# $\mathcal{J}$-$\mathcal{M}$OISE$^+$

Programming organisational agents with $\mathcal{M}$OISE$^+$ & *Jason*

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Software tools to build regulated MAS

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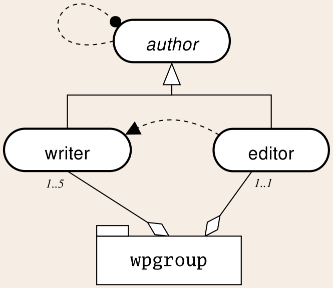
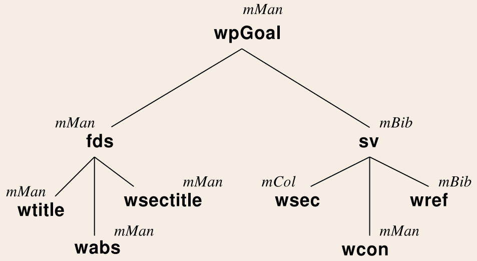
## Proposal

- Programming agents with a high abstraction level
  - AgentSpeak
  - BDI agents (reactive planning)
- Enable the programmer to state when the agent should adopt a role, a mission, ...
- Enable the agents to access organisational information
- Use *Jason* (open-source interpreter of AgentSpeak, developed by Rafael Bordini and Jomi Hübner)

## MOISE+ by example: “writing a paper”



(a) Structural Specification

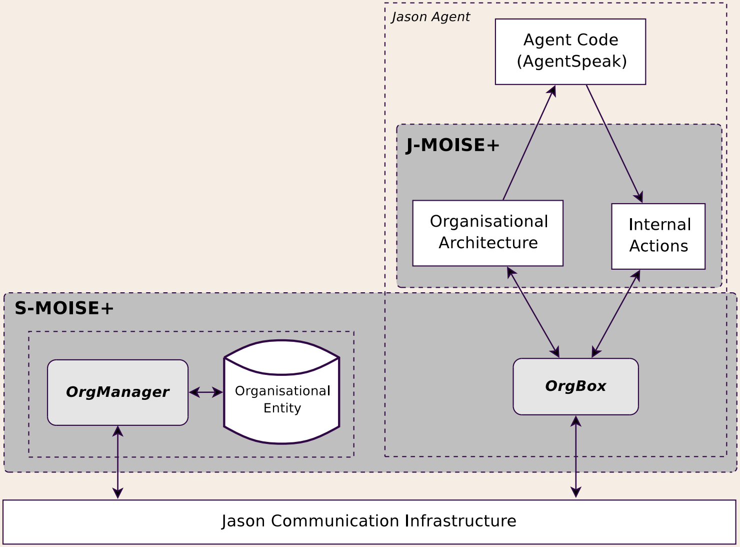


(b) Functional Specification

| | | |
|---|---|---|
| editor | *permission* | *mMan* |
| writer | *obligation* | *mCol* |
| writer | *obligation* | *mBib* |

(c) Deontic Specification

## General view



## Organisational Actions in AgentSpeak I

Example (AgentSpeak plan)

```
+some_event : some_context
  <- jmoise.create_group(wpgroup).
```

Some available Organisational Actions:

- For groups:
  - `create_group(<GrSpecId>[,<GrId>])`
  - `remove_group(<GrId>)`
- For schemes:
  - `create_scheme(<SchSpecId> [, <responsible groups>])`
  - `add_responsible_group(<SchId>,<GrId>)`
  - `remove_scheme(<SchId>)`
  - `set_goal_state(<SchId>,<Goal>,<State>)`

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## Organisational Actions in AgentSpeak II

- For Agents:
  - `adopt_role(<RoleId>,<GrId>)`
  - `remove_role(<RoleId>,<GrId>)`
  - `commit_mission(<MisId>,<SchId>)`
  - `remove_mission([<MisId>,] <SchId>)`
- OrgManager will perform those actions in case they are consistent, e.g. the adoption of role is contrained by
  - the cardinality of the role in the group
  - the compatibilities of the roles played by the agent

## Handling Organisational Events in AgentSpeak

Whenever something changes in the organisation, the organisation architecture updates the agent belief base accordingly.

Example (A new group is created)

```
+group(wpgroup,GId) : true
  <- jmoise.adopt_role(editor,GId).
```

or

```
+group(wpgroup,GId)[owner(O)] : my_friend(O)
  <- jmoise.adopt_role(editor,GId).
```

Example (Some group is destroyed)

```
-group(wpgroup,GId) <- .print("Group removed!").
```

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## Available Organisational Events I

- +/- **group(**$< GrSpecId >$**,**$< GrId >$**)[owner(**$< AgName >$**)]**: perceived by all agents when a group is created (event +) or removed (event −) by *AgName*.
- +/- **play(**$< AgName >$**,** $< RoleId >$, $< GrId >$**)**: perceived by the agents of *GrId* when an agent adopts (event +) or remove (event −) a role in group *GrId*.
- +/- **commitment(**$< AgName >$**,** $< MisId >$**,** $< SchId >$**)**: perceived by the *SchId* players when an agent commits or removes a commitment to a mission *MisId* in scheme *SchId*.

## Available Organisational Events II

- +/- **scheme(**$<$ *SchSpecId* $>$**,**$<$ *SchId* $>$**)[owner(**$<$ *AgName* $>$**)]**: perceived by all agents when a scheme is created (+) or finished (−) by *AgName*.
- + **scheme_group(**$<$ *SchId* $>$**,**$<$ *GrId* $>$**)**: perceived by *GrId* players when this group becomes responsible for the scheme *SchId*.
- + **goal_state(**$<$ *SchId* $>$**,** $<$ *GoalId* $>$**,** $<$ *State* $>$**)**: perceived by *SchId* players when the state of some goal changes.

