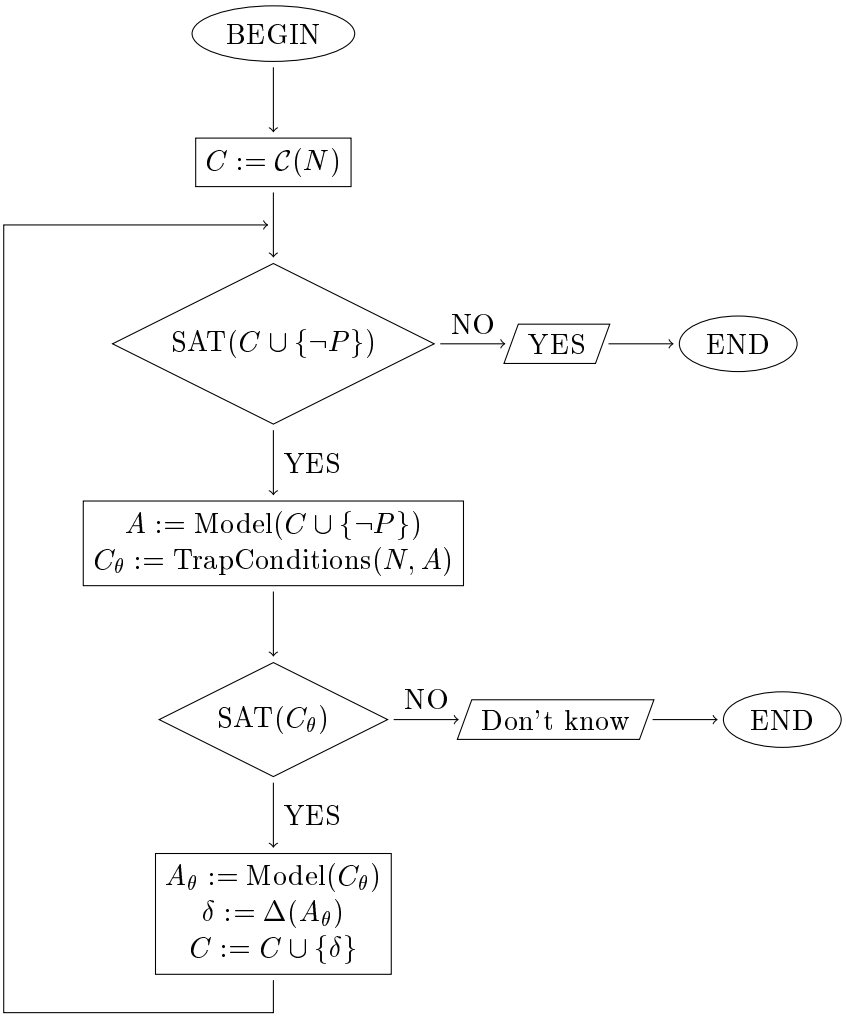
1 Peterson's Algorithm

1.1 Method



1.2 Constraints C_0

$$
\begin{array}{rl}
p_1 = 1 - u_1 & + u_6 \\
p_2 = 0 + u_1 - u_2 - u_3 & \\
p_3 = 0 \quad + u_2 + u_3 - u_4 - u_5 & \\
p_4 = 0 \quad + u_4 + u_5 - u_6 & \\
q_1 = 1 & - v_1 \quad + v_6 \\
q_2 = 0 & + v_1 - v_2 - v_3 \\
q_3 = 0 & + v_2 + v_3 - v_4 - v_5 \\
q_4 = 0 & + v_4 + v_5 - v_6 \\
(m_1 = f) = 1 - u_1 & + u_6 \\
(m_1 = t) = 0 + u_1 & - u_6 \\
(m_2 = f) = 1 & - v_1 \quad + v_6 \\
(m_2 = t) = 0 & + v_1 \quad - v_6 \\
(hold = 1) = 1 \quad + u_2 & - v_3 \\
(hold = 2) = 0 \quad - u_2 & + v_3 \\
p_4 \geq 1 & \\
q_4 \geq 1 & \\
\forall p \in S \cup T : \quad p \geq 0 &
\end{array}
$$

$$
\begin{aligned}
\delta_1 &= p_3 \vee q_2 \vee (m_2 = f) \vee (hold = 2) \\
\delta_2 &= p_2 \vee q_3 \vee (m_1 = f) \vee (hold = 1)
\end{aligned}
$$

