Role Dynamics in the *Jason* Team

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Abstract. This document presents the main ideas concerning the dynamics of the role within the *Jason* team. An agent's life cycle is decomposed into two phases: *exploration* and *herding*. During each of these two phases, an agent will play different roles according to the context (cluster size, number of herders, etc.).

Key words: Jason, organisation, roles

1 Introduction

As to remind the roles identified in the AC 2008 proposal we made, Figure 1 presenting the group structure in the *Jason* team.

Here is a reminder of the specific roles:

- *guard*: guards the corral so as to keep the herded cows safe inside it;
- *explorer*: explore the environment until it detects a cow;
- *scout*: follows the explorer;
- *tracker*: once a cow is detected, tracks all cows of a cluster so as to evaluate its size;
- *herder*: herds the cows detected by explorer to reach the corral (since they move quicker than cows, they can also continue to explore around the cluster);
- *herdboy*: helps the herder to lead cows to the corral;
- *ranger*: finds the "best" path to the corral.

Actually, an agent will follow a simple life cycle: exploration, herding, exploration, herding, etc. During these phases the agent will play some roles depending on the perception form the environment and its group.

The following section present these two phases in detail.

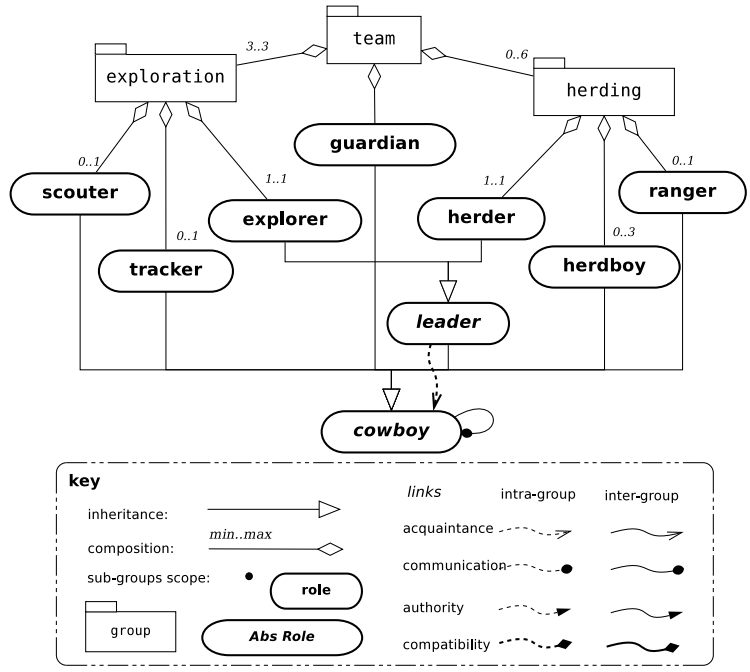

Fig. 1. Role and group structures

2 Exploration

2.1 Pairs formation

At the begin of the simulation, agents form pairs (so 3 pairs for a simulation). If during the simulation, an agent is exploring alone (only during the its exploration phase), it will try to find a partner.

2.2 Environment partitioning

Each pair is assigned to a specific area of the environment. This partition is chosen according to the agents' positions. As to simplify this partition, we choose to settle it as shown in figure 2.

This can be improved by computing the partition according to the position of the coral.

2.3 Role assignment

An exploration group can be composed of 1 or 2 agents. If it is a 1-agent group, the only agent plays the role explorer. If it is a 2-agent group, one agent plays the role explorer (the agent farest form the coral), the second one plays the role scout. During these role playings, each agent shares its perceptions with its partner.

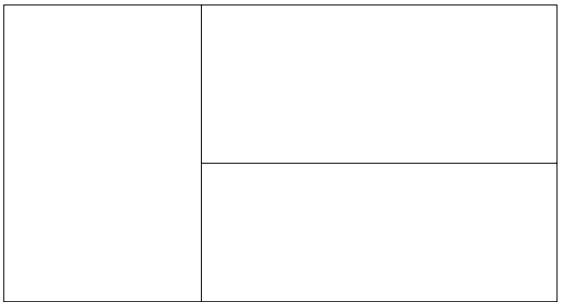

Fig. 2. Environment partitioning

AgentSpeak :

2.4 Explorer role playing

The tasks of the explorer are quite simple:

1. choose a target position: the near position which is least visited within its partition,
2. compute a path to the target position, using $A^\star$ algorithm,
3. move along the computed path.

This role playing ends as soon as the explorer perceives a cow.

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2.5 Scout role playing

The role of the scout is to help the explorer to find cows. As to maximize the number of visited cells, the scout must be positioned at a distance equal to the double of the perception distance of agents relatively to the explorer, orthogonally to the direction of the target position from the viewpoint of the explorer (figure 3)

This requires some coordination with the explorer:

- the explorer informs the scout of its next target position and its own position (in case the scout does not perceive it),
- the scout compute its next target position.

