

Artificial Intelligence

Week 4.1

Dr. Uzma Jamil

Department of Computer Science

Government College University, Faisalabad.

Rationality

- A rational agent does the **right thing** (what is this?)
- A fixed **performance measure** evaluates the sequence of observed action effects on the environment

Components of an AI System



An **agent** **perceives** its environment through **sensors** and **acts** on the environment through **actuators**.

Human: sensors are eyes, ears, actuators (effectors) are hands, legs, mouth.

Robot: sensors are cameras, sonar, lasers, bump, effectors are grippers, manipulators, motors

The agent's behavior is described by its function that maps percept to action.

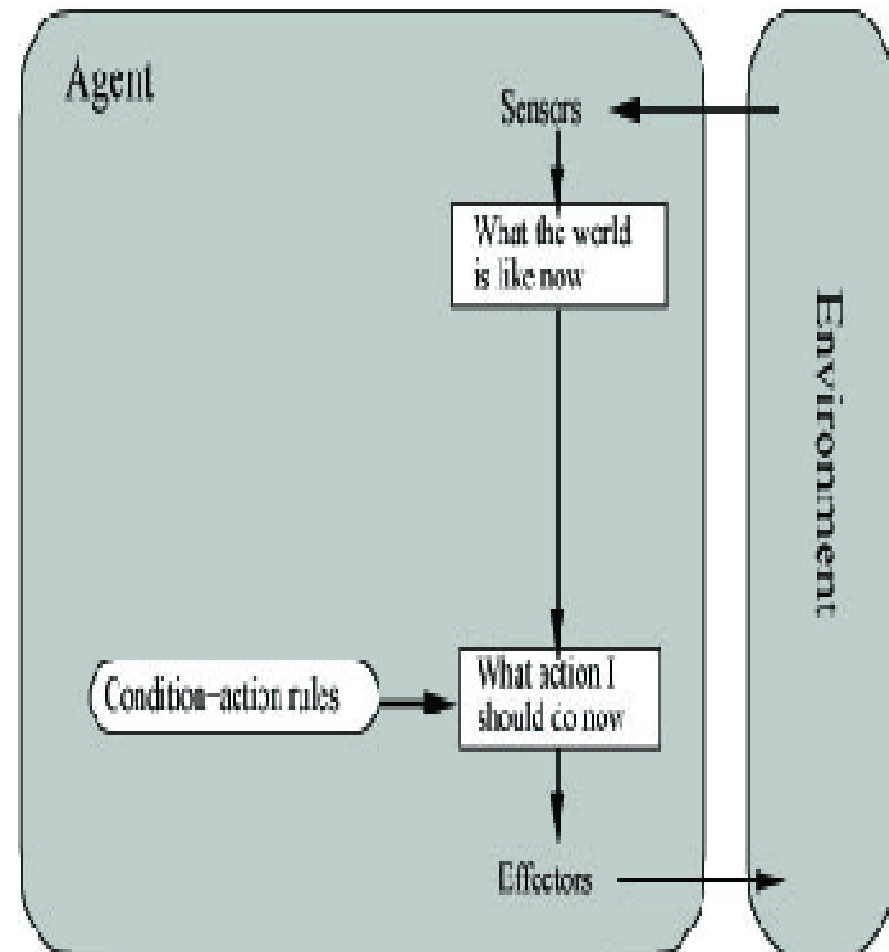
Agent Types

- Types of agents (increasing in generality and ability to handle complex environments)
 - Simple reflex agents
 - Reflex agents with state
 - Goal-based agents
 - Utility-based agents
 - Learning agent

