Introduction to Software Development for Artificial Intelligence

Dr. Lotfi ben Othmane
University of North Texas

Is the crow smart?

https://www.youtube.com/watch?v=s2IBayVsbz8

How much would you pay to get one of these?

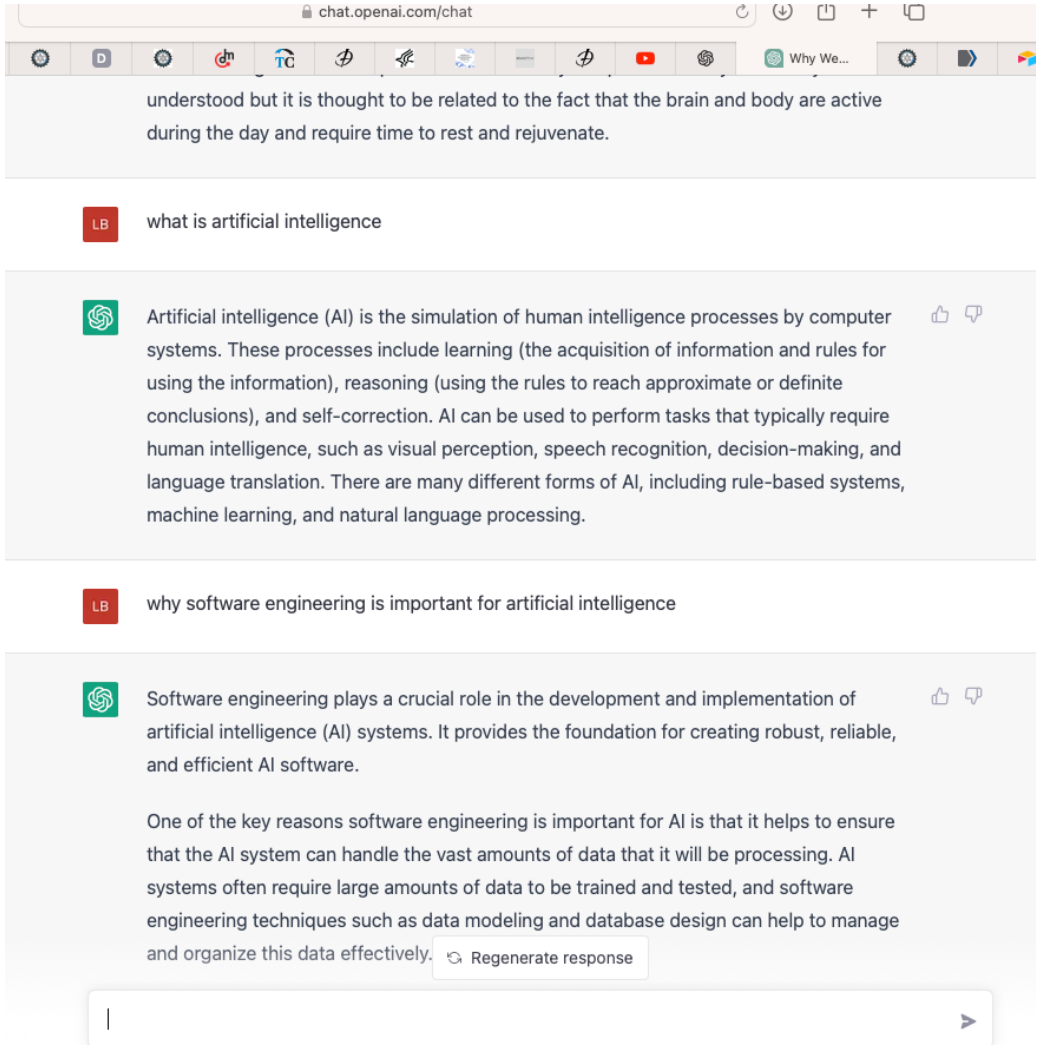
https://www.youtube.com/watch?v=fn3KWM1kuAw

Why this Robot is an AI System?

https://www.youtube.com/watch?v=fn3KWM1kuAw

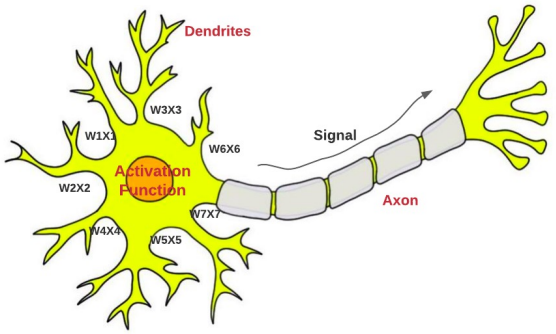
Let’s Ask ChatGPL3

https://chat.openai.com/chat



Definition

- The term has evolved since warren
  McCulloch and Walter Pitt's work of 1943
- People define it differently
- Sources that impact the definition :
  - functions of neurons in the brain
  - Formal analysis of propositional logic
  - Turing's theory of computation



