A linear conjunctive grammar for the circuit value problem

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Abstract

In this paper we show that the **P**-complete language of yes-instances of Circuit Value Problem under a certain supplied encoding can be generated by a linear conjunctive grammar.

Contents

1 Introduction

Conjunctive grammars, introduced in [1], are context-free grammars augmented with an explicit intersection operation. Linear conjunctive grammars are a subclass of conjunctive grammars defined by the same kind of restriction imposed on the body of rules as used to obtain linear context-free grammars out of general context-free.

A linear conjunctive grammar is defined as a quadruple $G = (\Sigma, N, P, S)$, where Σ is the alphabet of terminal symbols, N is the set of nonterminal symbols, $S \in N$ is the start symbol, and the rules from P are of the form

$$A \to u_1 B_1 v_1 \& \ldots \& u_n B_n v_n \quad (n \geqslant 1) \tag{1a}$$

$$A \to w, \tag{1b}$$

where A, B_i are nonterminal symbols and u_i, v_i, w are terminal strings. The conjunction has semantics of set-theoretic intersection of the languages generated by the individual strings. The language generated by a grammar is formally defined by a means of derivation, in which a nonterminal can be rewritten with a body of a rule enclosed in parentheses, and a conjunction of several identical terminal strings enclosed in parentheses can be rewritten with one such string without the parentheses. The language family generated by linear conjunctive grammars includes many nontrivial (and non-context-free) languages, such as $\{a^n b^n c^n \mid n \geqslant 0\}$, $\{wcw \mid w \in \{a,b\}^*\}$ [1], $\{ba^2ba^4b \ldots ba^{2n-2}ba^{2n}b \mid n \geqslant 0\}$ $\{(wc)^{|w|-1}w \mid w \in \{a,b\}^*\}$ or the language of all computations of a given Turing machine [3].

Linear conjunctive grammars are known to be computationally equivalent to triangular trellis automata (also known as real-time one-sided cellular automata) [5], which we will define as a quintuple $M = (\Sigma, Q, I, \delta, F)$, where Σ is the input alphabet, Q is a finite nonempty set of states, $I : \Sigma \to Q$ is a homomorphism that maps each symbol of the input alphabet to a single state, and the string of states $I(w) \in \Sigma^+$ forms the initial configuration of the automaton on an input string $w \in \Sigma^+$, $\delta : Q \times Q \to Q$ converts a pair of states into a single state, and is used to transform a configuration

$$(q_1, q_2, q_3, \ldots, q_{n-1}, q_n) \tag{2a}$$

to a configuration

$$(\delta(q_1, q_2), \delta(q_2, q_3), \ldots, \delta(q_{n-1}, q_n)), \tag{2b}$$

which is being done until the string shrinks to one state, when the membership of this single state in F determines whether the input string is accepted. The result of the computation on a string of states $\alpha \in Q^+$ is denoted as $\Delta(\alpha)$, and consequently the language generated by a triangular trellis automaton $M = (\Sigma, Q, I, \delta, F)$ is

$$L(M) = \{w \mid w \in \Sigma^+,\ \Delta(I(w)) \in F\} \tag{3}$$

Some theoretical properties of linear conjunctive grammars have been worked out in [3, 5]. The membership problem for linear conjunctive grammars (as well as that for general conjunctive grammars) is known to be **P**-complete [2]. In this paper we obtain a somewhat related and quite surprising result that not only they have a **P**-complete membership problem, but some ***P**-complete languages* can in fact be *generated* by particular linear conjunctive grammar. This is being done by constructing a linear conjunctive grammar for Circuit Value Problem (CVP), the basic **P**-complete problem.

2 The problem and its encoding

Let $(C_1, \ldots, C_n)$ $(n \geqslant 1)$ be a circuit with inputs $x_1, \ldots, x_m$ $(m \geqslant 1)$, where each gate C_k is one of the following:

1. An input x_i $(1 \leqslant i \leqslant m)$;
2. Negation of a preceding gate: $\neg C_i$ $(i < k)$
3. Conjunction of two preceding gates: $C_i \wedge C_j$ $(i < j < k)$,
4. Disjunction of two preceding gates: $C_i \vee C_j$ $(i < j < k)$.

The gate C_n is called the output of the circuit.

The Circuit Value Problem (CVP is stated as follows: given a circuit and a Boolean vector of input values $(\sigma_1, \ldots, \sigma_m)$, determine, whether the circuit evaluates to true on this vector. The pair *(circuit, vector of input values)* is called an instance of CVP.

