Temporal Planning to Coordinate Actions in Disaster Environment

Tabajara Krausburg Rodrigues
Pontifical Catholic University of Rio Grande do Sul - PUCRS
School of Informatics - FACIN
Porto Alegre, Brazil
tabajara.rodrigues@acad.pucrs.br

Abstract

In this report will be introduced the proposal of automated planning final assignment. The application is composed of number of agents that coordinate their actions to accomplish a task. We intend to use temporal planning to address this problem using the planner TFD.

Introduction

Planning is an important part of rational behavior, in which there exist a deliberation process before an action has been taken. Sometimes, critical environments are really a difficult task, because they involve high costs and risks. In this sense, actions must be planned before executed. The planning aims at choosing and organizing actions by anticipating their expected outcomes. The deliberation process can be time-consuming and very complicated, hence it must be used when it is strictly needed.(Nau *et al.* 2004).

In our proposal, we intend to explore temporal planning to coordinate agents' actions during a mission in a disaster environment. In this sense, one agent know the next steps of its teammate. In temporal planning the action is not seen as a single state transition but as a collection of local change and persistence conditions that are spread out in time (Nau *et al.* 2004). This process could be interesting for synchronize the group's actions (Crosby and Petrick 2014). Each agent would know the tasks it must carry out and with the information from the other agents it have a clue about what to do, whether it needs to wait for other agents. It will be formalized the domain and problem files in PDDL (Planning Domain Definition Language). The planner TDF (Temporal Fast Downward)[1] will be used in this work to specify the notion of temporal actions.

Scenario

The scenario consists of a disaster environment where we have a number of victims waiting for rescue operation. The goal of the system is save all the victims in the disaster area. All the agents start in the base command and they go to the disaster area. This area is divided into three zones: red zone, yellow zone and green zone. The red zone is the epicenter of disaster, it is a dangerous place, and only a small number of agents have permission to enter in this environment. The yellow zone is where the found victims are taken to, in this place the rescuers provide first-aid to the victims. The green zone is a safe place, there the doctors provide medical assistance to the injured people.

In this problem the agents may assume some roles as: firefighter, rescuer, doctor or victim. Doctors can only stay in the green zone, the rescuers can transit between the yellow and green zone and the firefighters and victims have free pass for all the zones.

- Firefighter - it looks for signal of life in the disaster environment and transport the victims between the zones;
- Rescuer - it provides first-aid and transport the victims between the yellow and green zone;
- Doctor - it provides medical assistance to the victims;
- Victim - it is rescued by the team;

Some possible actions that will be formalized are: look for the victims, move between zones, transport a victim, provide first-aid and provide medical assistance. This is only a first idea, other actions may be added or removed from this list. Each action will demand a different amount of time to be executed. As the initial state we will have the number of victims spread out in the red zone and the goal state will be all victims treated.

Technical Approach

The system will contains multiple agents, each agent will take a role in the application. These roles are distributed taking in account the capabilities of the agents. All the agents will share the same goal and they will execute actions concurrently. However, there are constraints over which actions can be performed simultaneously. Each action will take a certain amount of time to be executed, this time will guide the coordination of the agents. The overall time of the application must be minimized on order to save all the victims as quickly as possible.

To achieve our goal in this proposal, we will use the planner Temporal Fast Downward (Eyerich *et al.* 2009). This planner covers temporal dependencies and admits plans with concurrent durative actions. These actions are annotated with a start point and a duration. The heuristic that guide

[1] http://gki.informatik.uni-freiburg.de/tools/tfd/

the search is a context-enhanced additive extended to cope with numeric variables and durative actions. The evaluation of the system will be based on simulation of the problem instances. Three instances will be formalized in order to make the tests.

Project Management

Before starting the development of this work, it will be necessary driller out the research about temporal planning and the planner TFD in order to better execute this assignment. After that, the formalization process will be started out, followed by the tests and the writing of final report and presentation.

- (1 week) - Deeper research for temporal planning and TFD;
- (1 week) - Domain formalization;
- (1 week) - Define problem instances formalization and experiments;
- (2 weeks) - Perform experiments;
- (1 week) - Write the final report and prepare the presentation;

Conclusion

In this report we introduced the proposal for the automated planning final assignment. We expect have a good performance with temporal planning, in the development and results. With this approach, each agent is able to have access to the group plan without have a explicit communication between the agents, it needs only a coordination artifact that provides the global state of scenario. In this sense, an agent will be able to know the best moment to ask support from an other agent.

References

Matthew Crosby and Ronald P. A. Petrick. Temporal multi-agent planning with concurrent action constraints. In Alejandro Torreno Daniel Borrajo, Daniel L. Kovacs, editor, *Proceedings of the Distributed and Multi-Agent Planning workshop (ICAPS DMAP-2014). Collocated with ICAPS 2014*, pages 16–24, June 2014.

Patrick Eyerich, Robert Mattmüller, and Gabriele Röger. Using the context-enhanced additive heuristic for temporal and numeric planning, 2009.

Dana Nau, Malik Ghallab, and Paolo Traverso. *Automated Planning: Theory & Practice*. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 2004.