

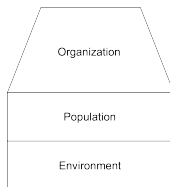
Two Concepts of Module, for Agent Societies and Inter-Societal Agent Systems

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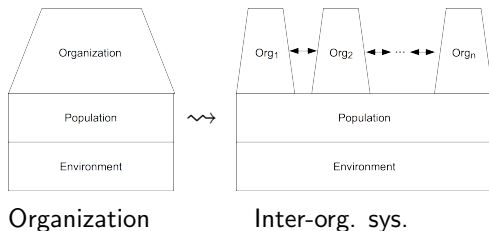
A personal view of the state of the art in MAS organization



Organization

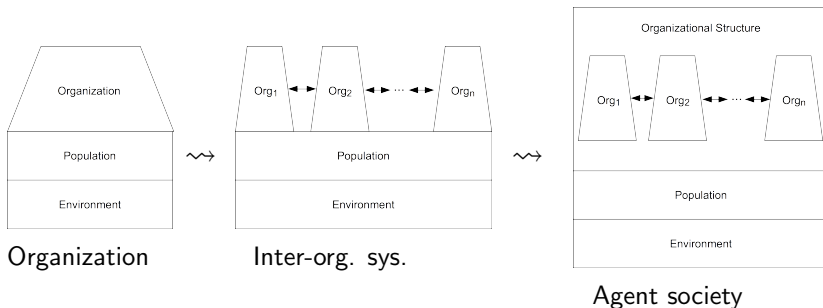
- ▶ In the state-of-the-art, a MAS appears as an **an organization**:
 - ▶ goals
 - ▶ roles
 - ▶ organizational form (hierarchy, network,...)
 - ▶ norms

A personal view of the state of the art in MAS organization



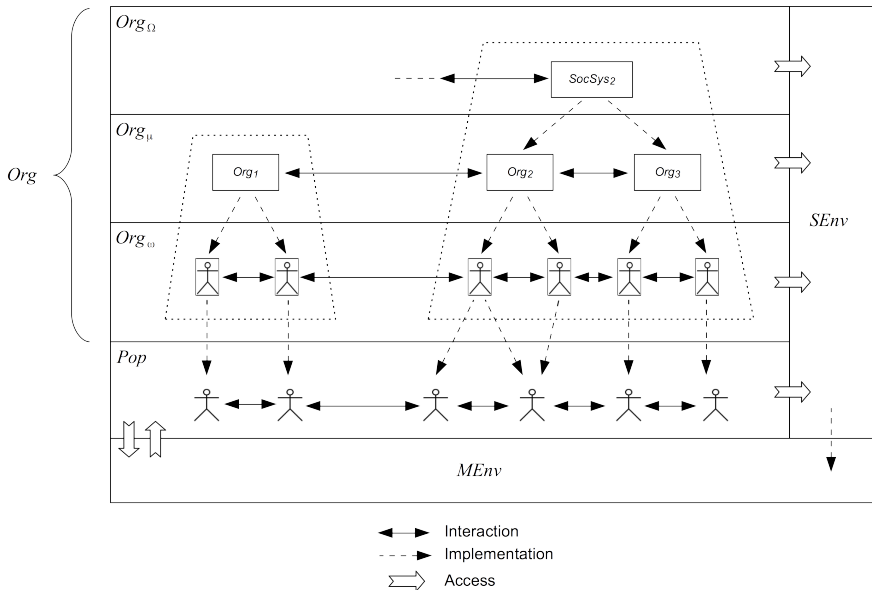
- ▶ But, **current MAS technology** allows the realization of **inter-organizational systems**:
 - ▶ **multiple organizations** running in parallel in a single platform (possibly as an **ad hoc collection** of organizations, **perhaps disconnected** from each other)

A personal view of the state of the art in MAS organization



- ▶ But, current MAS technology **also allows** the realization of **agent societies**:
 - ▶ **agent society** = a **set of organizations** related to each other in a **functional way**
 - ▶ serving each other
 - ▶ serving the system as a whole
 - ⇒ at the limit, a **full-fledged** society

An architecture for full-fledged agent societies



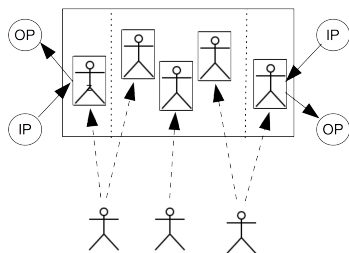
The proposals

We propose:

1. organizations as modules for agent societies
2. agent societies as modules for inter-societal agent systems

Organizations as modules

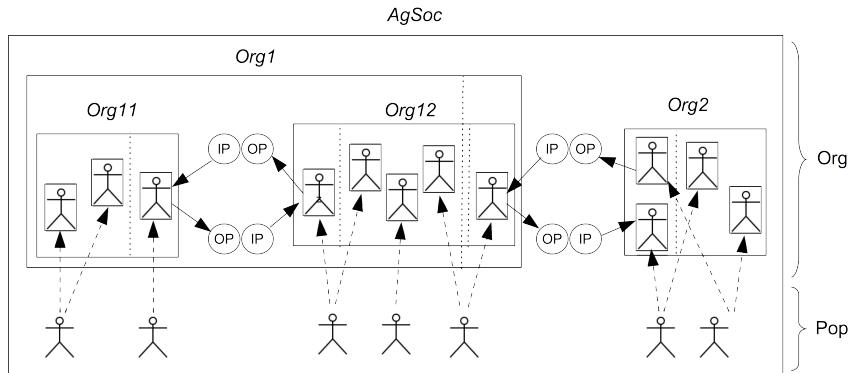
Encapsulated organization (basic form):



