowledge in memory



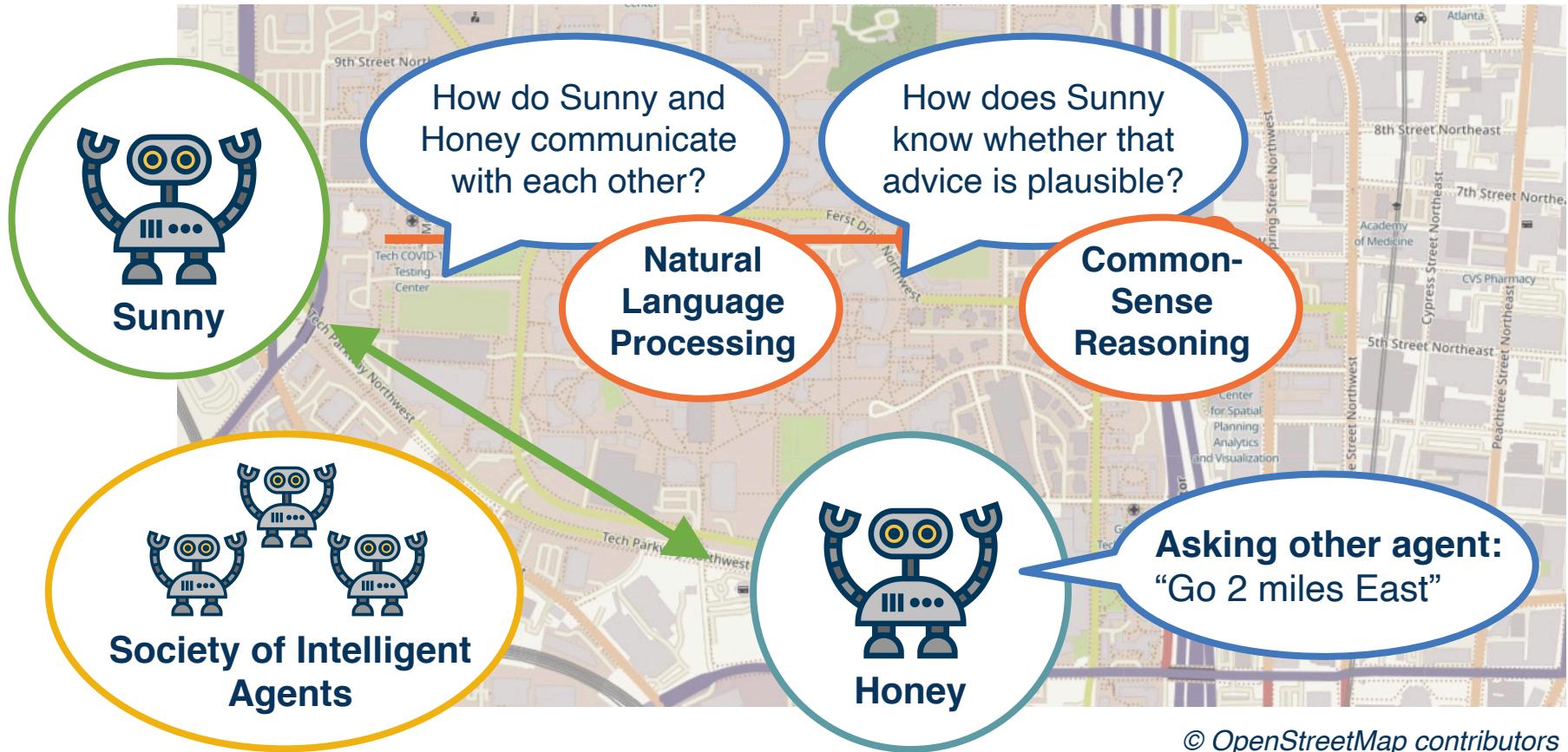
Allows for
experimentation that is
neither unethical nor
too expensive

