Distributed Artificial Intelligence
– Agent-Oriented Engineering –

Part 2

Gerhard Weiß

Institut für Informatik
Technische Universität München

Winter 2004/5
Outline

Motivation

Agent Architectures
  Overview
  BDI Architectures
  Layered Architectures
  Constraint-oriented Architectures
<table>
<thead>
<tr>
<th>Motivation</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent Architectures</td>
<td>BDI Architectures</td>
</tr>
<tr>
<td></td>
<td>Layered Architectures</td>
</tr>
<tr>
<td></td>
<td>Constraint-oriented Architectures</td>
</tr>
</tbody>
</table>

### Outline

**Motivation**

**Agent Architectures**

**Overview**

BDI Architectures

Layered Architectures

Constraint-oriented Architectures
What is an (Agent) Architecture?

▶ Architecture =
  arrangement of data and algorithms
  + flow of data and control
▶ Architectures determine behavioral space:
Types of Agent Architectures

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

Other characterizations:
- reactive versus deliberative architectures
- isolated versus social architectures
## Outline

**Motivation**

**Agent Architectures**
- Overview
- BDI Architectures
- Layered Architectures
- Constraint-oriented Architectures
General Principle

- Basic structure:
General Principle (Cont’d)

- Basic flow of internal data and control:

```
output
action
intentions
desires
options
generate
beliefs
brf
sensor
filter
input
```
PRS = “Procedural Reasoning System”
IRMA

IRMA = “Intelligent Resource-bounded Machine Architecture”
GRATE*

- Top-level view:

  - interagent communication
  - cooperation & control layer
  - interface

  - cooperation module
  - situation assessment module
  - communication manager
  - acquaintance model
  - self model
  - information store
  - control module

  task 1          task 2          task n
GRATE* (Cont’d)

Details:
COSY

- Top-level view
COSY (Cont’d)

- RDRC in detail:

```
agenda                   intention structure
filter
```

```
deliberation component  reaction component
```
Outline

Motivation

Agent Architectures
  Overview
  BDI Architectures
  Layered Architectures
  Constraint-oriented Architectures
General Principle)

Structure and flow of data/control:

(a) Horizontal layering  
(b) Vertical layering  
   (One pass control)  
(c) Vertical layering  
   (Two pass control)
INTERRAP

- Top-level view:
INTERRAP (Cont’d)

Details:
Touring Machines

- top-level view:
Touring Machines (Cont’d)

- details on planning layer:
Touring Machines (Cont’d)

- details on modeling layer:

```
Focus of Attention
↑
sensors, resource monitor, other layers
```
```
Model Library
```
```
Model Formation & Projection
```
```
Conflict Detection
```
```
Conflict Resolution Strategies
```
```
Outline

Motivation

Agent Architectures
  Overview
  BDI Architectures
  Layered Architectures
  Constraint-oriented Architectures
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
CCAF

- CCAF = “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)
Motivation
Agent Architectures
Overview
BDI Architectures
Layered Architectures
Constraint-oriented Architectures

CCAF (Cont’d)
Waffler

- Waffler: after a colloquialism for improvisation ("waffling")
- top-level view:
Waffler (Cont’d)

- the role of constraints in more detail: