Plan Recognition – Dissertation Abstract

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Abstract

The topic of the dissertation is plan recognition. Plan recognition is the task of recognizing the goal of an agent based on the observed actions. The aim of the current research is to develop an efficient approach to plan recognition in hierarchical task networks (HTN). We intend to improve the performance of existing parsing-based approach by heuristics based on landmarks.

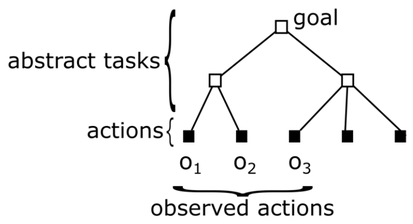
Motivation and related work

Currently there appear to be only two approaches to recognition of hierarchical plans. The first of these approaches is based on compilation to HTN planning (Höller et al. 2018). The second approach (Barták, Maillard, and Cardoso 2020) was inspired by parsing of grammars. As the approach of (Barták, Maillard, and Cardoso 2020) performs worse than the approach of (Höller et al. 2018) on instances with a high number of missing (unobserved) actions, we intend to modify the parsing-based approach to achieve a better performance.

Problem definition

An HTN plan recognition problem is defined as R = (F, C, A, M, s_0, O, G):

- F: set of fluents,
- C: set of compound tasks,
- A: set of actions,
- M: set of decomposition methods,
- s_0: initial state,
- O = <o_1, …, o_k>: observed plan prefix,
- G: set of possible goals.



The aim of plan recognition is to decide whether there is a goal g ∈ G and a sequence of actions <o_{k+1}, …,o_n> such that <o_1, …, o_n> is a valid plan for the goal g applicable in s_0.

Our approach

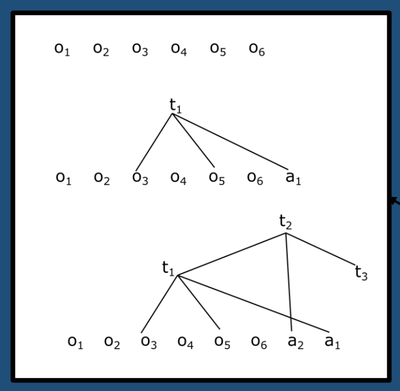
Our approach is based on the algorithm of (Barták, Maillard, and Cardoso 2020). They use decomposition methods to compose abstract tasks from available tasks until all observations are covered. This approach requires that all subtasks of a method are available in a plan. We want to improve this approach by applying methods some of whose subtasks are not yet available in a plan. Implementation of our approach is currently in progress.

Input: a sequence of observed actions
Output: a corresponding goal task
Variables: S – a set of partial plans, app_P for each partial plan P – a set of all methods applicable to P

1: P_0 = initial partial plan containing observed actions
2: $S = \{P_0\}$
3: **while** true **do**
4: $P = argmax_{P \in S} max\{h(m, P) | m \in app_P\}$
5: $m = argmax_m\{h(m, P) | m \in app_P\}$
6: **for all** possible applications of m to P **do**
7: P_1 = apply m to P
8: **if** P_1 is consistent with all conditions **then**
9: **if** P_1 covers all observations and a valid plan can be generated from P_1 **then**
10: **return** the root task of P_1
11: **else**
12: add P_1 to S
13: **end if**
14: **end if**
15: **end for**
16: **end while**

We choose the pair (P, m) of a partial plan P and a method m, which has the highest heuristic value. Our heuristic depends on the number of landmarks of the method m achieved in the plan P. A landmark of m is a fluent, an action, an abstract task, or another method, which must appear in each plan whose root task was decomposed using the method m. For extracting landmarks of methods, we use the algorithm proposed by (Höller and Bercher 2021).

The root task of a partial plan is a goal if all observed actions are covered in its decomposition tree and the new tasks after the plan can be ordered and decomposed to create a valid plan. For validation of the latter condition, we need to call an HTN planner to decompose the new abstract tasks.



A new partial plan is created by applying a decomposition method to an existing partial plan. A decomposition method may add new tasks after the sequence of observations.

References

Barták, R.; Maillard, A.; and Cardoso, R. C. 2020. Parsing-based Approaches for Verification and Recognition of Hierarchical Plans. In Plan, activity and intent recognition workshop at the thirty-fourth AAAI Conference on Artificial Intelligence.

Höller, D.; Behnke, G.; Bercher, P.; and Biundo, S. 2018. Plan and goal recognition as HTN planning. In 2018 IEEE Thirtieth International Conference on Tools with Artificial Intelligence, 466–473.

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