Knowledge-Based Artificial Intelligence: Cognitive Systems

Lesson Preview

- What is knowledge-based artificial intelligence?
- How does it fit into the rest of artificial intelligence?
- What can I expect to learn from this course?
- What is the structure of this course?

What are some things Watson must be able to do to participate in Jeopardy?

Read the clue

Search its knowledge base

Decide on an answer

Properly phrase that answer

Fundamental Conundrums of Artificial Intelligence

- Intelligent agents have limited resources.
- Computation is local, but problems have global constraints.
- Logic is deductive, but many problems are not.
- The world is dynamic, but knowledge is limited.
- Problem solving, reasoning, and learning are complex, but explanation and justification are even more complex.

Characteristics of AI Problems

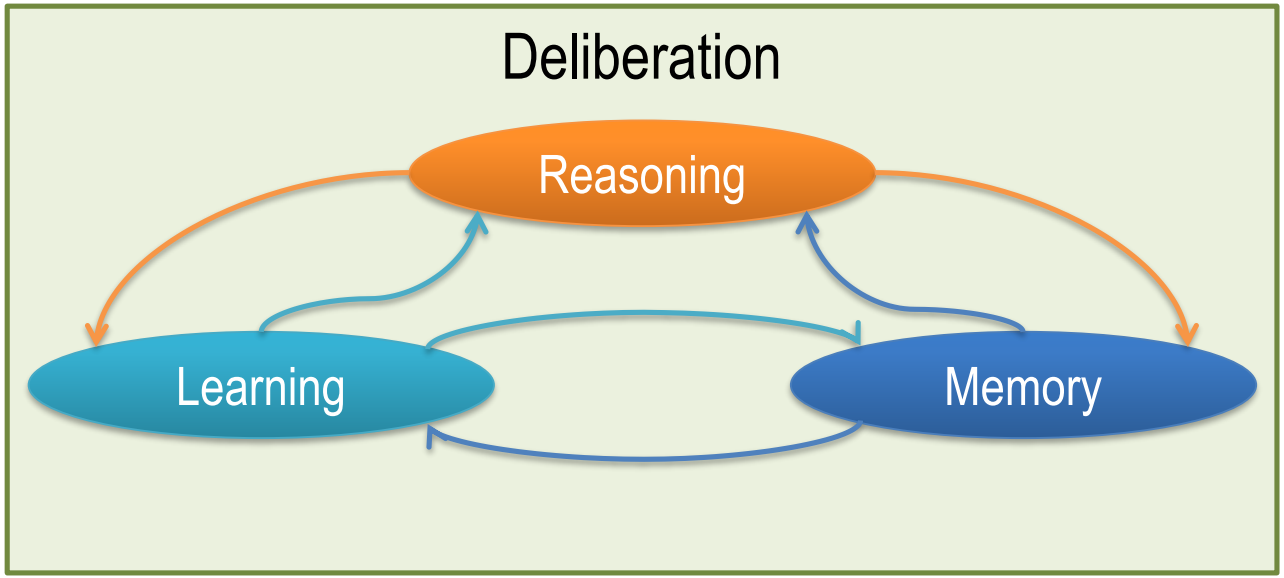
- Knowledge often arrives incrementally.
- Problems exhibit recurring patterns.
- Problems have multiple levels of granularity.
- Many problems are computationally intractable.
- The world is dynamic, but knowledge of the world is static.
- The world is open-ended, but knowledge is limited.