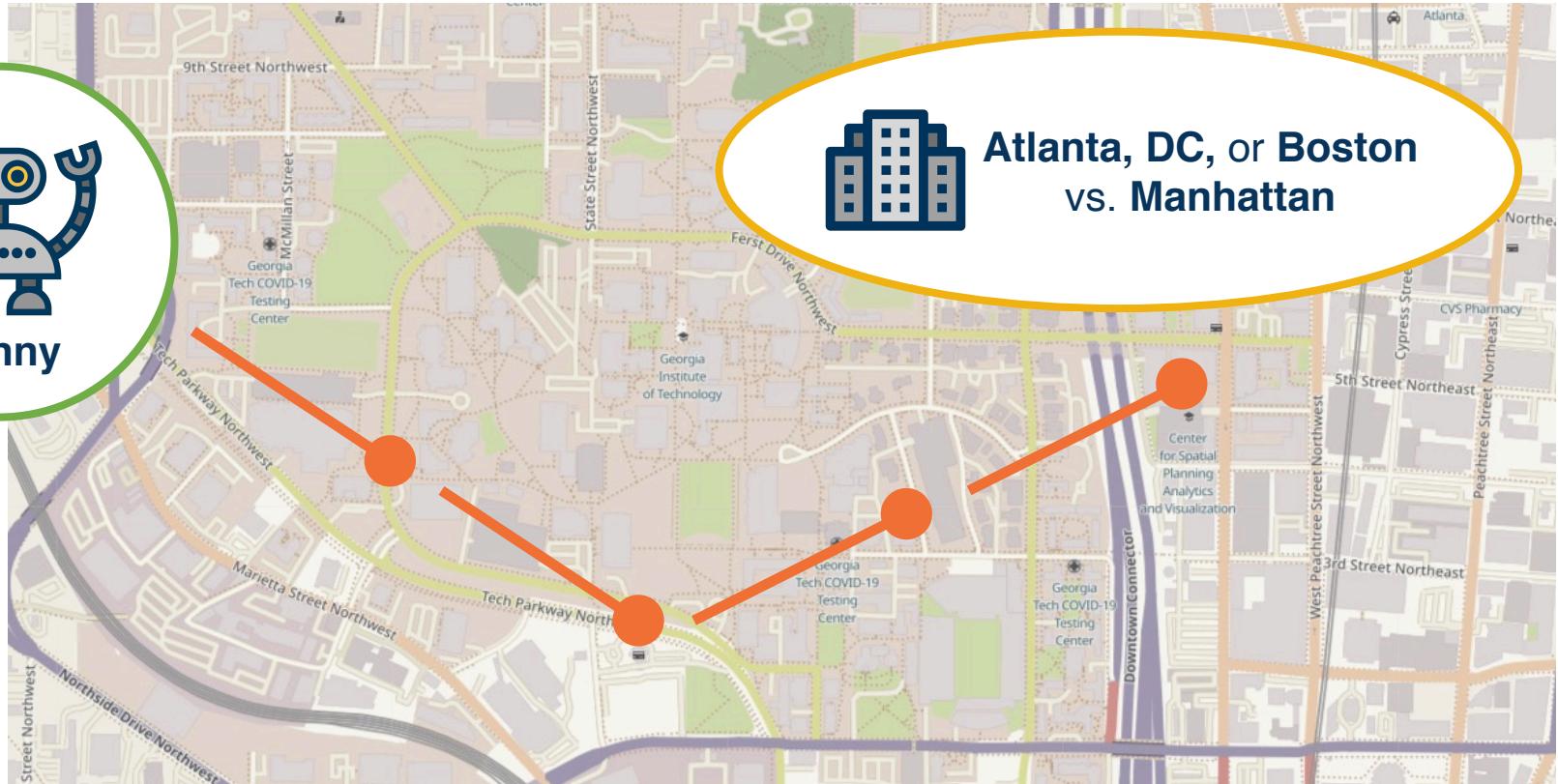
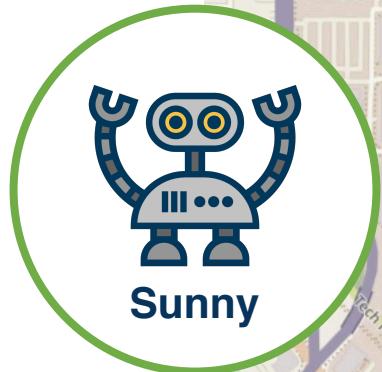
How can AI help advance research in Cognitive Science?



