Introduction to Artificial Intelligence

DA 221

Jan - May 2023

IIT Guwahati

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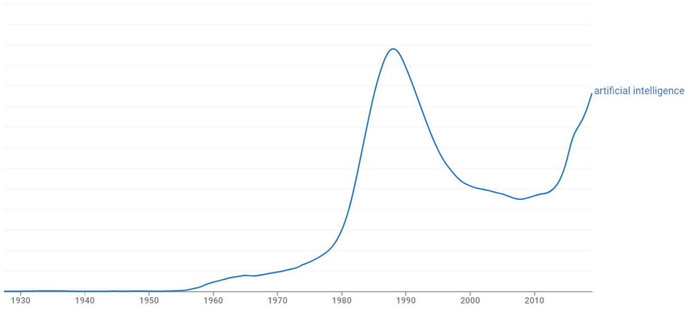
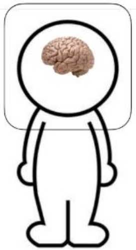
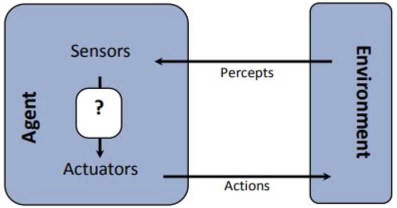
Lecture 04

Recap



- Familiar with some history of AI
  - Development timeline, researchers, breakthroughs
- Defined intelligence
  - Think like human, act like human
  - Think rationally, act rationally
  - Awareness about interdisciplinary approach to understand intelligence
- Defined artificial intelligence
  - Introduced the PEAS framework -Performance, Environment, Actuators, Sensors
  - Types of Environments
  - Types of Agent