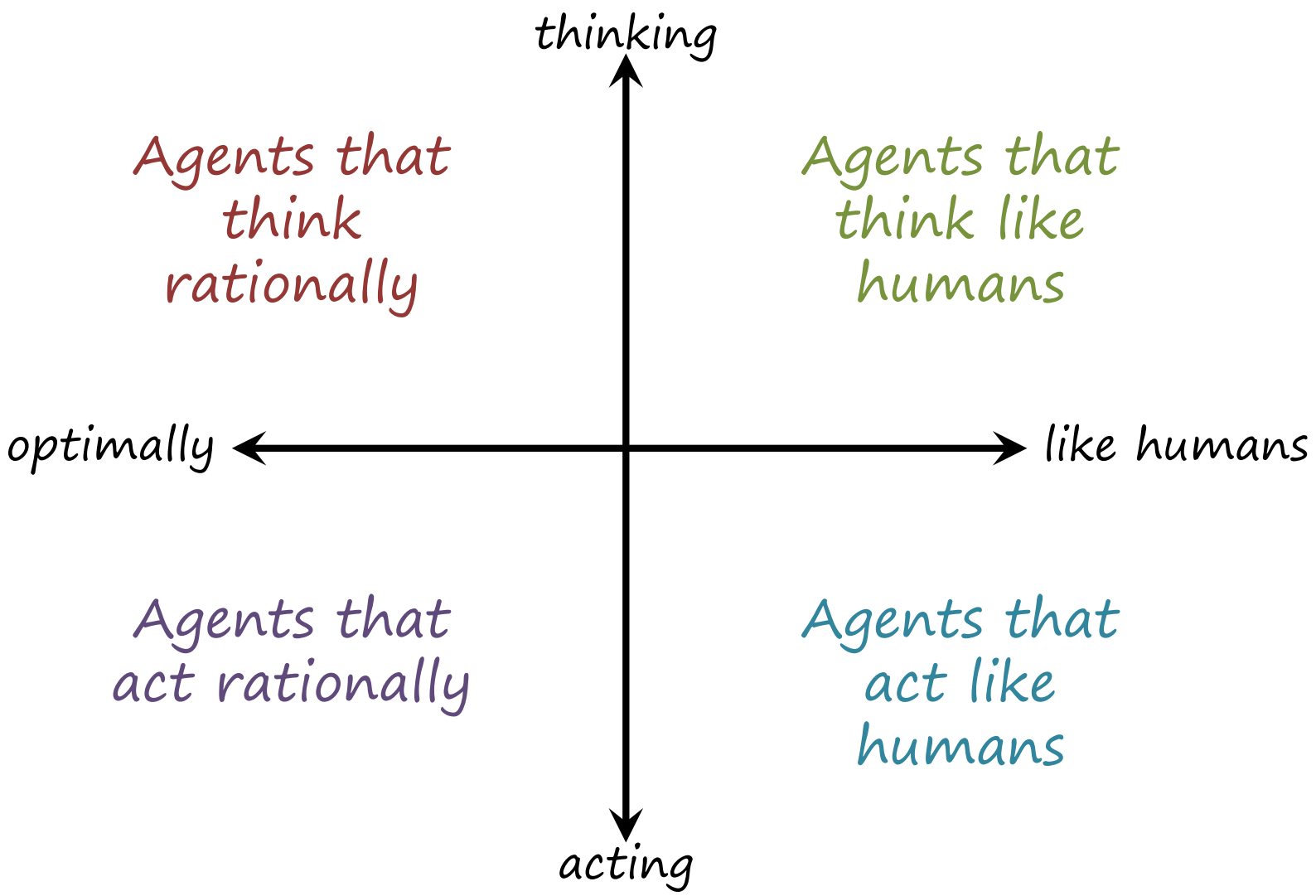
Characteristics of AI Agents

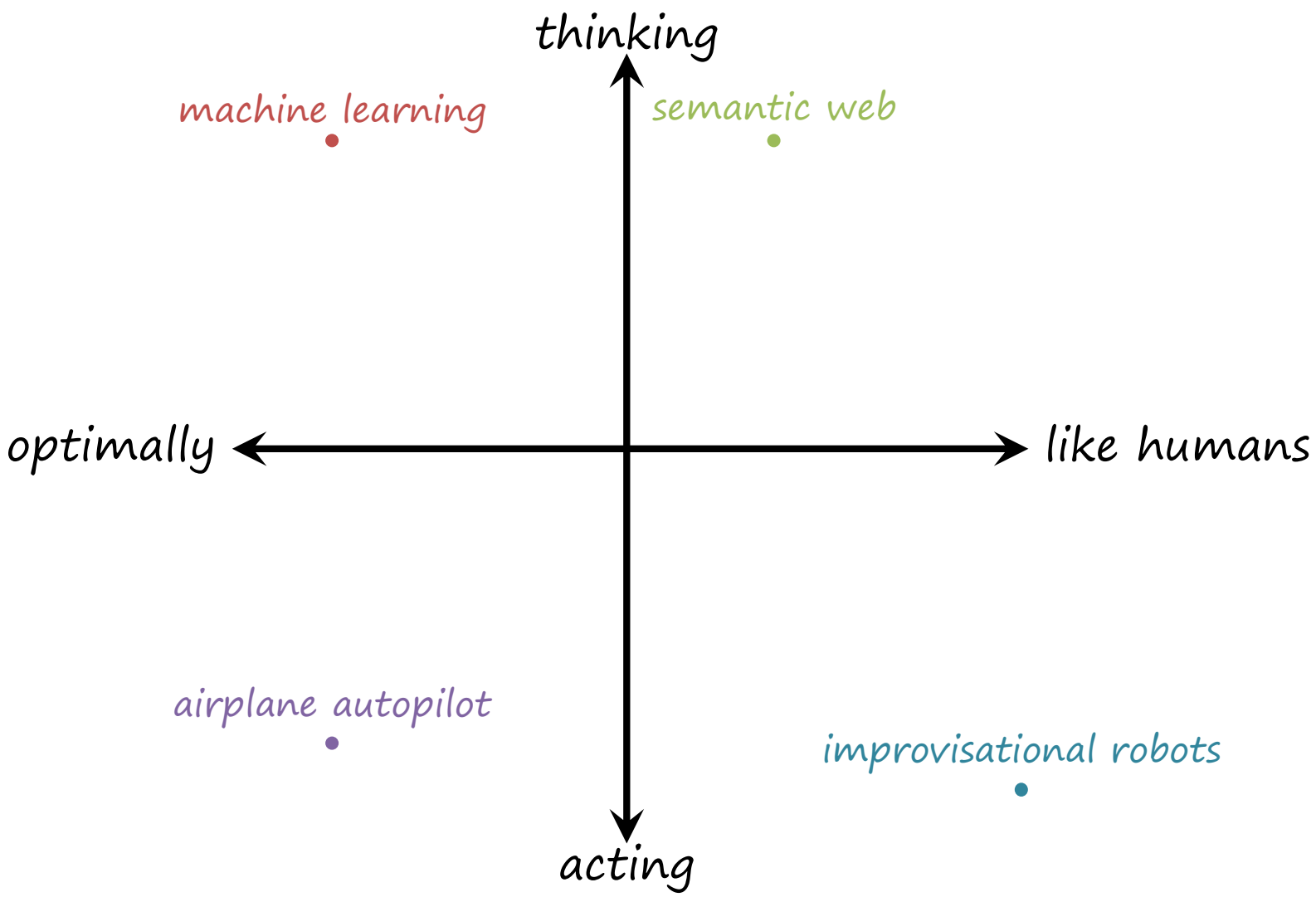
- Agents have limited computing power.
- Agents have limited sensors.
- Agents have limited attention.
- Computational logic is fundamentally deductive.
- AI agents' knowledge is incomplete relative to the world.

Which of these are AI problems?

- Answering questions on Jeopardy.
- Configuring the dimensions for the basement of a new house.
- Tying shoelaces.
- Deciding on a route to a new destination.
- Making sense of a news broadcast.
- Designing a robot that walks on water.
- Establishing whether a flower pot can be used as a drinking cup.
- Deciding whether or not a new animal is a bird.


Deliberation
Reasoning
Learning
Memory


thinking
Agents that think rationally
Agents that think like humans
optimally
like humans
Agents that act rationally
Agents that act like humans
acting

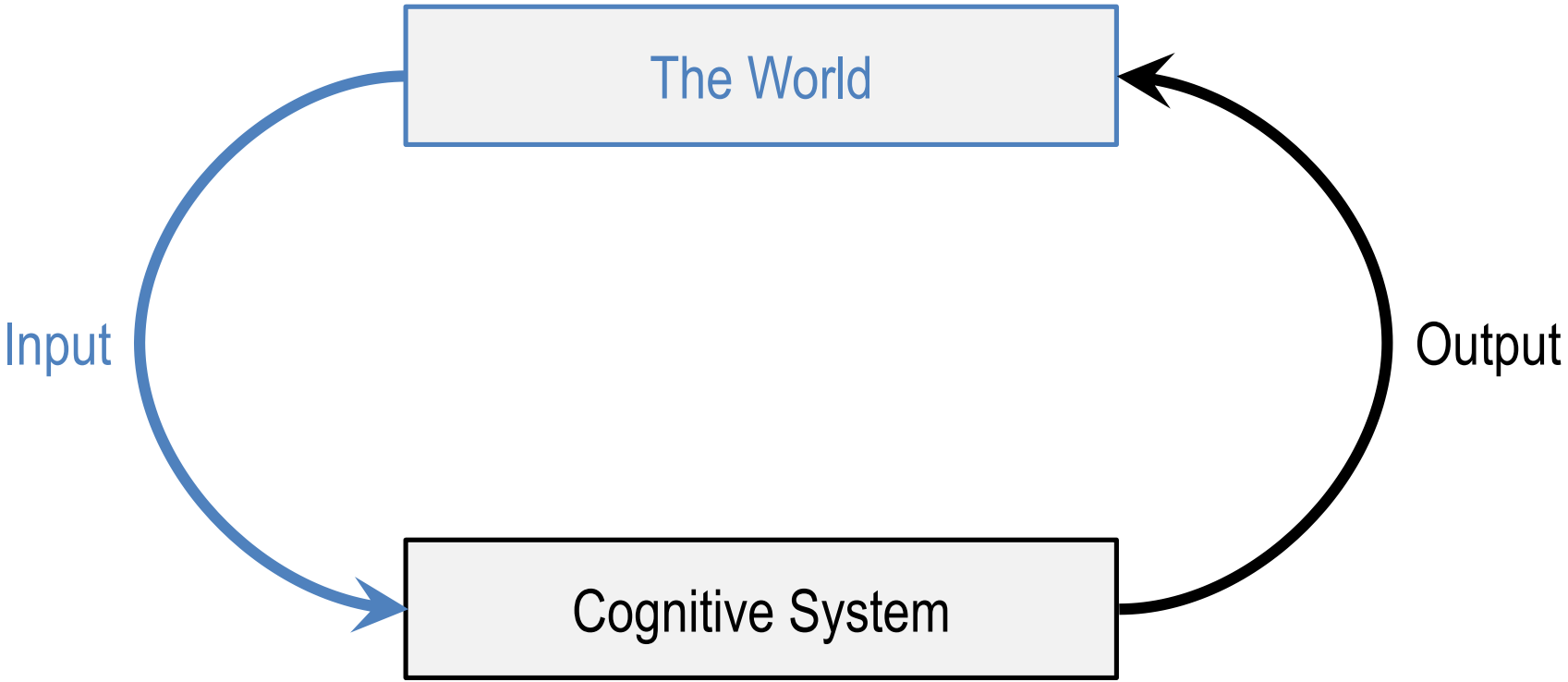

thinking
machine learning
semantic web
optimally
like humans
airplane autopilot
improvisational robots
acting