1.3 A_1

$$
\begin{aligned}
p_1 &= 0 \\
p_2 &= 0 \\
p_3 &= 0 \\
p_4 &= 1 \\
q_1 &= 0 \\
q_2 &= 0 \\
q_3 &= 0 \\
q_4 &= 1 \\
(m_1 = f) &= 0 \\
(m_1 = t) &= 1 \\
(m_2 = f) &= 0 \\
(m_2 = t) &= 1 \\
(hold = 1) &= 1 \\
(hold = 2) &= 0 \\
u_1 &= 1 \\
u_2 &= 0 \\
u_3 &= 1 \\
u_4 &= 0 \\
u_5 &= 1 \\
u_6 &= 0 \\
v_1 &= 1 \\
v_2 &= 1 \\
v_3 &= 0 \\
v_4 &= 1 \\
v_5 &= 0 \\
v_6 &= 0
\end{aligned}
$$

1.4 A_2

$$
\begin{aligned}
p_1 &= 0 \\
p_2 &= 0 \\
p_3 &= 0 \\
p_4 &= 1 \\
q_1 &= 0 \\
q_2 &= 0 \\
q_3 &= 0 \\
q_4 &= 1 \\
(m_1 = f) &= 0 \\
(m_1 = t) &= 1 \\
(m_2 = f) &= 0 \\
(m_2 = t) &= 1 \\
(hold = 1) &= 0 \\
(hold = 2) &= 1 \\
u_1 &= 1 \\
u_2 &= 1 \\
u_3 &= 0 \\
u_4 &= 0 \\
u_5 &= 1 \\
u_6 &= 0 \\
v_1 &= 2 \\
v_2 &= 0 \\
v_3 &= 2 \\
v_4 &= 0 \\
v_5 &= 2 \\
v_6 &= 1
\end{aligned}
$$

1.5 $A_{\theta 1}$

$$
\begin{aligned}
p_1 &= 0 \\
p_2 &= 0 \\
p_3 &= 1 \\
p_4 &= 0 \\
q_1 &= 0 \\
q_2 &= 1 \\
q_3 &= 0 \\
q_4 &= 0 \\
(m_1 = f) &= 0 \\
(m_1 = t) &= 0 \\
(m_2 = f) &= 1 \\
(m_2 = t) &= 0 \\
(hold = 1) &= 0 \\
(hold = 2) &= 1
\end{aligned}
$$

1.6 $A_{\theta 2}$

$$
\begin{aligned}
p_1 &= 0 \\
p_2 &= 1 \\
p_3 &= 0 \\
p_4 &= 0 \\
q_1 &= 0 \\
q_2 &= 0 \\
q_3 &= 1 \\
q_4 &= 0 \\
(m_1 = f) &= 1 \\
(m_1 = t) &= 0 \\
(m_2 = f) &= 0 \\
(m_2 = t) &= 0 \\
(hold = 1) &= 1 \\
(hold = 2) &= 0
\end{aligned}
$$

