

# NuSMV-ARCTL-TLACE – User manual

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This document is a short user manual about the generation of TLACEs (tree-like annotated counter-examples) using the modified version of NuSMV-ARCTL: NuSMV-ARCTL-TLACE.

Two options has been added to NuSMV to activate the generation of TLACEs. These are the following

```
-tlaces tl      sets tlaces explanation level to "tl",  
                value is used as bitmask  
                (1: disjunctions and conjunctions; 2: eu; 4: eg, 8: activate)  
-otlaces file   prints counter-example to file "file"
```

The **tlaces** option activates the generation of TLACEs. When this option is set to a value different from 0, the check of a CTL specification on a model leads to the execution of a new algorithm generating and displaying a TLACE if the specification is not satisfied. The value of the **tlaces** option works as a bitmask. If **tlaces**  $\wedge 1 \neq 0$ , the disjunctions and conjunctions will be explained as branches; otherwise, only one of the two possible branches will be generated. If **tlaces**  $\wedge 2 \neq 0$ , the **EU** operators will be explained: when a path explaining why a **E** $[\phi_1 \mathbf{U} \phi_2]$  specification is generated, each intermediate state satisfying  $\phi_1$  will lead to the generation of a branch starting at this state and explaining why this state satisfy  $\phi_1$ ; otherwise, only the path will be extended to explain why the last state satisfies  $\phi_2$ . If **tlaces**  $\wedge 4 \neq 0$ , the **EG** operators will be explained: when a path explaining why a **EG** $\phi$  specification is generated, each state of the path will be the start of a new branch explaining why this state satisfies  $\phi$ ; otherwise, the path explaining why **EG** $\phi$  is satisfied will be generated, but not the other branches. Finally, if **tlaces**  $\neq 0$ , a TLACE will be generated, in an XML format; otherwise, the standard behaviour of NuSMV will be use. The XML format of TLACEs can be described by the following context-free grammar

```

XML      ::= <?xml version="1.0" encoding="UTF-8"?>
           CNTEX
CNTEX    ::= <counterexample specification="SPEC">
           FIRSTNODE
           BRANCH
           </counterexample>
BRANCH   ::= | NODE
           BRANCH
FIRSTNODE ::= <node>
           STATE
           ANNOTATION
           BRANCHES
           </node>
NODE     ::= <node>
           <combinatorial>
           VALUES
           </combinatorial>
           <input>
           VALUES
           </input>
           STATEORLOOP
           </node>
STATEORLOOP ::= LOOP |
           STATE
           ANNOTATION
           BRANCHES
STATE      ::= <state id="ID">
           VALUES
           </state>
LOOP      ::= <loop to="ID" />
BRANCHES  ::= | <branch specification="SPEC">
           BRANCH
           </branch>
ANNOTATION ::= <annotation>
           SPEC
           </annotation>
VALUES    ::= | VALUE
           VALUES
VALUE     ::= <value variable="NAME">VAL</value>
SPEC      ::= | SPECIFICATION

```

This option can also be activated in the interactive mode of NuSMV by changing the value of the `tlaces_explain_level` variable using appropriate commands.

The second option, `otlaces`, defines the output file. When this option is used, its value becomes the path to the output file in which the generated TLACE will be printed. If the `tlaces` option is not specified (and then not activated), the `otlaces` option has no effect. This option can also be modified in the interactive mode of NuSMV by changing the value of the `output_tlaces_file` variable using appropriate commands.