

Logical Agents

CIS*3700 (Winter 2007)

Knowledge-Based Agents

- A knowledge-based agent is essentially a model-based agent:

```

function KB-AGENT(percept) returns an action
static: KB, a knowledge base
        t, a counter, initially 0, indicating time
  TELL(KB, MAKE-PERCEPT-SENTENCE(percept, t))
  action ← ASK(KB, MAKE-ACTION-QUERY(t))
  TELL(KB, MAKE-ACTION-SENTENCE(action, t))
  t ← t + 1
  return action
  
```

Knowledge Representation

- Knowledge Base (KB):
 - Consisting of a set of facts and rules about the world
 - Expressed as sentences of a representation language
- Access to KB:
 - Add new sentences by TELL
 - Query what is known by ASK

Inferences

- ASK is not a simple database retrieval
- Answer to a query may or may not be a sentence added by TELL
- Inference (answering a query) requires deriving new sentences from the old
- The answer should follow from what has been added to KB.

Declarative Approach

- Only tell the agent what it needs to know; the inference is handled by a general procedure.

Inference engine

←

domain-independent algorithms

Knowledge base

←

domain-specific content

KB: focusing on what (entities and their relationships)
 Engine: focusing on how to derive answers.

Wumpus World

4	§§§§§ Stench §		Breeze	PIT
3	Wumpus	Breeze §§§§§ Stench §	PIT	Breeze
2	§§§§§ Stench §	Breeze		
1	START	Breeze	PIT	Breeze
	1	2	3	4

PEAS Description

- Environment
 - Squares adjacent to wumpus are smelly
 - Squares adjacent to pit are breezy
 - Glitter if and only if gold is in the same square
 - Shooting kills wumpus if you are facing it
 - Wumpus screams when killed
 - Agent bumps when hitting a wall
 - Shooting uses up the only arrow
 - Grabbing picks up gold if in same square
 - Releasing drops the gold in same square



PEAS Description

- Performance measure
 - gold +1000, death -1000
 - -1 per step, -10 for using the arrow
- Sensors: Stench, Breeze, Glitter, Bump, Scream
- Actuators: Left turn, Right turn, Forward, Backward, Grab, Release, Shoot



Controlling the Environment

- Assumptions:
 - The cave is a 4 x 4 grid surrounded by walls
 - The agent always starts in square [1,1], facing the right
 - The locations of the gold and the wumpus are randomly chosen in those squares other than the start
 - Each square other than the start can be a pit, with a probability of 0.2
 - In most of these environments, the agent can safely retrieve the gold. In about 21% of the environments, the agent cannot get a positive score.



Controlling the Environment

- Variations:
 - Add one more agent so that the two agents can explore the gold together
 - Let the wumpus move or have multiple troves of gold or multiple wumpus
 - Use a bigger grid for the cave.



Exploring the Wumpus World

OK			
A,OK	OK		

A = Agent B = Breeze G = Glitter P = Pit
 OK = Safe S = Stench V = Visited W = Wumpus



Exploring the Wumpus World

OK	P?		
V,OK	A,B,OK	P?	

A = Agent B = Breeze G = Glitter P = Pit
 OK = Safe S = Stench V = Visited W = Wumpus



Exploring the Wumpus World

W!			
A,S, OK	OK		
V,OK	V,B, OK	P!	

A = Agent B = Breeze G = Glitter P = Pit
 OK = Safe S = Stench V = Visited W = Wumpus



Exploring the Wumpus World

	P?		
W!	A,S, G,B	P?	
V,S, OK	V,OK		
V,OK	V,B, OK	P!	

A = Agent B = Breeze G = Glitter P = Pit
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Reflection on Wumpus World

- Not efficient to solve using state space and search
- Agent draws conclusions from available information
- A conclusion is guaranteed to be correct if the available information is correct
 - Fundamental property of logical reasoning
- How to build such logical agents?