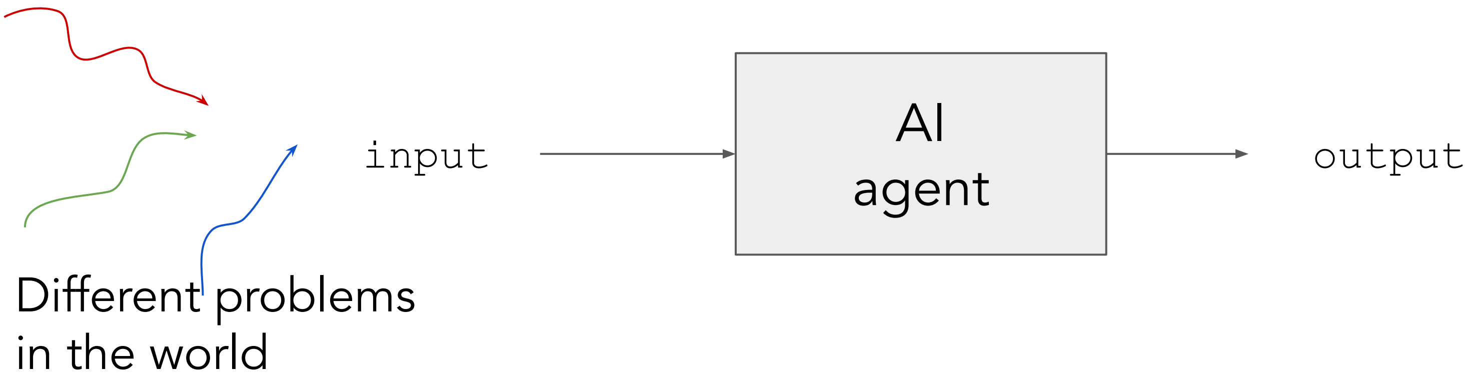


Problem Solving

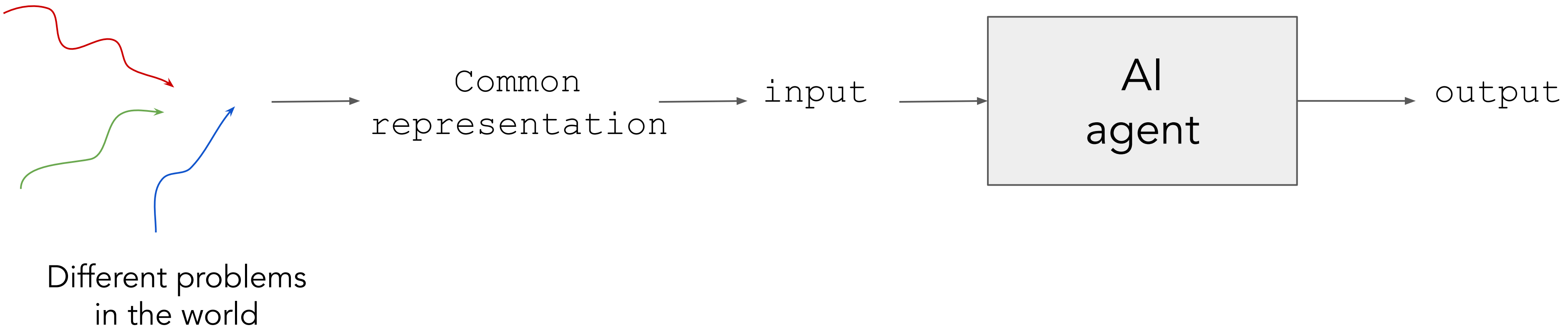
Early AI was concerned, a lot, with how to solve problems.

Goal is to be able to solve every problem in the world

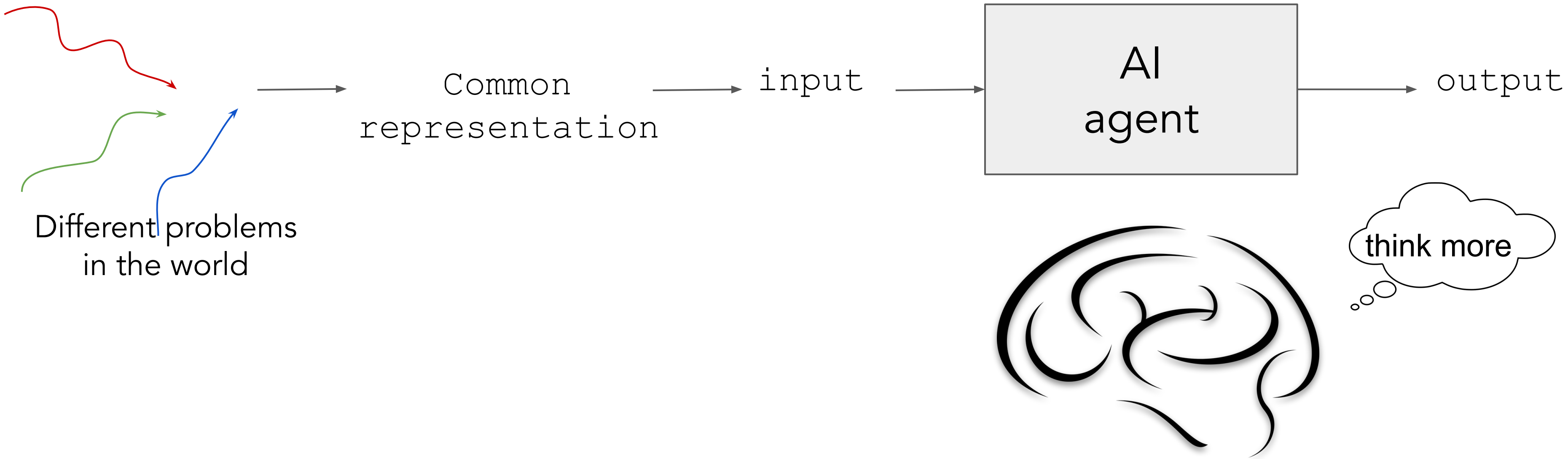
Is there one AI agent which can solve every problem?



Problem Solving



Problem Solving



Does brain receive
common representations?

Problem Solving

State

All information about the environment goes into a state

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Problem Solving Agent

An agent that tries to come up with a sequence of actions that will bring the environment into a desired state.

