cis32-ai — lecture # 20 — mon-10-apr-2006

today's topics:

- logic-based agents

Logic-Based Agents

- When we started talking about logic, it was as a means of representing knowledge.
- We wanted to represent knowledge in order to be able to build agents.
- We now know enough about logic to do that.
- We will now see how a *logic-based agent* can be designed to perform simple tasks.
- Assume each agent has a *database*, i.e., set of FOL-formulae.
  These represent information the agent has about environment.

- We'll write Δ for this database.
- Also assume agent has set of *rules*.

  We'll write R for this set of rules.
- We write $\Delta \vdash_R \phi$ if the formula ϕ can be proved from the database Δ using only the rules R.
- How to program an agent:

  Write the agent's rules R so that it should do action a whenever $\Delta \vdash_R Do(a)$.

  Here, Do is a predicate.
- Also assume A is set of actions agent can perform.

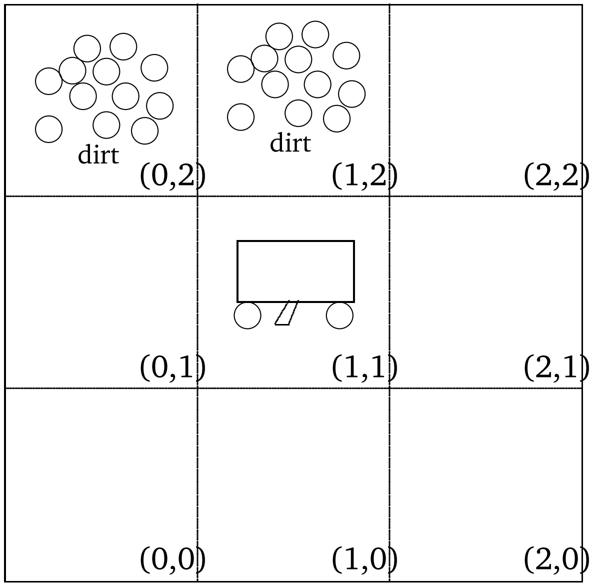
- The agent's operation:

for each a in A do
if $\Delta \vdash_R Do(a)$ then
return a
end-if
end-for
for each a in A do
if $\Delta \not\vdash_R \neg Do(a)$ then
return a
end-if
end-for
return $null$

- An example:

  We have a small robot that will clean up a house. The robot has sensor to tell it whether it is over any dirt, and a vacuum that can be used to suck up dirt. Robot always has an orientation (one of n, s, e, or w). Robot can move forward one "step" or turn right $90°$. The agent moves around a room, which is divided grid-like into a number of equally sized squares. Assume that the room is a 3×3 grid, and agent starts in square $(0, 0)$ facing north.

- Illustrated:



- Three *domain predicates* in this exercise:

$In(x, y)$	agent is at (x, y)
$Dirt(x, y)$	there is dirt at (x, y)
$Facing(d)$	the agent is facing direction d

- For convenience, we write rules as:

$$\phi(\ldots) \longrightarrow \psi(\ldots)$$

- First rule deals with the basic cleaning action of the agent

$$In(x, y) \wedge Dirt(x, y) \longrightarrow Do(suck) \quad (1)$$

- Hardwire the basic navigation algorithm, so that the robot will always move from $(0, 0)$ to $(0, 1)$ to $(0, 2)$ then to $(1, 2)$, $(1, 1)$ and so on.

- Once agent reaches $(2,2)$, it must head back to $(0,0)$.

$$In(0,0) \wedge Facing(north) \wedge \neg Dirt(0,0) \longrightarrow Do(forward) \quad (2)$$
$$In(0,1) \wedge Facing(north) \wedge \neg Dirt(0,1) \longrightarrow Do(forward) \quad (3)$$
$$In(0,2) \wedge Facing(north) \wedge \neg Dirt(0,2) \longrightarrow Do(turn) \quad (4)$$
$$In(0,2) \wedge Facing(east) \longrightarrow Do(forward) \quad (5)$$

- Other considerations:
  - *adding* new information after each move/action;
  - *removing* old information.
- Suppose we scale up to 10×10 grid?

Summary

- This lecture covered two logic-related topics.
- First is covered mechanical theorem proving:
  - Pointed out some problems.
  - Suggested resolution as a solution.
- Next we looked at how logic might be used to program an agent.
  - Assumes we have a theorem prover.