IRTES
sciences & ingénierie
Institut de Recherche sur les Transports, l'Énergie et la Société

SARL: www.sarl.io
Agent-Oriented Programming Language

Sebastian Rodriguez   Nicolas Gaud   Stéphane Galland

Seminar at ISCOD / LSTI - Institut Henri Fayol – Saint Étienne
February 19th, 2014

Janus Experience

Janus Experience

- Janus code base is almost 10 years old.
- Learned a lot of the DO's and DON'Ts.
- API became complex and difficult to maintain.
- Constant need to refactor to include new features.
- New patterns have changed software development (IoC, Event-Driven Communication, Distributed Objects, etc.).

Expectations for SARL

Expectations for SARL

- Nowadays we implement Agent with Object-Oriented concepts.
- Object-Oriented design with Object-Oriented concepts (interfaces, classes, methods, etc).
- Agents should be simple to extend.
- Provide the community a common discussion forum.

Design Principles

Design Principles

- Clear separation between Language and Platform related aspects
- Everything is distributed and it should be transparent.
- Massively parallel.
- Event-driven interactions.
- Platform- and architecture-independent.
- Coding should be fun (Ruby/Scala-like) ☺.
- All agents are holonic.
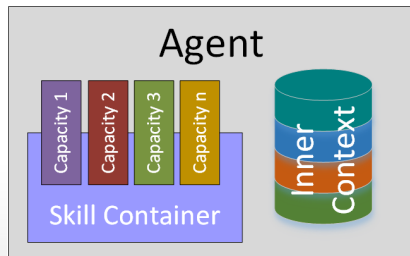- There is not only one way of interacting but infinite.

Agent

- An agent is an autonomous entity having some intrinsic skills to implement the capacities it exhibits.
- An agent defines a Context.
- An agent initially owns native capacities called Built-in Capacities.
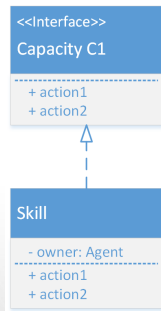
Capacities and Skill

Capacity

Specification of a collection of actions.

Action

- A specification of a transformation of a part of the designed system or its environment.

- Guarantees resulting properties if the system before the transformation satisfies a set of constraints.

- Defined in terms of pre- and post-conditions.

Skill

A possible implementation of a capacity fulfilling all the constraints of its specification.

```
<<Interface>>
Capacity C1
- - - - - - - - - - - - -
+ action1
+ action2
```

```
Skill
- - - - - - - - - - - - -
- owner: Agent
- - - - - - - - - - - - -
+ action1
+ action2
```

Context and Interactions

Context

- Defines the boundary of a sub-system.
- Collection of Spaces.
- Every Context has a Default Space.
- Every Agent has a Default Context, the context where it was spawned.
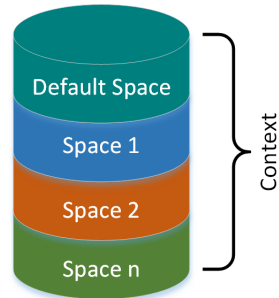
Space

Support of interaction between agents respecting the rules defined in various Space Specifications.

Context and Interactions (cont.)

Space Specification

- Defines the rules (including action and perception) for interacting within a given set of Spaces respecting this specification.
- Defines the way agents are addressed and perceived by other agents in the same space.
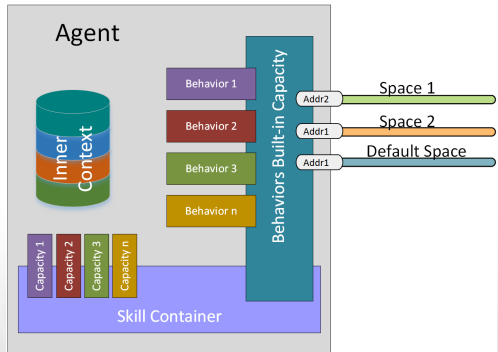- A way for implementing new interaction means.