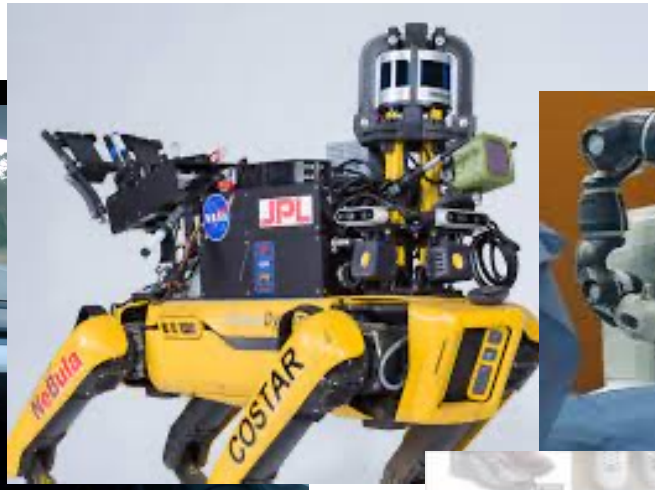
- AI is concerned with rational actions given
  - Objectives
  - Intractability

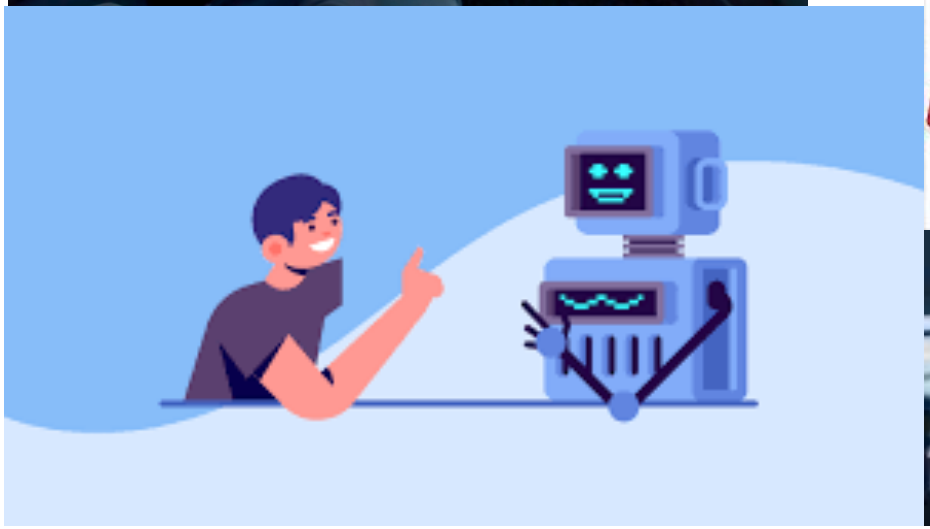
Is this an AI system?

https://www.youtube.com/watch?v=tlThdr3O5Qo

What can AI do today?

Applications of AI





Exercise

What are the benefits of AI?

Benefits of AI

- Civilization is the product of human intelligence
- Human intelligence + (bonus) machine intelligence → Faster progress
  - Increase production of good and services
  - Accelerate scientific research

Exercise

What are the risks of AI?

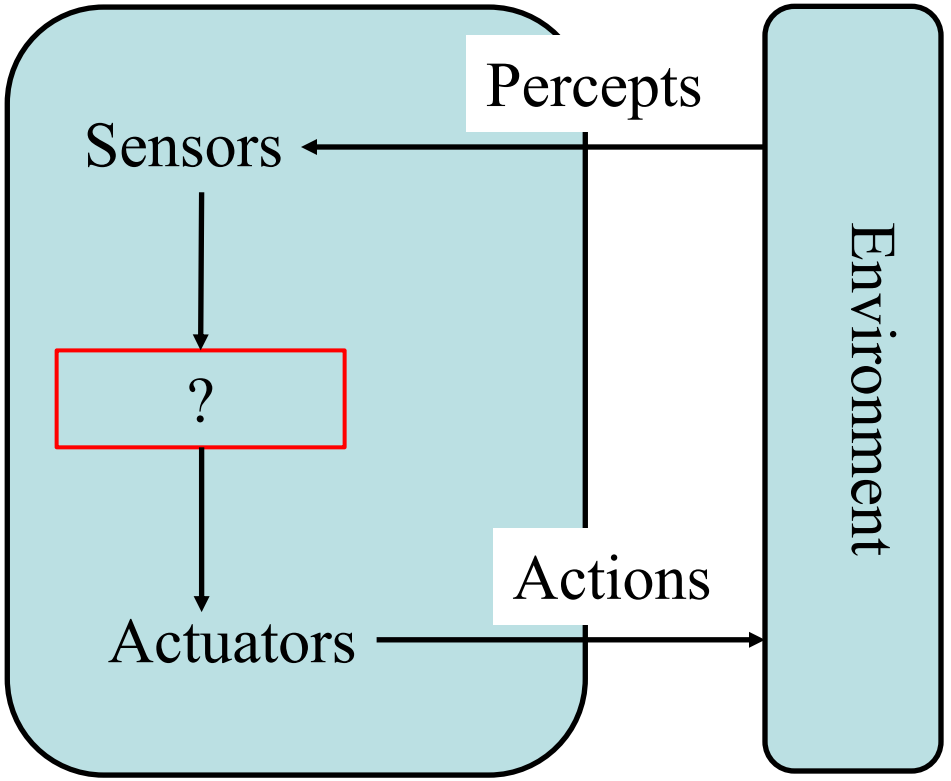
Risks of AI

- Francis Bacon once said “For Mechanical Arts are of ambiguous use, serving as well for hurt as for Remedy” (1609)

- Misuses include:
  - Lethal autonomous weapons
  - Surveillance and persuasion
  - Biased decision making
  - Cyber-attacks
  - Accidents due to limitations in ensuring safety
  - Spread of mis-information

Intelligent Agents – An Approach to AI

- Agent perceives its environment through sensors and acts upon the environment through actuators.
- Agent function (behavior) maps percept sequence to an action



Examples of Intelligent Agents

- Software:
  - Received files, input network messages
  - Action: display output, write files, etc.
- Robot
  - Sensors: Camera, infrared range finders, microphone, etc.
  - Action: DANCE ☺ …..

Example of AI behavior – a Vacuum Cleaner

What are the possible actions?

What are the perceptions?

What are the agent functions?

https://www.youtube.com/watch?v=D7pJ0bz7Ins

Example of AI behavior – a Vacuum Cleaner

Actions:

- Move left
- Move right
- Suck up the dirt
- Do nothing

You may set the rules for taking the actions

https://www.youtube.com/watch?v=D7pJ0bz7Ins

Rational Agent

A rational agent should select an action that maximizes its performance measure for each percept sequence, given the built-in knowledge

Rational Agent

- Performance measure
  evaluated given sequence of environment states.
  - E.g., time to clean, minimize the errors, minimize distance, etc.

- Performance measures should be designed according to what one wants to be achieved and not how the system should behave.

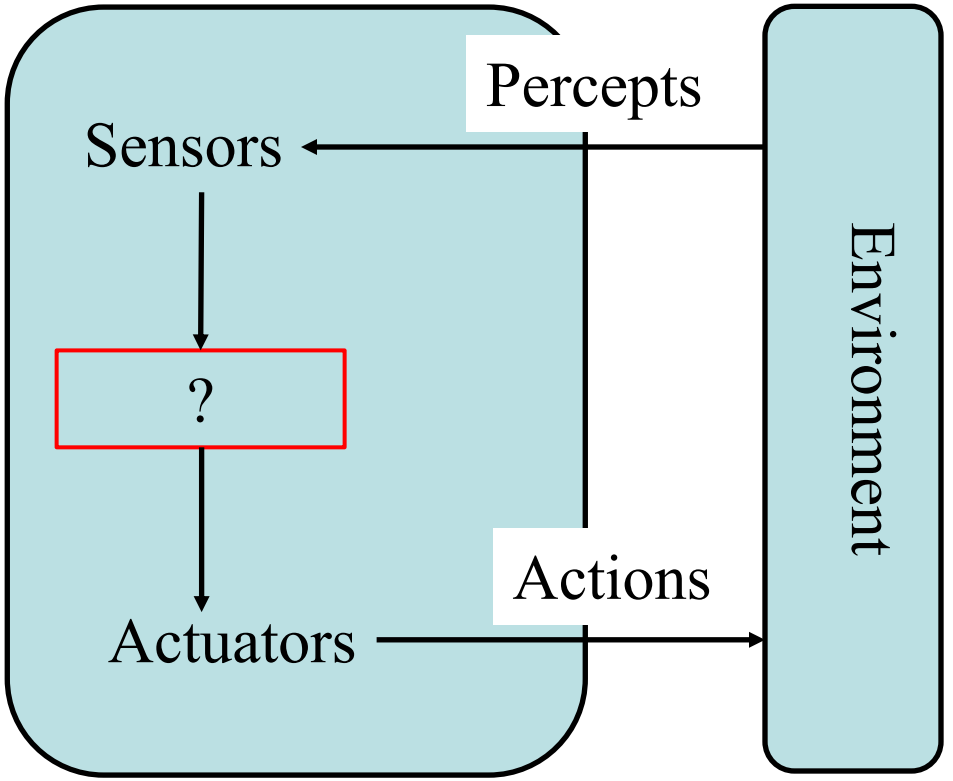
Agents v1 - Reflex Agents

- The agent maps sequence of percepts to actions.

```
Function VaccumeAgent()
  if status=Dirty
      return Suck
  else if location = A
      return Right
  else if location = B
      return Left
```

Agents v1 - Reflex Agents

- Reflex agents assume complete information about the environment and use deterministic rules.
- Does the agent have complete information about the environment?