Let us develop one particular encoding for instances of CVP as strings over a finite alphabet. We shall use the alphabet

$$\Sigma = \{a, b, c_r, c_\wedge, c_\vee, c_w, c_{w\neg}, c_{w0}, c_{w1}\}, \tag{4}$$

in which:

- the symbol a is used to specify the total number of gates in the circuit in unary notation;
- the symbol b is used to refer to the gates of the circuit by writing their numbers in unary notation;
- c_r is a read command;
- $c_\wedge$ and $c_\vee$ are commands for computing conjunction and disjunction respectively;
- c_w means "write";
- $c_{w\neg}$ means "write negation";
- c_{w0} and c_{w1} mean "write zero" and "write one" respectively.

Let $(\{x_1, \ldots, x_m\}, \{C_1, \ldots C_n\})$ be an instance of circuit value problem. For each gate C_k, define its literal representation $\omega(C_k)$:

$$\omega(C_k = x_i) = \begin{cases} b^{k-1}c_{w0}, & \text{if } x_i = 0 \\ b^{k-1}c_{w1}, & \text{if } x_i = 1 \end{cases} \tag{5a}$$

$$\omega(C_k = C_i \wedge C_j) = b^{i-1}c_r b^{j-i-1}c_\wedge b^{k-j-1}c_w \quad (i < j < k) \tag{5b}$$

$$\omega(C_k = C_i \vee C_j) = b^{i-1}c_r b^{j-i-1}c_\vee b^{k-j-1}c_w \quad (i < j < k) \tag{5c}$$

$$\omega(C_k = \neg C_i) = b^{i-1}c_r b^{k-i-1}c_{w\neg} \quad (i < k) \tag{5d}$$

It should be mentioned that $|\omega(C_k) = k|$ for every k-th gate of any of the four types (5).

Finally, define the literal representation of the whole instance of the problem as

$$a^n \cdot \omega(C_1) \cdot \ldots \cdot \omega(C_n) \in \Sigma^* \tag{6}$$

Example 1. *Consider the circuit* $\{C_1 = x_1, C_2 = x_2, C_3 = C_1 \wedge C_2, C_4 = \neg C_2, C_5 = C_3 \vee C_4\}$ *depending on the variables* x_1, x_2*, which is given in Figure 1. It can easily be checked that the circuit implements implication* $f(x_1, x_2) = x_2 \to x_1$*.*

The literal representation of the gates C_3*,* C_4 *and* C_5 *does not depend on the input, and is* $\omega(C_3 = C_1 \wedge C_2) = c_r c_\wedge c_w$*,* $\omega(C_4 = \neg C_2) = bc_r bc_{w\neg}$*,* $\omega(C_5 = C_3 \vee C_4) = bbc_r c_\vee c_w$*.*

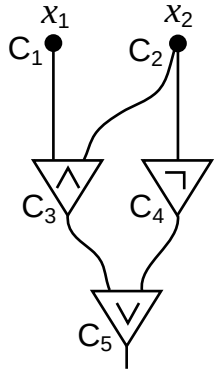

Figure 1: A sample circuit implementing $f(x_1, x_2) = x_2 \rightarrow x_1$.

For given values of x_1 and x_2, the literal representation of the first two gates is $\omega(C_1 = x_1) = c_{w\sigma_1}$, $\omega(C_2 = x_2) = bc_{w\sigma_2}$, and consequently the whole instance of CVP will be represented as

$$aaaaa\ c_{w\sigma_1}\ bc_{w\sigma_2}\ c_r c_\wedge c_w\ bc_r bc_{w\neg}\ bbc_r c_\vee c_w \tag{7}$$

The encoding of CVP presented in this section is somewhat different from the traditional encoding: first, the numbers of gates are usually given in binary notation; second, the vector of input values is usually given once and input variables can be used more than once. While there is obviously no loss of generality in the assumption that each input value is explicitly used only once, it is necessary to justify that the problem remains **P**-complete under the encoding that uses unary notation to represent the numbers of gates.

It can be easily shown that there is no exponential blowup in the transition to the unary notation, because the numbers notated refer to the numbers of the gates, and thus are bounded by the size of the input; consequently, the descriptions of circuits using binary notation can be converted to unary notation with no more than quadratic blowup, and this conversion can be easily done in logarithmic space, which proves that the language of yes-instances of CVP under the given encoding is a **P**-complete language.

