Roadmap – Where we go next!

▶ Background

▶ Intra-Agent Modeling
  - Introduction to Agent Architectures
    - What is an Agent Architecture?
    - Typification of Agent Architectures
What is an Agent Architecture?

Architecture =

arrangement of data and algorithms
+ flow of data and control

Architectures determine behavioral space:
Typification of Agent Architectures

Intra-Agent Modeling • Introduction to Agent Architectures

- Belief-Desire-Intention (BDI) architectures
- Layered architectures
- Constraint-oriented architectures

Other characterizations:

- reactive versus deliberative architectures
- isolated versus social architectures
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  ■ Introduction to Agent Architectures
  ■ BDI Architectures
    ● General Principle
    ● PRS
    ● IRMA
    ● GRATE*
    ● COSY
General Principle

General structure:

**Input**

- **BELIEFS**
  - ("databasis")

- **DESIRE**s
  - ("goals")

- **INTENTIONS**
  - ("current goals")

**Reasoning (inference/learning)**

**Output**
General Principle

General flow of internal data and control (Wooldridge 1999):

- General flow of internal data and control (Wooldridge 1999):
PRS (Georgeff & Lansky 87)

PRS = “Procedural Reasoning System”
IRMA (Bratman et al. 1988)

IRMA = “Intelligent Resource-bounded Machine Architecture”

[Diagram of IRMA architecture with labeled components: Plan Library, Intentions Structured into Plans, Opportunity Analyzer, Means-End Reasoner, Compatibility Filter, Filter Override Mechanism, Beliefs, Deliberation, Desires, Perception, Reasoner.]
**GRATE* (Jennings 1993)**

**Intra-Agent Modeling • BDI Architectures**

*top-level view:*

- **interagent communication**
  - communication manager
  - cooperation module
  - acquaintance model
  - self model
  - information store

- **cooperation & control layer**
  - situation assessment module

- **interface**
  - control module
  - task 1
  - task 2
  - task n
GRATE* (Jennings 1993)

- details:
top-level view:
RDRC in detail:

- Agenda
- Intention structure

Filter

- Deliberation component
- Reaction component

Scripts for execution & intra-protocol decisions
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    ● INTERRAP
    ● TouringMachines
Structure and flow of data/control (from Wooldridge 1999)

(a) Horizontal layering
(b) Vertical layering (One pass control)
(c) Vertical layering (Two pass control)
top-level view:

- **situative context**
- **activity patterns**
- **mental context**

- **filter + decision**

- **behavior based + plan based methods**

- **filter + decision**

- **execution**
details:

- cooperation component
- plan-based component
- behavior-based component
- social model (cooperation knowledge)
- mental model (planning knowledge)
- world model (behavior patterns)

world interface (acting - communication - perception)
Top-level view:

- Perception subsystem
- Planning layer
- Reactive layer
- Modeling layer
- Action subsystem
- Control subsystem
- CLOCK
details on planning layer:

- **Goal Stack**
- **Schema Library**
- **Partial Planner**
- **Topological World Map**
- **Action Effectors**

sensors, resource monitor, other layers
details on modeling layer:

- Focus of Attention
  - sensors, resource monitor, other layers

- Model Library
  - Model Formation & Projection

- Conflict Resolution Strategies
  - Conflict Detection
  - action effectors
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    ● General Principle
    ● CCAF
    ● Waffler
General Principle

▶ constraint = condition under which activity is to be carried out, thus behavior-influencing

▶ “constraints everywhere”

■ standard constraints: time, cost, quality

■ others: individual preferences, collective preferences, psychological and social commitments, resource limitations, roles an agent has to play, conventions, ...

▶ Key assumption: ability to act flexibly has much to do with flexible handling of constraints

▶ usual distinction: soft versus hard constraints

▶ particularly challenging: handling constraints in applications that are distributed, dynamic, and/or real-time
CCAFA (Weiß 2000)

CCAFA = “Constraint-Centered Architectural Framework”

Underlying assumptions:

- constraints and all agent-internal activities must be tightly intertwined
- an agent must be able to carry out activities in cooperation with others (shared/delegated), when required by constraints
- communication must be sensitive to constraints
- agents must be able to reason about constraints (quantification of strength, importance, risk of violation)
- constraint handling within an agent to be realized as a centralized process (efficiency)
Waffler: after a colloquialism for improvisation ("waffling")

top-level view:
the role of constraints in more detail:

- perception recalls concepts intentions
- focus limit recollection limit exploration proposes
- expectation propose inhibit reinforce
- pool of constraints limit, focus
- action deliberation possible actions