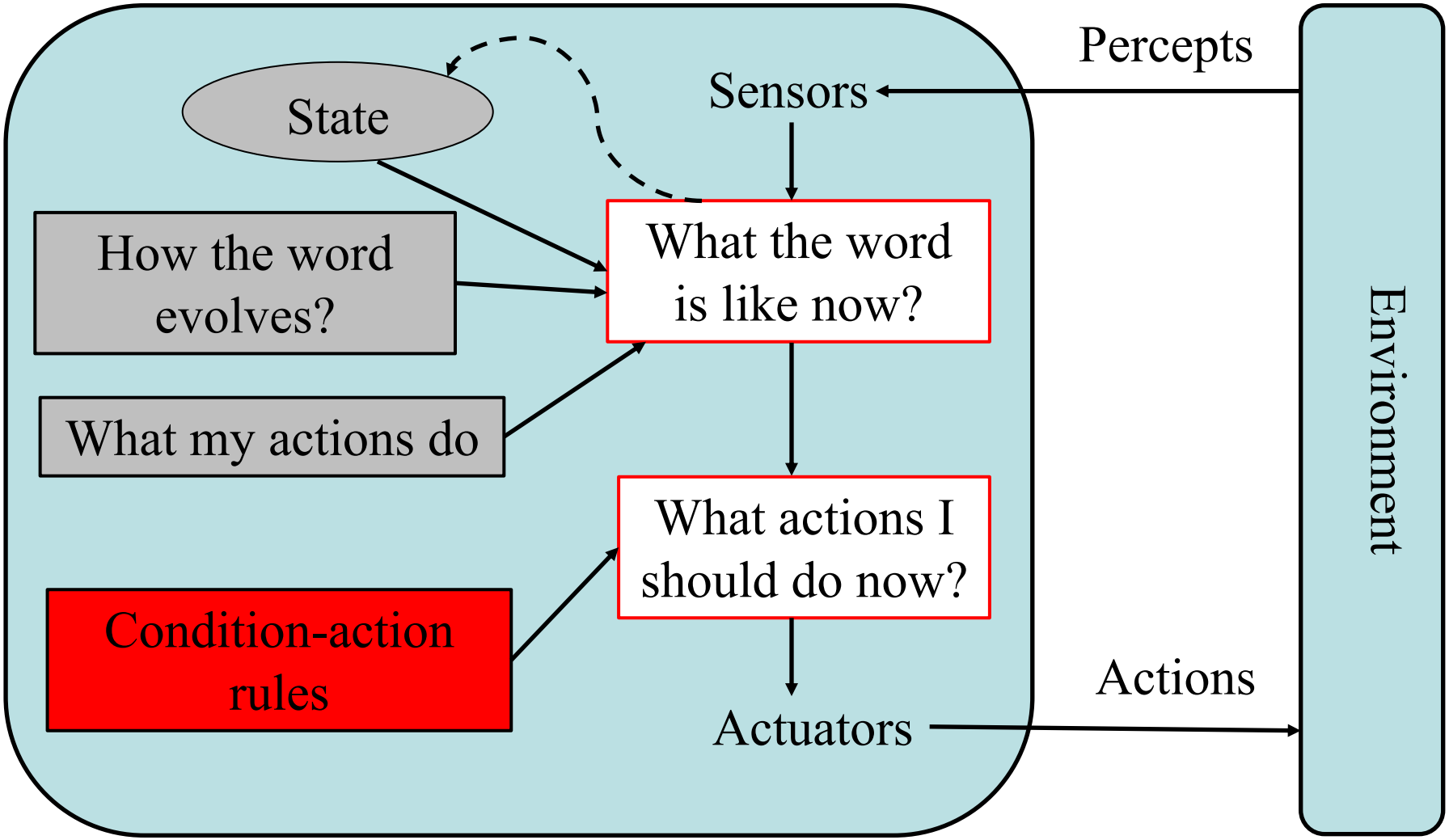


Agents v2 - Model-based Reflex Agents

- The agent's sensors may provide only partial information about the environment ➔ the agent has partial observability.

- The agent may maintain a sort of internal state and a model of the world that allows it to infer the environment from its actions and the percept sequence and decide the actions to take.

Agents v2 - Model-based Reflex Agents



Agents v3 – Goal-based Agents

- Do the sensors (inc. cameras) give a complete view of the environment?
- Can the car use a deterministic model to reach its destination?

Agents v3 – Goal-based Agents

- The agent needs sort of goal information that describe the desired state, e.g., destination to reach

➔ The actions are selected based on the state and goal.