## Available Organisational Events III

- **+ obligation(**$<$ *SchId* $>$**,** $<$ *MisId* $>$**)**
  **[role(**$<$ *RoleId* $>$**),group(**$<$ *GrId* $>$**)]**:
  perceived by an agent when is has an organisational obligation for a mission. It has a role (*RoleId*) in a group (*GrId*) responsible for a scheme (*SchId*) and this role is obligated to a mission in this scheme.
- **+ permission(**$<$ *SchId* $>$**,** $<$ *MisId* $>$**)**
  **[role(**$<$ *RoleId* $>$**),group(**$<$ *GrId* $>$**)]**:

## Achieving Organisational Goals

An achievement goal event (**+!g**) is create when an organisational goal **g** is permitted.

Example (Organisational goal)

If an agent is committed to a mission with goal **wsec**, whenever this goal is possible (all its pre-condition goals are satisfied), the following plan may be selected:

```
+!wsec[scheme(Sch)]
  :  commitment(A, mBib, Sch)
  <- ..... actions to write the section .....;
     .send(A,tell,[references]);
     jmoise.set_goal_state(Sch, wsec, satisfied).
```

The context of this plan uses organisational information to constraint its execution.

## Execution sample I

|  |  |
|---|---|
| jaime | action: jmoise.create_group(wpgroup) |
| all | perception: group(wpgroup,g1)[owner(jaime)] |
| jaime | action: jmoise.adopt_role(editor,g1) |
| olivier | action: jmoise.adopt_role(writer,g1) |
| jomi | action: jmoise.adopt_role(writer,g1) |
| all | perception:<br>play(jaime,editor,g1)<br>play(olivier,writer,g1)<br>play(jomi,writer,g1) |

## Execution sample II

| | |
|---|---|
| jaime | action: jmoise.create_scheme(writePaperSch, [g1]) |
| all | perception: scheme(writePaperSch,s1)[owner(jaime)] |
| all | perception: scheme_group(s1,g1) |
| jaime | perception: permission(s1,mManager)[role(editor),group(wpgroup)] |
| jaime | action: jmoise.commit_mission(mManager,s1) |
| olivier | perception: obligation(s1,mColaborator)[role(writer),group(wpgroup), obligation(s1,mBib)[role(writer),group(wpgroup) |
| olivier | action: jmoise.commit_mission(mColaborator,s1) |
| olivier | action: jmoise.commit_mission(mBib,s1) |

## Execution sample III

jomi perception:
obligation(s1,mColaborator)[role(writer),group(wpgroup),
obligation(s1,mBib)[role(writer),group(wpgroup)]

jomi action: jmoise.commit_mission(mColaborator,s1)

all perception:
commitment(jaime,mManager,s1)
commitment(olivier,mColaborator,s1)
commitment(olivier,mBib,s1)
commitment(jomi,mColaborator,s1)

## Execution sample IV

| | |
|---|---|
| all | perception: goal_state(s1,*,unsatisfied) |
| jaime | goal: wtitle<br>action: jmoise.set_goal_state(s1,wtitle,satisfied)<br>(after each set_goal_state all agents have theirs beliefs updated) |
| jaime | goal: wabs<br>action: jmoise.set_goal_state(s1,wabs,satisfied) |
| jaime | goal: wsectitles<br>action: jmoise.set_goal_state(s1,wsectitles,satisfied) |
| jaime | goal: fdv<br>action: jmoise.set_goal_state(s1,fdv,satisfied) |

## Execution sample V

| | |
|---|---|
| olivier | goal: wsecs |
| | action: jmoise.set_goal_state(s1,wsecs,satisfied) |
| jomi | goal: wsecs |
| | action: jmoise.set_goal_state(s1,wsecs,satisfied) |
| jaime | goal: wcon |
| | action: jmoise.set_goal_state(s1,wcon,satisfied) |
| olivier | goal: wref |
| | action: jmoise.set_goal_state(s1,wref,satisfied) |
| olivier | action: jmoise.set_goal_state(s1,sv,satisfied) |
| jaime | goal: wpGoal |
| | action: jmoise.set_goal_state(s1,wpGoal,satisfied) |

## Execution sample VI

```
  all  action: jmoise.remove_mission(s1)
jaime  action: jmoise.jmoise.remove_scheme(s1)
```

## Demo

- Agents' sources
- Application Execution
- Debugging

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## Summary

- A tool to program $\mathcal{M}$OISE$^+$ agents
  - Logic
  - BDI
  - AgentSpeak
- $\mathcal{J}$-$\mathcal{M}$OISE$^+$
  - OrgManager
  - Organisational actions
  - Organisational events
- An implementation is available at `http://jason.sourceforge.net`

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## References I

Bordini, R. H., Hübner, J. F., and Wooldrige, M. (2007).
*Programming Multi-Agent Systems in AgentSpeak using* **Jason**.
Wiley.

Hübner, J. F., Sichman, J. S., and Boissier, O. (2006).
S-MOISE+: A middleware for developing organised multi-agent systems.
In Boissier, O., Dignum, V., Matson, E., and Sichman, J. S., editors, *Proceedings of the International Workshop on Organizations in Multi-Agent Systems, from Organizations to Organization Oriented Programming in MAS (OOOP'2005)*, volume 3913 of *LNCS*. Springer.

Hübner, J. F., Sichman, J. S., and Boissier, O. (2007).
Developing organised multi-agent systems using the MOISE+ model: Programming issues at the system and agent levels.
*International Journal of Agent-Oriented Software Engineering*.