3 Checking the syntax

The first thing to do is to check whether the given string is syntactically correct – i.e., whether it represents an instance of CVP encoded using the method of Section 2. This task is already less trivial than could be expected, because even this language is non-context-free (indeed, if we suppose that it is context-free, then its homomorphic image under $h(\text{every symbol}) = a$, which equals $\{a^{\frac{n(n+3)}{2}} \mid n \geqslant 1\}$, is also context-free, which is known to be untrue).

We have to check that the string is of the form (6), or, equivalently, of the form

$$a^n u_1 u_2 \dots u_n, \tag{8}$$

where every u_k is a string of exactly k symbols of the form

$$b^* c_{w0}, \tag{9a}$$
$$b^* c_{w1}, \tag{9b}$$
$$b^* c_r b^* c_{w\neg}, \tag{9c}$$
$$b^* c_r b^* c_\wedge b^* c_w \quad \text{or} \tag{9d}$$
$$b^* c_r b^* c_\vee b^* c_w \tag{9e}$$

The last (and only the last) symbol of each u_k is one of $\{c_w, c_{w\neg}, c_{w0}, c_{w1}\}$ and is called *the write command of the gate*.

The set of valid literal representations of circuits can be defined inductively: a string $w \in \Sigma^*$ is a syntactically correct description of a circuit if and only if

- (Basis) w equals ac_{w0} or ac_{w1}.
- (Induction step) The string w can be factorized as

$$w = a^n u v \quad (n \geqslant 2;\ u, v \in (\Sigma \setminus \{a\})^+, |v| = n), \tag{10}$$

  where u ends with a write command, v is of the form (9) and $a^{n-1}u \in \Sigma^*$ is a syntactically correct description of a circuit.

It is not hard to construct a linear conjunctive grammar that will generate the set of strings conforming to this definition:

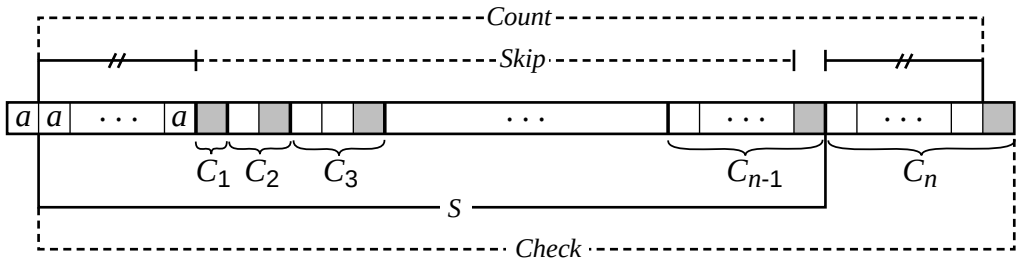

Figure 2: Checking the syntax by a linear conjunctive grammar.

$$S \to a\ Count\ s_{write}\ \&\ a\ Check \quad (s_{write} \in \{c_{w0}, c_{w1}, c_{w\neg}, c_w\}) \tag{11a}$$
$$S \to a\ s_{wdigit} \quad (s_{wdigit} \in \{c_{w0}, c_{w1}\}) \tag{11b}$$
$$Count \to a\ Count\ s_{inside} \quad (s_{inside} \in \{b, c_\vee, c_{w\wedge}, c_r\}) \tag{11c}$$
$$Count \to Skip\ s_{write} \quad (s_{write} \in \{c_{w0}, c_{w1}, c_{w\neg}, c_w\}) \tag{11d}$$
$$Skip \to Skip\ s_{not\text{-}a} \quad (s_{not\text{-}a} \in \{b, c_\vee, c_{w\wedge}, c_r, c_{w0}, c_{w1}, c_{w\neg}, c_w\}) \tag{11e}$$
$$Skip \to \epsilon \tag{11f}$$
$$Check \to Check_1\ c_{w0} \mid Check_1\ c_{w1} \mid Check_2\ c_{w\neg} \mid Check_3\ c_w \tag{11g}$$
$$Check_1 \to Check_1\ b \mid S \tag{11h}$$
$$Check_2 \to Check_2\ b \mid Check_1\ cr \tag{11i}$$
$$Check_3 \to Check_3\ b \mid Check_2\ c_\vee \mid Check_2\ c_\wedge \tag{11j}$$