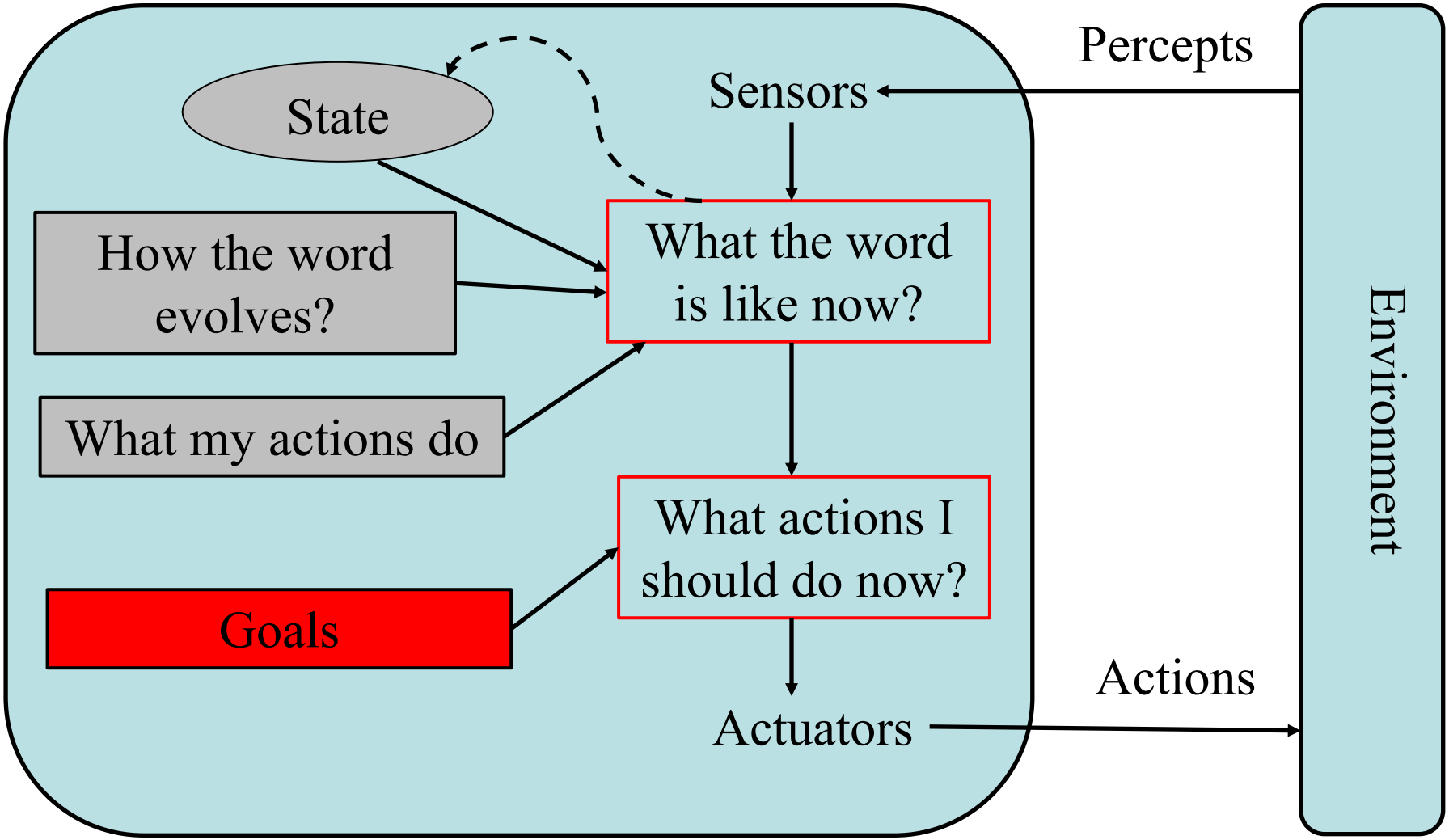
Example: The car turns right because it is on Elm Street 3940, and the goal is to park in the discovery park.

Agents v3 – Goal-based Agents

- The actions are selected based on the state and goal.

=> The agent needs to plan the sequence of actions to take to achieve the goal.

