NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

CZ3005
Artificial Intelligence

Knowledge-based Agent

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Knowledge Representation and Reasoning

- **Agent That Reason Logically**
  - Knowledge Based Agent
  - Propositional Logic
- **First Order Logic**
  - Syntax and Semantics
  - Inference Procedure

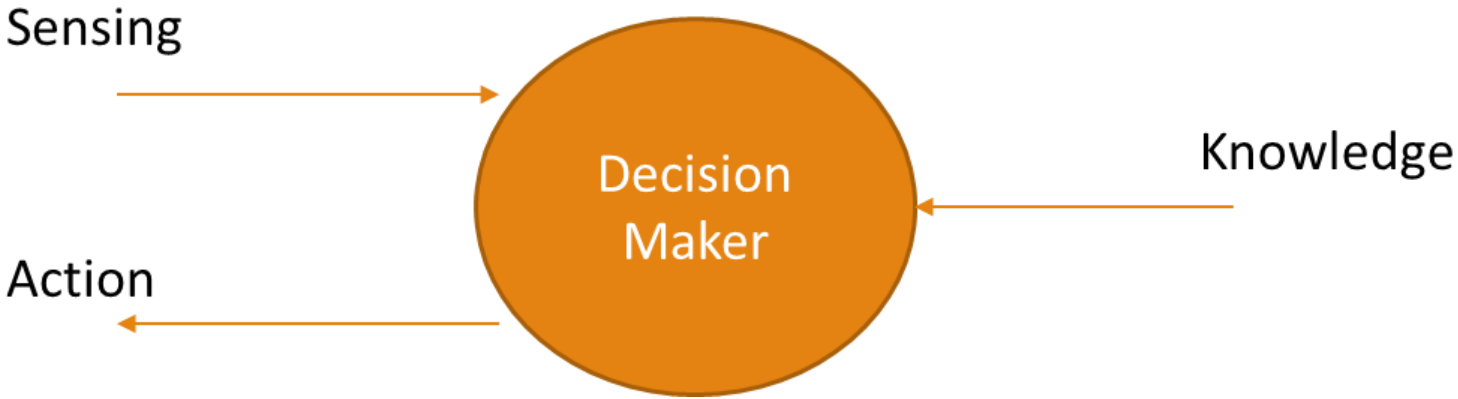
Knowledge Representation and Reasoning

- **Fuzzy Logic**
  - Basic Definition
  - Fuzzy Rule-Based System
  - Fuzzy Inference System
  - Adaptive Neuro Fuzzy Inference Systems (ANFIS)
- **Neural Networks**
  - Logistic Regression
  - Neural Networks
  - Neural Network Learning

From Search to Logical Reasoning

- Representation of Knowledge and the Reasoning Processes are central to the entire field of Artificial Intelligence
- A knowledge-based system (KBS) is a computer program that reasons and uses a knowledge base to solve complex problems.

Knowledge and Intelligence



Knowledge Based Approach

- **Agent That Knows**
  - Achieve competence by being told new knowledge or by learning
  - Achieve adaptability by updating their knowledge
  - Knowledge representation
- **Agent That Reasons**
  - Use knowledge to deduce course of actions
  - Inference Mechanism

Knowledge based Agent

- **Knowledge Base (KB)**
  - Set of sentences
  - Knowledge representation language
- **Adding and querying knowledge**
  - **Tell**: add a sentence to the KB
  - **Ask**: retrieve knowledge from the KB
- **Inference Mechanism**
  - Role: determine what follows from KB

Problem Formulation of KBS

- **Knowledge Based Systems**
- States: Instances of the KB (sets of sentences)
  –> Use **Tell** to build the KB

  e.g. Tell(KB, “Smoke ⇒ Fire”)
  Tell(KB, “Fire ⇒ Call_911”)
  …
  Tell(KB, “Smoke”)
  - Operators: Add / Infer a new sentence
  - Goal: Answer a query
    –> Use **Ask** to query the KB