The start symbol S generates the set of syntactically correct circuit descriptions using the rules (11b) to define the one-gate circuits ac_{w0} and ac_{w1} (basis of induction above), and the inductive rules (11a) that implement the factorization (10), with the nonterminal *Count* comparing the number of symbols in the last gate to the number of prefix a's and afterwards using the nonterminal *Skip* to throw out the rest of the string, and with the nonterminal *Check* simulating a finite automaton to determine whether the last gate is of the form (9), and once the whole of the gate has been read, calling the nonterminal S to determine whether the last $n-1$ a's and the first $n-1$ gates form a correct description of a circuit.

The operation of this grammar is illustrated in Figure 2, where the gray cells denote the write commands from the set $\{c_w, c_{w\neg}, c_{w0}, c_{w1}\}$.

4 Computing the value of a circuit

In this section we solve another problem: given a description of a circuit and assuming that it is syntactically valid, determine whether it evaluates to 1. It turns out that this task can be solved by a triangular trellis automaton; such an automaton will be constructed in this section.

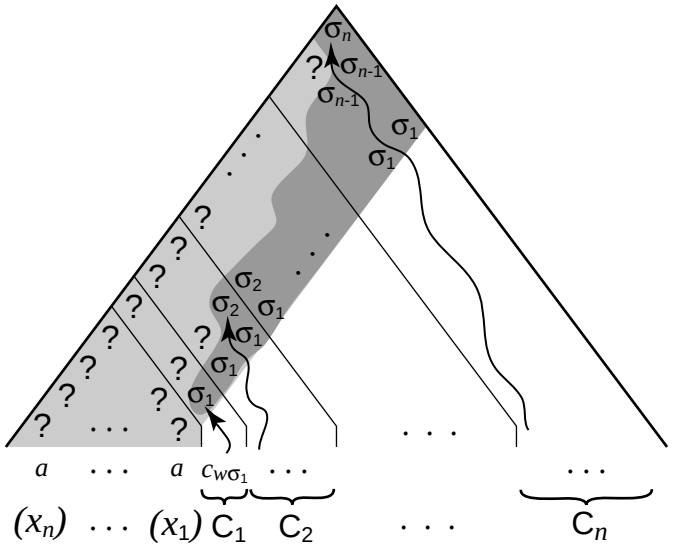

Figure 3: Overview of the computation on a circuit description $a^n\omega(C_1)\ldots\omega(C_n)$.

Before presenting a formal construction of the automaton, let us explain the main idea of the construction. The information flow in the automaton's computation is outlined in Figure 3: the gray band formed by n diagonals starting from the prefix a^n of the whole input string of length $O(n^2)$ is used to store the computed values of the gates, and the description of every gate is used as a microprogram implementing a single assignment statement. The value of i-th gate of a circuit $w = a^n\omega(C_1)\ldots\omega(C_n)$ is stored in the diagonal corresponding to the $(n-i+1)$-th symbol a; initially it is set to "?", and once the value of the gate is computed (exactly at the point $\Delta(I(a^iC_1\ldots C_i))$), the diagonal keeps reproducing this computed value (0 or 1) till the end of the computation; the consequent gates have a read-only access to this value.

Let us consider how the individual gates work, using a conjunction gate $C_k = C_i \wedge C_j$ $(i < j < k)$ as an example. Figure 4 shows some middle point

