

## APPENDIX A: TOOL VS PREDICTION

This Appendix contains an in-depth analysis of each of the 34 experiments used in the Evaluation section of the paper “Search-based Trace Diagnostic” by G. Araujo, R. Caldas, F. Formica, G. Rodrigues, P. Pelliccione, C. Menghi, 2024.

First, in Table 1 we present the precision and recall values as a summary of all experiments. Then, in **Experiment 1 - 34** we report the requirement in HLS, the range of acceptable values for the mutated terms, and the prediction. Finally, we analyze the experiment results, comparing the generated diagnostic with the prediction.

All the Decision Trees are available as png files in the Replication Package<sup>1</sup>.

ID	Experiment	Precision	Recall	Experiment	Precision	Recall
AT1	<i>exp1</i>	100.0%	100.0%	<i>exp2</i>	98.6%	97.6%
AT2	<i>exp3</i>	100.0%	100.0%	<i>exp4</i>	98.9%	100.0%
AT51	<i>exp5</i>	100.0%	100.0%	<i>exp6</i>	100.0%	100.0%
AT52	<i>exp7</i>	100.0%	100.0%	<i>exp8</i>	100.0%	100.0%
AT53	<i>exp9</i>	100.0%	100.0%	<i>exp10</i>	100.0%	100.0%
AT54	<i>exp11</i>	100.0%	97.3%	<i>exp12</i>	100.0%	98.1%
AT6a	<i>exp13</i>	100.0%	98.8%	<i>exp14</i>	96.5%	94.9%
AT6b	<i>exp15</i>	98.0%	98.7%	<i>exp16</i>	90.2%	92.8%
AT6c	<i>exp17</i>	100.0%	96.7%	<i>exp18</i>	95.9%	70.1%
AT6abc	<i>exp19</i>	100.0%	96.7%	<i>exp20</i>	97.2%	67.9%
CC1	<i>exp21</i>	100.0%	100.0%	<i>exp22</i>	99.4%	100.0%
CC2	<i>exp23</i>	100.0%	100.0%	<i>exp24</i>	94.4%	94.2%
CC3	<i>exp25</i>	–	–	<i>exp26</i>	100.0%	66.7%
CC4	<i>exp27</i>	100.0%	93.8%	<i>exp28</i>	99.6%	71.2%
CC5	<i>exp29</i>	96.4%	54.6%	<i>exp30</i>	99.3%	95.8%
CCx	<i>exp31</i>	100.0%	100.0%	<i>exp32</i>	99.9%	97.7%
RR	<i>exp33</i>	100.0%	76.2%	<i>exp34</i>	99.4%	100.0%

TABLE 1: Precision and Recall values for Experiments 1-34

1. <https://github.com/Gastd/ga-hls>

## Experiment 1

Requirement:

**forall**  $\tau_0$  **in**  $[0, 20]$  **such that**  $v@t(\tau_0) \leq \text{Num2}$

Range:

$\text{Num2} = \text{AT1}(120) \in [100, 140]\text{mph}$ .

Prediction:

- If  $\text{Num2} \leq 120.022620\text{mph}$ , then the requirement is falsified.
- If  $\text{Num2} > 120.022620\text{mph}$ , then the requirement is satisfied.

Diagnosis:

Figure 1 reports the diagnosis produced by `Diagnosis`.

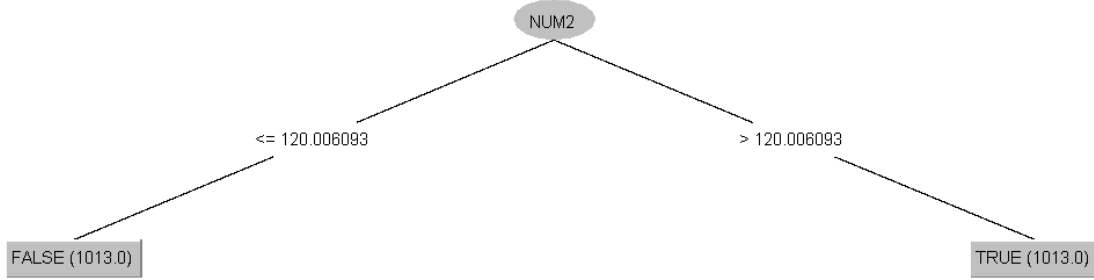


Fig. 1: Decision tree for requirement AT1 in experiment 1.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 2

Requirement:

**forall**  $\tau_0$  in [Num0, Num1] **such that**  $v@t(\tau_0) \leq$  Num2

Range:

Num0 = AT1(0)  $\in [0, 10]$ s,

Num1 = AT1(20)  $\in [10, 30]$ s,

Num2 = AT1(120)  $\in [100, 140]$ mph.

Prediction:

- Num0 does not affect the requirement satisfiability.
- Num1 and Num2 are not independent. The requirement satisfaction depends on the position of (Num1, Num2) with respect to the trace.
  - Below the trace, the requirement is mostly falsified.
  - Above the trace, the requirement is mostly satisfied.

Diagnosis:

Figure 2 reports the diagnosis produced by Diagnosis.

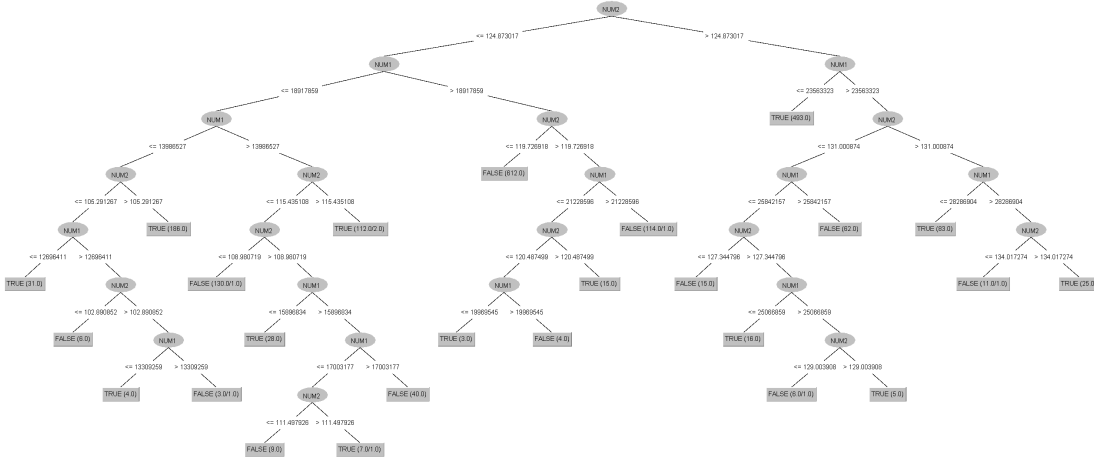
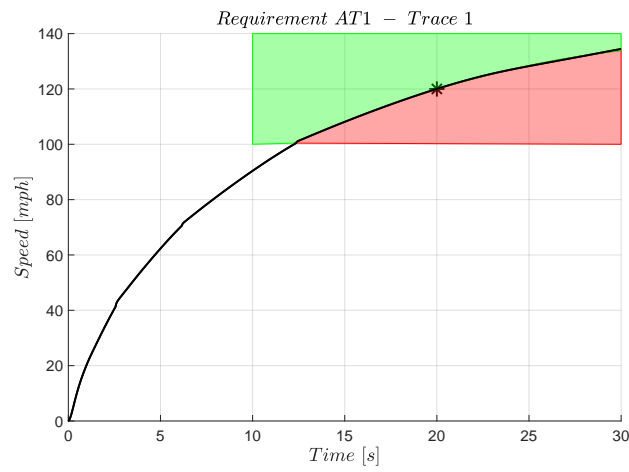


Fig. 2: Decision tree for requirement AT1 in experiment 2.

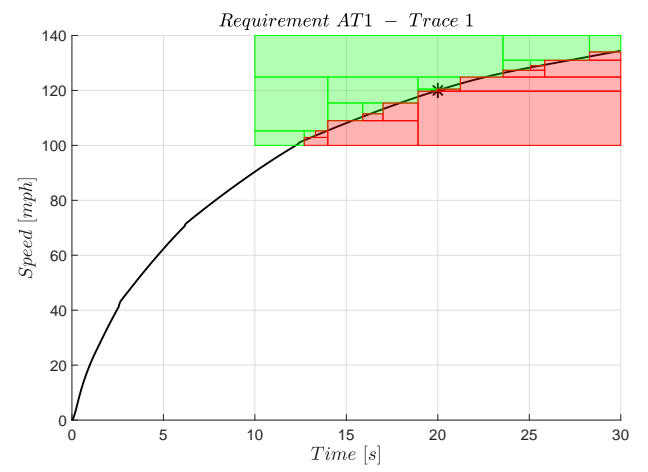
Discussion:

The decision tree produced by the tool tries to approximate the relation between Num1 and Num2 as shown in Figure 3a. Figure 3b shows the relation between Num1 and Num2 estimated by the tool, where the green area represents the satisfiability region, while the red one is the falsified one. The tool correctly identifies that Num0 is not relevant in this case.

The approximation is quite good, as the precision and recall are respectively 98.6% and 97.6%.



(a) Prediction for requirement AT1 in experiment 2.



(b) Tool result for requirement AT1 in experiment 2.

Fig. 3: Comparison between tool results and prediction for experiment 2.

### Experiment 3

Requirement:

**forall**  $\tau_0$  **in**  $[0,10]$  **such that**  $\omega@t(\tau_0) \leq \text{Num2}$ .

Range:

$\text{Num2} = \text{AT2}(4750) \in [4700, 4800]\text{rpm}$ .

Prediction:

- If  $\text{Num2} \leq 4754.401200\text{rpm}$ , then the requirement is falsified.
- If  $\text{Num2} > 4754.401200\text{rpm}$ , then the requirement is satisfied.

Diagnosis:

Figure 4 reports the diagnosis produced by `Diagnosis`.

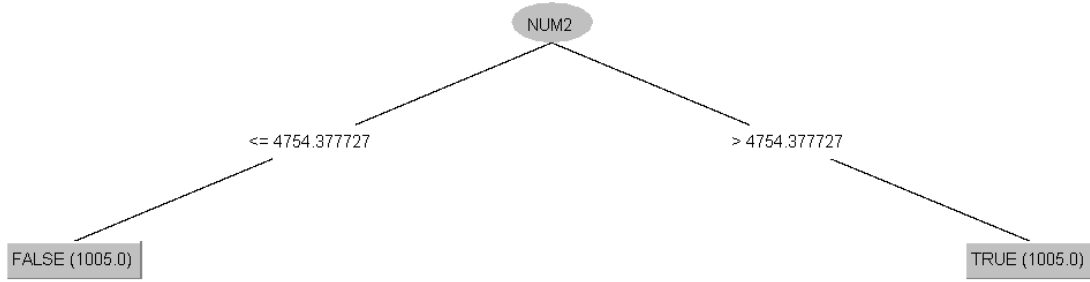


Fig. 4: Decision tree for requirement AT2 in experiment 3.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 4

Requirement:

**forall**  $\tau_0$  **in** [ Num0, Num1 ] **such that**  $\omega_{@t}(\tau_0) \leq$  Num2 .

Range:

Num0 = AT2( 0 )  $\in [0, 5]$ s,

Num1 = AT2( 10 )  $\in [5, 15]$ s,

Num2 = AT2( 4750 )  $\in [4700, 4800]$ rpm.

Prediction:

- Num0 does not affect the requirement satisfiability.
- If Num1  $\leq 7.1$ s, then the requirement is mostly satisfied.
- If Num1  $> 7.1$ s, then the requirement satisfiability depends on Num2:
  - If Num2  $\leq 4754.4$ rpm, then the requirement is mostly falsified.
  - If Num2  $> 4754.4$ rpm, then the requirement is mostly satisfied.

Diagnosis:

Figure 5 reports the diagnosis produced by Diagnosis.