1.7 C_θ

①

$$
\begin{aligned}
p_1 &\Longrightarrow o\_u_1 \\
p_2 &\Longrightarrow o\_u_2 \wedge o\_u_3 \\
p_3 &\Longrightarrow o\_u_4 \wedge o\_u_5 \\
p_4 &\Longrightarrow o\_u_6 \\
q_1 &\Longrightarrow o\_v_1 \\
q_2 &\Longrightarrow o\_v_2 \wedge o\_v_3 \\
q_3 &\Longrightarrow o\_v_4 \wedge o\_v_5 \\
q_4 &\Longrightarrow o\_v_6 \\
(m_1 = f) &\Longrightarrow o\_u_1 \wedge o\_v_4 \\
(m_1 = t) &\Longrightarrow o\_u_6 \\
(m_2 = f) &\Longrightarrow o\_v_1 \wedge o\_u_4 \\
(m_2 = t) &\Longrightarrow o\_v_6 \\
(hold = 1) &\Longrightarrow o\_v_3 \wedge o\_v_5 \wedge o\_u_3 \\
(hold = 2) &\Longrightarrow o\_u_3 \wedge o\_u_5 \wedge o\_v_3 \\
o\_u_1 &\Longrightarrow (p_2 \vee (m_1 = t)) \\
o\_u_2 &\Longrightarrow (p_3 \vee (hold = 1)) \\
o\_u_3 &\Longrightarrow (p_3 \vee (hold = 1)) \\
o\_u_4 &\Longrightarrow (p_4 \vee (m_2 = f)) \\
o\_u_5 &\Longrightarrow (p_4 \vee (hold = 2)) \\
o\_u_6 &\Longrightarrow (p_1 \vee (m_1 = f)) \\
o\_v_1 &\Longrightarrow (q_2 \vee (m_2 = t)) \\
o\_v_2 &\Longrightarrow (q_3 \vee (hold = 2)) \\
o\_v_3 &\Longrightarrow (q_3 \vee (hold = 2)) \\
o\_v_4 &\Longrightarrow (q_4 \vee (m_1 = f)) \\
o\_v_5 &\Longrightarrow (p_4 \vee (hold = 1)) \\
o\_v_6 &\Longrightarrow (q_1 \vee (m_2 = f))
\end{aligned}
$$

②

$$p_1 \vee q_1 \vee (m_1 = f) \vee (m_2 = f) \vee (hold = 1)$$

③$_1$

$$\neg p_4 \wedge \neg q_4 \wedge \neg(m_1 = t) \wedge \neg(m_2 = t) \wedge \neg(hold = 1)$$

③$_2$

$$\neg p_4 \wedge \neg q_4 \wedge \neg(m_1 = t) \wedge \neg(m_2 = t) \wedge \neg(hold = 2)$$