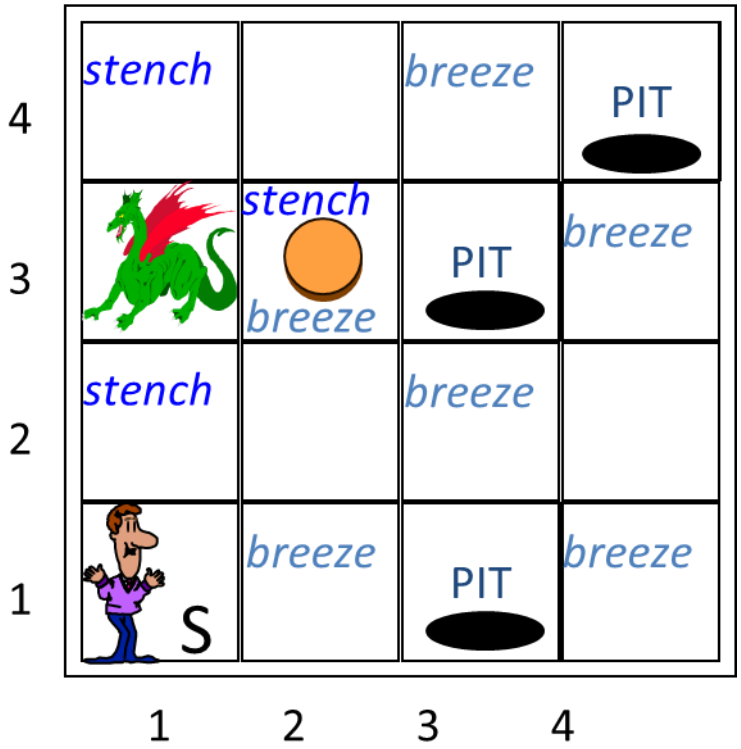
    e.g. Ask(KB, “**?** Call_911”)

Quiz

Open Kahoot.it

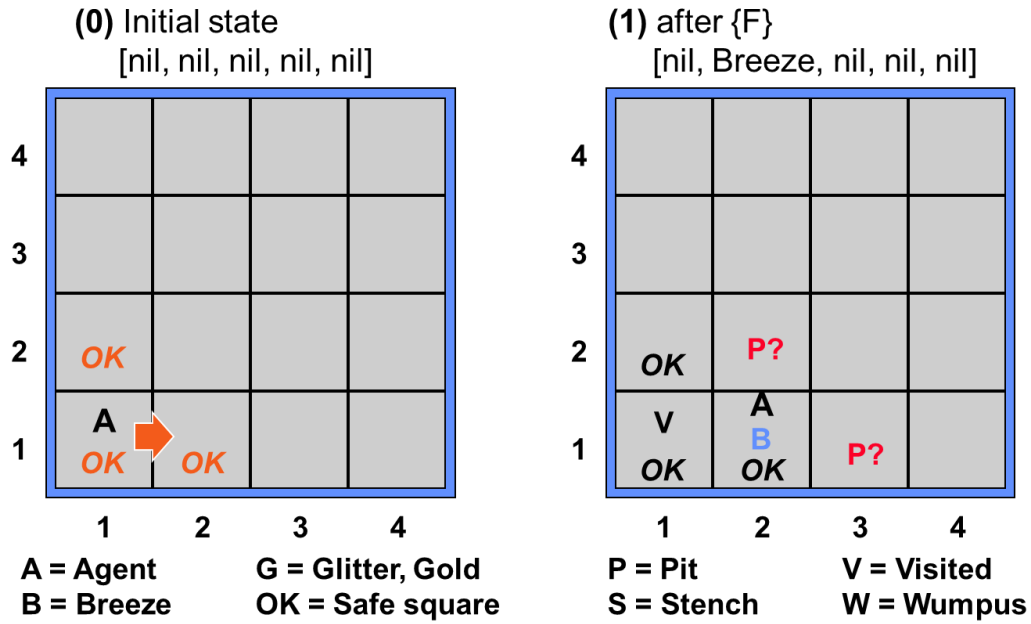
The Wumpus World

- **Problem Description**
  - Environments
    - Grid of Squares, Walls
    - Agent, Gold, Pits, Wumpus
  - Goals
    - Find the gold, return to S at [1,1].
  - Percepts
    - A list of 5 symbols, e.g. [Stench, Breeze, Glitter, Bump, Scream];
    - Agent's location not perceived.
  - Actions
    - Go-Forward, Turn-Left, Turn-Right, Grab, Shoot (1 arrow only), Climb.