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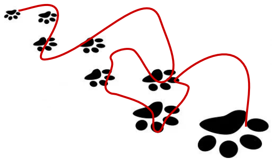
Problem Solving Agent

An agent that tries to come up with a sequence of actions that will bring the environment into a desired state.

Search

The process of looking for such a sequence, involving a systematic exploration of alternative actions.



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- $P : S \times (A \times S)* \to \mathrm{real}$ is the path cost function. A path is a sequence $[s_0 a_1 s_1 a_2 s_2 \ldots a_k s_k]$ such that $\forall i \in \{1..k\}\ \rho(s_{i-1}, a_i) = s_i$.

Image credit: https://cs.lmu.edu/~ray/notes/problemsolving/

Example

Water jug problem

- You have a 2-liter jug and a 1-liter jug;
- neither have any measuring marks on them at all.
- Initially both are empty.
- You need to get exactly 1 liter into the 2-liter jug.

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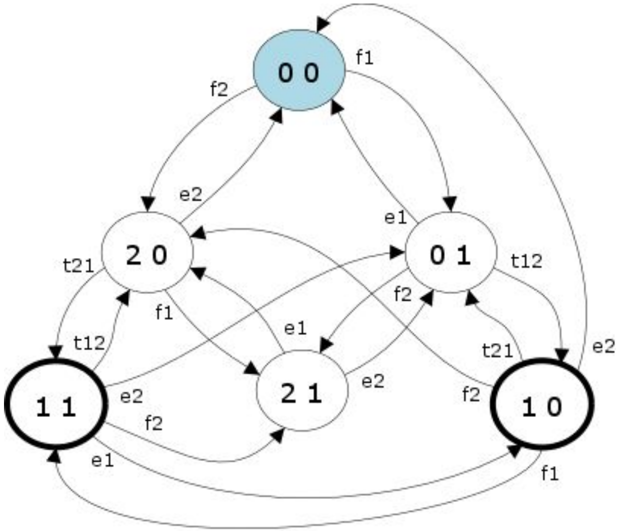
Water jug problem

- You need to get exactly 1 liter into the 2-liter jug

Defining the problem

- $S = \{(0,0), (1,0), (2,0), (0,1), (1,1), (2,1)\}$ (or, if you prefer, $\{0,1,2\} \times \{0,1\}$
- $s = (0,0)$
- $A = \{f2, f1, e2, e1, t21, t12\}$



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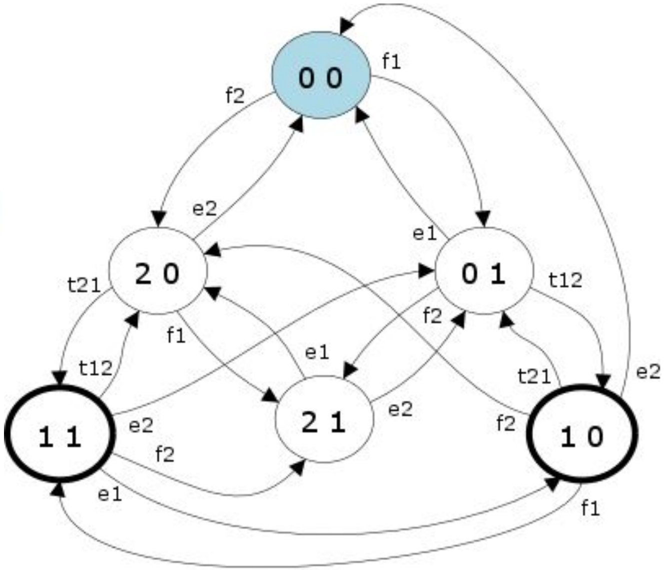
- ρ is given by the diagram
- $G = \lambda(x,y).\, x = 1$
- $P(p) = \text{length}(p)$ (the number of actions in the path)

