

intelligent agents

Eleni Kaldoudi
Researcher, ICS-FORTH

C-472: Machine Vision
Department of Computer Science
University of Crete at Heraklion

13 February 1997

intelligence

R.A. Brooks (MIT)

**“... the sort of stuff humans do,
pretty much all the time” (!)**

- ◆ **intelligence is determined by the dynamics of interaction with the world**
- ◆ **intelligence is in the eye of the observer**

traditional approach

- ◆ **top-down approach**
 - ◆ **thought and reasoning - introspection**
 - **I/O to thoughts and reasoning**
(knowledge representation)
 - **what thoughts and reasoning do?**
(planning, problem solving,...)
-
-

- ◆ **static environment**
- ◆ **closed system**
- ◆ **sense-model-plan-act**
- ◆ **define and control a search space**

key realizations (around 1984)

- ◆ **dynamic environment**
- ◆ **interaction with the environment**
- ◆ **collaboration of system components**
- ◆ **situatedness**
- ◆ **embodiment**
- ◆ **intelligence**
- ◆ **emergence**

agents * active vision * animate vision
artificial creatures * behavior-based approach

what is an agent ?

self-contained program
capable of controlling its own decision making and acting,
based on perception of complex and dynamic environments
and in pursuit of one or more goals

a system that can be most conveniently described by the
intentional stance, by ascribing mental qualities

pro-attitudes

desire
intention
obligation
commitment

....

information attitudes

belief
knowledge

agents' characteristics

agent: goals, sensors, effectors, environment

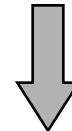
- ◆ autonomy
- ◆ social ability
- ◆ reactivity
- ◆ pro-activeness
- ◆ adaptivity

interaction dynamics

environment

agent components

agent society



emergent intelligence

characteristics of agent architectures

- ◆ **task-oriented modules**
- ◆ **task-specific solutions**
- ◆ **de-emphasized representations**
- ◆ **de-centralized control**
- ◆ **emergent goals and activity**
- ◆ **learning - redundancy**

two interesting problems

- ◆ **action - selection**
- ◆ **learning from experience**

action selection: the problem

**assume: multiple goals,
 specific sensor data and
 a variety of possible actions**

**what are the next actions in order to
 optimize the achievement of goals ???**

requirements

- ◆ **favor maximum progress**
- ◆ **minimize contradictory actions**
- ◆ **take opportunities**
- ◆ **be real-time**
- ◆ **improve by experience**
- ◆ **when things go wrong, degrade, don't break down**
- ◆ **avoid endless loops**
- ◆ **be adequate**

action selection: towards a solution

- ◆ **a theoretically computed action selection policy is not possible**
 - **resource limitations**
 - **incomplete and incorrect information**
 - **dynamic, non-deterministic environment**
 - **time-varying goals**
 - **....**

- ◆ **solutions depend on**
 - **nature of goals**
 - **nature of sensor data**
 - **command control and fusion**

learning: the problem

**assume: multiple, time-varying goals,
specific sensor data and
set of actions or competence modules**

**how can the agent improve the action selection
behavior based on experience ???**

requirements

- ◆ **incremental learning**
- ◆ **selective learning**
- ◆ **unsupervised learning**
- ◆ **cope with noise, faulty sensor data, etc.**
- ◆ **possibility for built-in knowledge**

learning: towards a solution

focus of attention

perceptual selectivity

what stimuli might possibly be attended to any time

cognitive selectivity

what internal structures are attended to at any time

applications

Interface agents

Information Agents and Cooperative Information Systems

Believable Agents

Cooperative Problem Solving and Distributed AI

power systems management

air-traffic control

particle accelerator control

intelligent document retrieval

patient care

telecommunications network management

spacecraft control

computer integrated manufacturing

transportation management

job shop scheduling

steel coil processing control

more details in ...

- ◆ R.A. Brooks, “Intelligence without Reason”, A.I. Memo no. 1293, AI Lab, MIT, 1991 ([http:// www.ai.mit.edu](http://www.ai.mit.edu))
- ◆ P. Maes, “Modeling Adaptive Autonomous Agents”, Artificial Life Journal, ed. C. Langton, vol. (1&2), MIT Press, 1994. ([http:// www.media.mit.edu](http://www.media.mit.edu))
- ◆ N.R. Jennings, M. Wooldridge, “Software Agents”, IEE Review, Jan. 96, 17-20, 1996. (<http://www.elec.qmw.ac.uk/dai>)
- ◆ M. Wooldridge, N.R. Jennings, “Intelligent Agents: Theory and Practice”, Knowledge Engineering Review, vol 10(2), 115-152, 1995. (<http://www.elec.qmw.ac.uk/dai>)
- ◆ Y. Shoham, “Agent-Oriented Programming”, Artificial Intelligence, vol 60, 51-92, 1993.
- ◆ L.N. Foner, “Paying Attention to What’s Important: Using Focus of Attention to Improve Unsupervised Learning”, MSc Thesis, MIT, 1996
- ◆ <http://ksl/stanford.edu>

cite as

Ε. Καλδούδη, “Πράκτορες Λογισμικού (Software Agents) – Εισαγωγή”, Σεμινάριο στα πλαίσια του μαθήματος “C-472: Μηχανική Όραση”, Υπεύθυνος: καθ. Σ. Ορφανουδάκης, Τμήμα Επιστήμης Υπολογιστών του Πανεπιστημίου Κρήτης, 13 Φεβρουαρίου 1997