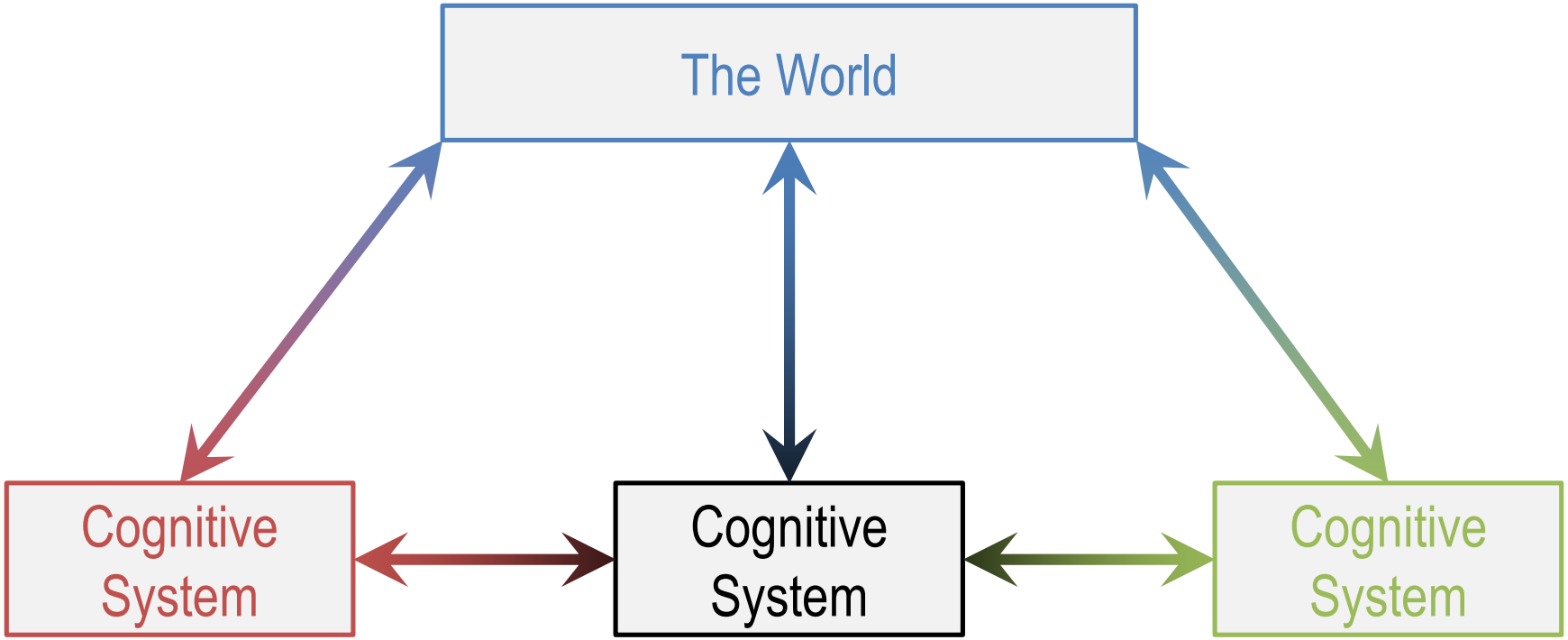
What are cognitive systems?

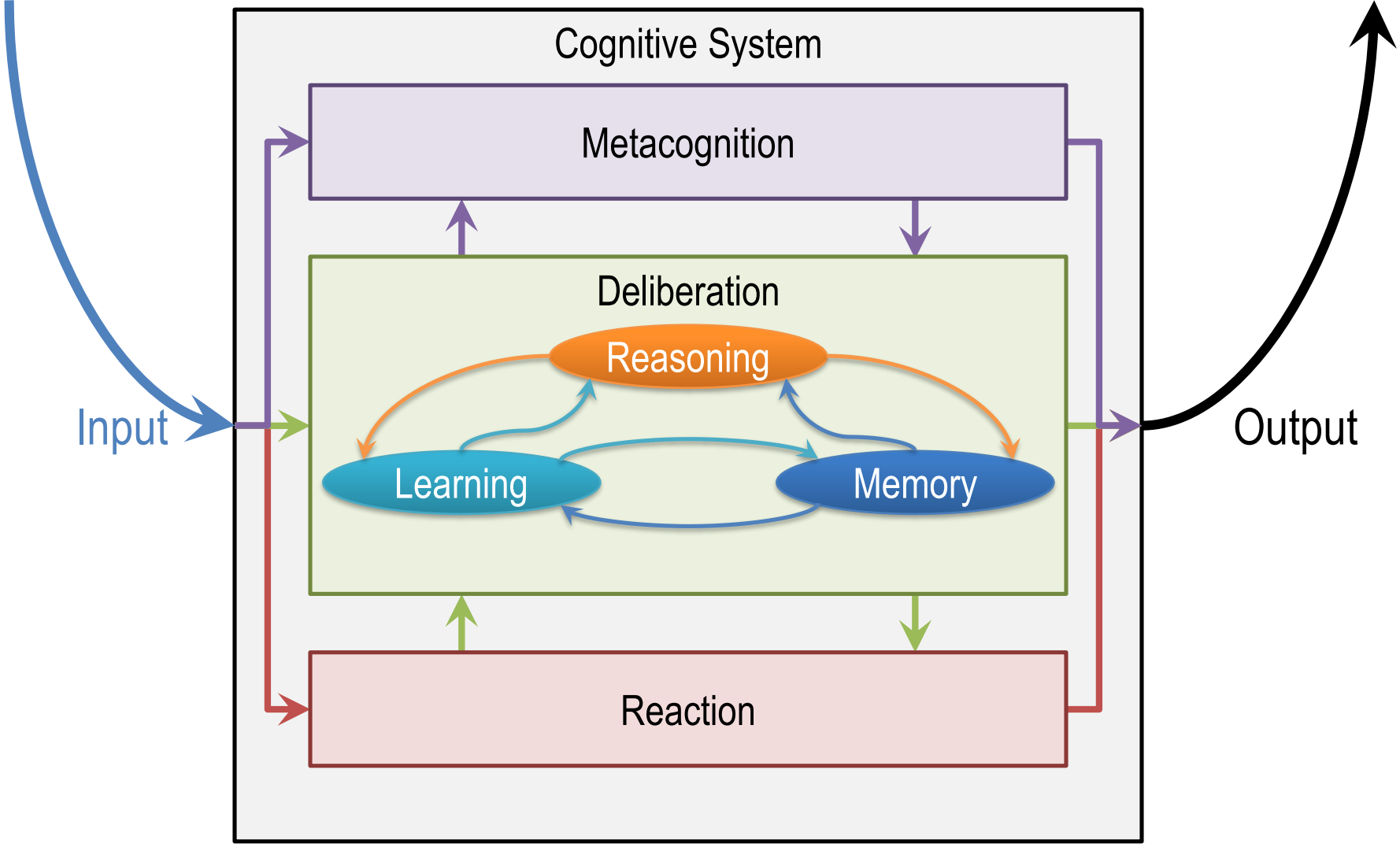
Cognitive: dealing with human-like intelligence.