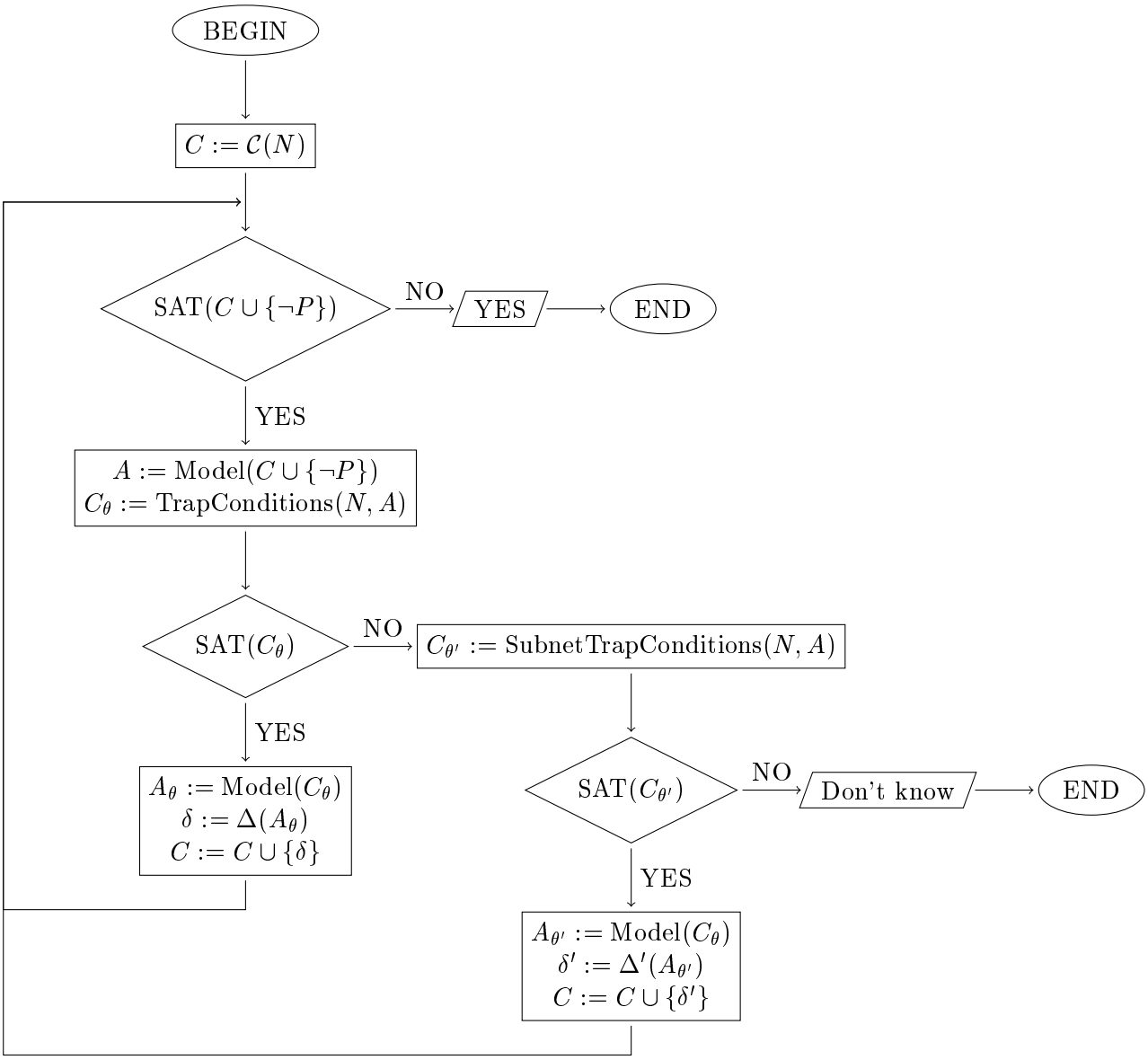
1.8 Benchmark

Give by Daniel Kroening:

		Our tool			
		positive	don't know	timeout 10 min	
Mist	positive	8	3	0	11
	negative	0	28	0	28
	timeout 1 min	15	23	0	38
		23	54	0	77

2 Cyclic net

2.1 Method



2.2 Petri net

2.3 Constraints C_0

$$
\begin{aligned}
s_1 &= 1 - t_2 \\
s_2 &= 0 + t_1 - t_2 \\
s_3 &= 0 + t_2 \\
s_4 &= 0 + t_3 \\
s_5 &= 1 - t_1 + t_3 \\
s_6 &= 0 + t_1 - t_3 \\
s_1 &\geq 1 \\
s_2 \geq 1 \quad & s_4 \geq 1 \\
s_5 &\geq 1 \\
\forall p \in S \cup T : p &\geq 0
\end{aligned}
$$

$$\delta_1' = (t_1 > 0) \wedge (t_2 = 0) \wedge (t_3 > 0) \implies (s_3 > 0)$$

2.4 A_1

$$
\begin{aligned}
s_1 &= 1 \\
s_2 &= 1 \\
s_3 &= 0 \\
s_4 &= 1 \\
s_5 &= 1 \\
s_6 &= 0 \\
t_1 &= 1 \\
t_2 &= 0 \\
t_3 &= 1
\end{aligned}
$$

2.5 $A_{\theta' 1}$

$$
\begin{aligned}
s_1 &= 0 \\
s_2 &= 0 \\
s_3 &= 1 \\
s_4 &= 0 \\
s_5 &= 0 \\
s_6 &= 0
\end{aligned}
$$

2.6 C_θ

$$
\begin{aligned}
s_1 &\implies o\_t_1 \wedge o\_t_2 \\
s_2 &\implies o\_t_2 \\
s_3 &\implies o\_t_3 \\
s_4 &\implies true \\
s_5 &\implies o\_t_1 \\
s_6 &\implies o\_t_2 \\
o\_t_1 &\implies (s_1 \vee s_2 \vee s_6) \\
o\_t_2 &\implies s_3 \\
o\_t_3 &\implies (s_3 \vee s_4 \vee s_5)
\end{aligned}
$$