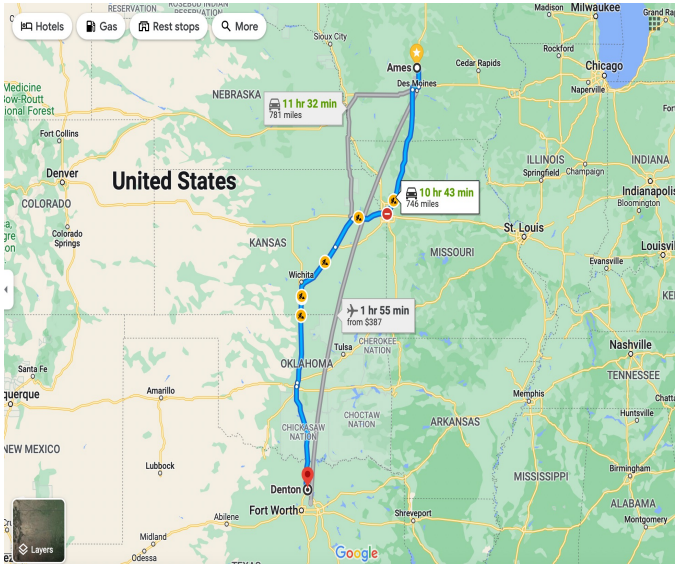
Agents v3 – Goal-based Agents



Agents v4 – Utility-based Agents

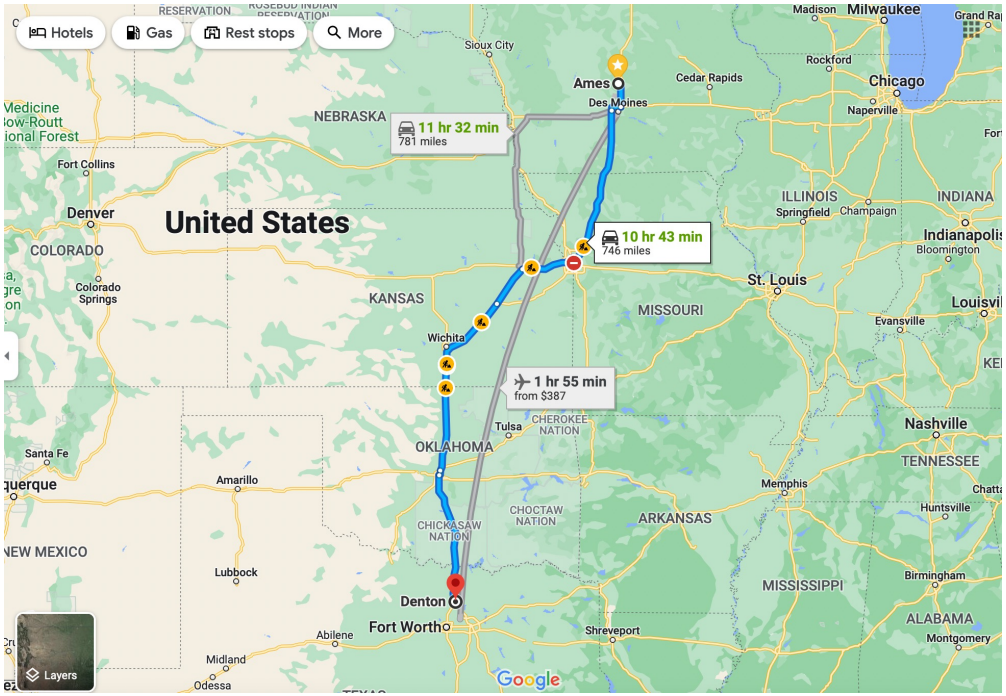
- What would be a performance measure for my trip?

➔ The actions are selected based on the state, the goal, and the utility function. The utility function internalizes the performance measure



Agents v4 – Utility-based Agents

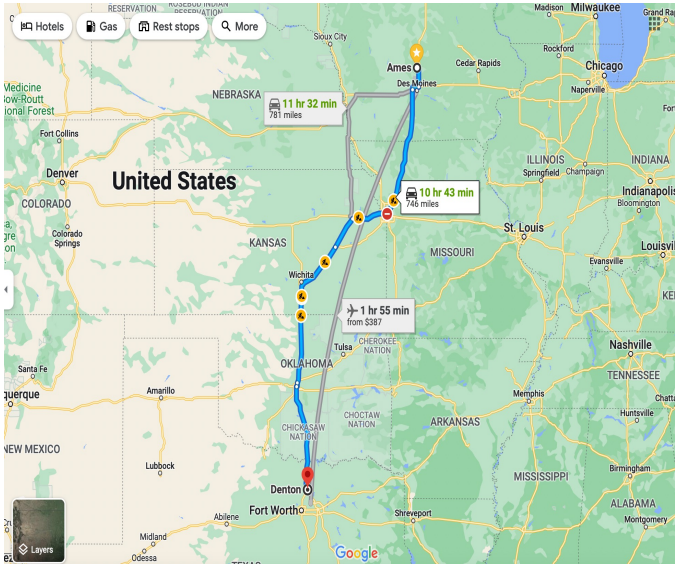
- What path should I take to reach my goal: Denton, TX?
- What criteria did I use in the selection?