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Navigational Problem: Perception, Action, Cognition

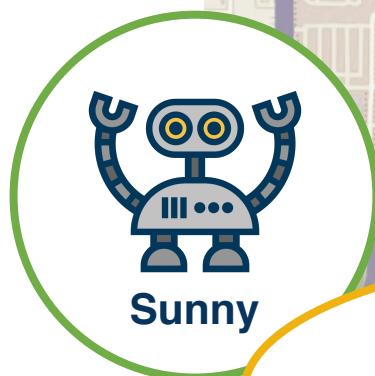




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Navigational Problem: Perception, Action, Cognition





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Navigational Problem: Perception, Action, Cognition



Learning from Experience

Interaction,
feedback



Case-Based Reasoning

Store and Retrieve
cases from memory



Reinforcement Learning

Positive or
negative rewards



Subsymbolic Representation

Probability theory
Hidden Markov
Model (HMM)



Deliberation

Plans to navigate one location to another



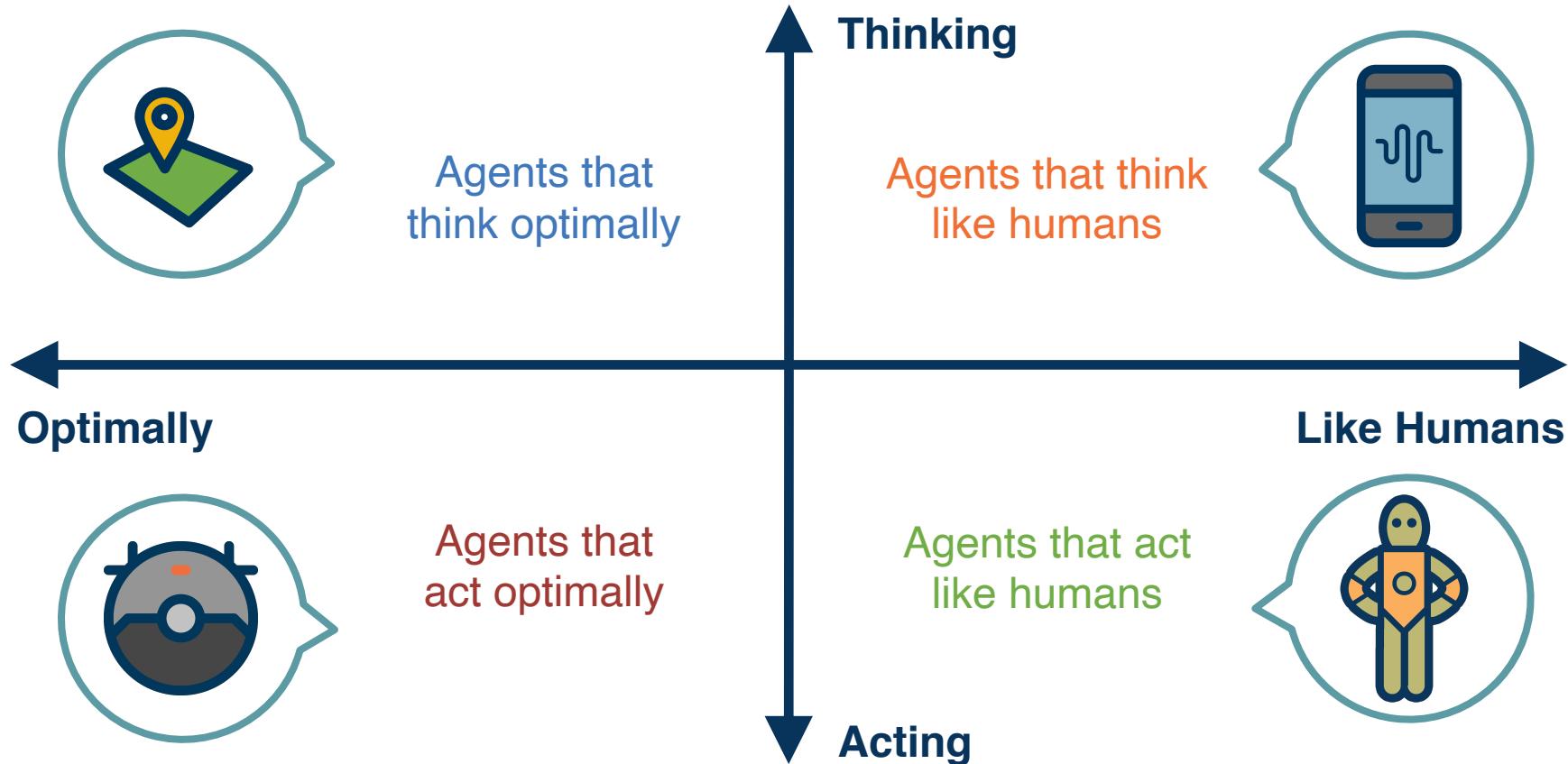
Reflection

Meta-reasoning for self-adaptation

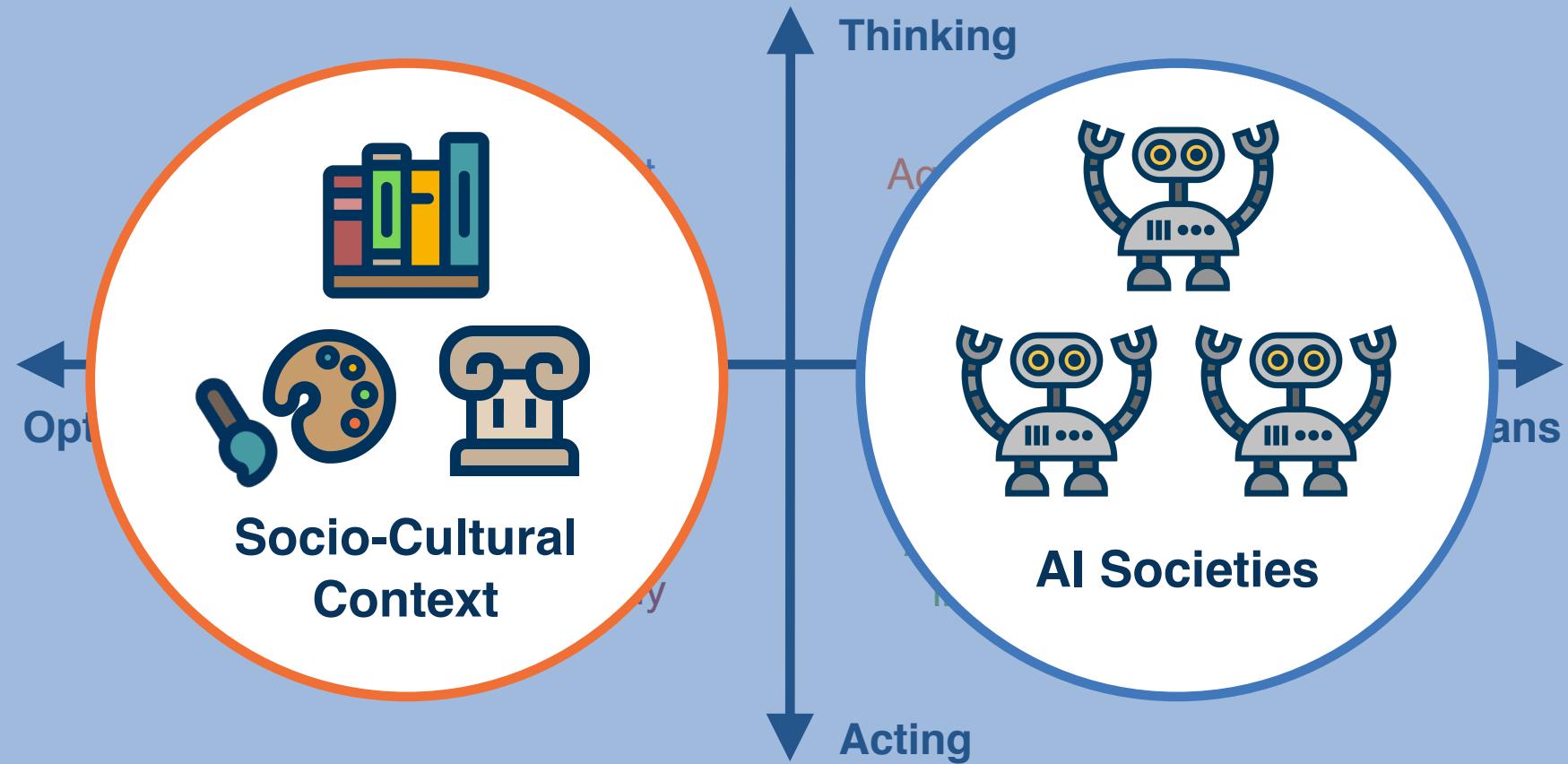
Navigational Problem: Deliberation and Reflection



