Technische Universität Dresden • Fakultät Informatik

Titel der Arbeit

Bachelorarbeit zur Erlangung des ersten Hochschulgrades

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Abstract

Lorem ipsum

1 Introduction

2 Preliminaries

2.1 Transition Systems

Motivation of transition systems

The following definition is directly taken form Principles of Modelchecking, Baier p. 20

Definition 2.1. A *transition system* TS is a tuple $(S, Act, \longrightarrow, I, AP, L)$ where

- S is a set of states,
- Act is a set of actions,
- $\longrightarrow \subseteq S \times Act \times S$ is transition relation,
- $I \subseteq S$ is a set of initial states,
- AP is a set of atomic propositions, and
- $L : S \rightarrow \mathcal{P}(AP)$

A transition system is called *finite* if S, AP and L are finite.

2.2 Markov Chain

2.3 Markov Decision Process

3 View

Views are the central objective of this thesis. The purpose of a viewis to obtain a simplification of a given transition system (TS). It is an independend TS derived from a given TS and represents a (simpliefied) viewon the given one - hence the name. Thereby the original TS is retained.

3.1 Grouping Function

The conceptional idea of a viewis to group states by some criteria and structure the rest of the system accordingly. To formalize the grouping we define a dedicated function.

Definition 3.1. Let $\mathrm{TS} = (S, Act, \longrightarrow, I, AP, L)$ be a transition system. We call any function $F : S \to \mathbb{N}$ a *grouping function.*

Two states are grouped to a new state if and only if the grouping function maps them to the same value. The definition offers an easy way of defining groups of states and labels them with a natural number. It is also very close to the actual implementation later on. The exact mapping depends on the desired grouping. In order to define a new set of states for the view, we define an equivalence relation R based on a given grouping function F.

Definition 3.2. Let F be a grouping function. We define the equivalence relation $R := \{(s_1, s_2) \in S \times S \mid F(s_1) = F(s_2)\}$

R is an equivalence relation because the equality relation is one. The property directly conveys to R. We observe that two states s_1, s_2 are grouped to a new state if and only if $(s_1, s_2) \in R$. This is if and only if the case when $s_1, s_2 \in [s_1]_R = [s_2]_R$ where $[s_i]_R$ denotes the equivalence class of R.

3.2 Formal Definition

The definition of a viewis dependend on a given transition system and a grouping function F. We derive the equivalnce relation R as in Definition 3.2 and use its equivalence classes $[s]_R$ as states for the view. The rest of the transition system is structured accordingly.

Definition 3.3. Let $\mathrm{TS} = (S, Act, \longrightarrow, I, AP, L)$ be a transition system and F a grouping function. A *view* is a transition system $(S', Act', \longrightarrow', I', L')$ that is derived from TS where

- $S' = \{[s]_R \mid s \in S\}$ where R is an equivilance relation according to Defintion 3.2,
- $Act' = Act$
- $\longrightarrow' = \{([s_1]_R, \alpha, [s_2]_R) \mid \exists s_1 \in [s_1]_R \exists s_2 \in [s_2]_R : ([s_1]_R, \alpha, [s_2]_R) \in \longrightarrow\}$
- $I' = \{[s']_R \in S' \mid \exists s \in [s']_R : s \in I\}$

- $L' : S' \to \mathcal{P}(AP), [s]_R \mapsto \bigcup_{s \in [s]_R} \{L(s)\}$

Note that the definition is in a most general form in the sense that if in a viewa property accounts to one part of some entity the whole entity recieves the property i.e.

- $(s_1, \alpha, s_2) \in \longrightarrow \;\; \Rightarrow \;\; ([s_1]_R, \alpha, [s_2]_R) \in \longrightarrow'$
- $s \in I \;\; \Rightarrow \;\; [s]_R \in I'$
- $\forall s \in S : L(s) \in L'([s]_R)$

4 View Examples

4.1 Transition Systems

4.2 Markov Chain

4.3 Markov Decision Process

4.4 Comparison of the Examples

5 Outlook

References