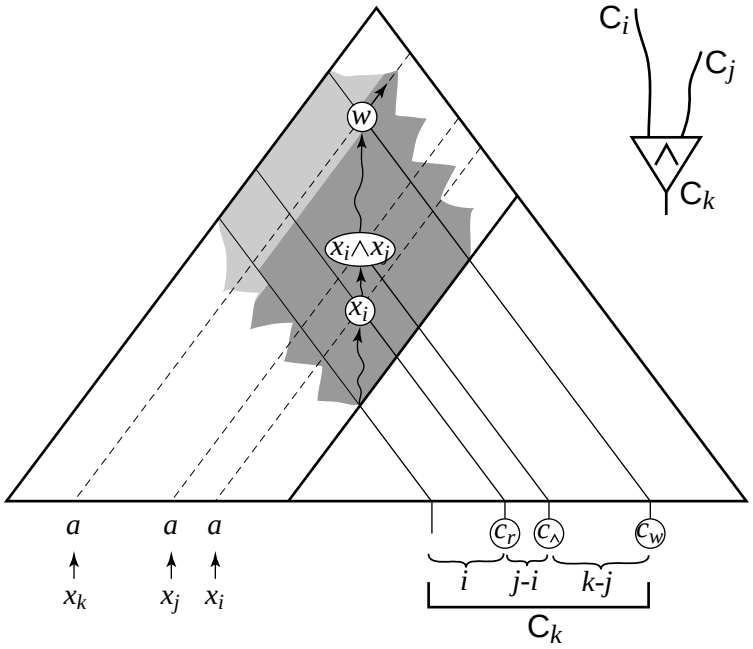

Figure 4: Operation of an individual conjunction gate $C_k = C_i \wedge C_j$.

of the gray band of circuit values, corresponding to the gate C_k. At this point the values of the gates $C_1, \ldots, C_{k-1}$ have already been computed, and the area shown in the figure is expected to use these values to compute the value of C_k.

The literal representation of the gate C_k,

$$b^{i-1}c_r b^{j-i-1}c_\wedge b^{k-j-1}c_w \tag{12}$$

could be, as mentioned above, viewed as a microprogram implementing the assignment statement $C_k = C_i \wedge C_j$. The substring $b^{i-1}c_r$, i symbols long, is used to find the value of the gate C_i in the gray band and to remember its value. The substring $b^{j-i-1}c_\wedge$ seeks the diagonal corresponding to the gate C_j, at the same time carrying the value of the gate C_i; its last symbol $c_\wedge$, instructs the automaton to read the value of the gate C_j and to compute its conjunction with the remembered value of the gate C_i. This value is carried on by the substring $b^{k-j-1}c_w$, which finds the gate C_k, and replaces the question mark there with the computed value $C_i \wedge C_j$.

Let us now construct a triangular trellis automaton to perform this kind

of computation. Define $M = (\Sigma, Q, I, \delta, F)$, where the set of states Q is

$$\underbrace{\{?, 0, 1\}}_{\text{Digit}} \times (\underbrace{\{-, r, \vee, \wedge, w0, w1, w\neg, w\}}_{\text{Commands}} \cup \underbrace{\{\nwarrow, \nwarrow 0, \nwarrow 1, \nearrow, \nearrow 0, \nearrow 1\}}_{\text{Arrows}} \cup \{\text{␣}\}) \tag{13}$$

The first component of every pair, *the digit*, can be 0 or 1 only in the diagonals forming the gray band in Figures 3 and 4, once the value of the corresponding gates is computed (shown in dark gray in these figures); all other cells have ? as the first component.

The second component can be *a command*, *an arrow* or *space*. The eight possible *commands* originate from the input symbols b, c_r, $c_\vee$, $c_\wedge$, c_{w0}, c_{w1}, $c_{w\neg}$ and c_w respectively; they are propagated in the left direction until executed, where execution results in conversion to an arrow or in alteration of a digit in the diagonal. The *arrows* organize the data flow necessary to execute commands: their intended direction is upward, but since triangular trellis automata do not support direct upward communication, it is being implemented by a pair of a left-up and a right-up arrow. An arrow can optionally carry some value, obtained by an earlier read command, a conjunction command or a disjunction command, and intended to be used by some later conjunction, disjunction, write or write negation command. The states with a *space* as a second component are called the *unmarked states* and do not have any task to perform besides holding the digit and propagating it to the right; these states can only appear in the diagonals corresponding to the values of the gates.

We shall use the following compact notation for the states from Q:

- The states of the form $(?, \text{command})$ will be denoted by the name of the command alone – i.e., $w\neg$ means $(?, w\neg)$.
- The states that have space as the second component will be denoted by the first component alone: ?, 0 and 1 mean $(?, \text{␣})$, $(0, \text{␣})$ and $(1, \text{␣})$ respectively.
- The states of the form $(0, \text{command})$ and $(1, \text{command})$ will be denoted as the number with the name of the command as a subscript: $0_\wedge$ means $(0, \wedge)$ and 1_{w0} means $(1, w0)$.
- The states that have an arrow as the second component will be denoted with their second component as a superscript: $0^\nearrow$ and $1^{\nwarrow 0}$ mean $(0, \nearrow)$ and $(1, \nwarrow 0)$ respectively.