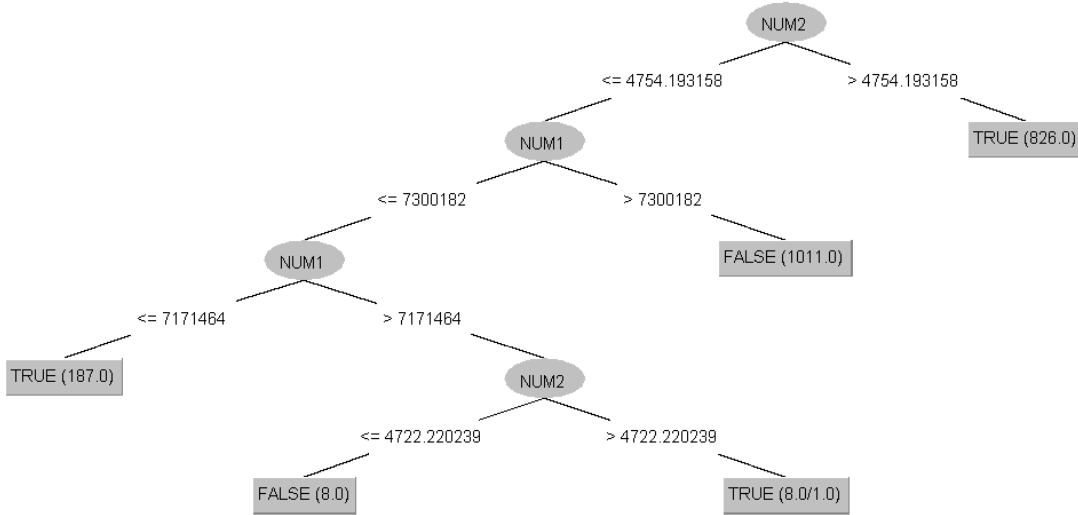
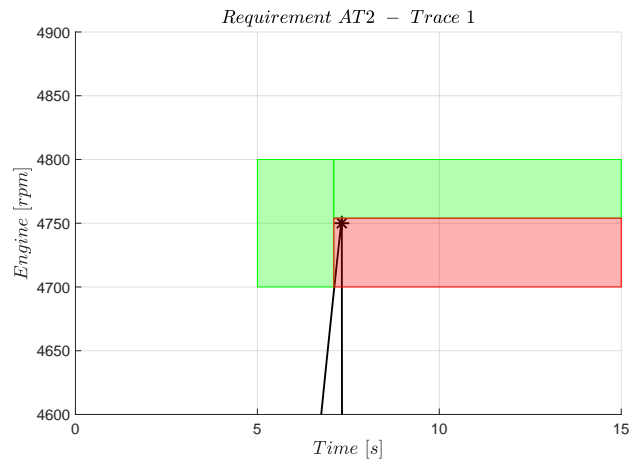


Fig. 5: Decision tree for requirement AT2 in experiment 4.

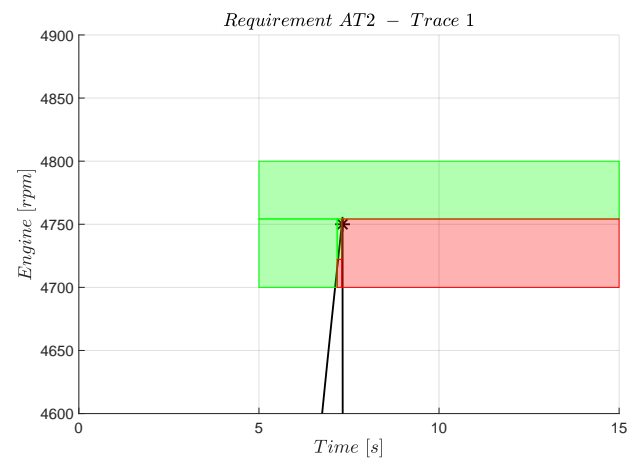
Discussion:

The decision tree produced by the tool matches approximatively the prediction: the engine speed threshold is 4754rpm in both cases, while the time threshold is 7.2s for the tool and 7.1s for the prediction. Even if the prediction and the tool return different priorities for Num0 and Num1, they identify the same region of satisfiability, as shown in Figure 6a and Figure 6b. The tool correctly identifies that Num0 is not relevant in this case.

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 98.9% and 100.0%.



(a) Prediction for requirement AT2 in experiment 4.



(b) Tool result for requirement AT2 in experiment 4.

Fig. 6: Comparison between tool results and prediction for experiment 4.

## Experiment 5

Requirement:

**forall**  $\sigma_0$  **in**  $[t2i(0)+1, t2i(30)]$  **such that**  $((gear@i(\sigma_0-1) \neq 1) \text{ and } (gear@i(\sigma_0) = 1))$  **implies** ( **forall**  $\tau_0$  **in**  $[i2t(\sigma_0), i2t(\sigma_0) + Num6]$  **such that**  $(gear@t(\tau_0) = 1)$  )

Range:

$Num6 = AT51(2.5) \in [0, 5]s$ .

Prediction:

- If  $Num6 \leq 1.65s$ , then the requirement is satisfied.
- If  $Num6 > 1.65s$ , then the requirement is falsified.

Diagnosis:

Figure 7 reports the diagnosis produced by `Diagnosis`.

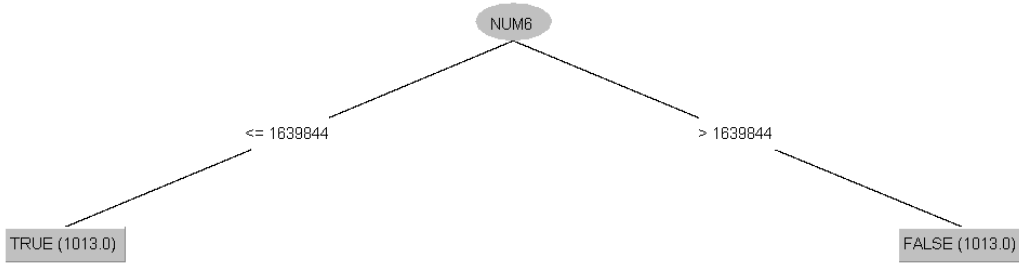


Fig. 7: Decision tree for requirement AT51 in experiment 5.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.



## Experiment 6

Requirement:

**forall**  $\sigma_0$  **in** [**t2i**(Num0)+1,**t2i**(Num2)] **such that** ((gear@i( $\sigma_0$ -1)  $\neq$  1) **and** (gear@i( $\sigma_0$ ) = 1)) **implies** ( **forall**  $\tau_0$  **in** [**i2t**( $\sigma_0$ ), **i2t**( $\sigma_0$ )+Num6] **such that** (gear @t( $\tau_0$ ) = 1 ))

Range:

Num0 = AT51( 0 )  $\in$  [0, 15]s,

Num2 = AT51( 30 )  $\in$  [15, 45]s,

Num6 = AT51( 2.5 )  $\in$  [0, 5]s.

Prediction:

- Num2 does not affect the requirement satisfiability.
- If Num0  $\leq$  7.23s, then the requirement satisfiability depends on Num6:
  - If Num6  $\leq$  1.65s, then the requirement is mostly satisfied.
  - If Num6  $>$  1.65s, then the requirement is mostly falsified.
- If Num0  $>$  7.23s, then the requirement is mostly satisfied.

Diagnosis:

Figure 8 reports the diagnosis produced by Diagnosis.

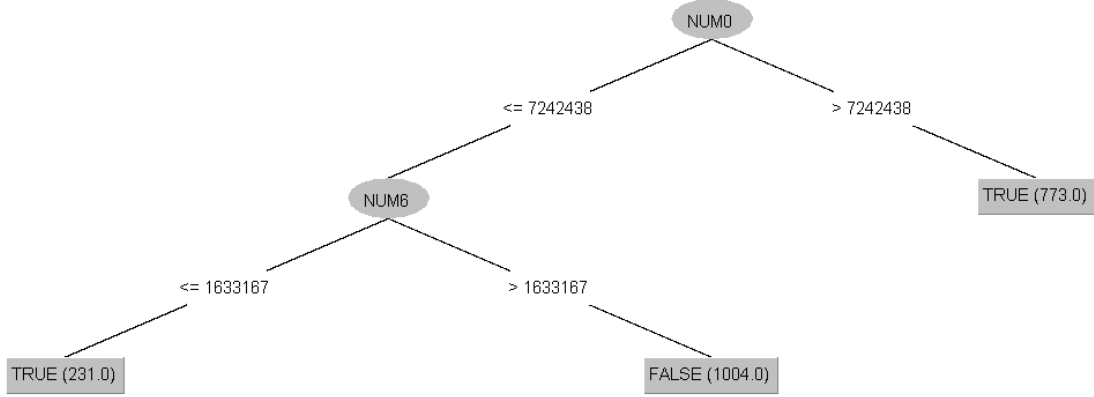


Fig. 8: Decision tree for requirement AT51 in experiment 6.

Discussion:

The tool correctly identifies that Num2 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 7

Requirement:

**forall**  $\sigma_0$  **in**  $[t2i(0)+1, t2i(30)]$  **such that**  $((gear@i(\sigma_0-1) \neq 2) \text{ and } (gear@i(\sigma_0) = 2))$  **implies** ( **forall**  $\tau_0$  **in**  $[i2t(\sigma_0), i2t(\sigma_0) + Num6]$  **such that**  $(gear@t(\tau_0) = 2)$  )

Range:

$Num6 = AT52(2.5) \in [0, 5]s.$

Prediction:

- If  $Num6 \leq 1.20s$ , then the requirement is satisfied.
- If  $Num6 > 1.20s$ , then the requirement is falsified.

Diagnosis:

Figure 9 reports the diagnosis produced by `Diagnosis`.

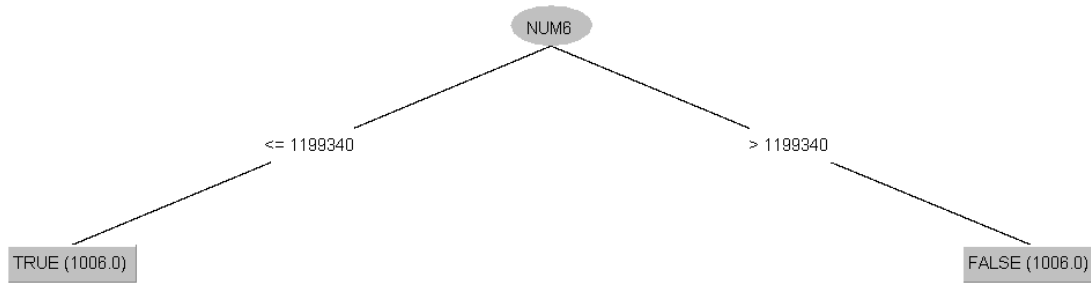


Fig. 9: Decision tree for requirement AT52 in experiment 7.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 8

Requirement:

**forall**  $\sigma_0$  **in** [**t2i**(Num0)+1,**t2i**(Num2)] **such that** ((gear@i( $\sigma_0$ -1)  $\neq$  2) **and** (gear@i( $\sigma_0$ ) = 2)) **implies** ( **forall**  $\tau_0$  **in** [**i2t**( $\sigma_0$ ), **i2t**( $\sigma_0$ )+Num6] **such that** (gear @t( $\tau_0$ ) = 2 ))

Range:

Num0 = AT52( 0 )  $\in$  [0, 15]s,

Num2 = AT52( 30 )  $\in$  [15, 45]s,

Num6 = AT52( 2.5 )  $\in$  [0, 5]s.

Prediction:

- Num2 does not affect the requirement satisfiability.
- If Num0  $\leq$  1.76s, then the requirement satisfiability depends on Num5:
  - If Num6  $\leq$  1.20s, then the requirement is mostly satisfied.
  - If Num6  $>$  1.20s, then the requirement is mostly falsified.
- If Num0  $>$  1.76s, then the requirement is mostly satisfied.

Diagnosis:

Figure 10 reports the diagnosis produced by Diagnosis.

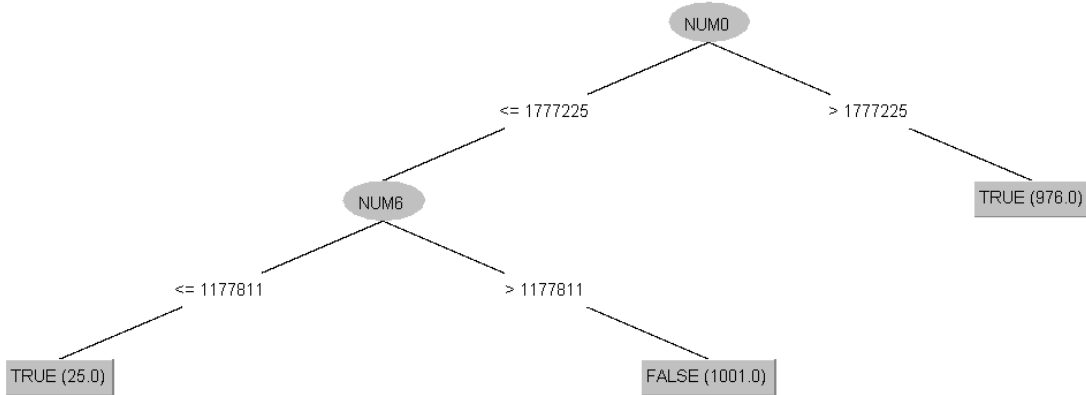


Fig. 10: Decision tree for requirement AT52 in experiment 8.

Discussion:

The tool correctly identifies that Num2 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 9

Requirement:

**forall**  $\sigma_0$  **in**  $[t2i(0)+1, t2i(30)]$  **such that**  $((gear@i(\sigma_0-1) \neq 3) \text{ and } (gear@i(\sigma_0) = 3))$  **implies** ( **forall**  $\tau_0$  **in**  $[i2t(\sigma_0), i2t(\sigma_0) + Num6]$  **such that**  $(gear@t(\tau_0) = 3)$  )

Range:

$Num6 = AT53(2.5) \in [0, 5]s.$

Prediction:

- If  $Num6 \leq 2.04s$ , then the requirement is satisfied.
- If  $Num6 > 2.04s$ , then the requirement is falsified.

Diagnosis:

Figure 11 reports the diagnosis produced by *Diagnosis*.

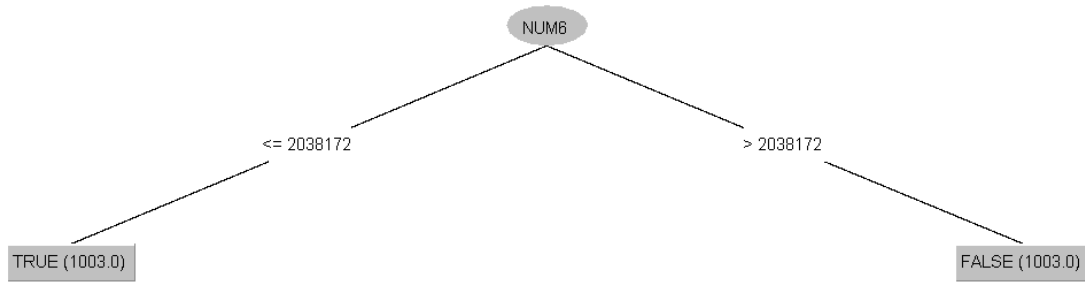


Fig. 11: Decision tree for requirement AT53 in experiment 9.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 10

Requirement:

**forall**  $\sigma_0$  **in** [**t2i**(Num0)+1,**t2i**(Num2)] **such that** ((gear@i( $\sigma_0$ -1)  $\neq$  3) **and** (gear@i( $\sigma_0$ ) = 3)) **implies** ( **forall**  $\tau_0$  **in** [**i2t**( $\sigma_0$ ), **i2t**( $\sigma_0$ )+Num6] **such that** (gear @t( $\tau_0$ ) = 3 ))

Range:

Num0 = AT53( 0 )  $\in [0, 15]$ s,

Num2 = AT53( 30 )  $\in [15, 45]$ s,

Num6 = AT53( 2.5 )  $\in [0, 5]$ s.

Prediction:

- Num0 does not affect the requirement satisfiability.
- If Num2  $\leq 18.48$ s, then the requirement is mostly satisfied.
- If Num2  $> 18.48$ s, then the requirement satisfiability depends on Num5:
  - If Num6  $\leq 2.04$ s, then the requirement is mostly satisfied.
  - If Num6  $> 2.04$ s, then the requirement is mostly falsified.

Diagnosis:

Figure 12 reports the diagnosis produced by Diagnosis.

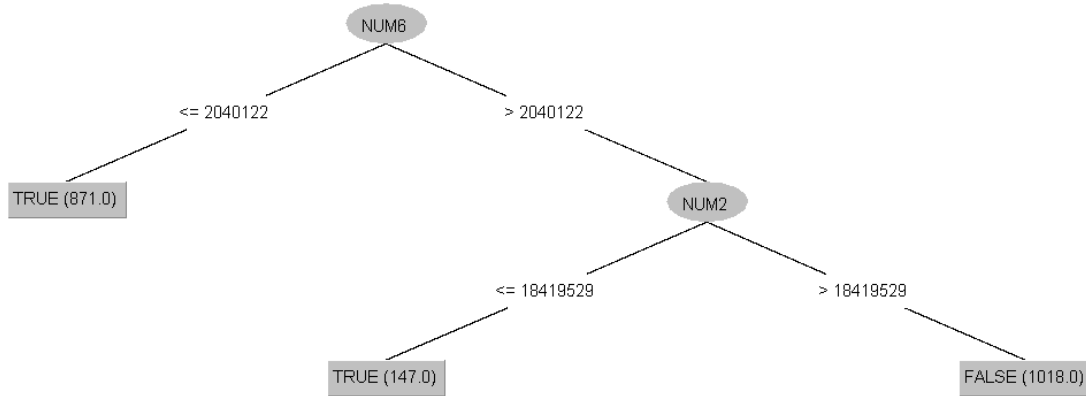


Fig. 12: Decision tree for requirement AT53 in experiment 10.

Discussion:

The tool correctly identifies that Num0 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 11

Requirement:

**forall**  $\sigma_0$  **in**  $[t2i(0)+1, t2i(30)]$  **such that**  $((gear@i(\sigma_0-1) \neq 4) \text{ and } (gear@i(\sigma_0) = 4))$  **implies** ( **forall**  $\tau_0$  **in**  $[i2t(\sigma_0), i2t(\sigma_0) + Num6]$  **such that**  $(gear@t(\tau_0) = 4)$  )

Range:

$Num6 = AT54(2.5) \in [0, 5]s.$

Prediction:

- If  $Num6 \leq 1.80s$ , then the requirement is satisfied.
- If  $Num6 > 1.80s$ , then the requirement is falsified.

Diagnosis:

Figure 13 reports the diagnosis produced by *Diagnosis*.

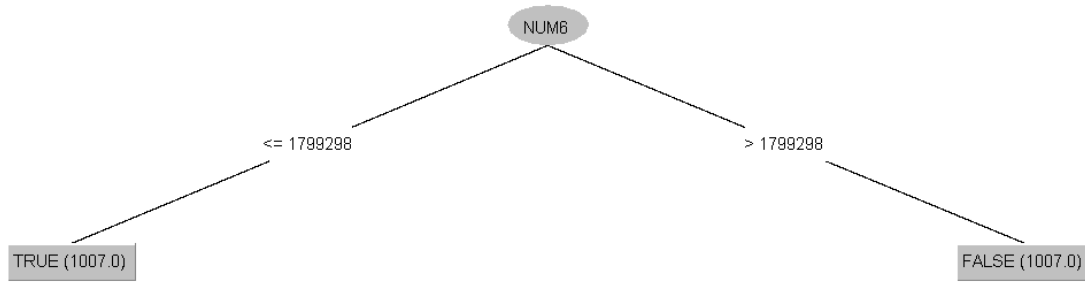


Fig. 13: Decision tree for requirement AT54 in experiment 11.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 97.3%.

## Experiment 12

Requirement:

**forall**  $\sigma_0$  **in** [**t2i**(Num0)+1,**t2i**(Num2)] **such that** ((gear@i( $\sigma_0$ -1)  $\neq$  4) **and** (gear@i( $\sigma_0$ ) = 4)) **implies** ( **forall**  $\tau_0$  **in** [**i2t**( $\sigma_0$ ), **i2t**( $\sigma_0$ )+Num6] **such that** (gear @t( $\tau_0$ ) = 4 ))

Range:

Num0 = AT54( 0 )  $\in$  [0, 15]s,

Num2 = AT54( 30 )  $\in$  [15, 45]s,

Num6 = AT54( 2.5 )  $\in$  [0, 5]s.

Prediction:

- Num0 does not affect the requirement satisfiability.
- If Num2  $\leq$  18.84s, then the requirement is mostly satisfied.
- If Num2 > 18.84s, then the requirement satisfiability depends on Num5:
  - If Num6  $\leq$  1.80s, then the requirement is mostly satisfied.
  - If Num6 > 1.80s, then the requirement is mostly falsified.

Diagnosis:

Figure 14 reports the diagnosis produced by Diagnosis.

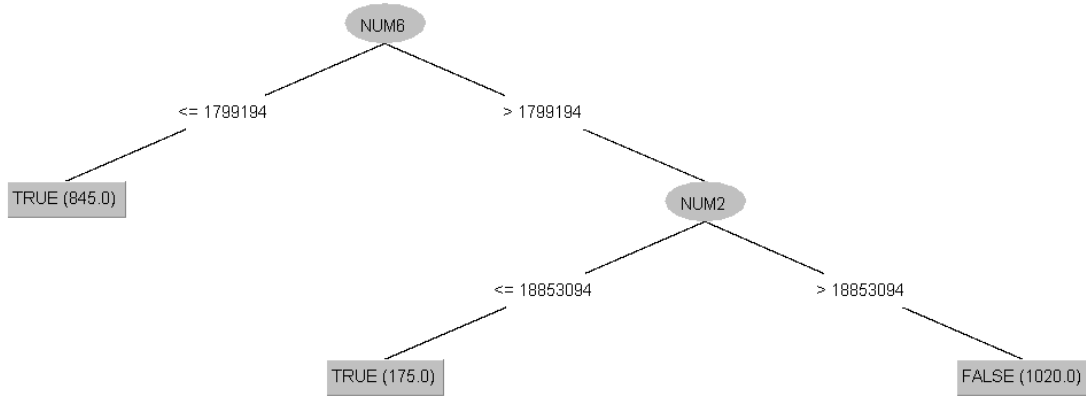


Fig. 14: Decision tree for requirement AT54 in experiment 12.

Discussion:

The tool correctly identifies that Num0 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 98.1%.

## Experiment 13

Requirement:

(forall  $\tau_0$  in  $[0,30]$  such that  $\omega@t(\tau_0) < \text{Num2}$ ) implies (forall  $\tau_1$  in  $[0,4]$  such that  $v@t(\tau_1) < \text{Num5}$ )

Range:

$\text{Num2} = \text{AT6a}(3000) \in [2800, 3200]\text{rpm}$ ,

$\text{Num5} = \text{AT6a}(35) \in [30, 40]\text{mph}$ .

Prediction:

- If  $\text{Num2} \leq 2913.192700\text{rpm}$ , then the requirement is mostly satisfied.
- If  $\text{Num2} > 2913.192700\text{rpm}$ , then the requirement satisfiability depends on  $\text{Num5}$ :
  - If  $\text{Num5} \leq 35.960581\text{mph}$ , then the requirement is mostly falsified.
  - If  $\text{Num5} > 35.960581\text{mph}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 15 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 139 Satisfied formulas and 111 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

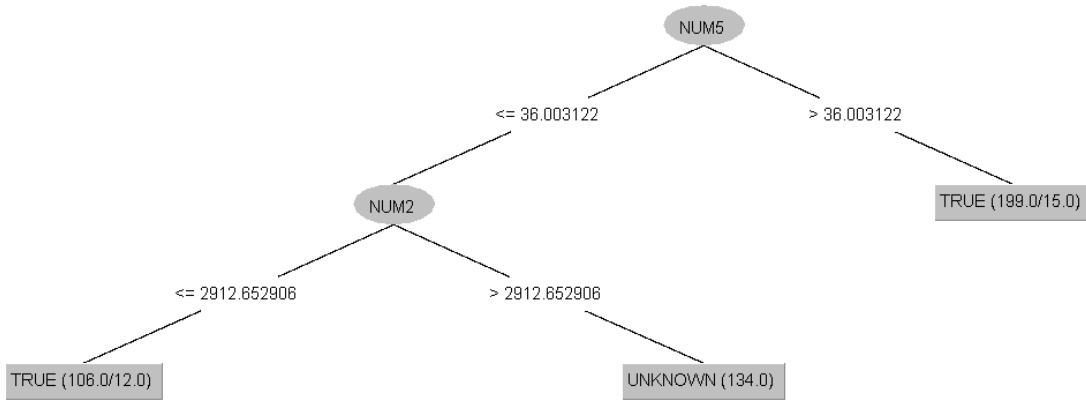


Fig. 15: Decision tree for requirement AT6a in experiment 13.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 98.8%.