$$s_1 \vee s_5$$

$$\neg s_1 \wedge \neg s_2 \wedge \neg s_4 \wedge \neg s_5$$

2.7 $C_{\theta'}$

$$
\begin{aligned}
s_1 &\implies o\_t_1 \wedge o\_t_2 \\
s_2 &\implies o\_t_2 \\
s_3 &\implies o\_t_3 \\
s_4 &\implies true \\
s_5 &\implies o\_t_1 \\
s_6 &\implies o\_t_2 \\
o\_t_1 = (t_1 > 0) &\implies (s_1 \vee s_2 \vee s_6) \\
o\_t_2 = (t_2 > 0) &\implies s_3 \\
o\_t_3 = (t_3 > 0) &\implies (s_3 \vee s_4 \vee s_5)
\end{aligned}
$$

$$(t_1 = 1) \wedge (t_2 = 0) \wedge (t_3 = 1)$$

$$s_1 \vee s_2 \vee s_3 \vee s_4 \vee s_5 \vee s_6$$

$$\neg s_1 \wedge \neg s_2 \wedge \neg s_4 \wedge \neg s_5$$

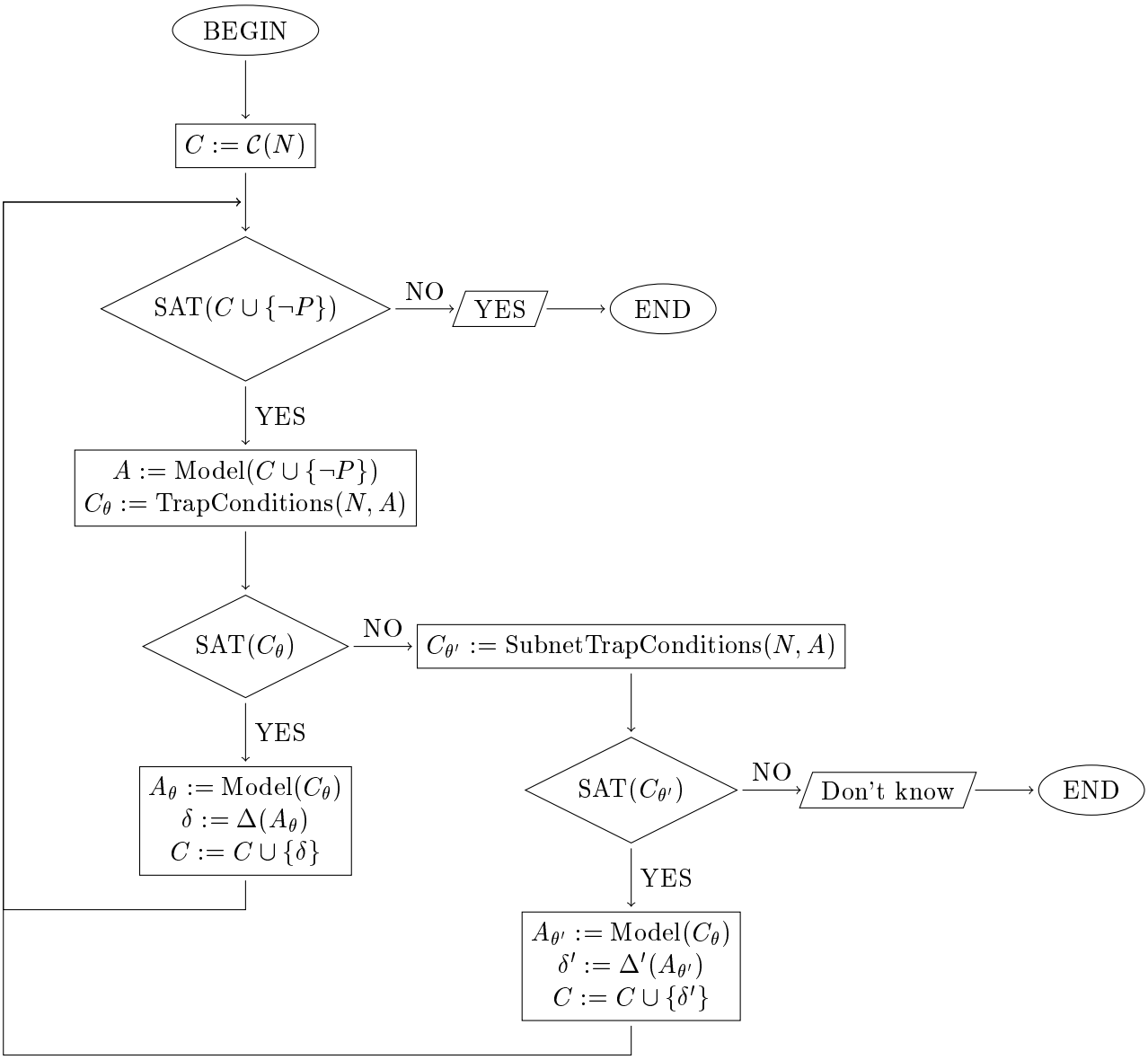
2.8 Benchmark

Give by Daniel Kroening:

