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

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Surroundings of the agent (real or virtual).

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Representation and Reasoning

Knowledge representation and reasoning methods used by the agent.

Actions and Actuators

Operations performed by the effectors, usually

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*

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