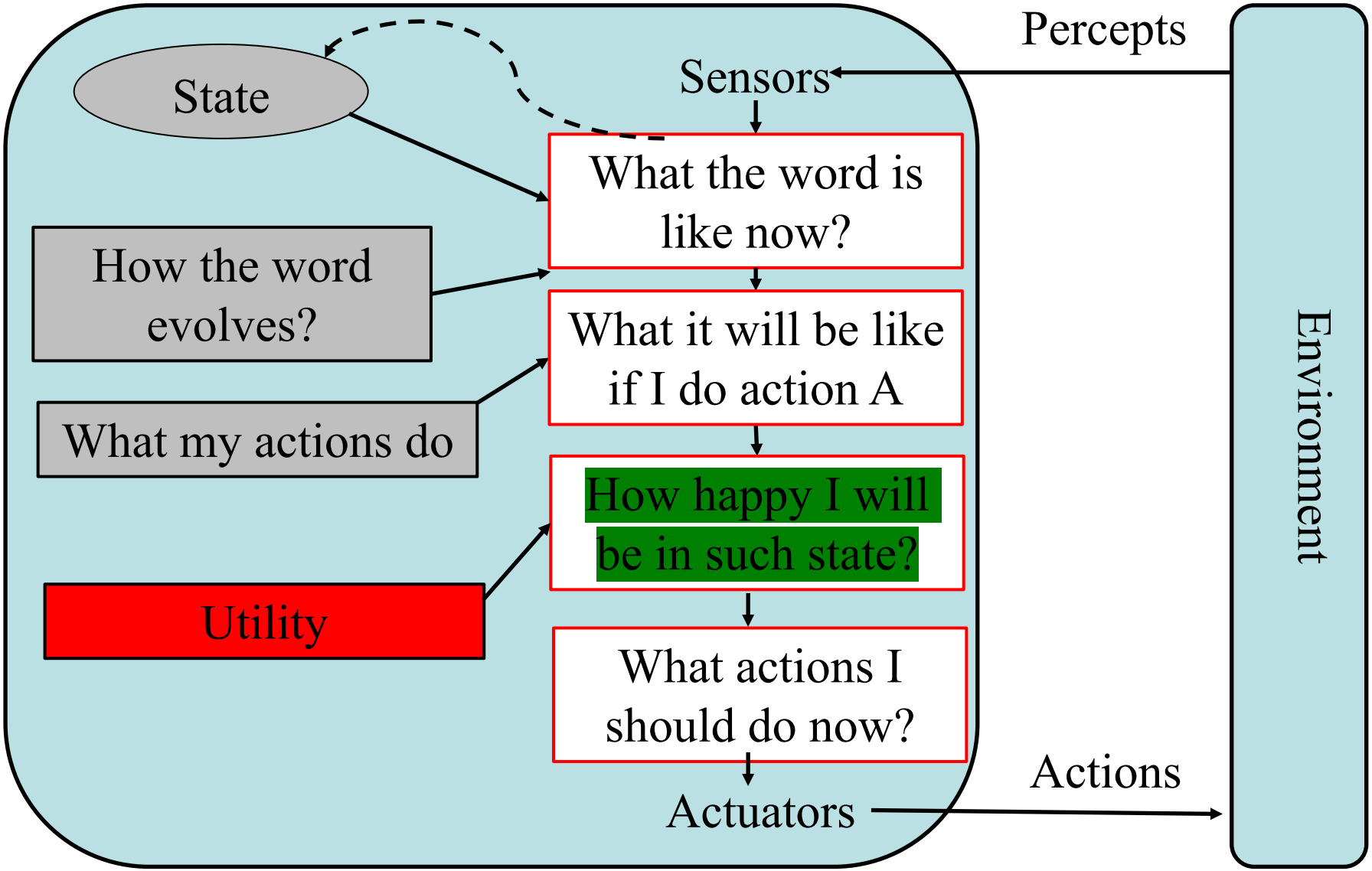
Agents v4 – Utility-based Agents

- The performance measure for my trip is the distance I drive.

➔ What would be the utility function?



Agents v4 – Utility-based Agents



Agents v5 – Learning Agents

- The autonomous car needs to map all the possible percept sequences to actions

Let us think:

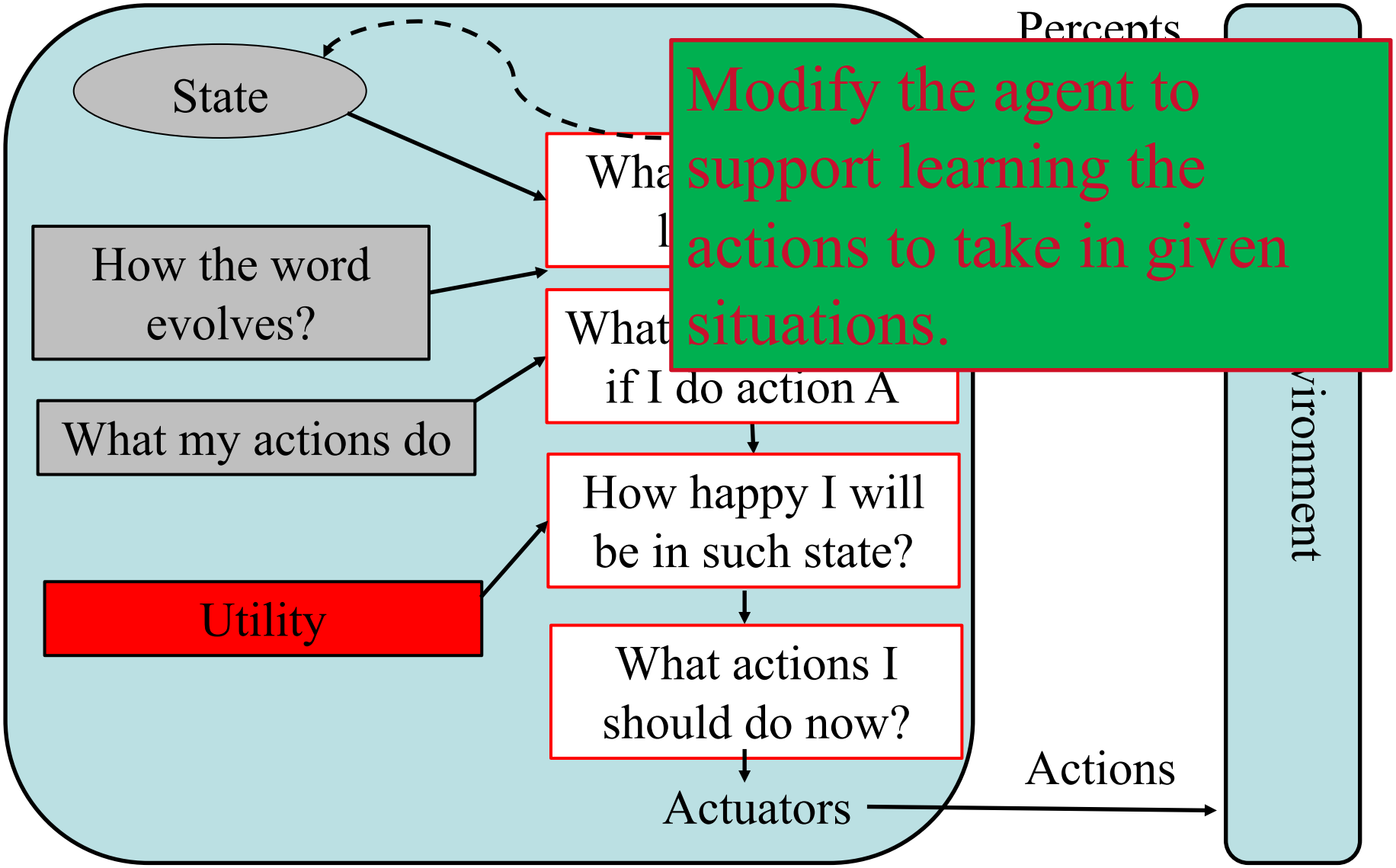
- What actions can an autonomous car do?
- What order of magnitude is this map of percepts to actions?
- Can we specify the map manually?

