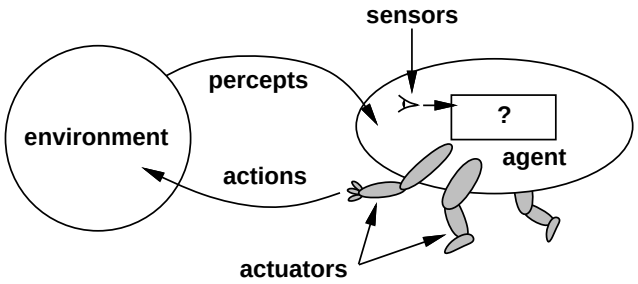
COMP9414/9814/3411: Artificial Intelligence

2. Environment Types

Agent Model



The PEAS model of an Agent

- Performance measure
- Environment
- Actuators
- Sensors

Agents as functions

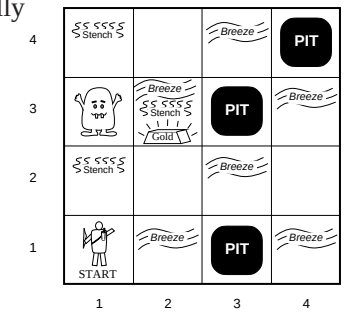
Agents can be evaluated empirically, sometimes analysed mathematically

Agent is a function from percept sequences to actions

Ideal rational agent would pick actions which are expected to maximise the performance measure.

Example AI Environment - Wumpus World

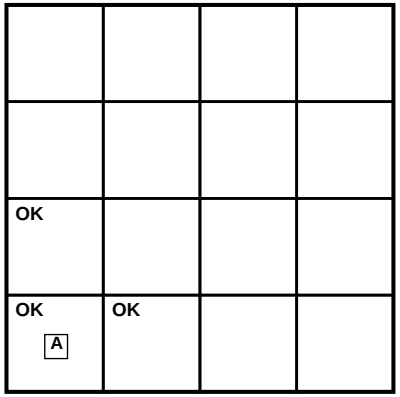
- Environment
  - Squares adjacent to Wumpus are Smelly
  - Squares adjacent to Pit are Breezy
  - Glitter iff Gold is in the same square
  - Shoot
    - kills Wumpus if you are facing it
    - uses up the only arrow
  - Grab
    - picks up Gold if in same square



Wumpus World PEAS description

- Performance measure
  - Return with Gold +1000, death -1000
  - -1 per step, -10 for using the arrow
- Actuators
  - Left, Right, Forward, Grab, Shoot
- Sensors
  - Breeze, Glitter, Stench

Exploring a Wumpus World



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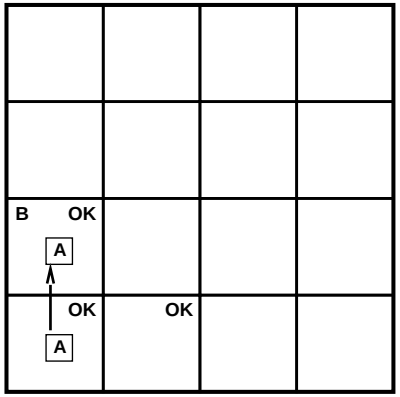

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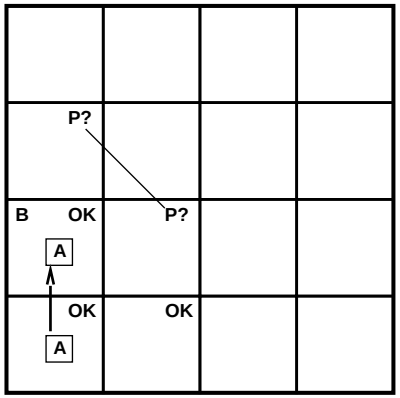
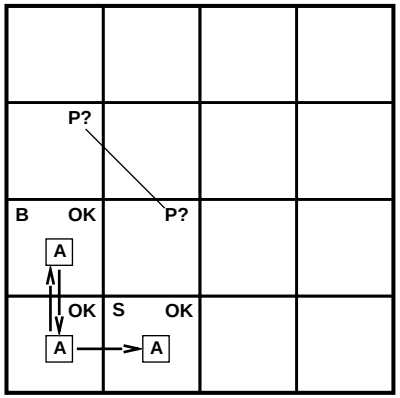
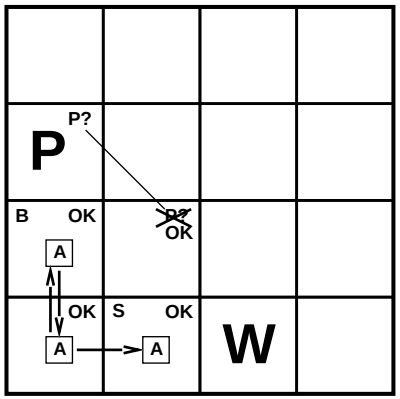