Simple Reflex Agent

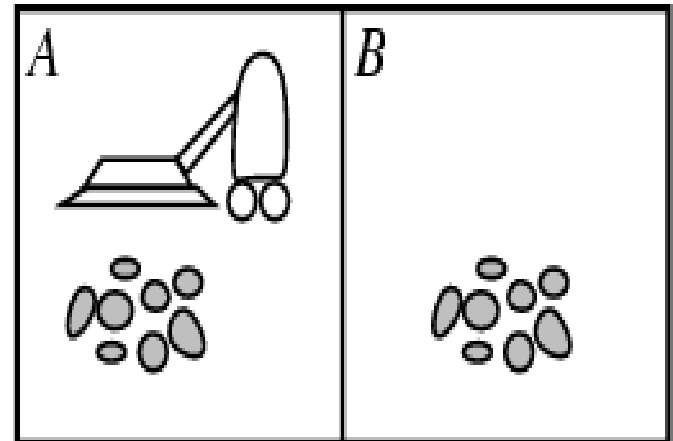
- Use simple “if then” rules
- Can be short sighted

```
SimpleReflexAgent(percept)
  state = InterpretInput(percept)
  rule  = RuleMatch(state, rules)
  action = RuleAction(rule)
  Return action
```



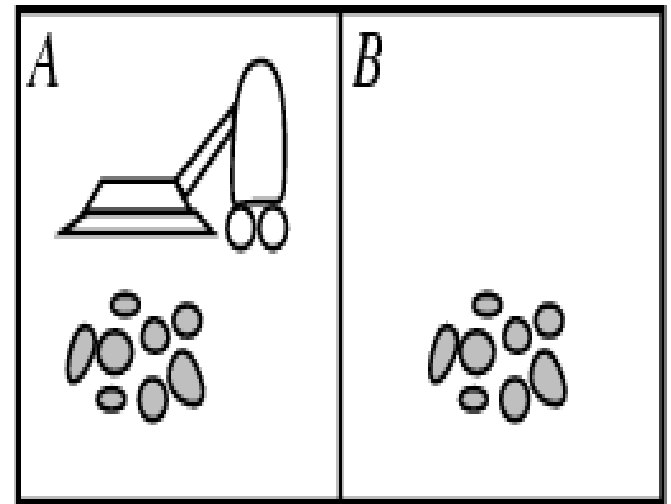
Example: Vacuum Agent

- Performance?
 - 1 point for each square cleaned in time T ?
 - #clean squares per time step - #moves per time step?
- Environment: vacuum, dirt, multiple areas defined by square regions
- Actions: left, right, suck, idle
- Sensors: location and contents
 - [A, dirty]
- Rational is not omniscient
 - Environment may be partially observable
- Rational is not clairvoyant
 - Environment may be stochastic
- Thus Rational is not always successful