		Our tool			
		positive	don't know	timeout 10 min	
Mist	positive	8	3	0	11
	negative	0	28	0	28
	timeout 1 min	15	19	4	38
		23	50	4	77

3 Empty trap net

3.1 Method



3.2 Petri net

3.3 Constraints C_0

$$
\begin{aligned}
s_1 &= 1 - t_2 \\
s_2 &= 0 + t_1 - t_2 \\
s_3 &= 0 + t_2 \\
s_4 &= 0 + t_3 \\
s_5 &= 1 - t_1 + t_3 \\
s_6 &= 0 + t_1 - t_3 \\
s_1 &\geq 1 \\
s_2 &\geq 1 \quad s_4 \geq 1 \\
s_5 &\geq 1 \\
\forall p \in S \cup T : p &\geq 0
\end{aligned}
$$

$$\delta_1' = (t_1 > 0) \wedge (t_2 = 0) \wedge (t_3 > 0) \implies (s_3 > 0)$$

3.4 A_1

$$
\begin{aligned}
s_1 &= 1 \\
s_2 &= 1 \\
s_3 &= 0 \\
s_4 &= 1 \\
s_5 &= 1 \\
s_6 &= 0 \\
t_1 &= 1 \\
t_2 &= 0 \\
t_3 &= 1
\end{aligned}
$$

3.5 $A_{\theta' 1}$

$$
\begin{aligned}
s_1 &= 0 \\
s_2 &= 0 \\
s_3 &= 1 \\
s_4 &= 0 \\
s_5 &= 0 \\
s_6 &= 0
\end{aligned}
$$

3.6 C_θ

$$
\begin{aligned}
s_1 &\implies o\_t_1 \wedge o\_t_2 \\
s_2 &\implies o\_t_2 \\
s_3 &\implies o\_t_3 \\
s_4 &\implies true \\
s_5 &\implies o\_t_1 \\
s_6 &\implies o\_t_2 \\
o\_t_1 &\implies (s_1 \vee s_2 \vee s_6) \\
o\_t_2 &\implies s_3 \\
o\_t_3 &\implies (s_3 \vee s_4 \vee s_5)
\end{aligned}
$$

$$s_1 \vee s_5$$

$$\neg s_1 \wedge \neg s_2 \wedge \neg s_4 \wedge \neg s_5$$

3.7 $C_{\theta'}$

$$
\begin{aligned}
s_1 &\implies o\_t_1 \wedge o\_t_2 \\
s_2 &\implies o\_t_2 \\
s_3 &\implies o\_t_3 \\
s_4 &\implies true \\
s_5 &\implies o\_t_1 \\
s_6 &\implies o\_t_2 \\
o\_t_1 = (t_1 > 0) &\implies (s_1 \vee s_2 \vee s_6) \\
o\_t_2 = (t_2 > 0) &\implies s_3 \\
o\_t_3 = (t_3 > 0) &\implies (s_3 \vee s_4 \vee s_5)
\end{aligned}
$$

$$(t_1 = 1) \wedge (t_2 = 0) \wedge (t_3 = 1)$$

$$s_1 \vee s_2 \vee s_3 \vee s_4 \vee s_5 \vee s_6$$

$$\neg s_1 \wedge \neg s_2 \wedge \neg s_4 \wedge \neg s_5$$

3.8 Benchmark

Give by Daniel Kroening:

		Our tool			
		positive	don't know	timeout 10 min	
Mist	positive	8	3	0	11
	negative	0	28	0	28
	timeout 1 min	15	19	4	38
		23	50	4	77