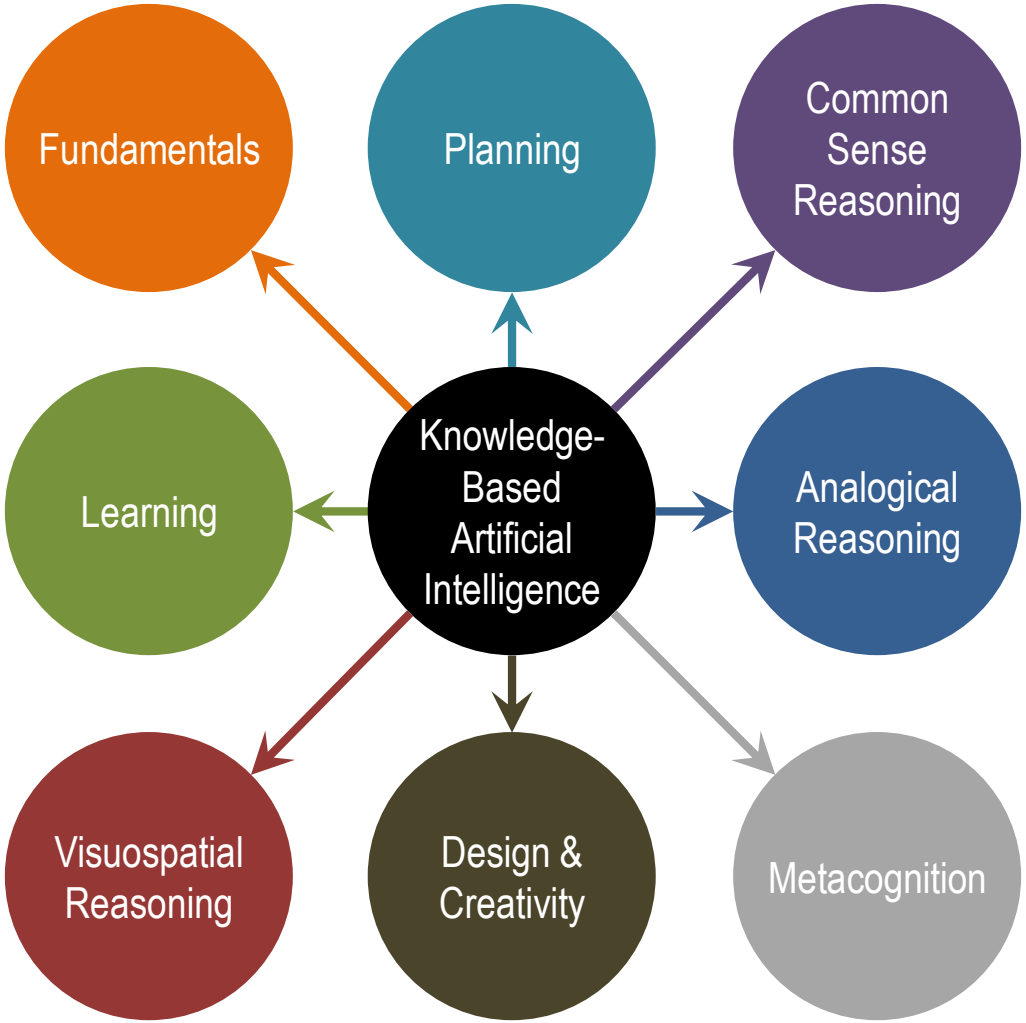
Systems: multiple interacting components such as learning, reasoning, and memory.

Cognitive Systems: Systems that exhibit human-like intelligence through processes like learning, reasoning, and memory.

