Agents

Is it an agent or a program?

Agent Definition
An autonomous entity that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors.
PEAS Description

Systematic characterization of agents

Percepts
Concepts that depend on recognition by the sensors.
The percept sequence is the complete perceptual history.

Environment
Surroundings of the agent (real or virtual).

Actions
Operations performed by the effectors, usually resulting in changes in the environment.

Sensors
Devices or functions that gather data from the environment, or about the internal state of the agent.

Based on [?]
**ESPRA Description**

Systematic characterization of agents

**Environment**
Surroundings of the agent (real or virtual).

**Sensors**
Devices or functions that gather data from the environment, or about the internal state of the agent.

**Percepts**
Concepts that depend on recognition by the sensors.
The *percept sequence* is the complete perceptual history.

**Representation and Reasoning**
Knowledge representation and reasoning methods used by the agent.

**Actions and Actuators**
Operations performed by the effectors, usually

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resulting in changes in the environment.

rearranged and expanded PEAS description from [?]
Rational Agent

An agent that does the “right thing”

limited perspective
- based on knowledge available to the agent
- subjective view

judging rationality
- difficult to do for the agent itself
  requires reflection, self-awareness
- objective performance measure
- outside observers
**Ideal Rational Agent**

Always does the "best" right thing

**Percept Sequences**
- knows what to do for each possible sequence

**Actions**
- selects the right action according to the percept sequence and its built-in knowledge

**Performance Measure**
- is maximized

Does this prevent "stupid" behavior?
Mapping

of percept sequences to actions

Table
listing percept sequences and corresponding actions

Advantages
• simple design
• efficient
• deterministic
• not necessarily explicitly represented

Problems
• limited to reflexive behavior
  (no internal state)
• may be extremely large

related to behaviorism

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Autonomy

behavior is determined by experience

knowledge
   built-in knowledge is augmented by experience

learning
   acquired information is used to enhance the knowledge base

flexibility
   agents that rely only on built-in knowledge usually are less flexible

independence
   interaction with the user and other agents is limited
   the agent is in control of its own behavior
Structure of Agents

**Agent Program**
- a function that implements a mapping from percepts to actions

**Agent Architecture**
- computing device that runs the agent program

**Agent** = Architecture + Program
see also PAGE Description [?], page 37, PEAS description RN04
Agent Program

generic structure
  accept percepts from an environment
  generate actions

information
  internal data structures

memory
  to store the percept sequence

behavior
  decision-making procedures

the term "program" does not imply lack of autonomy
Reflex Agents

behavior based on input/output associations

associations
- can be described as tables, condition-action rules
  (if-then rules, production rules)

behavior
- observes the world
- looks up a matching entry or rule
- performs the specified action
Reflex Agents with Internal State

Agents that keep track of the world

*internal state*
- information about how the world involves
- effects of the agent’s action on the world

in addition to the associations of the reflex agent
Goal-Based Agents

Finding desirable situations

**goal information**
- situations that should be sought out

**Search / Planning**
- may be necessary to satisfy goals that can’t be achieved immediately

**Decision-Making**
- different from the condition-action rules:
  - involves consideration of the future
- usually less efficient, but far more flexible
Utility-Based Agents

more general internal performance measure

Utility
- a function that maps a state onto a real number, which indicates the degree of happiness

Conflicts
- utilities allow decisions for conflicting goals and trade-offs

Multiple Goals
- the likelihood of success can be weighed against the importance of the goals

in practice often merged with goal-based agent
Environment

World in which an agent lives

accessible
   can the sensors detect all relevant aspects?

deterministic
   is the next state completely determined by the current state and the actions selected by the agent?
   may depend on the point of view

episodic
   are there sequences of perceptions and actions that clearly belong together?
**static** vs. **dynamic**

does the environment stay unchanged while the agent is deliberating?

**discrete** vs. **continuous**

is there a limited number of clearly distinct percepts and actions?

*most difficult case: inaccessible, nonepisodic, dynamic, continuous*
Summary - Introduction

agent vs. program
autonomy, mobility, environment

agent characterization
Page, Peas, Espra: environment, sensors, percepts, representation and reasoning, actions and actuators

agent types
(ideal) rational agent, reflex agent, goal-based agent, utility-based agent, knowledge-based agent, planning agent, learning agent

environment
important properties that influence the design and behavior of agents