A state is called *an activator* if one of the following holds: (i) it is an unmarked state, (ii) it is marked with a right arrow, or (iii) it holds the digit 0 or 1, and it is marked with a write command ($w0$, $w1$, w or $w\neg$). The full list of activators is $\{?, 0, 1, 0_{w0}, 1_{w0}, 0_{w1}, 1_{w1}, 0_{w}, 1_{w}, 0_{w\neg}, 1_{w\neg}, ?^{\nearrow}, 0^{\nearrow}, 1^{\nearrow}, ?^{\nearrow 0}, 0^{\nearrow 0}, 1^{\nearrow 0}, ?^{\nearrow 1}, 0^{\nearrow 1}, 1^{\nearrow 1}\}$.

The initial function $I : \Sigma \to Q$ maps a to "?", b to "$-$" and every command $c_{\ldots}$ to the state with the same name as the subscript of c (e.g., $I(c_{w0}) = w0$). The values of I are tabulated in Table 1.

input symbol	a	b	c_r	$c_\wedge$	$c_\vee$	c_w	$c_{w\neg}$	c_{w0}	c_{w1}
I(input symbol)	?	$-$	r	$\wedge$	$\vee$	w	$w\neg$	$w0$	$w1$

Table 1: The initial function of the automaton.

Now let us specify the transition function of the automaton. For every $(q', q'') \in Q \times Q$, define $\delta(q', q'')$ as follows:

Reduplication of a digit If q' is either an unmarked state or is marked with a write command, while q'' is either unmarked or marked with a right arrow, then $\delta(q', q'')$ is an unmarked state that inherits the digit from q'.

Reduplication of a command If q' is not an activator and q'' is marked with some command, then $\delta(q', q'')$ is formed by the digit from q' and by the command from q''.

Turning of an arrow If q'' is marked with a left arrow – i.e., the second component of q'' is one of $\{\nwarrow, \nearrow 0, \nwarrow 1\}$ – then the second component of $\delta(q', q'')$ is a right arrow loaded with the same cargo as the left arrow of q''; the digit in $\delta(q', q'')$ is inherited from q'.

Execution of a command If q' is an activator and q'' is marked with a command, then

- If q'' is marked with a write command ($w0$, $w1$, w or $w\neg$), then it can be proved that the digit in q' must be ?. Additionally, it can be proved that if q'' is marked with w or $w\neg$, then q' is marked with a right arrow carrying a digit.

  The state $\delta(q', q'')$ is then defined as

  1. $(0, \lrcorner)$, if q'' is marked with $w0$;

2. $(1, \lrcorner)$, if q'' is marked with $w1$;
3. (the digit on the arrow in q', $\lrcorner$), if q'' is marked with w;
4. (negation of the digit on the arrow in q', $\lrcorner$), if q'' is marked with $w\neg$;

Note that this is the only case when the digit in $\delta(q', q'')$ differs from the digit in q'.

- If q'' is marked with a read command r, then $\delta(q', q'')$ retains the digit from q' and is marked with a left arrow carrying the same digit from q' – i.e., $\delta(q', q'')$ can be $0^{\nwarrow 0}$ or $1^{\nwarrow 1}$ depending on q'.
- If q'' is marked with a dash command (meaning "proceed to the next row"), then $\delta(q', q'')$ retains the digit from q' and
  - if q' is marked with a right arrow carrying some digit, then $\delta(q', q'')$ is marked with a left arrow carrying the same digit.
  - if q' is marked with something else, then $\delta(q', q'')$ is marked with a left arrow carrying nothing.
- If q'' is marked with a $\wedge$ or $\vee$ command, then it can be proved that q' is marked with a right arrow carrying a digit. $\delta(q', q'')$ retains the digit from q' and is marked with a left arrow carrying the digit computed by the command:
  - If q'' is marked with $\wedge$ command, then $\delta(q', q'')$ is marked with the conjunction of the first component of q' and the digit carried by the arrow in q'.
  - If q'' is marked with $\vee$ command, then $\delta(q', q'')$ is marked with the disjunction of the first component of q' and the digit carried by the arrow in q'.

The values of the transition function δ constructed in accordance with these rules are given in Tables 2 to 10 on pages 14 to 19 (the whole 45×45 table is too large to fit in a single page, and is therefore splitted into nine tables). The empty cells in these tables are the transitions left undefined; they can be set arbitrarily, because it can be proved that they are not accessible on any syntactically correct input.

The sole accepting state is $(1, \lrcorner)$, or 1 in the short notation.