Reflex Vacuum Agent

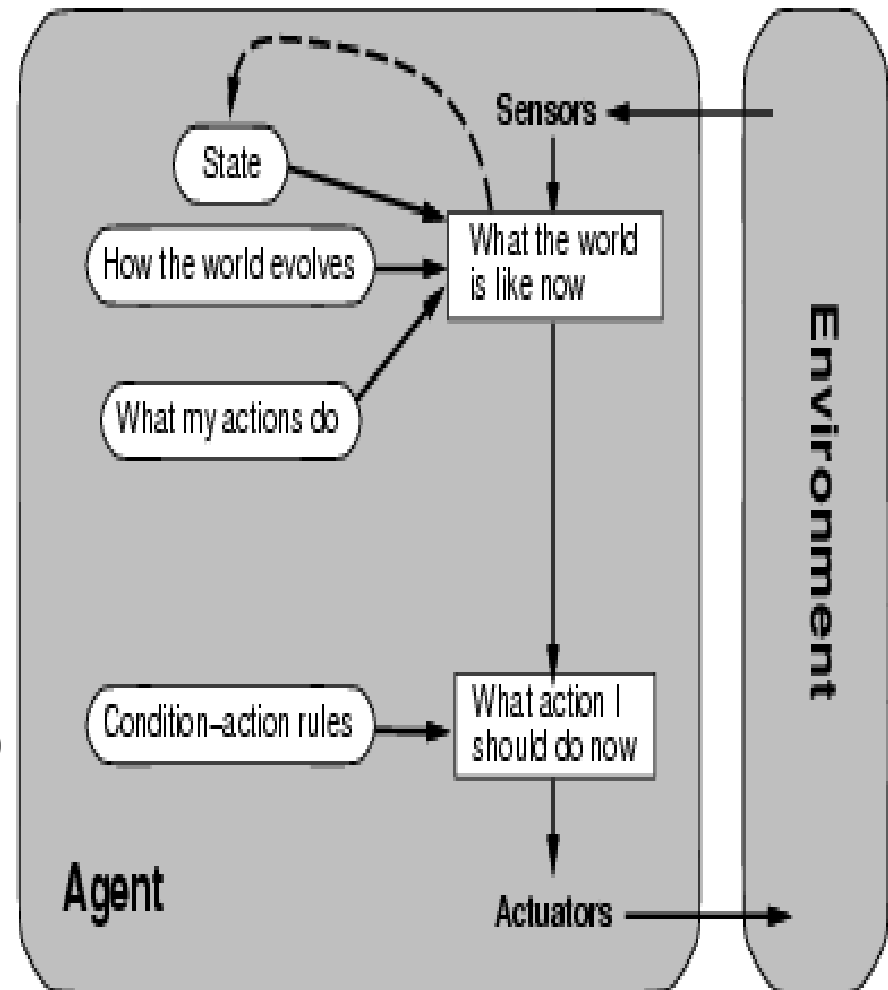
- If status=Dirty then return Suck
else if location=A then return Right
else if location=B then return Left



Reflex Agent With State

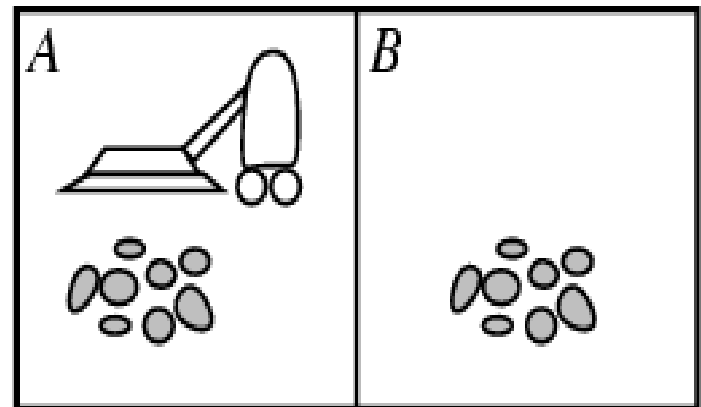
- Store previously-observed information
- Can reason about unobserved aspects of current state

```
ReflexAgentWithState(percept)
  state = UpdateDate(state,action,percept)
  rule  = RuleMatch(state, rules)
  action = RuleAction(rule)
  Return action
```