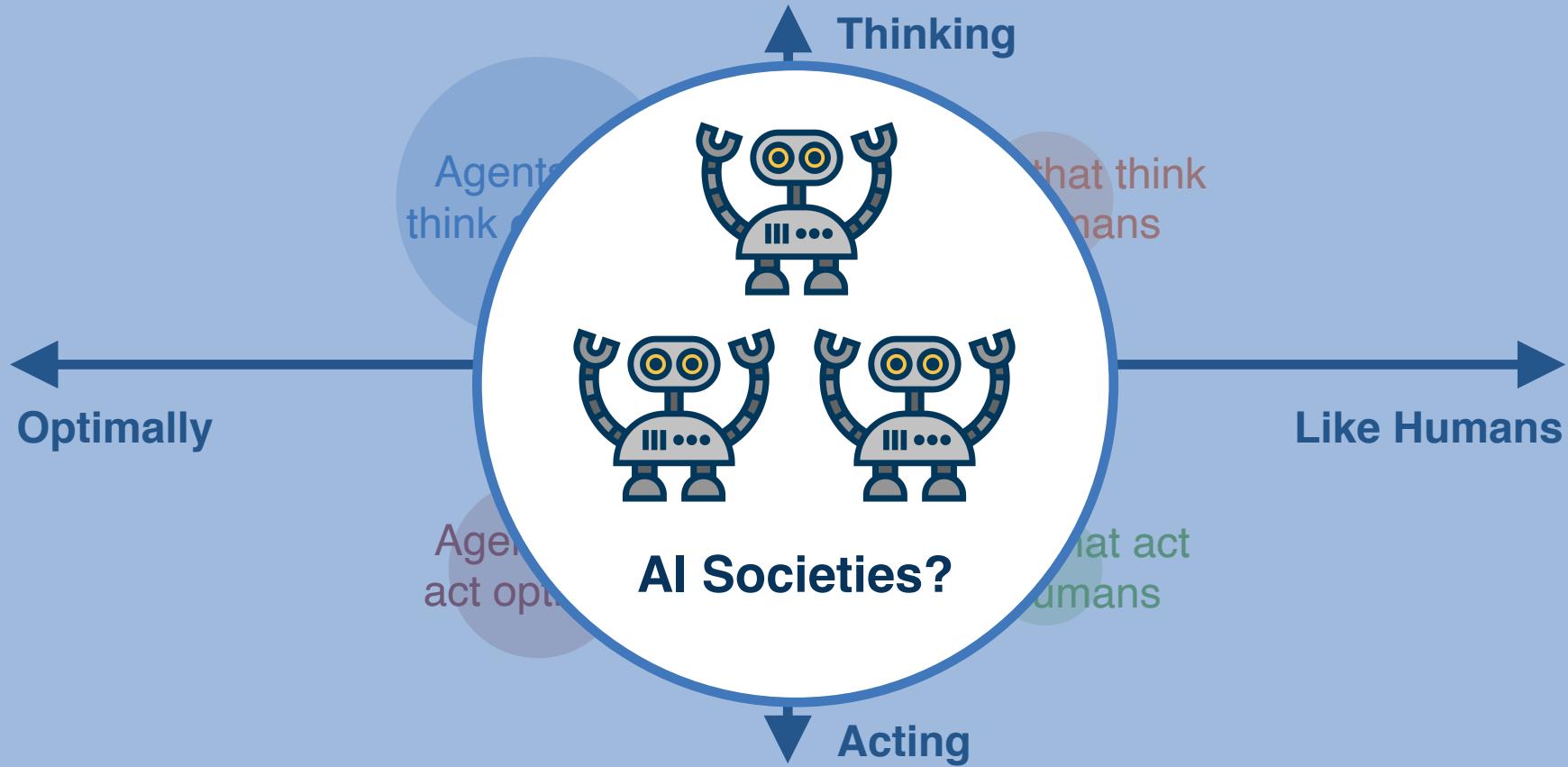
Design Choices of Designing an AI Agent



Four Schools of AI



Discussion: What is Missing Here?



Schools of AI: Where Are We Now?