- ▶ abstract
- ▶ implemented

Organizations as modules

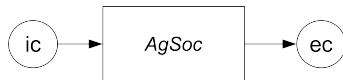
Encapsulated organization (general form):



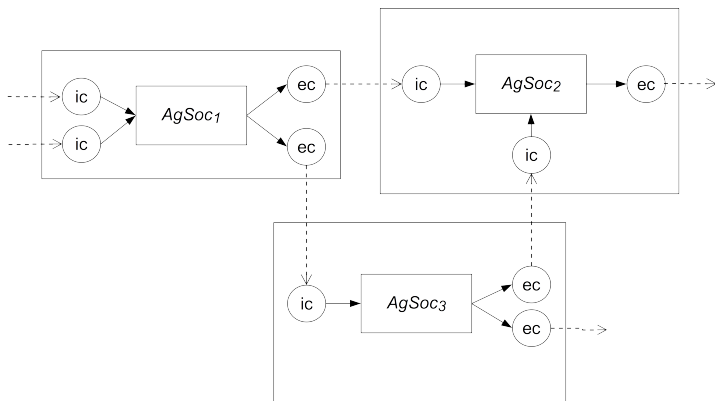
- ▶ abstract
- ▶ implemented

Agent societies as modules

Encapsulated agent society:

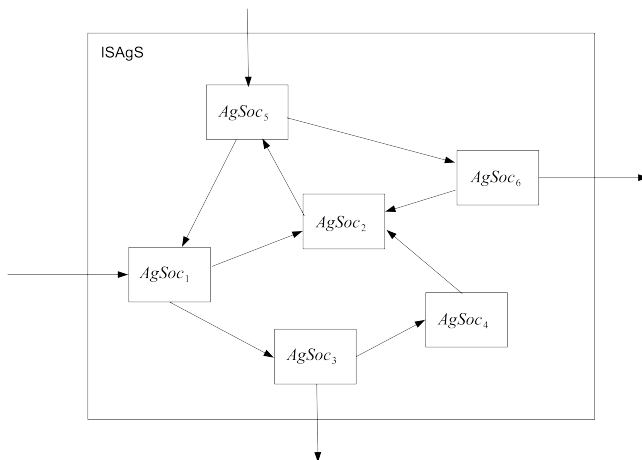


Agent society as module for inter-societal agent system:



Agent societies as modules

Inter-societal agent system:



We do not consider here recursively structured agent societies:

- **higher-level agent societies**

A Toy Module Language

Organizations as modules in agent societies:

```
org-unit modules:
  org-unit OU1:
    output ports:
      OP1 -> ...
    roles R1,...,Rn
    role behaviors:
      R1 -> ...
      ...
      Rn -> ...
    role interactions:
      R1 x R2 -> ...
      ...
      Rm x Rn -> ...
  org-unit OU2:
    input ports:
      IP1 -> ...
    roles R1,...,Rn
    role behaviors:
      R1 -> ...
      ...
      Rn -> ...
    role interactions:
      R1 x R2 -> ...
      ...
      Rm x Rn -> ...

agent society AgSoc1:
  population:
    ag1, ag2, ..., agm
  organization units:
    OU1
    OU2
  connections:
    OU1.OP1 -> OU2.IP1
  implementation:
    OU1.R1 -> ag1
    ...
    OU1.Rn -> agk
    ...
    OU2.R1 -> agn
    ...
    OU2.Rn -> agm
```

A Toy Module Language

Agent societies as modules in inter-societal agent systems:

```
org-unit modules:
  ...
ag-soc modules:
  ag-soc AgSoc1:
    export-channels:
      EC1 -> ...
    population:
      ...
    organization units:
      ...
    connections:
      ...
    implementation:
      ...
  ag-soc AgSoc2:
    import-channels:
      IC1 -> ...
    population:
      ...
    organization units:
      ...
    connections:
      ...
    implementation:
      ...

inter-soc-ag-sys ISAS1:
  agent societies:
    AgSoc1
    AgSoc2
  connections:
    AgSoc1.EC1 -> AgSoc2.IC1
```

A Toy Module Language

This module language: to be integrated into *SML*.

- ▶ *SML - A Society Modeling Language*
 - a description language for full-fledged agent societies
 - presented at WESAAC 2017
 - draft report available on the website of the event

Conclusions

1. **Organizations** are suitable candidates as modules for agent societies.

Conclusions

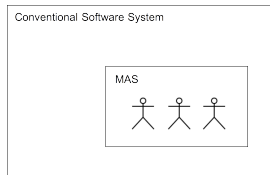
1. **Organizations** are suitable candidates as modules for agent societies.
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Conclusions

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2. **Agent societies** are suitable candidates as modules for inter-societal agent systems.
3. **Modularization** allows for the development of **repositories** of organizations and agent societies.
(with an **external** module language)

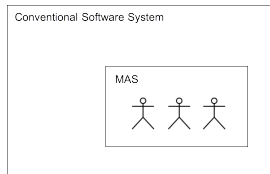
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3. **Modularization** allows for the development of **repositories** of organizations and agent societies.
(with an **external** module language)
4. The **encapsulation of organizations and agent societies** may allow for the integration of agent-based systems (as specialized types of components) into **conventional software systems**:



Conclusions

1. **Organizations** are suitable candidates as modules for agent societies.
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3. **Modularization** allows for the development of **repositories** of organizations and agent societies.
(with an **external** module language)
4. The **encapsulation of organizations and agent societies** may allow for the integration of agent-based systems (as specialized types of components) into **conventional software systems**:



5. Maybe, the way to lead MAS technology into **mainstream Software Engineering**.

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