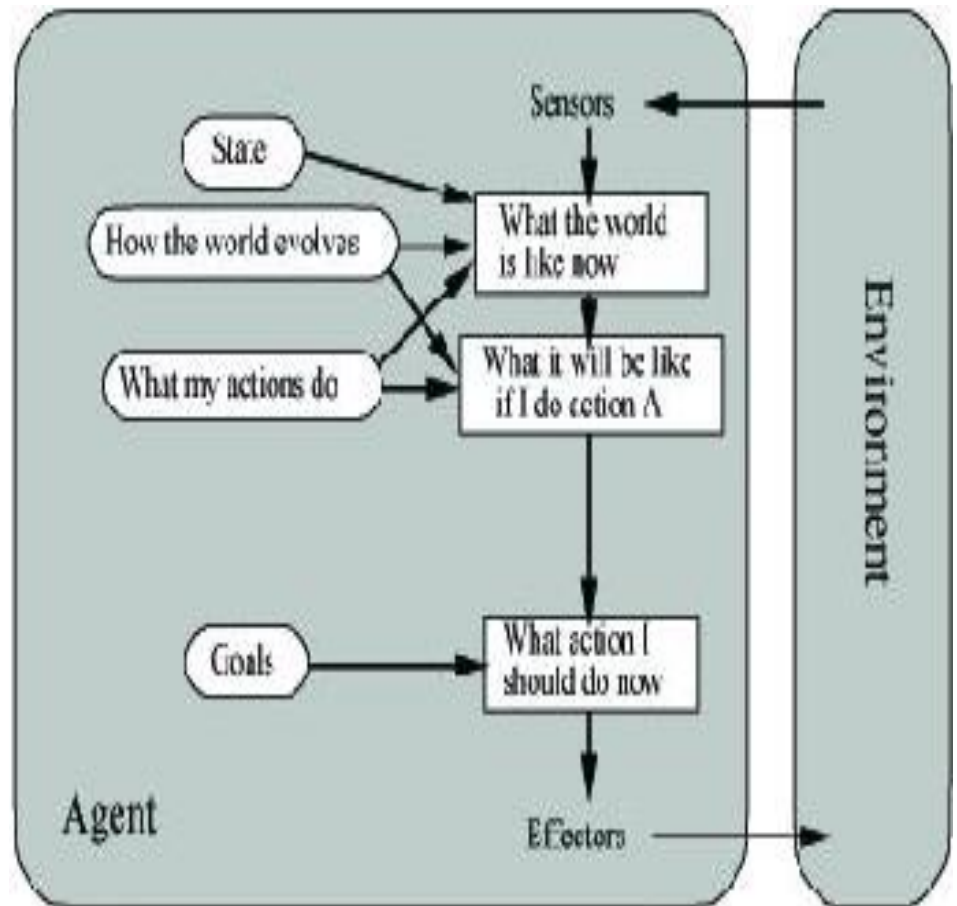
Reflex Vacuum Agent

- If status=Dirty then Suck
- else if have not visited other square in >3 time units,
go there



