Multi-Agent Programming Contest 2016 Participation Registration

Introduction

1. What is the name of your team?

   PUCRS.

2. Who are the members of your team? Please provide names, academic degrees and institutions.

   Rafael Cauê Cardoso (PhD Student at PUCRS);

   Ramon Fraga Pereira (PhD Student at PUCRS);

   Maurício Cecilio Magnaguagno (PhD Student at PUCRS);

   Artur Freitas (PhD Student at PUCRS);

   Túlio Basegio (PhD Student at PUCRS);

   Alison Roberto Panisson (PhD Student at PUCRS);

   Guilherme Azevedo (MSc Student at PUCRS);

   Guilherme Krzisch (MSc Student at PUCRS);

   Tabajara Krausburg (MSc Student at PUCRS);

   Anibal Sólon Heinsfeld (MSc, CTO at Planejei);

   Rafael Heitor Bordini (PhD, currently Associate Professor at PUCRS);

   Felipe Rech Meneguzzi (PhD, currently Associate Professor at PUCRS);

3. Who is the main-contact? Please also provide an Email address.

   Rafael Cauê Cardoso (rafael_caue@hotmail.com).

4. How much time (man hours) will you have invested (approximately) until the tournament?

   156 man hours in 2015, and 72 man hours in 2016 (228 total, although versions from 2015 and 2016 differ significantly).

System Analysis and Design

1. Briefly, what is the main strategy of the team?

   At the start of each simulation's round, we send agents to explore the environment (mainly shops, to check which are the items' prices and availability). After that, we wait for jobs. When we receive one, we evaluate if its reward is greater than the expected (estimated value) expense in finishing this job. If this is a "good" job, we split each task from the job to the available agents, using Contract Net Protocol (CNP). We also post some jobs to try to trick the enemy team.

2. Will you use any existing multi-agent system methodology such as Prometheus, O-MaSE, or Tropos?

   We modelled parts of our system in Prometheus. Some of the diagrams can be found in the paper Limitations and Divergences in Approaches for Agent-Oriented Modelling and Programming presented in EMAS 2016.

3. Do you plan to distribute your agents on several machines?

   No, we will use only one machine.

4. Is your solution based on the centralisation of coordination/information on a specic agent? Conversely if you plan a decentralised solution, which strategy do you plan to use?

We are using mostly decentralised solutions. For example, for task allocation we are using CNP, and for the inital exploration of the environment we are using token ring. We do have a centralised structure where agents can share some simple information, such as if an agent is busy or not.

5. Describe the communication strategy in the agent team. Can you estimate the communication complexity in your approach?

   Agents only communicate directly with each other when employing token ring algorithms. At the moment this only happens during the initial exploration of the environment, where in the worst case complexity will be `(a-1) * (f-1) + f`, where `a` is the number of agents and `f` is the number of facilities.

6. Describe the team coordination strategy (if any)

   We are using three coordination strategies:

   For the initial exploration of the environment we are using token ring communication, an agent will start the ring by sending a list with its route to all facilities that still need to be explored to the next agent in the ring. Each subsequent agent updates the list if there is any route that it does better. The last agent in the ring delete the winners from the ring, but an agent can only explore one facility, so if an agent were to win more than one facility, he only wins the one with the smaller route, and the other ones are sent to the new ring.

   For deciding the tasks that each agent will do in a job, we are using CNP. An agent plays the role of initiator, and all agents play the role of bidders (including the initiator). Agents place bids for tasks (e.g., buying items, building items, delivering items) according to their availability (distance to the task, if it can use a specific tool, etc.). Agents that win a task but cannot complete it on its own, can then create new contract nets and delegate the tasks that it needs help with.

   We are also using a centralised structure (a Cartago artefact) to store common information. We can use that information in various plans, for example, the initiator of a CNP may restrict tasks to agents that are not busy (information stored in our centralised structure).

7. How are the following agent features implemented: autonomy, proactiveness, reactiveness?

   Autonomy: our agents are autonomous by default, since JaCaMo uses Jason agents, which are based on the AgentSpeak language. Thus, any goal that contains multiple plans is a choice to be determined by the agent. For example, in our system agents have multiple plans to determine their bid, and thus, we can say that the agent determine their bid autonomously.

   Proactiveness: our initial exploration strategy, job strategies, and recharge strategies are all proactive. The agents start with the goal to explore and to complete jobs, but these are all greater goals which agents continuously work towards but can also work on other minor goals. Our agents also do not wait to be low, or on a certain threshold of battery, they plot a course that guarantees that they will always have battery (if possible).

   Reactiveness: the initiator agent reacts to the announcements of new jobs by creating the contract nets for them. We also have a strategy that reacts to the number of steps in the round, if it is almost over then our agents react by changing certain strategies.

Software Architecture

Please explain the reasons for your answers.

1. Which programming language do you plan to use to implement the multi-agent system? (e.g. 2APL, Jason, Jadex, JIAC, Goal, Java, C++, ...)

   We are implementing the system using the JaCaMo MAS development platform.

2. Which development platform and tools are you planning to use?

   We are using Eclipse IDE with JaCaMo plugin.

3. Which runtime platform and tools are you planning to use? (e.g. Jade, AgentScape, simply Java, ...)

   Java.

4. Which algorithms will be used?

   CNP, token ring, and a few new ones that we developed specifically for this scenario.

Agent team strategy

Please address the following points, or at least comment if not applicable:

1. Describe the team coordination strategy (if any)

   See our answer to question 6 of the **System Analysis and Design** section.

2. Does your team strategy use some distributed optimization technique w.r.t. e.g. minimizing distances travelled by the agents?

   Yes. Almost all strategies that involve agent movement consider at least an estimate of the agents' movement.

3. Describe and discuss the information exchanged (and shared) in the agent team.

   Agents share if they are free or busy, and also about new discoveries that they made by exploring the environment.

4. Describe the communication strategy in the agent team. Can you estimate the communication complexity in your approach?

   See our answer to question 5 of the **System Analysis and Design** section.

5. Did your system do some background processing, i.e. some computation which happened while agents of the team were idle, e.g. between sending an action message to the simulation server and receiving a perception message for the subsequent simulation step?

   Yes, our agents are constantly reasoning about the environment and possible jobs to take. If there isn't anything to reason about, then the agents start to reason about jobs that they can propose to trick the enemy team.

6. Possibly discuss additional technical details of your system like e.g. failure/crash recovery and alike.

   If an agent fails an action such as a go_to or charge, we implemented a system that can repeat that action, otherwise it would be possible for an agent to fail a go_to action and then keep trying to execute the continue action (and thus never moving). We have a few extra strategies but they are not done, and we might not finish them in time for the competition. If we do manage to finish them on time, we will describe them in the paper.