Use case for organizational approach

- Space Specification: Organization
- Space: Group
- Agent interface: Behavior, Role
- Addressing: Role Address

IRTES
sciences & ingénierie

Context and Interactions (cont.)

Default Space: an Event Space

- Event-driven interaction space.

- Default Space of a context, contains all agents of the considered context.

- Event: the specification of some occurrence in a Space that may potentially trigger effects by a participant.

Agent

Inner Context

Behavior 1
Behavior 2
Behavior 3
Behavior n

Behaviors Built-in Capacity

Addr2 — Space 1
Addr1 — Space 2
Addr1 — Default Space

Capacity 1
Capacity 2
Capacity 3
Capacity n

Skill Container

Contexts and Holonic properties

- All agents have at least one External Context (the default one).

- All agents participate in the Default Space of all Contexts they belong to.
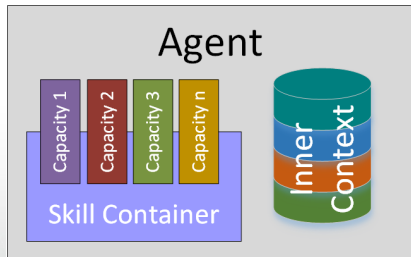
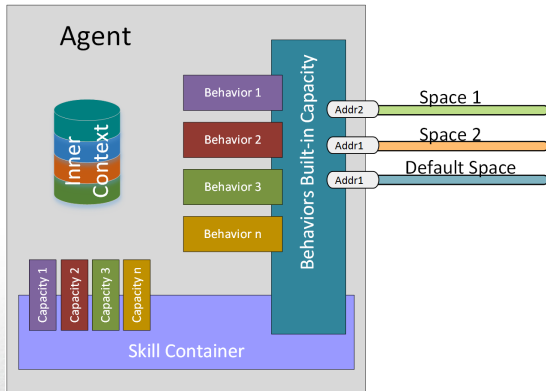- The Janus Context is omnipresent.
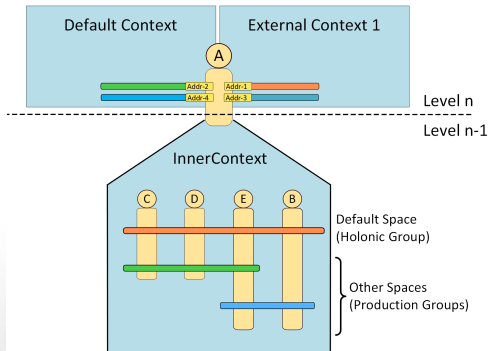
Outline

Built-in Capacities

A SARL Agent has inherently a set of Built-in Capacities

Current Built-in Capacities

- ExternalContextAccess
- InnerContextAccess
- Behaviors
- Lifecycle
- Schedules
- DefaultContextInteractions

Behaviors Built-in Capacity

Agent

Inner Context

Behavior 1
Behavior 2
Behavior 3
Behavior n

Behaviors Built-in Capacity

Addr2 — Space 1
Addr1 — Space 2
Addr1 — Default Space

Capacity 1
Capacity 2
Capacity 3
Capacity n

Skill Container

Behavior

Defines the actions to be performed on a given perception (Events) in a Space.

Show me the Code!

Demo

☺

IRTES
sciences & ingénierie

Summary

What does SARL currently provide ?

- Defines general agent-technology concepts: Context, Space, Agent, Capacity, Skill.
- All agents are holons.
- Intuitive Syntax (and the associated Eclipse-based IDE).
- Extensible (Capacities and Skill)
- No single way of interacting imposed.
- Janus as SARL platform
  - Fully distributed.
  - Dynamic discovery of Kernels.
  - Automatic synchronization of kernels' data (easy recovery).
  - Micro-Kernel implementation.

Future works

- Define the organizational extensions firstly based on CRIO then MOISE ☺: static and dynamic (normative).
- Define the concept of Environment.
  - Environment dynamics and interface.
  - How to define "objects" inside the environment. (artifacts?)
  - Simulation extension.
- Enforcing Pre- and post-conditions.
- Formal specification.