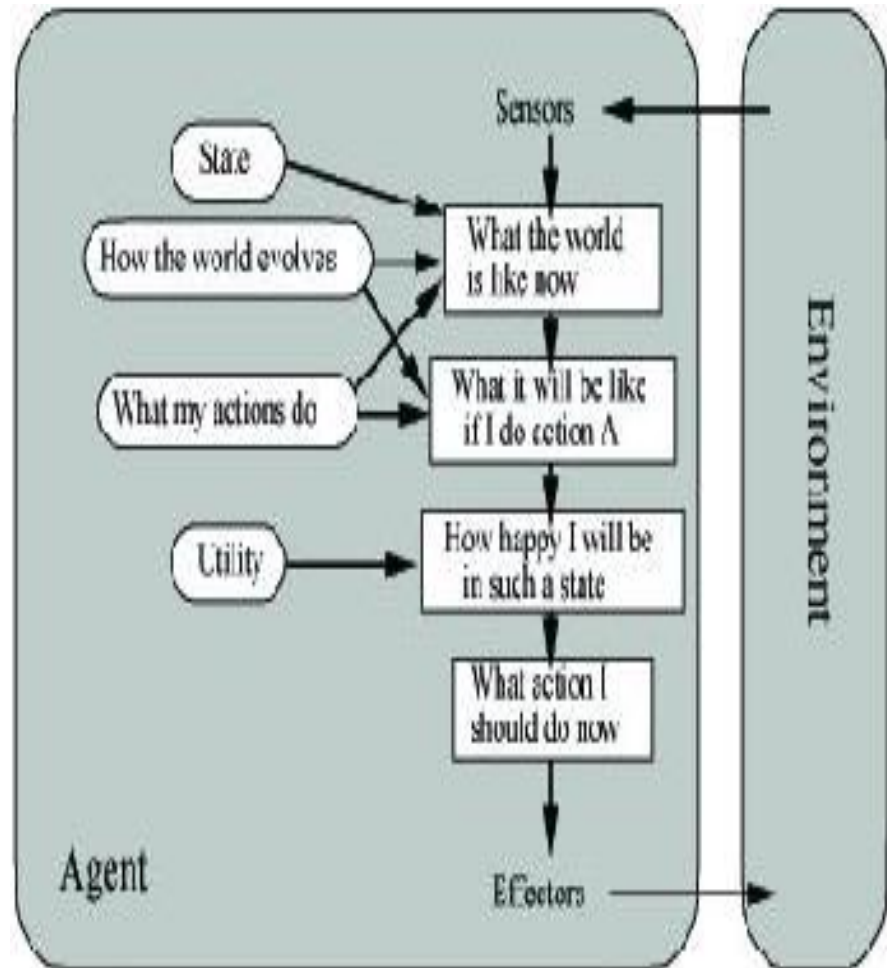
Goal-Based Agents

- Goal reflects desires of agents
- May project actions to see if consistent with goals
- Takes time, world may change during reasoning