## Experiment 14

Requirement:

(forall  $\tau_0$  in  $[0, \text{Num1}]$  such that  $\omega@t(\tau_0) < \text{Num2}$ ) implies (forall  $\tau_1$  in  $[0, \text{Num4}]$  such that  $v@t(\tau_1) < \text{Num5}$ )

Range:

$\text{Num1} = \text{AT6a}(30) \in [20, 40]\text{s}$ ,

$\text{Num2} = \text{AT6a}(3000) \in [2800, 3200]\text{rpm}$ ,

$\text{Num4} = \text{AT6a}(4) \in [2, 6]\text{s}$ ,

$\text{Num5} = \text{AT6a}(35) \in [30, 40]\text{mph}$ .

Prediction:

- $\text{Num1}$  does not affect the requirement satisfiability.
- If  $\text{Num2} \leq 2913\text{rpm}$ , then the requirement is mostly satisfied.
- If  $\text{Num2} > 2913\text{rpm}$ , then the requirement satisfiability depends on  $\text{Num4}$  and  $\text{Num5}$ :
  - $\text{Num4}$  and  $\text{Num5}$  are not independent. The requirement satisfaction depends on the position of  $(\text{Num4}, \text{Num5})$  with respect to the trace.
    - \* Below the trace, the requirement is mostly falsified.
    - \* Above the trace, the requirement is mostly satisfied.

Diagnosis:

Figure 16 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 192 Satisfied formulas and 108 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

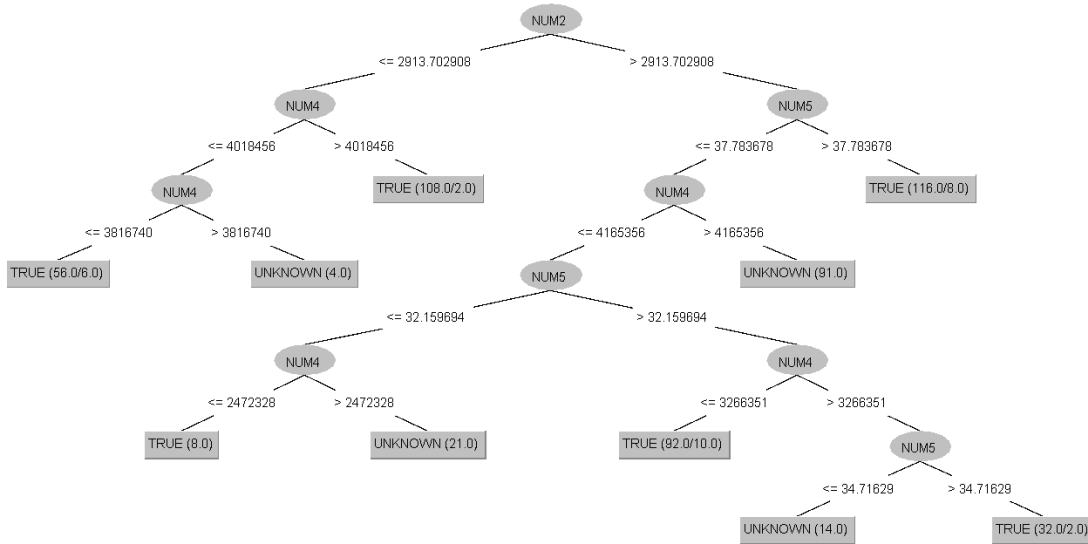


Fig. 16: Decision tree for requirement AT6a in experiment 14.

Discussion:

The tool correctly identifies that  $\text{Num1}$  is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 96.5% and 94.9%.

## Experiment 15

Requirement:

(forall  $\tau_0$  in  $[0,30]$  such that  $\omega@t(\tau_0) < \text{Num2}$ ) implies (forall  $\tau_1$  in  $[0,8]$  such that  $v@t(\tau_1) < \text{Num5}$ )

Range:

$\text{Num2} = \text{AT6b}(3000) \in [2800, 3200]\text{rpm}$ ,

$\text{Num5} = \text{AT6b}(50) \in [40, 60]\text{mph}$ .

Prediction:

- If  $\text{Num2} \leq 2830.707000\text{rpm}$ , then the requirement is mostly satisfied.
- If  $\text{Num2} > 2830.707000\text{rpm}$ , then the requirement satisfiability depends on  $\text{Num3}$ :
  - If  $\text{Num5} \leq 51.918594\text{mph}$ , then the requirement is mostly falsified.
  - If  $\text{Num5} > 51.918594\text{mph}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 17 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 111 Satisfied formulas and 89 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

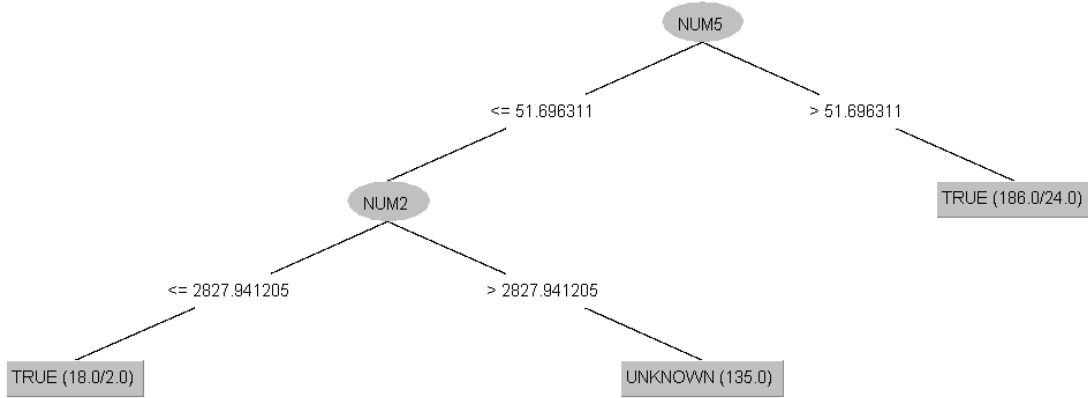


Fig. 17: Decision tree for requirement AT6b in experiment 15.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 98.0% and 98.7%.

## Experiment 16

Requirement:

(forall  $\tau_0$  in  $[0, \text{Num1}]$  such that  $\omega@t(\tau_0) < \text{Num2}$ ) implies (forall  $\tau_1$  in  $[0, \text{Num4}]$  such that  $v@t(\tau_1) < \text{Num5}$ )

Range:

$\text{Num1} = \text{AT6b}(30) \in [20, 40]\text{s}$ ,

$\text{Num2} = \text{AT6b}(3000) \in [2800, 3200]\text{rpm}$ ,

$\text{Num4} = \text{AT6b}(8) \in [4, 12]\text{s}$ ,

$\text{Num5} = \text{AT6b}(50) \in [40, 60]\text{mph}$ .

Prediction:

- $\text{Num1}$  and  $\text{Num2}$  are not independent. The requirement satisfaction depends on the position of  $(\text{Num1}, \text{Num2})$  with respect to the trace.
  - Below the trace, the requirement is mostly satisfied.
  - Above the trace, then the requirement satisfiability depends on  $\text{Num4}$  and  $\text{Num5}$ :
    - \*  $\text{Num4}$  and  $\text{Num5}$  are not independent. The requirement satisfaction depends on the position of  $(\text{Num4}, \text{Num5})$  with respect to the trace.
      - Below the trace, the requirement is mostly falsified.
      - Above the trace, the requirement is mostly satisfied.

Diagnosis:

Figure 18 reports the diagnosis produced by Diagnosis. The tool cannot produce the required amount of formulas within the time budget. The results are based on 246 Satisfied formulas and 104 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

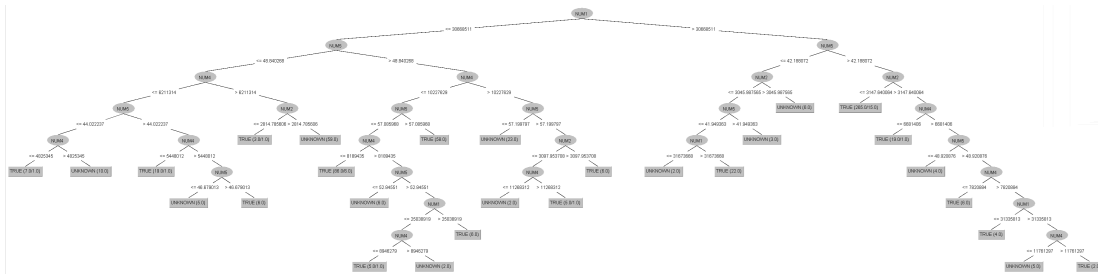


Fig. 18: Decision tree for requirement AT6b in experiment 16.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 90.2% and 92.8%.

## Experiment 17

Requirement:

(forall  $\tau_0$  in  $[0,30]$  such that  $\omega@t(\tau_0) < \text{Num2}$ ) implies (forall  $\tau_1$  in  $[0,20]$  such that  $v@t(\tau_1) < \text{Num5}$ )

Range:

$\text{Num2} = \text{AT6c}(3000) \in [2800, 3200]\text{rpm}$ ,

$\text{Num5} = \text{AT6c}(65) \in [50, 80]\text{mph}$ .

Prediction:

- If  $\text{Num2} \leq 2973.074700\text{rpm}$ , then the requirement is mostly satisfied.
- If  $\text{Num2} > 2973.074700\text{rpm}$ , then the requirement satisfiability depends on  $\text{Num3}$ :
  - If  $\text{Num5} \leq 70.976826\text{mph}$ , then the requirement is mostly falsified.
  - If  $\text{Num5} > 70.976826\text{mph}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 19 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 147 Satisfied formulas and 103 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

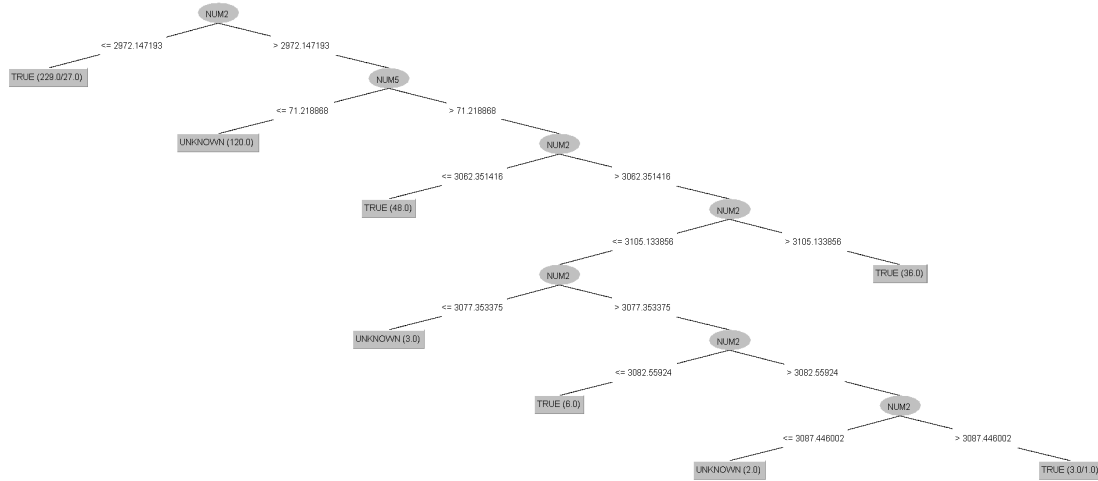


Fig. 19: Decision tree for requirement AT6c in experiment 17.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 96.7%.