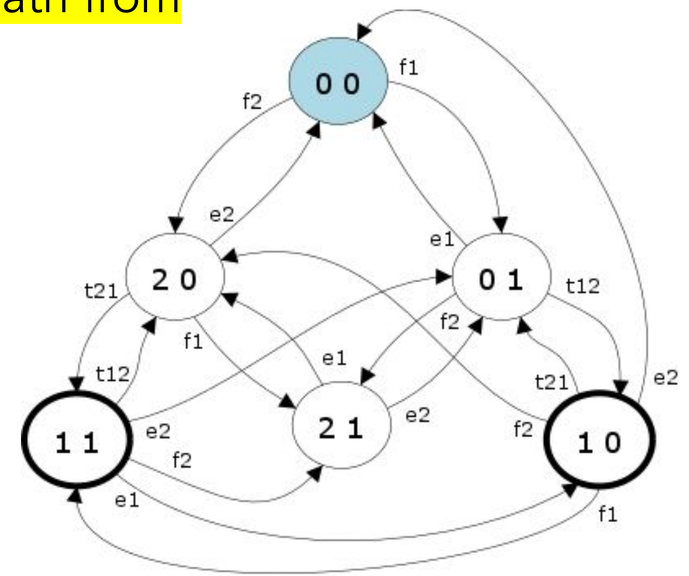


Water jug problem

Solving the problem

an agent would start at the initial state and explore the state space by following links until it arrived in a goal state. A solution to the water jug problem is a path from the initial state to a goal state.

- $[f1, f2, e2, t12]$
- $[f1, e1, f2, t21, t12, f1, e2, t12]$
- $[f2, t21]$



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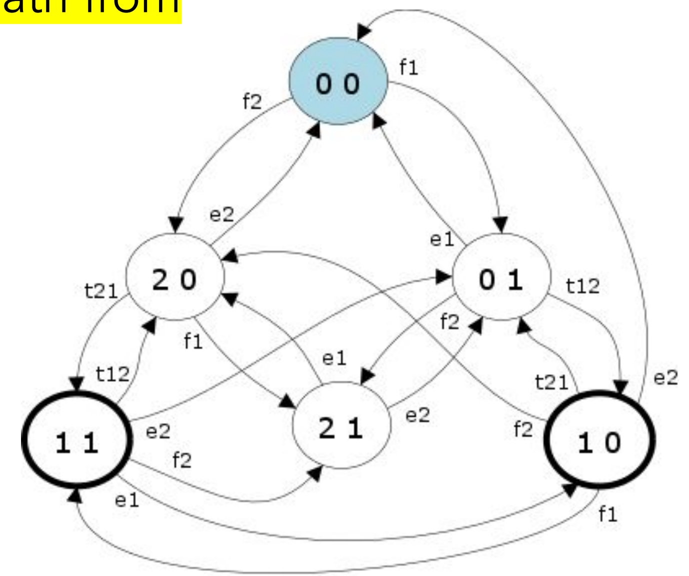

There are can be infinite number of solutions. Sometimes we are interested in the solution with the smallest path cost

Example

Water jug problem

- You have a 4-liter jug and a 3-liter jug;
- neither have any measuring marks on them at all.
- Initially both are empty.
- You need to get exactly 2 liters in the 4-liter jug.

- *How many states are there?*
- *How many (legal) transitions are there?*
- *Solve the problem by hand*

Example

Many problems can be formulated as search problems

Problem	States	Actions
8-puzzle	Tile configurations	Up, Down, Left, Right
8-queens (incremental formulation)	Partial board configurations	Add queen, remove queen
8-queens (complete-state formulation)	Board configurations	Move queen
TSP	Partial tours	Add next city, pop last city
Theorem Proving	Collection of known theorems	Rules of inference
Vacuum World	Current Location and status of all rooms	Left, Right, Suck
Road Navigation (Route Finding)	Intersections	Road segments
Internet Searching	Pages	Follow link
Counterfeit Coin Problem	A given weighing	Outcome of the weighing (less, equal, greater)

Image credit: https://cs.lmu.edu/~ray/notes/problemsolving/

Next class

- Focus on different search algorithms to help solve a problem given the state space, actions, and goal.

Thank you