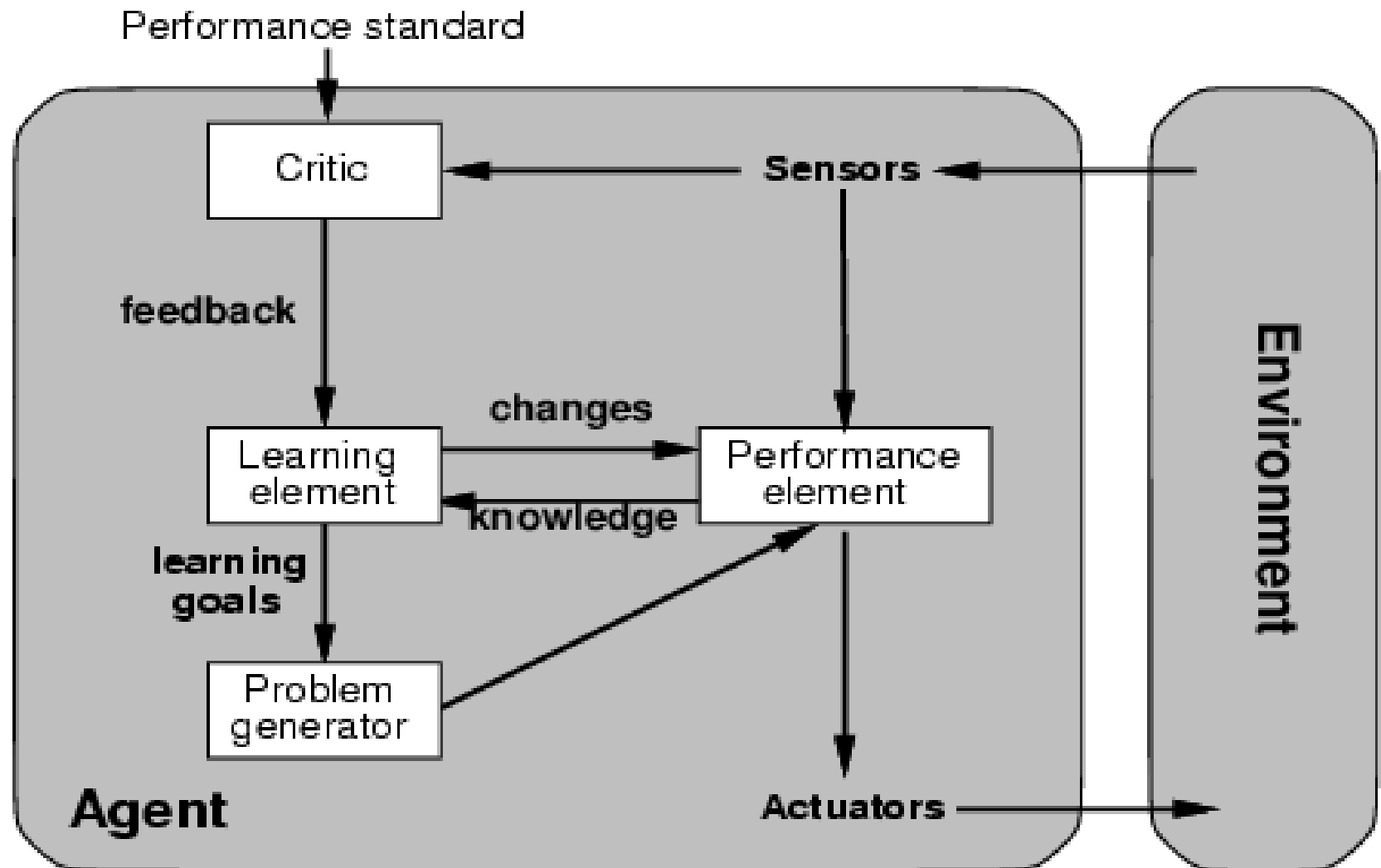


Utility-Based Agents

- Evaluation function to measure utility $f(\text{state}) \rightarrow \text{value}$
- Useful for evaluating competing goals

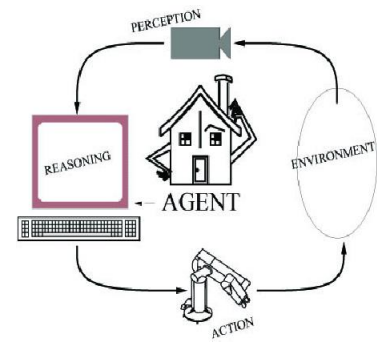


Learning Agents



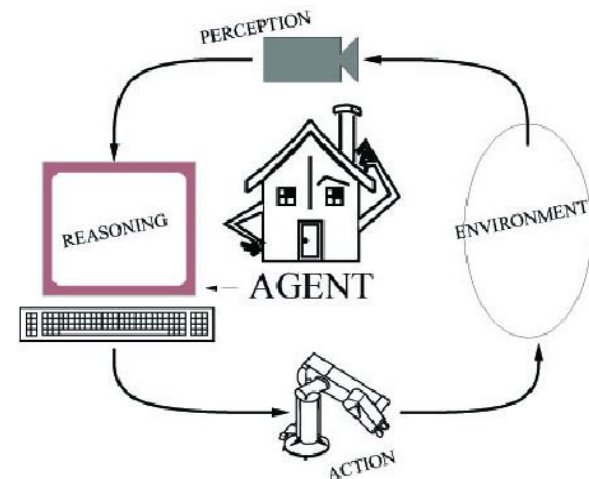
Pathfinder Medical Diagnosis System

- **Performance:** Correct [Hematopathology diagnosis](#)
- **Environment:** Automate human diagnosis, partially observable, deterministic, episodic, static, continuous, single agent
- **Actuators:** Output diagnoses and further test suggestions
- **Sensors:** Input symptoms and test results
- **Reasoning:** Bayesian networks, Monte-Carlo simulations



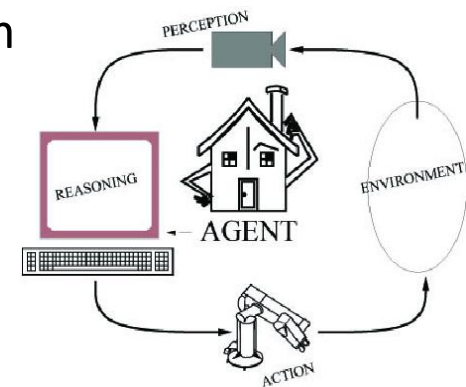
Alvinn

- **Performance:** Stay in lane, on road, maintain speed
- **Environment:** Driving Hummer on and off road without manual control (Partially observable, stochastic, episodic, dynamic, continuous, single agent), Autonomous automobile
- **Actuators:** Speed, Steer
- **Sensors:** Stereo camera input
- **Reasoning:** Neural networks