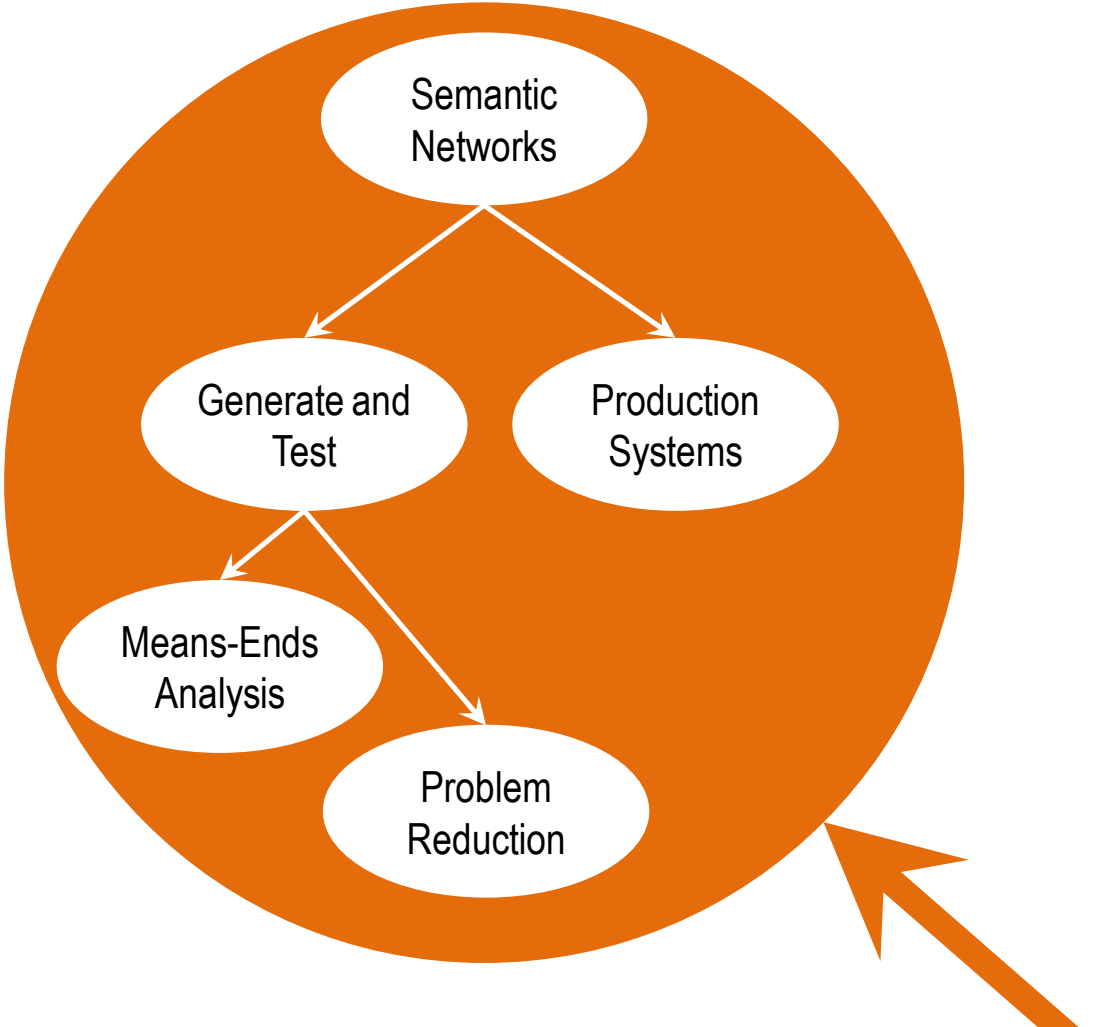

The World
Input
Output
Cognitive System


The World
Cognitive System
Cognitive System
Cognitive System

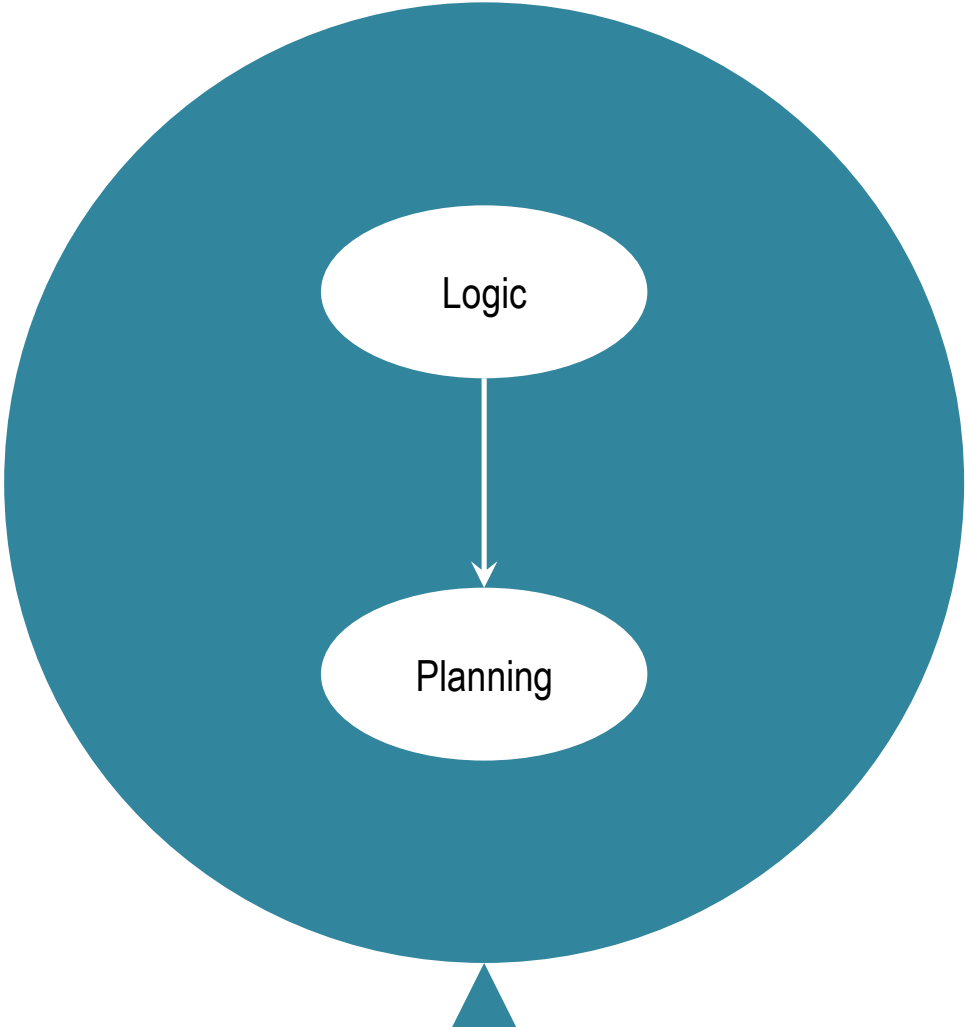

Cognitive System
Metacognition
Deliberation
Reasoning
Learning
Memory
Reaction
Input
Output


Fundamentals
Planning
Common Sense Reasoning
Learning
Knowledge-Based Artificial Intelligence
Analogical Reasoning
Visuospatial Reasoning
Design & Creativity
Metacognition

