MASARYK UNIVERSITY
FACULTY OF INFORMATICS

# Parameter Synthesis from Hypotheses Formulable in CTL Logic

BACHELOR THESIS

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# Declaration

Hereby I declare, that this paper is my original authorial work, which I have worked out by my own. All sources, references and literature used or excerpted during elaboration of this work are properly cited and listed in complete reference to the due source.

Samuel Pastva

**Advisor:** John Foo, Ph.D.

# Acknowledgement

I would like to thank my supervisor . . .

# Abstract

The aim of the bachelor work is to provide . . .

# Keywords

keyword1, keyword2 . . .

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# 1 Introduction

Lorem Ipsum [?]

# 2 Algorithm

In this chapter, we describe the distributed algorithm that computes the assumption function $\mathcal{A}$. We assume a distributed environment with fixed number of reliable processes connected by reliable, order-preserving channels (The order preservation can be relaxed to some extent). We also assume that each process has a fixed identifier and the set of all process identifiers equals the result set of the partition function.

## 2.1 Algorithm outline

The main idea of the algorithm is described in REFERENCE and resembles other CTL model checking algorithms.

**procedure** CHECKCTL($\phi, \mathcal{K} = (id, f, \mathcal{P}, S, I, \xrightarrow{p}, L)$)<br>
    $\mathcal{A} \leftarrow \{(p, s, \alpha) \mid p \in \mathcal{P} \wedge \alpha \in L(s)\}$<br>
    **for all** $i < |\phi|$ **do**<br>
        **for all** $\psi$ **in** $cl(\phi)$ **where** $|\psi| = i$ **do**<br>
            $\mathcal{A} \leftarrow$ CHECKFORMULA($\psi, \mathcal{K}, \mathcal{A}$)<br>
        **end for**<br>
    **end for**<br>
**end procedure**

The algorithm starts by initializing the assumption function with atomic propositions.

## 2.2 Common operations

In this section, we define functions used to simplify the algorithm description. Let us fix a formula $\phi$ and a parametrised kripke fragment $\mathcal{K} = (id, f, \mathcal{P}, S, I, \xrightarrow{p}, L)$ as input of the algorithm.

Intuitively, function $validStates : cl(\phi) \times AS^{\phi}_{\mathcal{K}} \rightarrow S \times 2^{\mathcal{P}}$ computes a set of states and parameters where truth of given formula is assumed.

$$validStates(\phi, \mathcal{A}) = \{(s, p) \mid \mathcal{A}(s, p, \phi) = \mathtt{tt}\}$$

Function *predecessors* : $S \rightarrow S \times 2^{\mathcal{P}}$ computes set of direct predecessors of given node including the color sets labeling the appropriate transitions.

$$predecessors(to) = \{(from, P) \mid P = \{p \mid from \xrightarrow{p} to\}\}$$

Symmetrically, function *successors* : $S \rightarrow S \times 2^{\mathcal{P}}$ computes set of direct successors of given node including the color sets labeling the appropriate transitions.

$$predecessors(from) = \{(to, P) \mid P = \{p \mid from \xrightarrow{p} to\}\}$$

## 2.3 Exist Next Operator

**Process variables:**
$\mathcal{K} = (id, f, \mathcal{P}, S, I, \xrightarrow{p}, L)$ ▷ Kripke fragment
$\phi = \mathrm{EX}\phi_1$ ▷ CTL formula
$\mathcal{A}$ ▷ Initial assumption function
**procedure** INIT
    **for all** *state* **in** $validStates(\phi_1, \mathcal{A}, \mathcal{K})$ **do**
        **for all** $(pred, tranCol)$ **in** $predecessors(state, \mathcal{K})$ **do**
            SEND$(f(state), (pred, \mathcal{P} \cup tranCol))$
        **end for**
    **end for**
**end procedure**
**procedure** RECEIVE$(colSet, to)$
    $\mathcal{A} \leftarrow \mathcal{A} \cup \{(p, to, \phi) \mid p \in colSet\}$
**end procedure**

## 2.4 Exist Until Operator

**Process variables:**
$\mathcal{K} = (id, f, \mathcal{P}, S, I, \xrightarrow{p}, L)$ ▷ Kripke fragment
$\phi = \mathrm{E}\phi_1\mathrm{U}\phi_2$ ▷ CTL formula
$\mathcal{A}$ ▷ Initial assumption function
**procedure** INIT
    **for all** *state* **in** $validStates(\phi_2, \mathcal{A}, \mathcal{K})$ **do**

$\mathcal{A} \leftarrow \mathcal{A} \cup (\mathcal{P}, state, \phi)$
**for all** $(pred, tranCol)$ **in** $predecessors(state, \mathcal{K})$ **do**
SEND$(f(state), (state, pred, \mathcal{P} \cup tranCol))$
**end for**
**end for**
**end procedure**
**procedure** RECEIVE$(colSet, from, to)$
$colSet \leftarrow colSet \cap valid(\phi_1, to, \mathcal{A})$
**if** $colSet \neq \emptyset$ **and** $colSet \setminus valid(\phi, to, \mathcal{A}) \neq \emptyset$ **then**
$\mathcal{A} \leftarrow \mathcal{A} \cup (colSat, to, \phi)$
**for all** $(pred, tranCol)$ **in** $predecessors(to, \mathcal{K})$ **do**
SEND$(f(pred), (to, pred, colSat \cup tranCol))$
**end for**
**end if**
**end procedure**

## 2.5 All Until Operator

**Process variables:**
$\mathcal{K} = (id, f, \mathcal{P}, S, I, \xrightarrow{p}, L)$ ▷ Kripke fragment
$\phi = \mathrm{A}\phi_1\mathrm{U}\phi_2$ ▷ CTL formula
$S = \emptyset$
$\mathcal{A}$ ▷ Initial assumption function
**procedure** INIT
**for all** $state$ **in** $validStates(\phi_2, \mathcal{K})$ **do**
**for all** $(pred, tranCol)$ **in** $predecessors(state, \mathcal{K})$ **do**
SEND$(f(state), (state, pred, \mathcal{P} \cup tranCol))$
**end for**
**end for**
**end procedure**
**procedure** RECEIVE$(colSet, from, to)$
$S \leftarrow S \cup (to, from, colSet)$
$colSet \leftarrow colSet \cap valid(\phi_1, to, \mathcal{K})$
**if** $colSet \neq \emptyset$ **and** $colSet \setminus valid(\phi, to, \mathcal{K}) \neq \emptyset$ **then**
$\mathcal{A} \leftarrow \mathcal{A} \cup (colSat, to, \phi)$
**for all** $(pred, tranCol)$ **in** $predecessors(to, \mathcal{K})$ **do**
SEND$(f(pred), (to, pred, colSat \cup tranCol))$

```
        end for
    end if
end procedure
```

# A First appendix

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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# B Another appendix

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