## Experiment 18

*Requirement:*

$$(\text{forall } \tau_0 \text{ in } [0, \text{Num1}] \text{ such that } \omega @ t(\tau_0) < \text{Num2}) \text{ implies } (\text{forall } \tau_1 \text{ in } [0, \text{Num4}] \text{ such that } v @ t(\tau_1) < \text{Num5})$$

*Range:*

$$\text{Num1} = \text{AT6c}(30) \in [20, 40]s,$$
$$\text{Num2} = \text{AT6c}(3000) \in [2800, 3200]\text{rpm},$$
$$\text{Num4} = \text{AT6c}(20) \in [15, 25]s,$$
$$\text{Num5} = \text{AT6c}(65) \in [50, 80]\text{mph.}$$

*Prediction:*

- If  $Num2 \leq 2973rpm$ , then the requirement is mostly satisfied.
- If  $Num2 > 2973rpm$ , then  $Num1$  and  $Num2$  are not independent. The requirement satisfaction depends on the position of  $(Num1, Num2)$  with respect to the trace.
  - To the left of the trace, the requirement is mostly satisfied.
  - To the right the trace, then the requirement satisfiability depends on  $Num4$  and  $Num5$ :
    - \*  $Num4$  and  $Num5$  are not independent. The requirement satisfaction depends on the position of  $(Num4, Num5)$  with respect to the trace.
      - Below the trace, the requirement is mostly falsified.
      - Above the trace, the requirement is mostly satisfied.

*Diagnosis:*

Figure 20 reports the diagnosis produced by `Diagnosis`. The tool cannot produce the required amount of formulas within the time budget. The results are based on 239 Satisfied formulas and 111 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

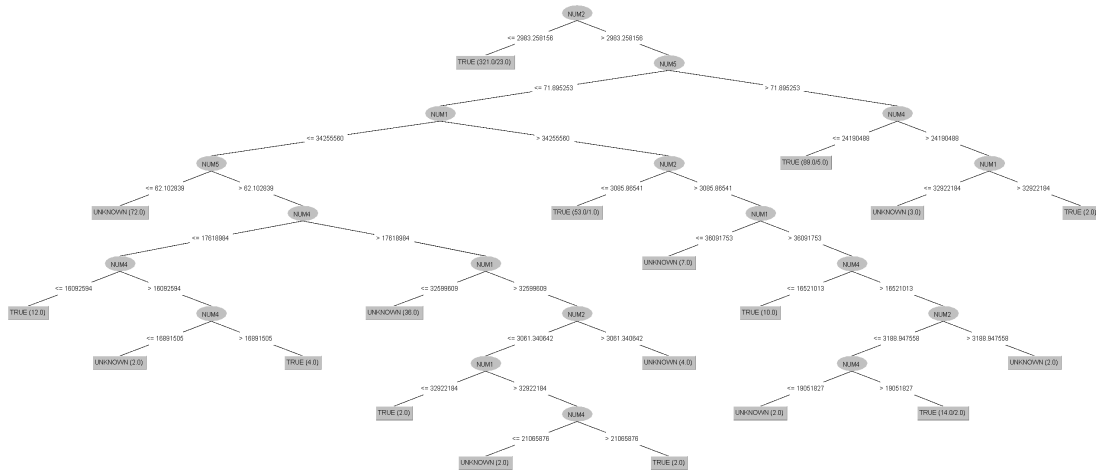


Fig. 20: Decision tree for requirement AT6c in experiment 18.

*Discussion:*

The diagnosis produced by the tool does not correspond exactly with the one defined by the expert: The precision and recall are respectively 95.9% and 70.1%. This is probably caused by the insufficient number of formulas produced by the tool within the time limit.

## Experiment 19

Requirement:

((forall  $\tau_0$  in  $[0,30]$  such that  $\omega@t(\tau_0) < 3000$ ) implies (forall  $\tau_1$  in  $[0,4]$  such that  $v@t(\tau_1) < 35$ )) and  
 ((forall  $\tau_2$  in  $[0,30]$  such that  $\omega@t(\tau_2) < 3000$ ) implies (forall  $\tau_3$  in  $[0,8]$  such that  $v@t(\tau_3) < 50$ )) and  
 ((forall  $\tau_4$  in  $[0,30]$  such that  $\omega@t(\tau_4) < \text{Num14}$ ) implies (forall  $\tau_5$  in  $[0,20]$  such that  $v@t(\tau_5) < \text{Num17}$ ))

Range:

Num14 = AT6abc(3000)  $\in [2800, 3200]$ rpm,

Num17 = AT6abc(65)  $\in [50, 80]$ mph.

Prediction:

- If  $\text{Num14} \leq 2942.661200$ rpm, then the requirement is mostly satisfied.
- If  $\text{Num14} > 2942.661200$ rpm, then the requirement satisfiability depends on Num3:
  - If  $\text{Num17} \leq 66.981754$ mph, then the requirement is mostly falsified.
  - If  $\text{Num17} > 66.981754$ mph, then the requirement is mostly satisfied.

Diagnosis:

Figure 21 reports the diagnosis produced by Diagnosis. The tool cannot produce the required amount of formulas within the time budget. The results are based on 185 Satisfied formulas and 115 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

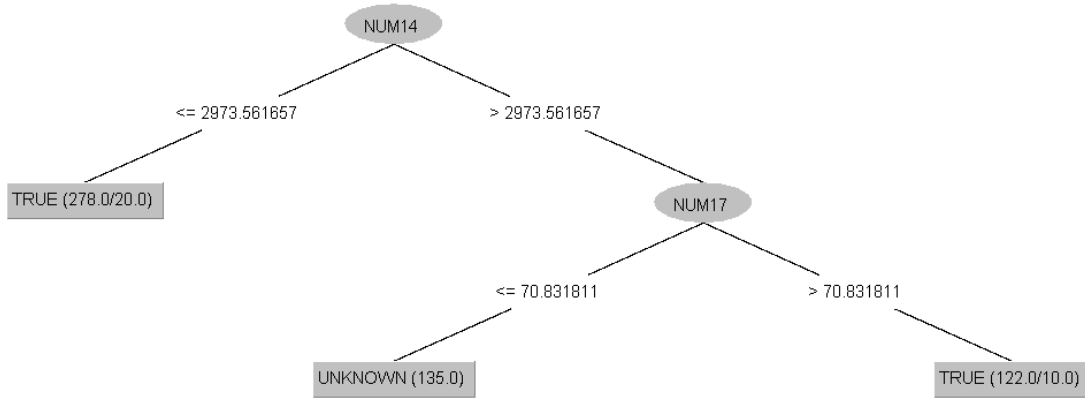


Fig. 21: Decision tree for requirement AT6abc in experiment 19.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 96.7%.

## Experiment 20

Requirement:

((forall  $\tau_0$  in  $[0,30]$  such that  $\omega@t(\tau_0) < 3000$  implies (forall  $\tau_1$  in  $[0,4]$  such that  $v@t(\tau_1) < 35$ )) and  
 ((forall  $\tau_2$  in  $[0,30]$  such that  $\omega@t(\tau_2) < 3000$  implies (forall  $\tau_3$  in  $[0,8]$  such that  $v@t(\tau_3) < 50$ )) and  
 ((forall  $\tau_4$  in  $[0, \text{Num13}]$  such that  $\omega@t(\tau_4) < \text{Num14}$  implies (forall  $\tau_5$  in  $[0, \text{Num16}]$  such that  $v@t(\tau_5) < \text{Num17}$ )))

Range:

Num13 = AT6abc(30)  $\in [20, 40]$ s,

Num14 = AT6abc(3000)  $\in [2800, 3200]$ rpm,

Num16 = AT6abc(20)  $\in [15, 25]$ s,

Num17 = AT6abc(65)  $\in [50, 80]$ mph.

Prediction:

- If  $\text{Num13} \leq 31.6$ s, then the requirement satisfiability depends on  $\text{Num14}$ :
  - If  $\text{Num14} \leq 2943$ rpm, then the requirement is mostly satisfied.
  - If  $\text{Num14} > 2943$ rpm, then the requirement satisfiability depends on  $\text{Num16}$  and  $\text{Num17}$ :
    - \*  $\text{Num16}$  and  $\text{Num17}$  are not independent. The requirement satisfaction depends on the position of  $(\text{Num16}, \text{Num17})$  with respect to the trace.
      - Below the trace, the requirement is mostly falsified.
      - Above the trace, the requirement is mostly satisfied.
- If  $\text{Num13} > 31.6$ s, then the requirement is mostly satisfied.

Diagnosis:

Figure 22 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 289 Satisfied formulas and 111 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

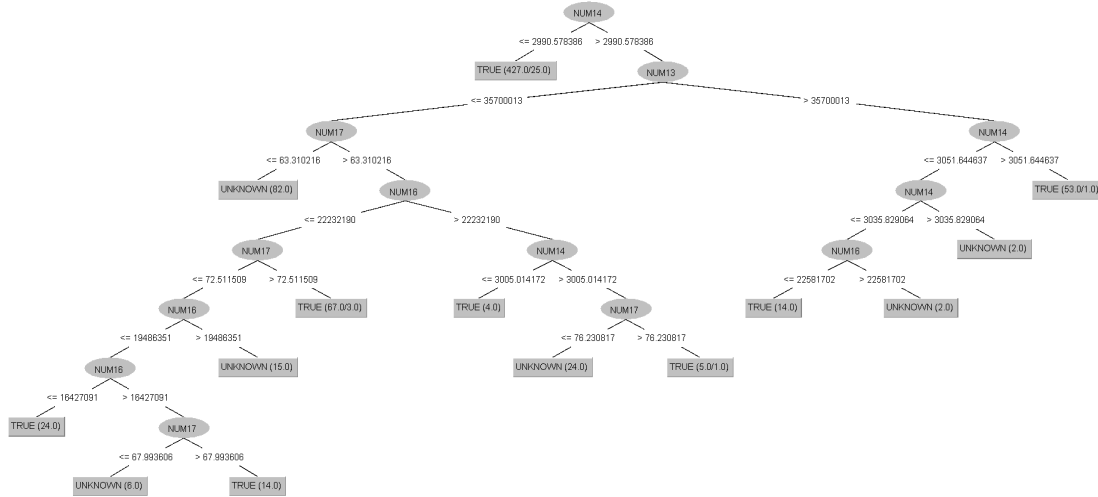


Fig. 22: Decision tree for requirement AT6abc in experiment 20.

Discussion:

The diagnosis produced by the tool does not correspond exactly with the one defined by the expert: The precision and recall are respectively 97.2% and 67.9%. This is probably caused by the insufficient number of formulas produced by the tool within the time limit.

## Experiment 21

Requirement:

**forall**  $\tau_0$  **in**  $[0,100]$  **such that**  $((y5@t(\tau_0) - y4@t(\tau_0)) \leq \text{Num2})$

Range:

$\text{Num2} = \text{CC1}(40) \in [30, 50]\text{m}$ .

Prediction:

- If  $\text{Num2} \leq 41.180040\text{m}$ , then the requirement is mostly falsified.
- If  $\text{Num2} > 41.180040\text{m}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 23 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 215 Satisfied formulas and 185 Unsatisfied formulas.

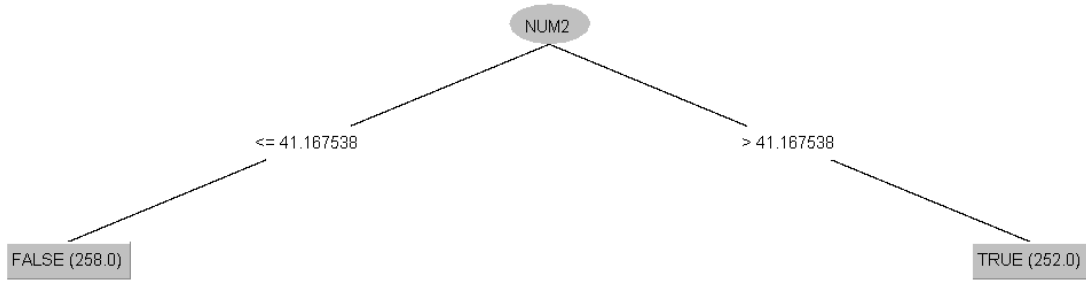


Fig. 23: Decision tree for requirement CC1 in experiment 21.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 100.0%.