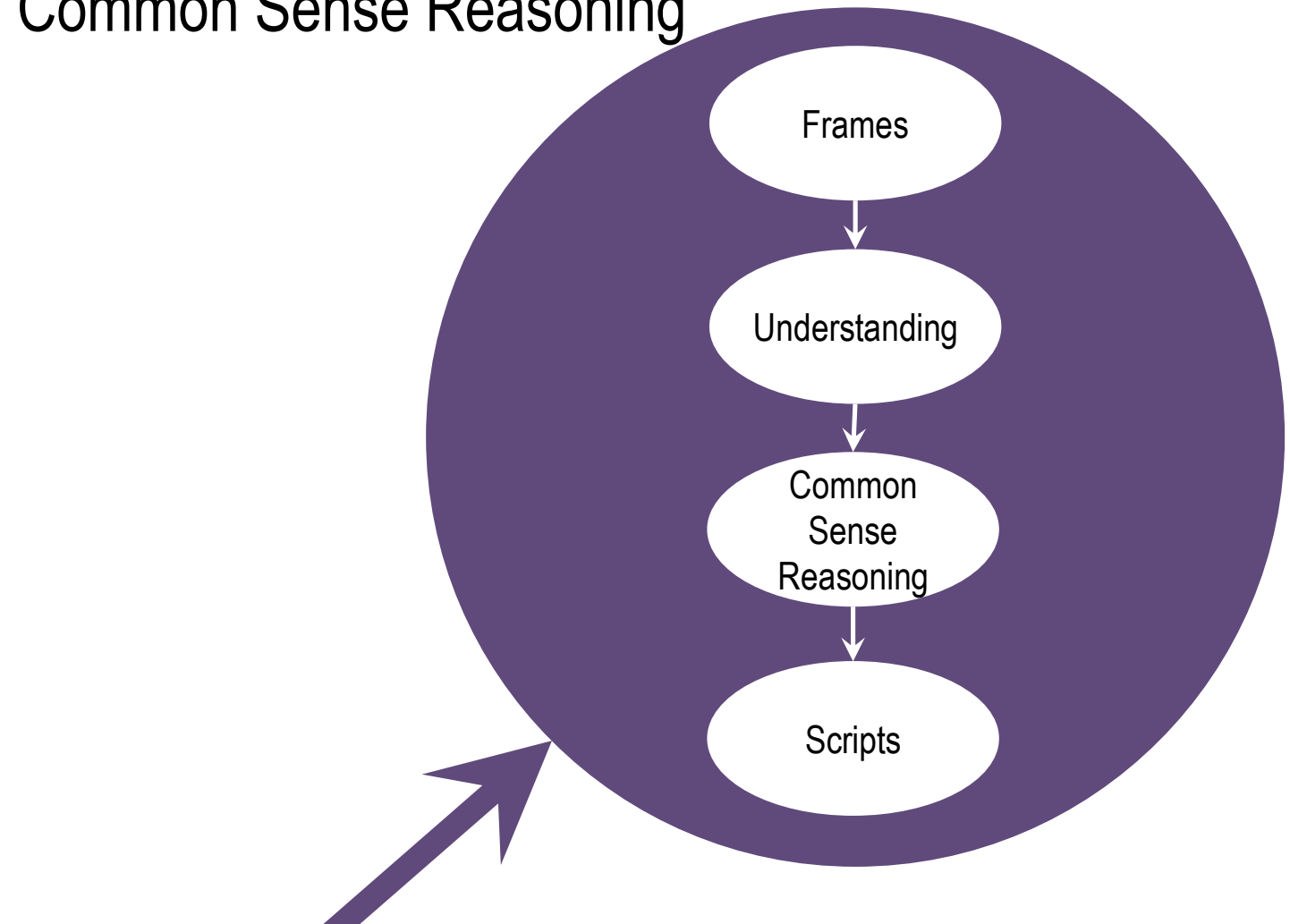
Fundamentals



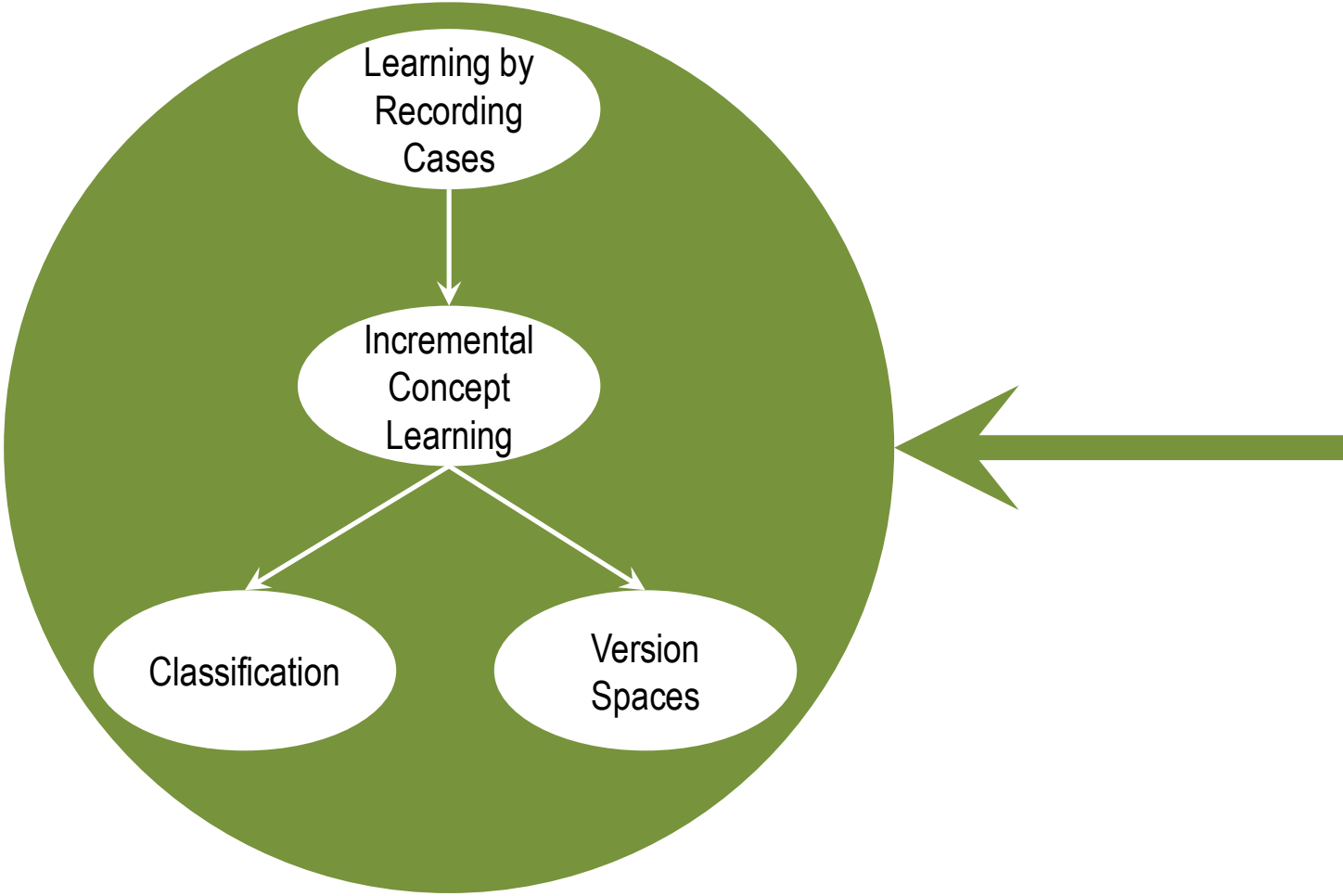
Planning



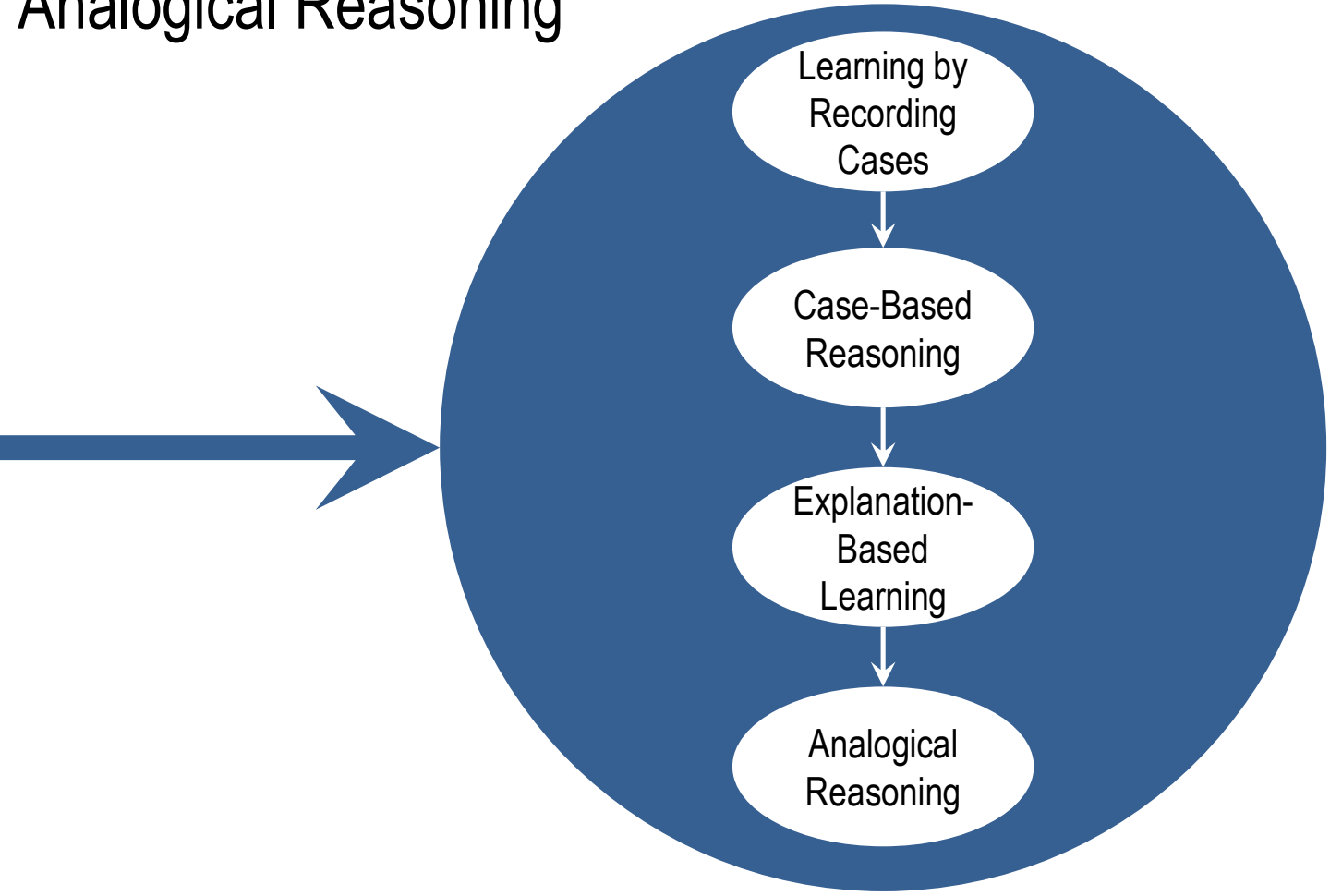