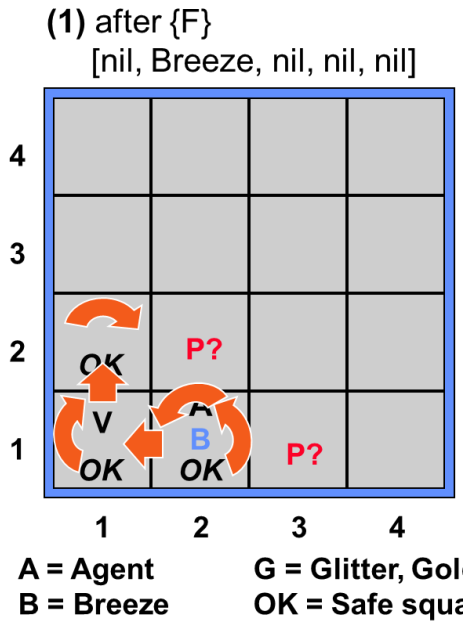


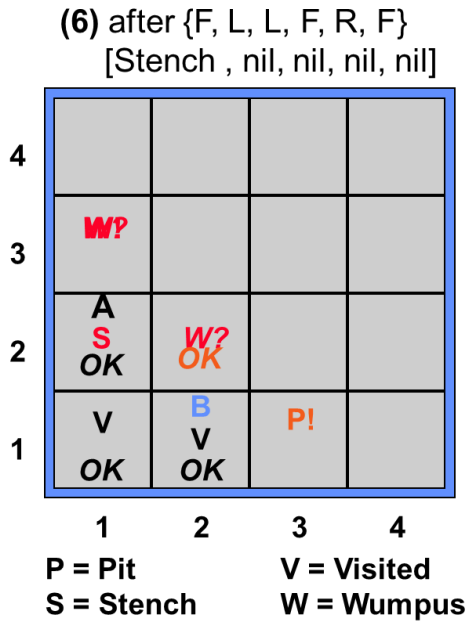
The Wumpus World

- **Initial State**
  - Agent at [1,1]; gold, pits and wumpus in random squares.
- **Knowledge**
  - “In all squares adjacent to the one where the wumpus is, the agent will perceive a stench.”
  - “In all squares adjacent to a pit, the agent will perceive a breeze.”
  - In the square where the gold is, the agent will perceive a glitter.”
  - When walking into a wall, the agent will perceive a bump.”
  - When the wumpus is killed, the agent will perceive a scream.”

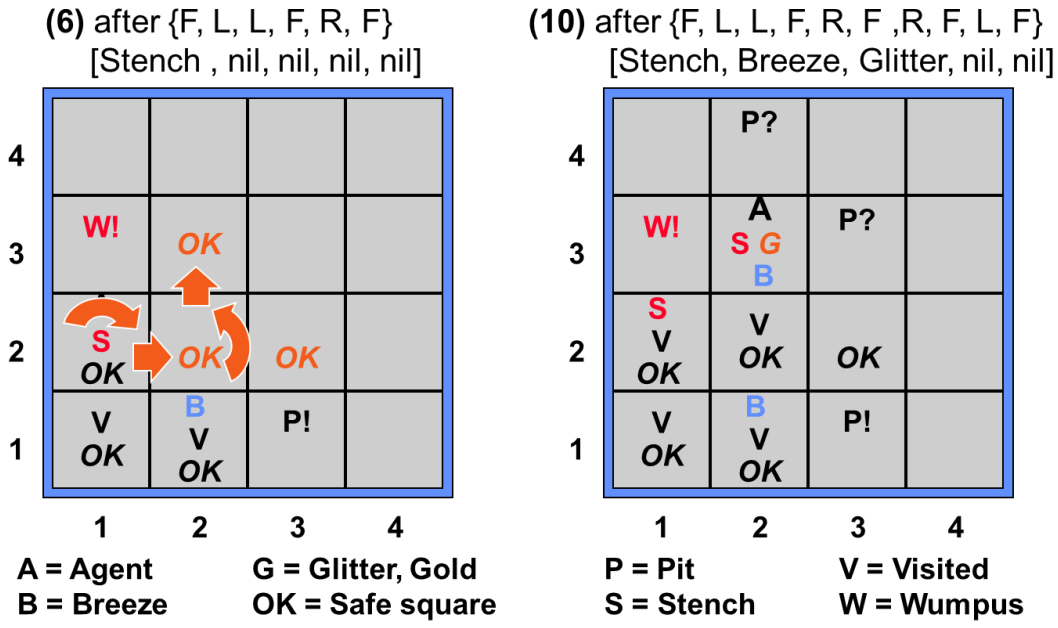


Acting and Reasoning





Acting and Reasoning



Acting and Reasoning