But before that, the scout must move towards the explorer until it perceives it.

This role playing ends as soon as the explorer (which is now a tracker) a herder, as to begin the herding phase.

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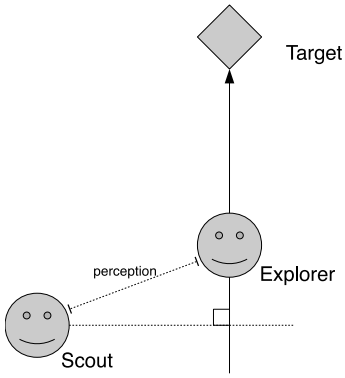

Fig. 3. Position of the scout relatively to the explorer during exploration phase

2.6 Tracker role playing

Once the explorer perceives a cow, it plays the tracker role which aims at evaluating the size of the cluster of cows. The tracker does the following tasks:

1. compute the next target position: a position at the opposite of the coral position according the center of the cluster,
2. circle the coral as to reach the target position,
3. count the perceived cows until it reaches the target position (maintaining a counter $size$),
4. once the target position is reached, decide whether the group must split, grow or remain as it is, with respect to the following rules:
   - if ($\text{size} \leq \tau < \tau_{\max}$) then split the group: one herder is sufficient to herd the cluster to the coral; the scout plays now the explorer role,
   - if ($\tau < \text{size} \leq \tau_{\max}$) then the group is kept: the two agents are sufficient; the explorer plays now the herder role and the scout now plays the herdboy role,
   - if ($\tau < \tau_{\max} < \text{size}$) then the group must recruit nearest explorer agents or negotiate with other herder agents to recruit herdboy agents.

Negotiation between herders will depends on:

- the sizes of the respective clusters,
- the distance between the agents to recruit and the recruiting agent.

At the end of this role playing, the explorer is positioned so as to have the cluster between itself and the coral. In this position, it only has to move to the coral to "push" the cluster in the good direction.

During this phase, the scout continues to play this role.

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3 Herding

This phase starts as soon as a tracker becomes a herder. At the same moment, the scout becomes either a herdboy or an explorer, depending on the size of the cluster.

3.1 Herder role playing

The role of a herder is to guide a cluster to the coral. As said before, the cluster (its center) is positioned between the herder and the coral.

Mainly, the tasks for a herder are:

1. update the size of the cluster[1],
2. recruit if necessary (see section 2.6),
3. compute the center of the cluster,
4. compute the target position with respect of the position of the coral and the center of the cluster,
5. compute the path to reach this position by using $A^\star$,
6. compute its next position according to the previous information,
7. inform its herdboys of this position,
8. compute the path to the next position using $A^\star$,
9. move to its next position.

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We can identify some **exceptions**:

- **immobile cluster**: if the cluster does not move for t_{max} steps, the herder must change its target direction by adding an α angle to the direction.
- **two clusters meet**: if two clusters start to merge, herders must decide whether the cluster must merge or not. This implies negotiation between the two agents depending on the total size of the cluster.
- **cluster too big**: if the cluster size $> \tau_{supermax}(\tau_{supermax} > \tau_{max})$, it must split into two clusters. As to do this, the herder go to the center of the cluster as to create a breach in the cluster (and becomes then ranger). New herders must be chosen among the herdboys for the new clusters. The ranger becomes an explorer as to be easily recruited by the new herders.

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[1] necessary to detect whether a cluster is too big

3.2 Herdboy role playing

The herdboy role is quite simple: it helps the herder to herd a cluster to the coral. Herdboys are led by one herder. Once a herder begins to herd a cluster to the coral, some herdboys may help it to achieve this task.

Herdboys' tasks are:

1. detect close clusters, as to decide whether they merge or not,
2. compute its next position thanks to information coming from its herder: each herdboy moves to a position near the herder around the cluster. E.g. if the herder is on the line from coral to cluster, the first herdboy position itself on a line at 10° left from the herder's position, the second one on a line at 10° right, etc.
3. compute the path to the next position using $A^\star$,
4. move the next position.

If the cluster too big exception occurs, herdboys must try to enter in the breach created by the herder to help the cluster splitting.

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3.3 Ranger role playing

The ranger's role is to create a breach inside a big cluster to create two separate cluster. Once it is done, it becomes an explorer. The idea is to split the cluster by letting the cows move by side, since herdboys move to the position of the ranger and do not constrain cows anymore. Once it is done, the side of the cluster are free, and cows can move by side. It leads herdboys during this stage.

Ranger's tasks are:

1. inform herdboys they have to move to its position around the cluster,
2. compute its next target position: the point at the opposite of its current position according to the center of the cluster,
3. compute the path to this position using $A^\star$,
4. move to the next position.

AgentSpeak :

4 TODO list

1. add *AgentSpeak* specification for each role
2. specify the dynamic role-chart with roles and triggers to sum up the role dynamics