Common Sense Reasoning



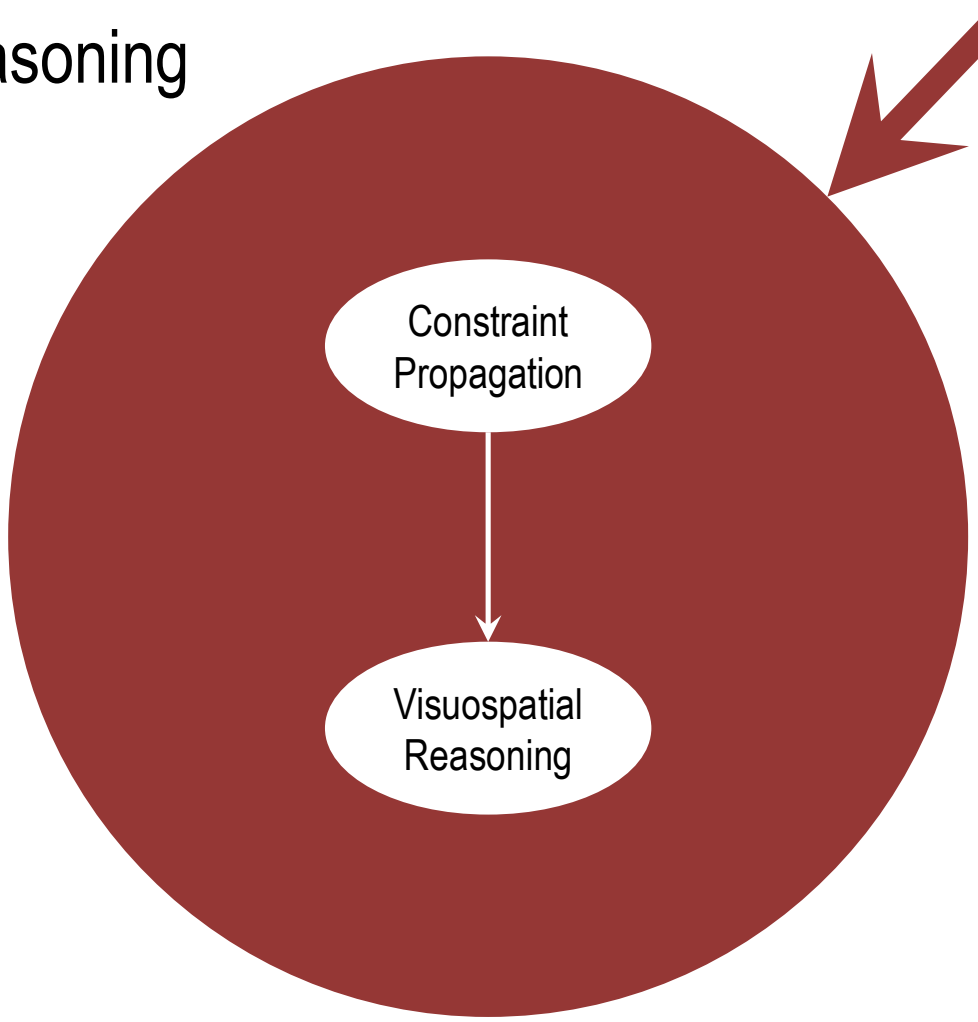
Learning


Learning by Recording Cases
Incremental Concept Learning
Classification
Version Spaces