## Experiment 22

Requirement:

**forall**  $\tau_0$  **in** [ Num0 , Num1 ] **such that** ( (y5@t( $\tau_0$ ) - y4@t( $\tau_0$ ))  $\leq$  Num2 )

Range:

Num0 = CC1( 0 )  $\in [0, 50]$ s,

Num1 = CC1( 100 )  $\in [50, 100]$ s,

Num2 = CC1( 40 )  $\in [30, 50]$ m.

Prediction:

- Num1 does not affect the requirement satisfiability.
- If Num2  $\leq$  41.2m, then the requirement satisfiability depends on Num0:
  - If Num0  $\leq$  22.5s, then the requirement is mostly falsified.
  - If Num0  $>$  22.5s, then the requirement is mostly satisfied.
- If Num2  $>$  41.2m, then the requirement is mostly satisfied.

Diagnosis:

Figure 24 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 766 Satisfied formulas and 234 Unsatisfied formulas.

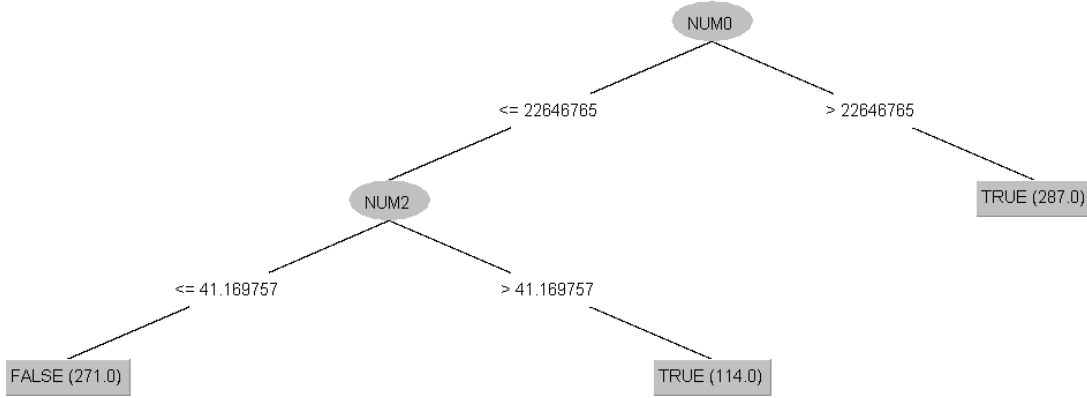


Fig. 24: Decision tree for requirement CC1 in experiment 22.

Discussion:

The tool correctly identifies that Num1 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 99.4% and 100.0%.

## Experiment 23

Requirement:

**forall**  $\tau_0$  **in** [Num0,70] **such that** (**exists**  $\tau_1$  **in** [ $\tau_0, \tau_0+30$ ] **such that** ((y5@t( $\tau_1$ ) - y4@t( $\tau_1$ )) > 15)

Range:

Num0 = CC2(0)  $\in [0, 20]$ s.

Prediction:

- If  $Num0 \leq 3.25$ s, then the requirement is mostly falsified.
- If  $Num0 > 3.25$ s, then the requirement is mostly satisfied.

Diagnosis:

Figure 25 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 496 Satisfied formulas and 104 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

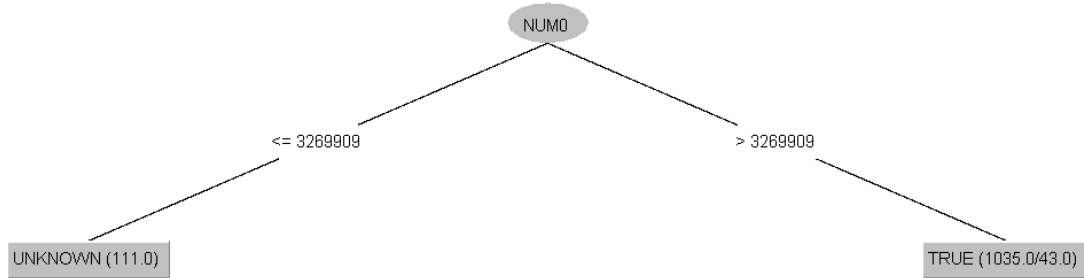


Fig. 25: Decision tree for requirement CC2 in experiment 23.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.0%.

## Experiment 24

Requirement:

**forall**  $\tau_0$  **in** [Num0,70] **such that** (**exists**  $\tau_1$  **in** [ $\tau_0$ +Num2, $\tau_0$ +30] **such that** ((y5@t( $\tau_1$ ) - y4@t( $\tau_1$ )) > Num4)

Range:

Num0 = CC2(0)  $\in [0, 20]$ s,

Num2 = CC2(0)  $\in [0, 10]$ s,

Num4 = CC2(15)  $\in [12, 18]$ m.

Prediction:

- Num2 does not affect the requirement satisfiability.
- If Num0  $\leq 3.25$ s, then the requirement is mostly falsified.
- If Num0  $> 3.25$ s, then the requirement satisfiability depends on Num2:
  - If Num4  $\leq 15.1$ m, then the requirement is mostly satisfied.
  - If Num4  $> 15.1$ m, then the requirement is mostly falsified.

Diagnosis:

Figure 26 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 91 Satisfied formulas and 109 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

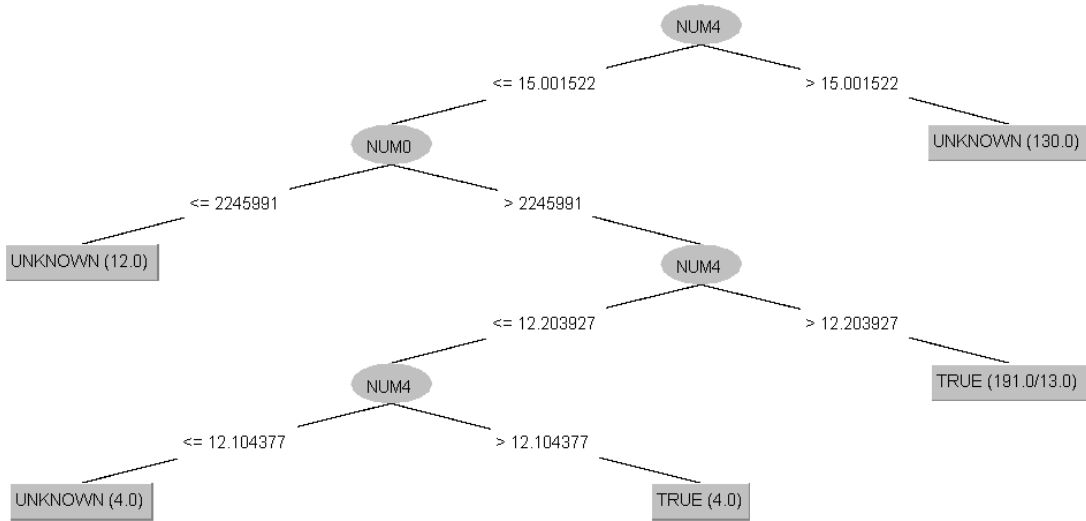


Fig. 26: Decision tree for requirement CC2 in experiment 24.

Discussion:

The tool correctly identifies that Num2 is not relevant in this case. The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 94.4% and 94.2%.

## Experiment 25

Requirement:

**Quant0**  $\tau_0$  in  $[0,80]$  **such that** ((**forall**  $\tau_1$  in  $[\tau_0, \tau_0+20]$  **such that** (  $y2@t(\tau_1) - y1@t(\tau_1) < 20$  )) **or** (**exists**  $\tau_2$  in  $[\tau_0, \tau_0+20]$  **such that** (  $y5@t(\tau_2) - y4@t(\tau_2) > 40$  )))

Range:

**Quant0** = CC3(**forall**)  $\in \{\text{forall}, \text{exists}\}$ .

Prediction:

- If  $Quant0 = \text{forall}$ , then the requirement is falsified.
- If  $Quant0 = \text{exists}$ , then the requirement is satisfied.

Diagnosis:

The tool cannot determine the satisfiability of any of the generated formulas.

Discussion:

It is impossible to compare the tool results and the prediction since the tool returned only Unknown results.

## Experiment 26

Requirement:

Quant0  $\tau_0$  in  $[0,80]$  such that (( Quant1  $\tau_1$  in  $[\tau_0, \tau_0+20]$  such that (  $y_2@t(\tau_1) - y_1@t(\tau_1) < 20$  )) Log2 (exists  $\tau_2$  in  $[\tau_0, \tau_0+20]$  such that (  $y_5@t(\tau_2) - y_4@t(\tau_2) > 40$  )))

Range:

Quant0 = CC3( forall )  $\in \{forall, exists\}$ ,

Quant1 = CC3( forall )  $\in \{forall, exists\}$ ,

Log2 = CC3( or )  $\in \{and, or\}$ .

Prediction:

The prediction for experiment 26 is in Figure 27.

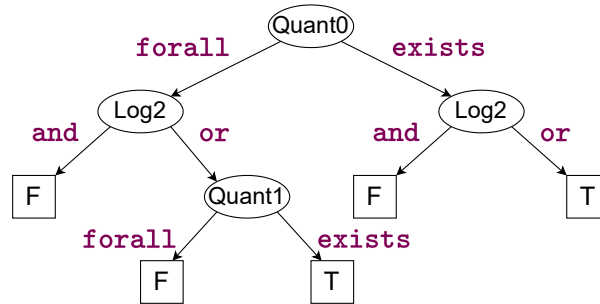


Fig. 27: Prediction for requirement CC3 in experiment 26.

Diagnosis:

Figure 28 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 26 Satisfied formulas and 74 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

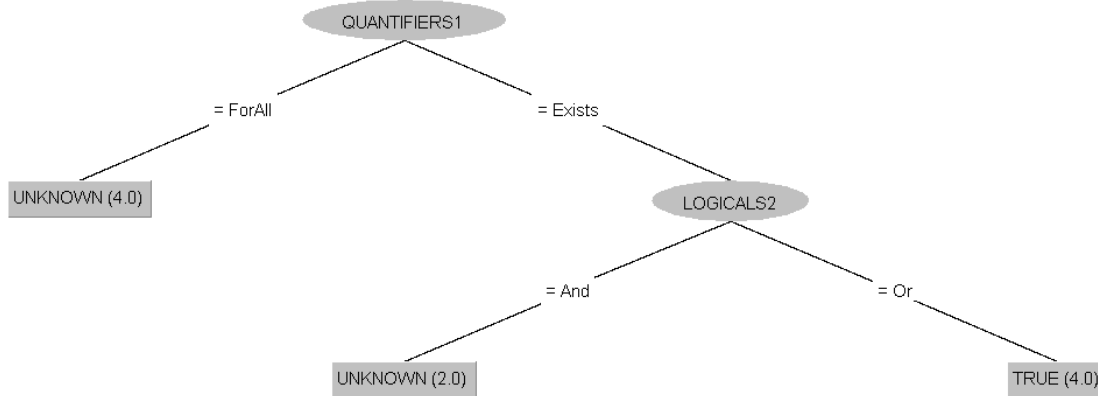


Fig. 28: Decision tree for requirement CC3 in experiment 26.

Discussion:

The diagnosis produced by the tool does not correspond accurately with the one defined by the expert: The precision and recall are respectively 100.0% and 66.7%. The low recall value is probably caused by the significant number of formulas that remain Undecided.

## Experiment 27

Requirement:

**forall**  $\tau_0$  **in**  $[0,65]$  **such that** (**exists**  $\tau_1$  **in**  $[\tau_0, \tau_0+30]$  **such that** (**forall**  $\tau_2$  **in**  $[\tau_1, \tau_1+5]$  **such that**  $((y5@t(\tau_2) - y4@t(\tau_2)) > \text{Num4})))$

Range:

$\text{Num4} = \text{CC4}(8) \in [6, 10]\text{m}$ .

Prediction:

- If  $\text{Num4} \leq 7.915200\text{m}$ , then the requirement is mostly satisfied.
- If  $\text{Num4} > 7.915200\text{m}$ , then the requirement is mostly falsified.