Exploring a Wumpus World



Exploring a Wumpus World



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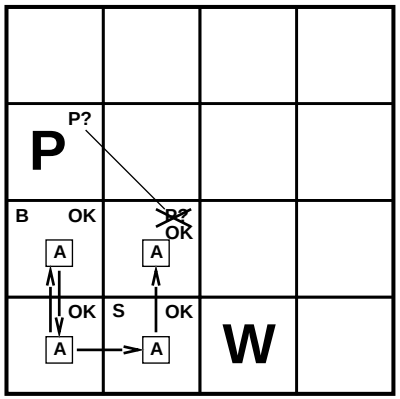

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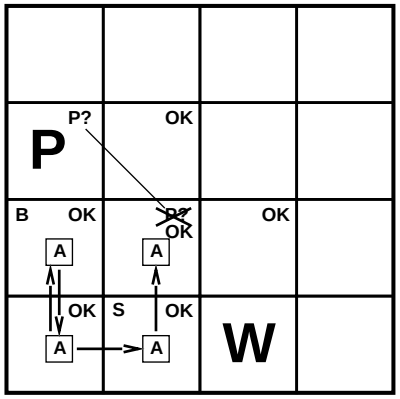

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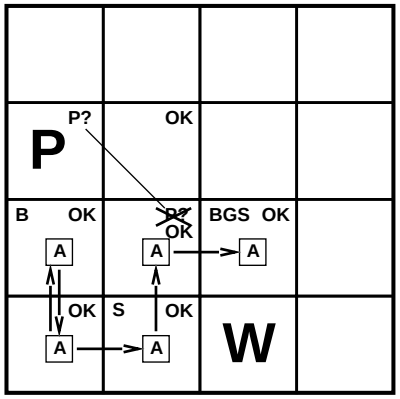

Example: Automated Taxi

Performance measure: safety, reach destination, maximize profits, obey laws, passenger comfort, ...

Environment: city streets, freeways, traffic, pedestrians, weather, customers, ...

Actuators: steer, accelerate, brake, horn, speak/display, ...

Sensors: video, accelerometers, gauges, engine sensors, keyboard, GPS, ...

Examples of AI Tasks?

Environment types

We can classify environments as:

- Fully Observable vs. Partially Observable
- Deterministic vs. Stochastic
- Single-Agent vs. Multi-Agent
- Episodic vs. Sequential
- Static vs. Dynamic
- Discrete vs. Continuous
- Known vs. Unknown
- Simulated vs. Situated or Embodied

Environment types

Fully Observable: percept contains all relevant information about the world

Deterministic: current state of world uniquely determines the next

Episodic: only the current (or recent) percept is relevant

Static: environment doesn't change while the agent is deliberating

Discrete: finite number of possible percepts/actions

Known: the rules of the game, or physics/dynamics of the environment are known to the agent

Simulated: a separate program is used to simulate an environment, feed percepts to agents, evaluate performance, etc.

Environment types

	Chess	Wumpus World	Dice Game	Poker	Internet Shopping	Robocup Soccer
Fully Observable						
Deterministic						
Multi-Agent						
Episodic						
Static						
Discrete						
Known						
Simulated						

The real world is (of course) partially observable, stochastic, multi-agent sequential, dynamic, continuous, unknown, situated and embodied.

Situated and Embodied Cognition

Rodney Brooks 1991:

- Situatedness: The robots are situated in the world – they do not deal with abstract descriptions, but with the "here" and "now" of the environment which directly influences the behaviour of the system.
- Embodiment: The robots have bodies and experience the world directly – their actions are part of a dynamics with the world, and actions have immediate feedback on the robot's own sensations.

Situated vs. Embodied

- Situated but not Embodied: Airline reservation system:
  - it deals with thousand of requests per second and its responses vary as its database changes.
  - but it interacts with the world only through sending and receiving messages.
- Embodied but not Situated: an industrial spray painting robot:
  - does not perceive any aspects of the shape of an object presented to it for painting; simply goes through a pre-programmed series of actions
  - but it has physical extent and its servo routines must correct for its interactions with gravity and noise present in the system.

State of the art

Which of the following can be done at present?

- Play a decent game of table tennis
- Drive along a curving mountain road
- Drive in the center of Cairo
- Play a decent game of bridge
- Discover and prove a new mathematical theorem
- Write an intentionally funny story
- Give competent legal advice in a specialized area of law
- Translate spoken English into spoken Swedish in real time

Summary

- Environments can be classified in terms of whether they are observable, deterministic, single- or multi- agent, episodic, static, discrete, known, simulated.
- The environment type strongly influences the agent design (discussed in the next lecture..)