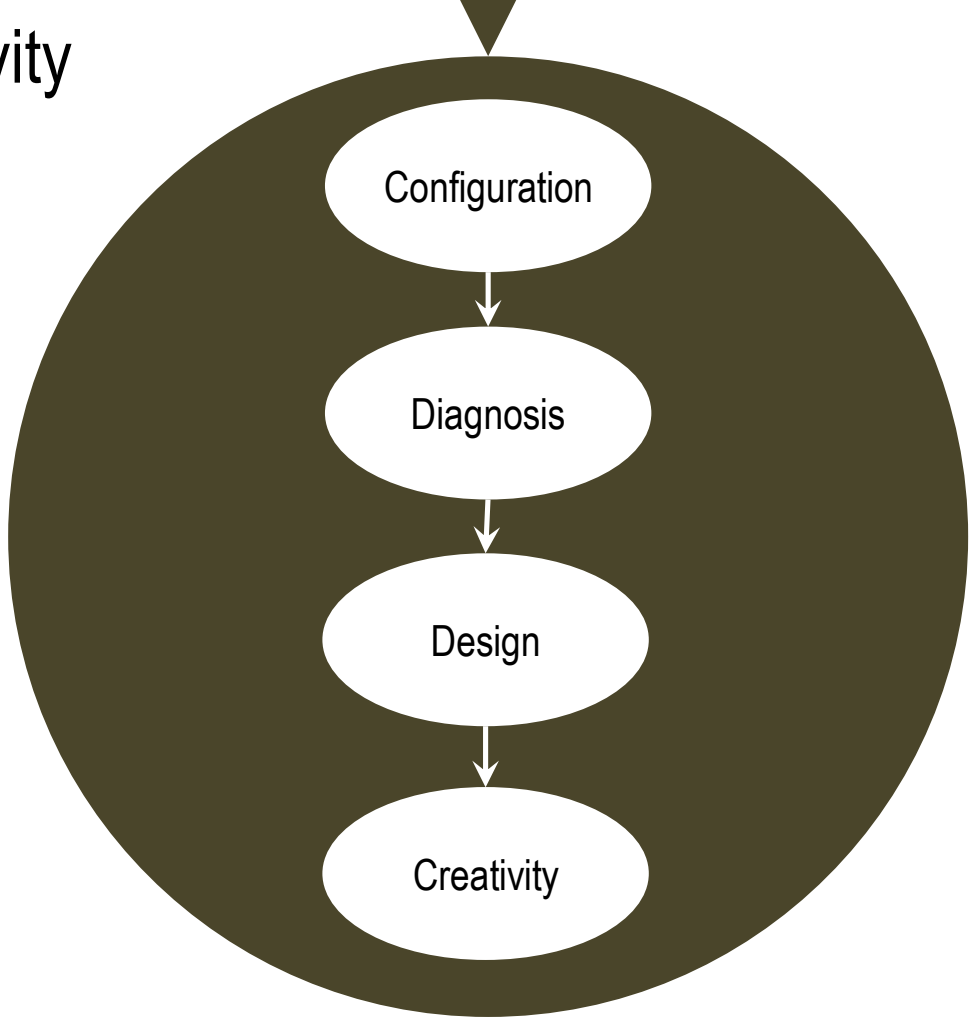
Analogical Reasoning



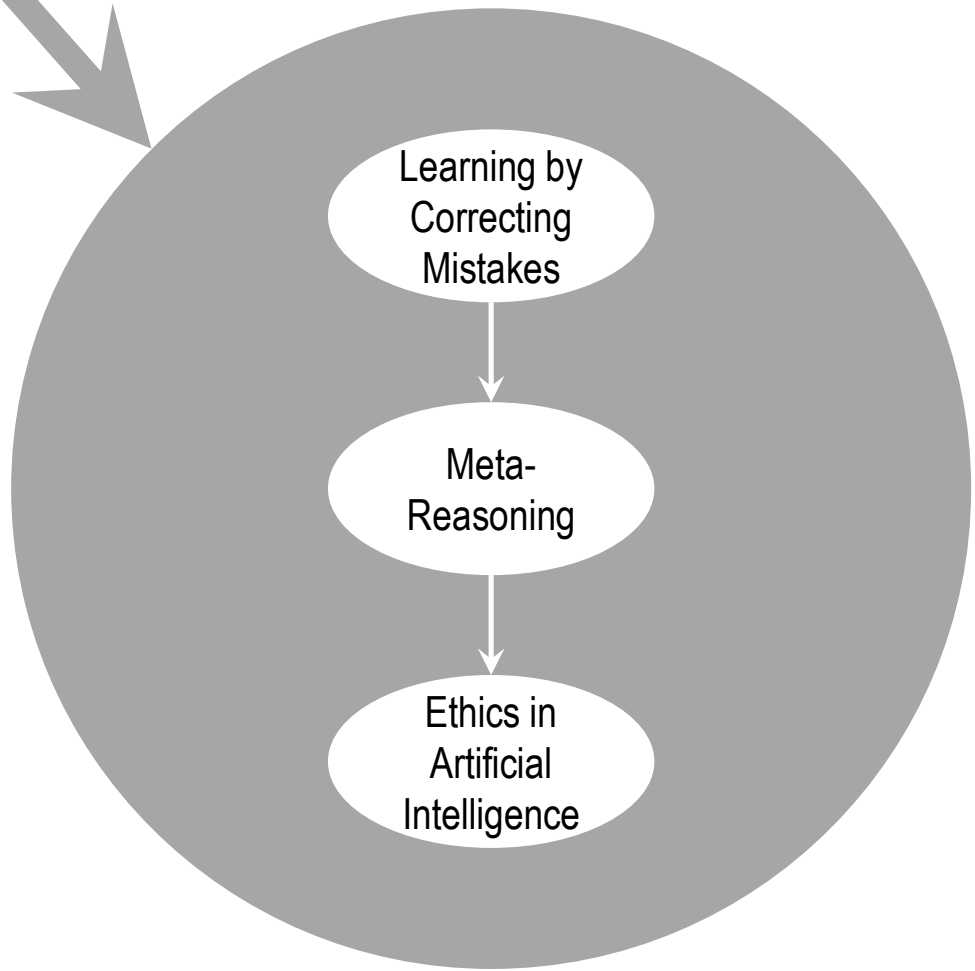
Visuospatial Reasoning

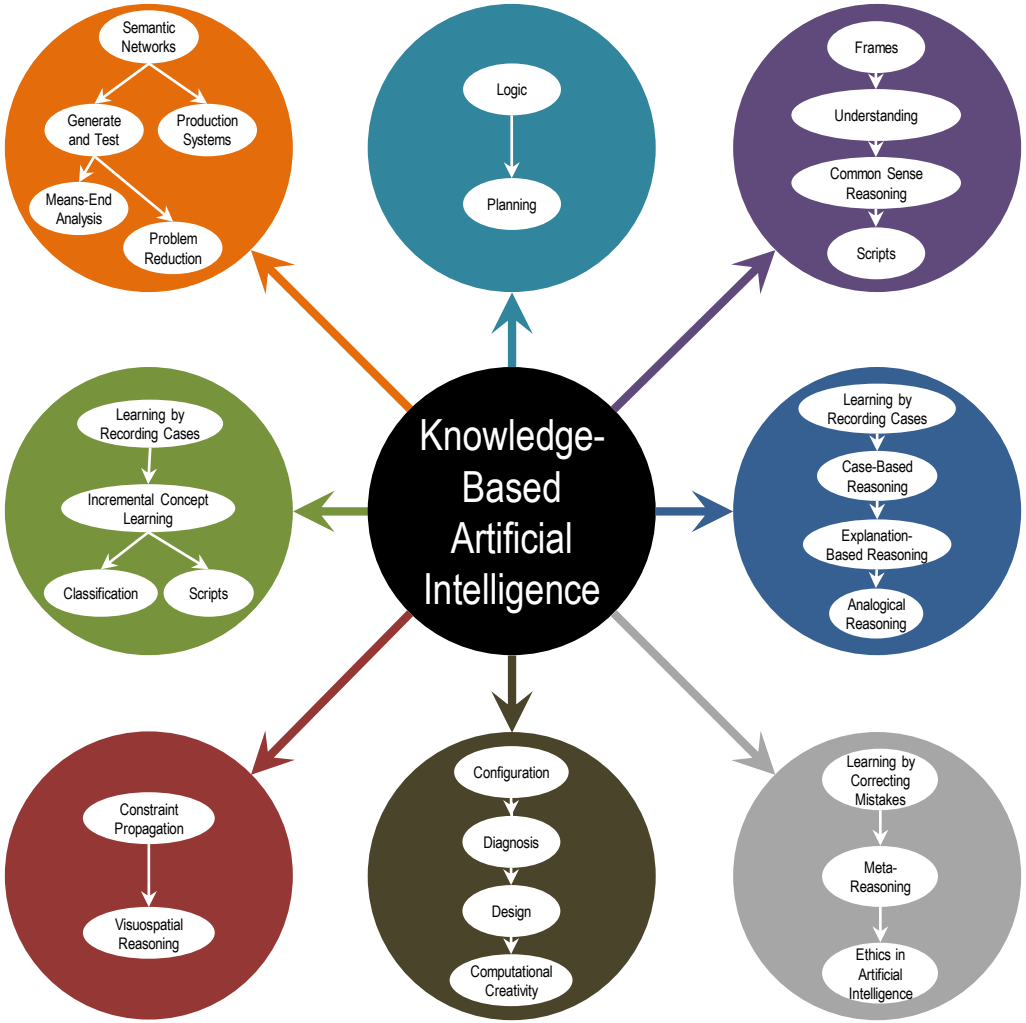


Design & Creativity



Metacognition




Knowledge-Based Artificial Intelligence
Semantic Networks
Generate and Test
Production Systems
Means-End Analysis
Problem Reduction
Logic
Planning
Frames
Understanding
Common Sense Reasoning
Scripts
Learning by Recording Cases
Incremental Concept Learning
Classification
Scripts
Learning by Recording Cases
Case-Based Reasoning
Explanation-Based Reasoning
Analogical Reasoning
Constraint Propagation
Visuospatial Reasoning
Configuration
Diagnosis
Design
Computational Creativity
Learning by Correcting Mistakes
Meta-Reasoning
Ethics in Artificial Intelligence

To recap…

- Conundrums and characteristics
- Four schools of AI
- What is KBAI?
- Cognitive Systems
- Topics in AI