Diagnosis:

Figure 29 reports the diagnosis produced by `Diagnosis`. The tool cannot produce the required amount of formulas within the time budget. The results are based on 68 Satisfied formulas and 82 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

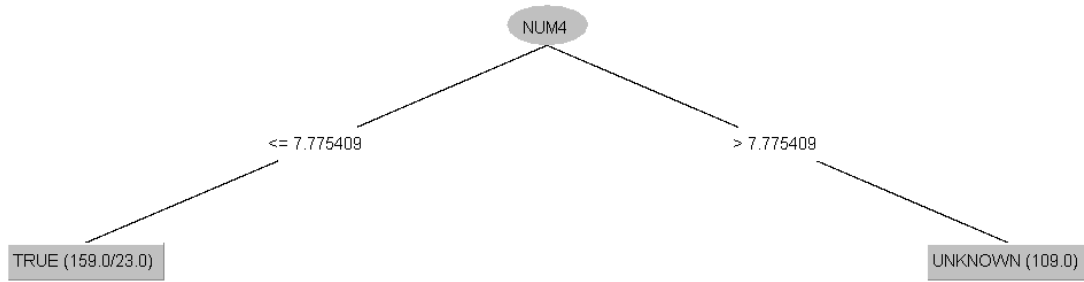


Fig. 29: Decision tree for requirement CC4 in experiment 27.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 100.0% and 93.8%.

## Experiment 28

Requirement:

Quant0  $\tau_0$  in  $[0,65]$  such that (exists  $\tau_1$  in  $[\tau_0, \tau_0+30]$  such that (Quant2  $\tau_2$  in  $[\tau_1, \tau_1+5]$  such that ((y5@t( $\tau_2$ ) - y4@t( $\tau_2$ )) > Num4 )))

Range:

Quant0 = CC4(**forall**)  $\in \{\text{forall}, \text{exists}\}$ ,

Quant2 = CC4(**forall**)  $\in \{\text{forall}, \text{exists}\}$ ,

Num4 = CC4(**8**)  $\in [6, 10]m$ .

Prediction:

- If Quant0 = **forall**, then the requirement satisfiability depends on Quant2:
  - If Quant2 = **forall**, then the requirement satisfiability depends on Num4:
    - \* If Num4  $\leq 7.91m$ , then the requirement is mostly satisfied.
    - \* If Num4  $> 7.91m$ , then the requirement is mostly falsified.
  - If Quant2 = **exists**, then the requirement is satisfied.
- If Quant0 = **exists**, then the requirement is satisfied.

Diagnosis:

Figure 30 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 156 Satisfied formulas and 94 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

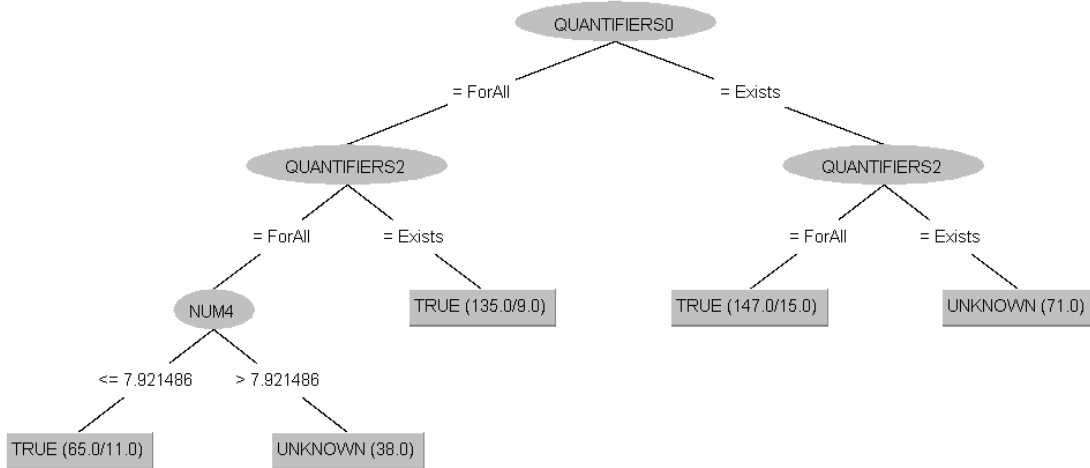


Fig. 30: Decision tree for requirement CC4 in experiment 28.

Discussion:

The diagnosis produced by the tool does not correspond accurately with the one defined by the expert: The precision and recall are respectively 99.6% and 71.2%. The Decision Tree contains one extra branch compared to the expert's prediction, due to a set of Undecided formulas.

## Experiment 29

Requirement:

**forall**  $\tau_0$  **in**  $[0,72]$  **such that** (**exists**  $\tau_1$  **in**  $[\tau_0, \tau_0+8]$  **such that** ((**forall**  $\tau_2$  **in**  $[\tau_1, \tau_1+5]$  **such that** (( $y2@t(\tau_2) - y1@t(\tau_2)) > \text{Num4}$ )) **implies** (**forall**  $\tau_3$  **in**  $[\tau_1+5, \tau_1+20]$  **such that** (( $y5@t(\tau_3) - y4@t(\tau_3)) > \text{Num7}$ ))))))

Range:

$\text{Num4} = \text{CC5}(9) \in [7, 11]\text{m}$ ,

$\text{Num7} = \text{CC5}(9) \in [7, 11]\text{m}$ .

Prediction:

- If  $\text{Num4} \leq 10.001060\text{m}$ , then the requirement satisfiability depends on  $\text{Num1}$ :
  - If  $\text{Num7} \leq 7.587900\text{m}$ , then the requirement is mostly satisfied.
  - If  $\text{Num7} > 7.587900\text{m}$ , then the requirement is mostly falsified.
- If  $\text{Num4} > 10.001060\text{m}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 31 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 19 Satisfied formulas and 81 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

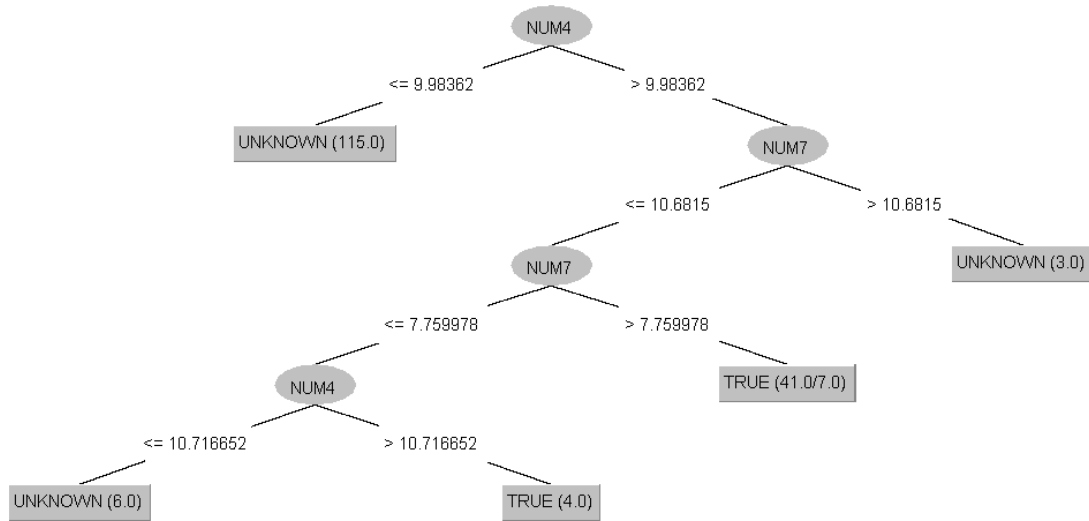


Fig. 31: Decision tree for requirement CC5 in experiment 29.

Discussion:

The diagnosis produced by the tool does not correspond accurately with the one defined by the expert: The precision and recall are respectively 96.4% and 54.6%. The low recall value is caused by the limited number of available Satisfied formulas.



### Experiment 30

Requirement:

**forall**  $\tau_0$  **in**  $[0,72]$  **such that** (**exists**  $\tau_1$  **in**  $[\tau_0, \tau_0+8]$  **such that** ((**forall**  $\tau_2$  **in**  $[\tau_1, \tau_1+5]$  **such that** (( $y2@t(\tau_2) - y1@t(\tau_2)$ ) **Rel6** **Num4**)) **implies** (**forall**  $\tau_3$  **in**  $[\tau_1+5, \tau_1+20]$  **such that** (( $y5@t(\tau_3) - y4@t(\tau_3)$ ) **Rel9** **Num7**))))))

Range:

**Rel6** = CC5( $\geq$ )  $\in \{>, <\}$ ,

**Num4** = CC5( $9$ )  $\in [7, 11]m$ ,

**Rel9** = CC5( $\geq$ )  $\in \{>, <\}$ ,

**Num7** = CC5( $9$ )  $\in [7, 11]m$ .

Prediction:

The prediction for experiment 30 is in Figure 32.

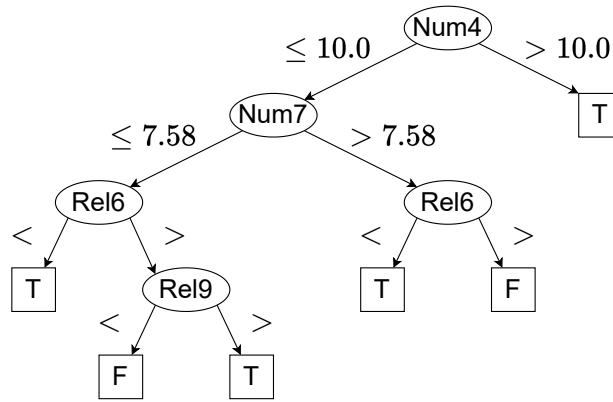


Fig. 32: Prediction for requirement CC5 in experiment 30.

Diagnosis:

Figure 33 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 95 Satisfied formulas and 55 formulas where the Trace Checker cannot determine the Satisfiability, which will be considered as Unsatisfied.

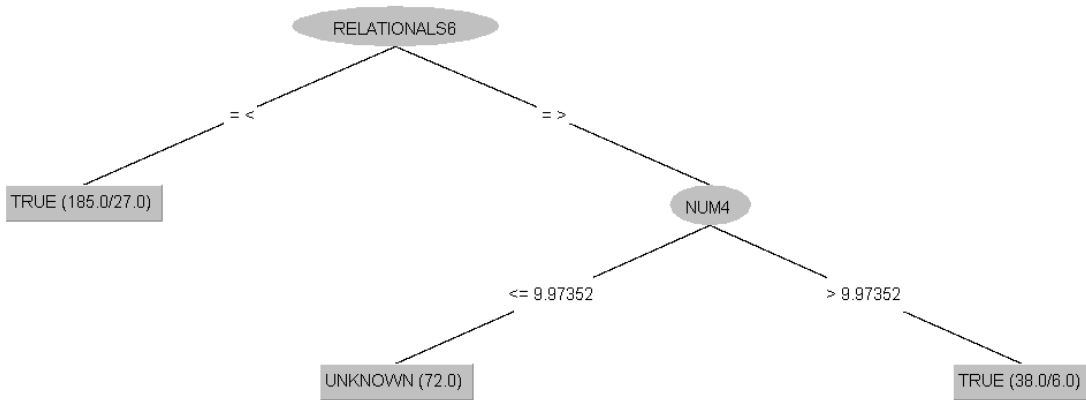


Fig. 33: Decision tree for requirement CC5 in experiment 30.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 99.3% and 95.8%.

### Experiment 31

Requirement:

(**forall**  $\tau_0$  **in**  $[0,50]$  **such that**  $((y5@t(\tau_0) - y4@t(\tau_0)) > \text{Num2}))$  **and** (**forall**  $\tau_1$  **in**  $[0,50]$  **such that**  $((y4@t(\tau_1) - y3@t(\tau_1)) > 7.5))$  **and** (**forall**  $\tau_2$  **in**  $[0,50]$  **such that**  $((y3@t(\tau_2) - y2@t(\tau_2)) > 7.5))$  **and** (**forall**  $\tau_3$  **in**  $[0,50]$  **such that**  $((y2@t(\tau_3) - y1@t(\tau_3)) > 7.5))$ )

Range:

$\text{Num2} = \text{CCx}(7.5) \in [5, 10]\text{m}$ .

