

# Accepted Manuscript

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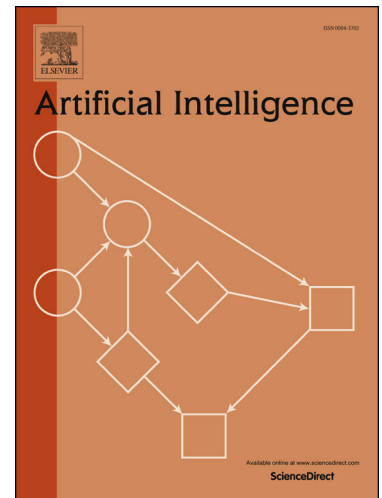
PII: S0004-3702(18)30110-3  
DOI: <https://doi.org/10.1016/j.artint.2018.03.006>  
Reference: ARTINT 3064

To appear in: *Artificial Intelligence*

Received date: 8 November 2016  
Revised date: 9 March 2018  
Accepted date: 20 March 2018

Please cite this article in press as: R. Mirsky et al., Sequential plan recognition: An iterative approach to disambiguating between hypotheses, *Artif. Intell.* (2018), <https://doi.org/10.1016/j.artint.2018.03.006>

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# Sequential Plan Recognition: An Iterative Approach to Disambiguating Between Hypotheses

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## Abstract

Plan recognition algorithms output hypotheses about an agent's plans from its observed actions. Due to imperfect knowledge about the agent's behavior and the environment, it is often the case that there are multiple hypotheses about an agent's plans that are consistent with the observations, though only one of these hypotheses is correct. This paper addresses the problem of how to disambiguate between hypotheses during the recognition process, by querying the acting agent about whether a given plan is part of the correct hypothesis. The main contribution is a sound and complete process for reducing the set of possible hypotheses called Sequential Plan Recognition (SPR). SPR iteratively queries the user and revises the set of possible hypotheses according to the outcome of the query. Several policies are provided for choosing which plans to query the agent. These policies address the problem of how to reduce the number of hypotheses during the recognition process using a minimal number of queries. The proposed policies include policies that use maximum likelihood and information gain measures.

The paper provides a complexity analysis of the SPR process and the proposed query policies. It demonstrates its efficiency on two known domains from the literature, describing how performance and runtime are affected by features in the domain. Our results can inform the design of future plan recognition systems that interleave the recognition process with intelligent interventions of their users.

## 1 Introduction

Plan recognition (PR), the task of inferring agents' plans based on their observed actions, is a fundamental problem in AI, with a broad range of applications, such as inferring transportation routines [Liao et al., 2007], advising in health care [Allen et al., 2006], or recognizing users' activities in gaming and educational software [Harpstead et al., 2013, Uzan et al., 2013].

A hypothesis is a set of plans that explain an agent's intended activities. Ideally, the output of a PR algorithm is a single hypothesis that explains the

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