Agents v5 – Learning Agents

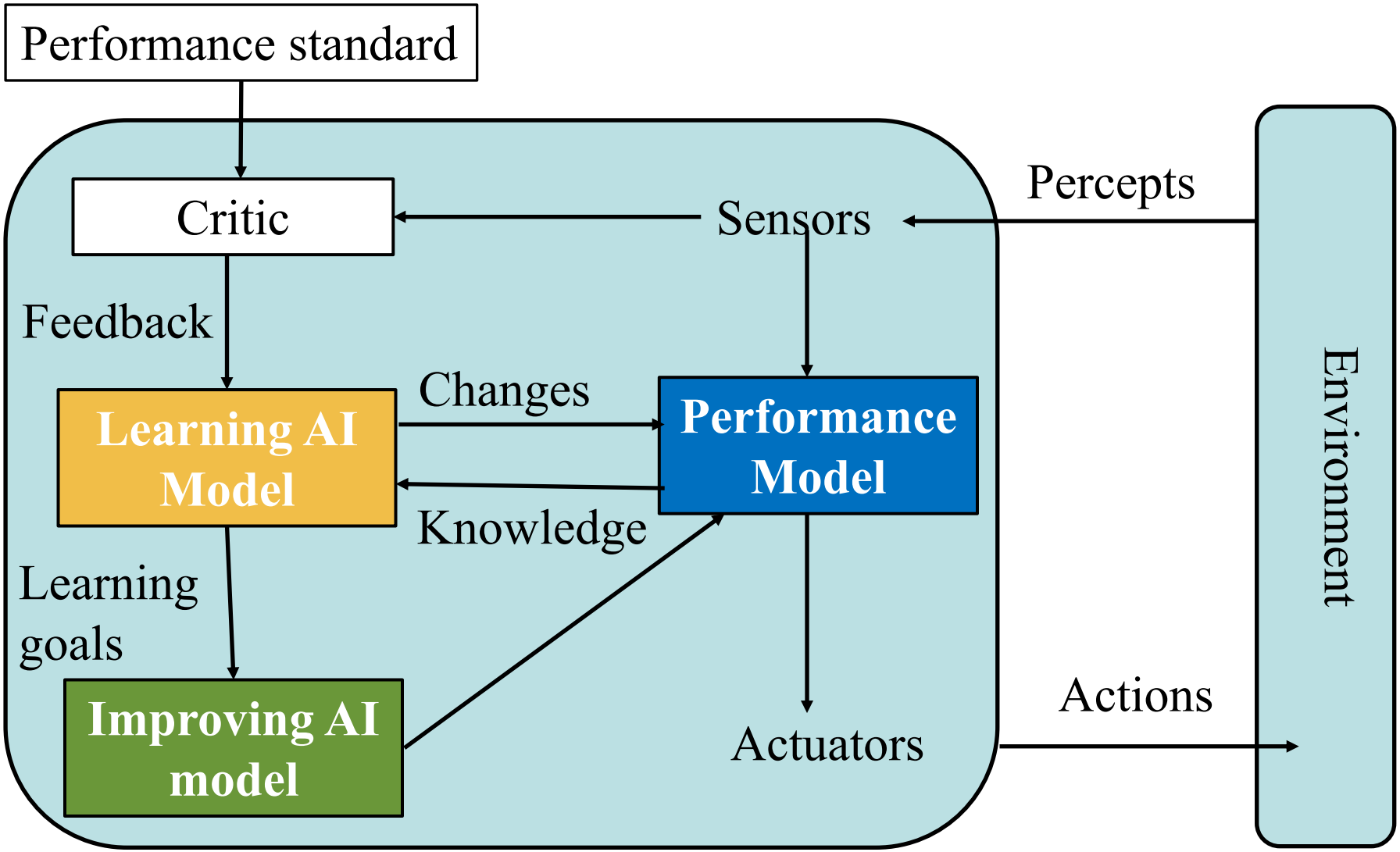
Smart systems learn from the actions and environment and build their models.

https://www.youtube.com/watch?v=y3RIHnK0_NE

Agents v5 – Learning Agents



Learning Agents



Agents v5 – Learning Agents

- Learning allows the agent to map inputs to outputs and to operate in unknown environments

- Performance model - responsible for selecting external actions
- Critic - provides feedback on how the agent is doing with respect to the fixed performance standard
- Learning model - uses the feedback to determine how the performance elements should be modified to do better
- Improving AI model - suggests actions that may do better in the long run (exploratory actions)

Check Yourself

1. What is AI?
2. What is an agent?
3. What are the 5 types of agents?
4. What are the three “learning” capabilities that learning agents use?

Thank you

Any Question?