Talespin

- **Performance:** Entertainment value of generated story
- **Environment:** Generate text-based stories that are creative and understandable
 - One day Joe Bear was hungry. He asked his friend Irving Bird where some honey was. Irving told him there was a beehive in the oak tree. Joe threatened to hit Irving if he didn't tell him where some honey was.
 - Henry Squirrel was thirsty. He walked over to the river bank where his good friend Bill Bird was sitting. Henry slipped and fell in the river. Gravity drowned. Joe Bear was hungry. He asked Irving Bird where some honey was. Irving refused to tell him, so Joe offered to bring him a worm if he'd tell him where some honey was. Irving agreed. But Joe didn't know where any worms were, so he asked Irving, who refused to say. So Joe offered to bring him a worm if he'd tell him where a worm was. Irving agreed. But Joe didn't know where any worms were, so he asked Irving, who refused to say. So Joe offered to bring him a worm if he'd tell him where a worm
- **Actuators:** Add word/phrase, order parts of story
- **Sensors:** Dictionary, Facts and relationships stored in database
- **Reasoning:** Planning

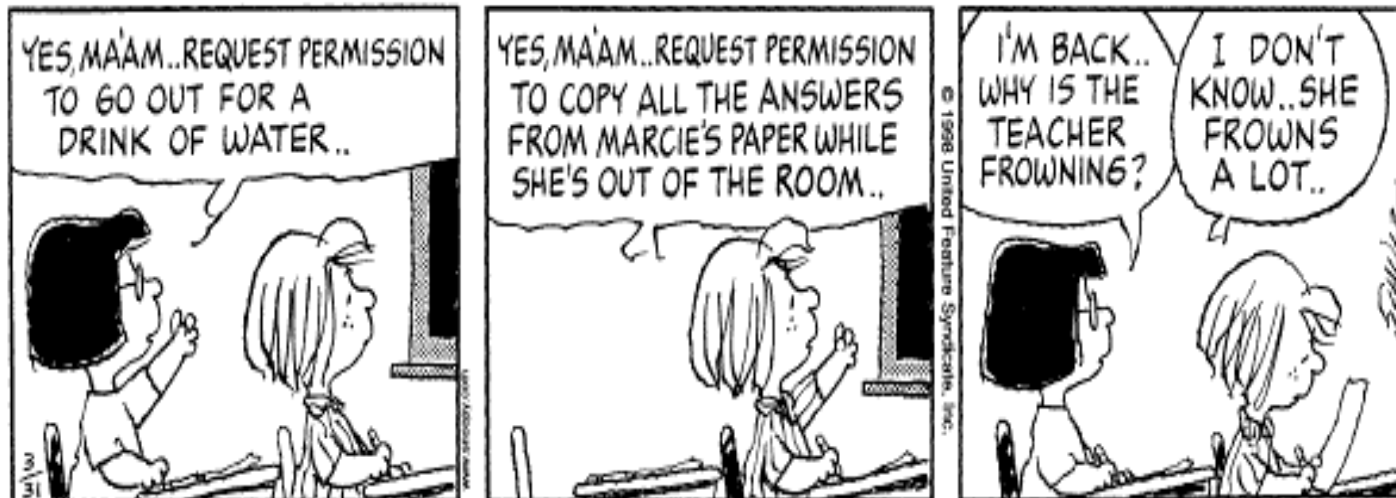


Other Example AI Systems

- Translation of Caterpillar truck manuals into 20 languages
- Shuttle packing
- Military planning (Desert Storm)
- Intelligent vehicle highway negotiation
- Credit card transaction monitoring
- Billiards robot
- Juggling robot
- Credit card fraud detection
- Lymphatic system diagnoses
- Mars rover
- Sky survey galaxy data analysis

Other Example AI Systems

- Knowledge Representation
- Search
- Problem solving
- Planning
- Machine learning
- Natural language processing
- Uncertainty reasoning
- Computer Vision
- Robotics



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