Prediction:

- If  $\text{Num2} \leq 7.389400\text{m}$ , then the requirement is mostly satisfied.
- If  $\text{Num2} > 7.389400\text{m}$ , then the requirement is mostly falsified.

Diagnosis:

Figure 34 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 95 Satisfied formulas and 105 Unsatisfied formulas.

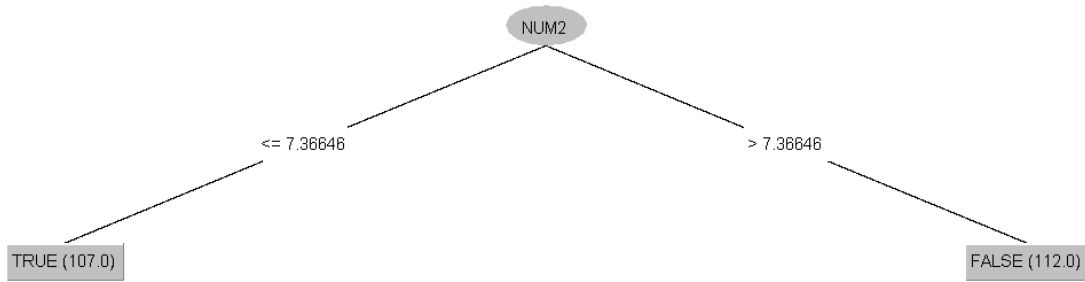


Fig. 34: Decision tree for requirement CCX in experiment 31.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are both 100.%.

### Experiment 32

Requirement:

(forall  $\tau_0$  in [Num0, Num1] such that  $((y5@t(\tau_0) - y4@t(\tau_0)) > \text{Num2}))$  and (forall  $\tau_1$  in [0,50] such that  $((y4@t(\tau_1) - y3@t(\tau_1)) > 7.5))$  and (forall  $\tau_2$  in [0,50] such that  $((y3@t(\tau_2) - y2@t(\tau_2)) > 7.5))$  and (forall  $\tau_3$  in [0,50] such that  $((y2@t(\tau_3) - y1@t(\tau_3)) > 7.5))$ )

Range:

Num0 = CCx(0)  $\in [0, 25]$ s,

Num1 = CCx(50)  $\in [25, 75]$ s,

Num2 = CCx(7.5)  $\in [5, 10]$ m.

Prediction:

- If  $\text{Num0} \leq 18.2$ s, then the requirement satisfiability depends on  $\text{Num2}$ :
  - If  $\text{Num2} \leq 7.4$ m, then the requirement is mostly satisfied.
  - If  $\text{Num2} > 7.4$ m, then the requirement is mostly falsified.
- If  $\text{Num0} > 18.2$ s, then the requirement satisfiability depends on  $\text{Num2}$ :
  - If  $\text{Num2} \leq 8.9$ m, then the requirement is mostly satisfied.
  - If  $8.9\text{m} < \text{Num2} \leq 9.3\text{m}$ , then the requirement satisfiability depends on  $\text{Num1}$ :
    - \* If  $\text{Num1} \leq 39.6$ s, then the requirement is mostly satisfied.
    - \* If  $\text{Num1} > 39.6$ s, then the requirement is mostly falsified.
  - If  $\text{Num2} > 9.3\text{m}$ , then the requirement is mostly falsified.

Diagnosis:

Figure 35 reports the diagnosis produced by *Diagnosis*. The tool cannot produce the required amount of formulas within the time budget. The results are based on 495 Satisfied formulas and 605 Unsatisfied formulas.

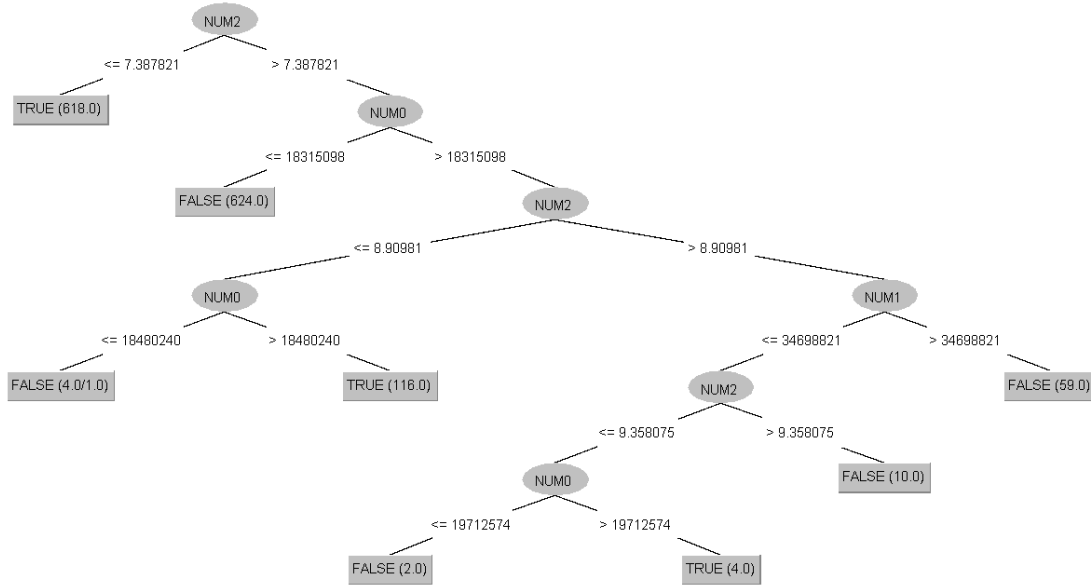


Fig. 35: Decision tree for requirement CCX in experiment 32.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 99.9% and 97.7%.

### Experiment 33

Requirement:

**forall**  $\tau_0$  **in**  $[0, \infty]$  **such that**  $((d\_pos\_x @t(\tau_0) - v\_pos\_x @t(\tau_0)) < \text{Num2} \text{ Log1 } d2obs @t(\tau_0) > 50)$

Range:

**Num2** = RR(20)  $\in [500, 700]$ cm,

**Log1** = RR(**and**)  $\in \{\text{and, or, implies}\}$ .

Prediction:

- If **Log1** = **and**, then the requirement is always falsified.
- If **Log1** = **or**, then the requirement satisfiability depends on **Num3**:
  - If **Num2**  $\leq 547.6140$ cm, then the requirement is mostly falsified.
  - If **Num2**  $> 547.6140$ cm, then the requirement is mostly satisfied.
- If **Log1** = **implies**, then the requirement satisfiability depends on **Num3**:
  - If **Num2**  $\leq 547.6140$ cm, then the requirement is mostly satisfied.
  - If **Num2**  $> 547.6140$ cm, then the requirement is mostly falsified.

Diagnosis:

Figure 36 reports the diagnosis produced by **Diagnosis**.

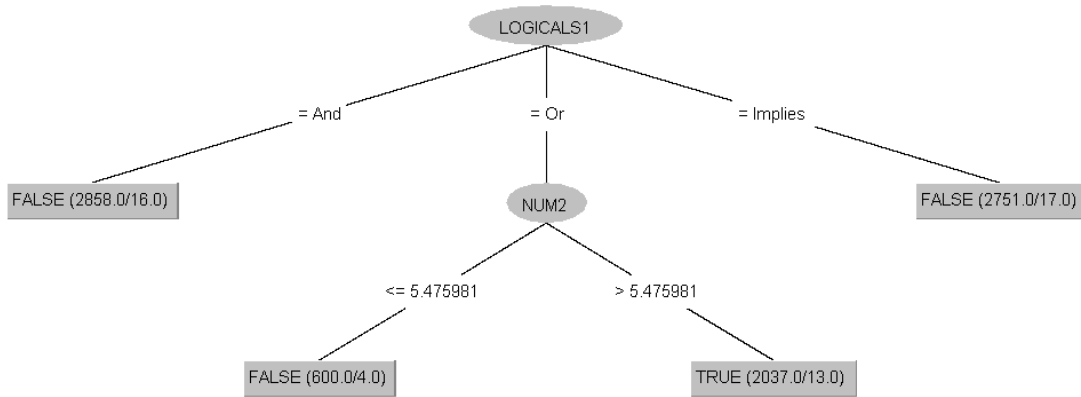


Fig. 36: Decision tree for requirement RR in experiment 33.

Discussion:

The diagnosis produced by the tool corresponds approximately with the one defined by the expert: The precision and recall are respectively 100.0% and 76.2%. The tool decision tree is missing a branch for the **Implies** node.

### Experiment 34

Requirement:

**forall**  $\tau_0$  **in**  $[0, \infty]$  **such that**  $((d\_pos\_x @t(\tau_0) - v\_pos\_x @t(\tau_0)) < \text{Num2} \text{ Log1 } d2obs @t(\tau_0) > \text{Num3})$

Range:

$\text{Num2} = \text{RR}(20) \in [500, 700]\text{cm}$ ,

$\text{Log1} = \text{RR}(\text{and}) \in \{\text{and}, \text{or}\}$ ,

$\text{Num3} = \text{RR}(50) \in [0, 2.5]\text{cm}$ .

Prediction:

- If  $\text{Log1} = \text{and}$ , then the requirement satisfiability depends on  $\text{Num2}$ :
  - If  $\text{Num2} \leq 548\text{cm}$ , then the requirement is mostly falsified.
  - If  $\text{Num2} > 548\text{cm}$ , then the requirement satisfiability depends on  $\text{Num3}$ :
    - \* If  $\text{Num3} \leq 0.687\text{cm}$ , then the requirement is mostly satisfied.
    - \* If  $\text{Num3} > 0.687\text{cm}$ , then the requirement is mostly falsified.
- If  $\text{Log1} = \text{or}$ , then the requirement satisfiability depends on  $\text{Num2}$ :
  - If  $\text{Num2} \leq 548\text{cm}$ , then the requirement satisfiability depends on  $\text{Num3}$ :
    - \* If  $\text{Num3} \leq 0.687\text{cm}$ , then the requirement is mostly satisfied.
    - \* If  $\text{Num3} > 0.687\text{cm}$ , then the requirement is mostly falsified.
  - If  $\text{Num2} > 548\text{cm}$ , then the requirement is mostly satisfied.

Diagnosis:

Figure 37 reports the diagnosis produced by *Diagnosis*.

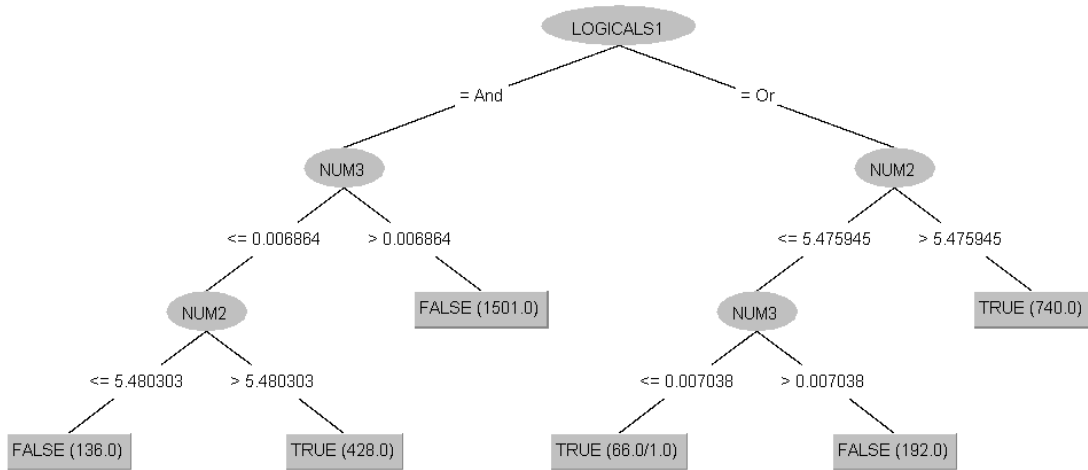


Fig. 37: Decision tree for requirement RR in experiment 34.

Discussion:

The diagnosis produced by the tool corresponds with the one defined by the expert: The precision and recall are respectively 99.4% and 100.0%.