Consider the circuit from Example 1 in Section 2 (see Figure 1), and let $x_1 = 1$ and $x_2 = 0$. Then the corresponding instance of CVP, illustrated in

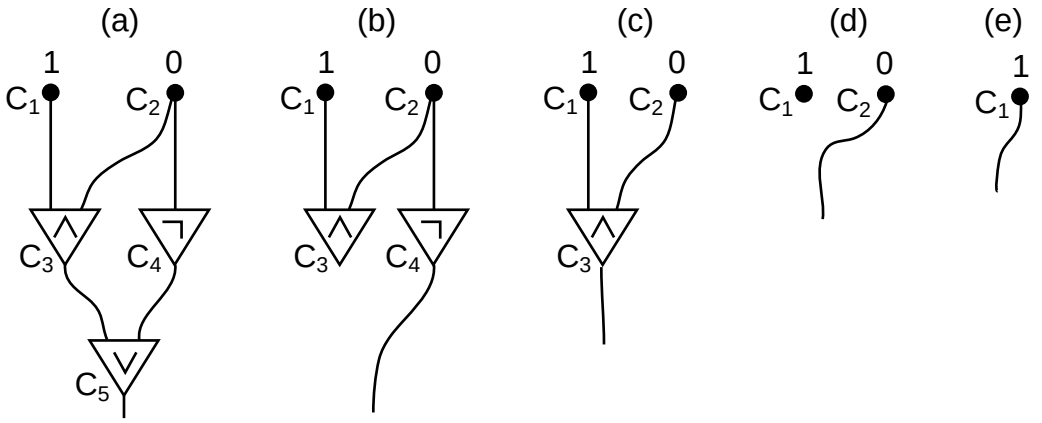

Figure 5: Sample circuits.

Figure 5(a) is encoded as

$$aaaaa\ c_{w1}\ bc_{w0}\ c_r c_\wedge c_w\ bc_r bc_{w\neg}\ bbc_r c_\vee c_w \tag{14a}$$

and the computation of the automaton on the string (14a) is given in Figure 6 on page 18; this is an accepting computation, because 1 is an accepting state. It is easily seen that the computations of the same automaton on the four substrings of (14a) that also denote circuits,

$$aaaa\ c_{w1}\ bc_{w0}\ c_r c_\wedge c_w\ bc_r bc_{w\neg} \tag{14b}$$
$$aaa\ c_{w1}\ bc_{w0}\ c_r c_\wedge c_w \tag{14c}$$
$$aa\ c_{w1}\ bc_{w0} \tag{14d}$$
$$a\ c_{w1} \tag{14e}$$

are included in the computation on (14a) (as in Figure 6) as "subcomputations". It can be observed that the automaton accepts the circuit descriptions (14b) and (14e) (these circuits are illustrated in Figure 5(b,e)) and rejects (14c) and (14d), given in Figure 5(c,d).

5 Putting things together

Having constructed a linear conjunctive grammar for the language of syntactically valid descriptions of circuits (in Section 3) and a triangular trellis

	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nwarrow}$	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$
$?$	$?$	$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$0^{\nearrow 0}$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$-$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$w0$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w1$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$\wedge$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$\vee$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
r		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
w	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w\neg$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$?^{\nwarrow}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 0}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 1}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow}$		$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$?$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 0}$		$?^{\nwarrow 0}$	0	1	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	0	1	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 1}$		$?^{\nwarrow 1}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	1	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			

Table 2: The transition function of the automaton, part 1 of 9 (? by ?).

	0	0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nwarrow}$	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$
$?$	$?$	$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$0^{\nearrow 0}$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$-$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$w0$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w1$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$\wedge$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$\vee$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
r		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
w	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w\neg$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$?^{\nwarrow}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 0}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 1}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow}$		$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$?$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 0}$		$?^{\nwarrow 0}$	0	1	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	0	1	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 1}$		$?^{\nwarrow 1}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	1	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			

Table 3: The transition function of the automaton, part 2 of 9 (? by 0).

	1	1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nwarrow}$	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$
$?$	$?$	$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$0^{\nearrow 0}$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$-$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$w0$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w1$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$\wedge$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$\vee$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
r		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
w	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$w\neg$	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$	$?$	$?$	$?$
$?^{\nwarrow}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 0}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nwarrow 1}$		$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow}$		$?^{\nwarrow}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	$?$	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 0}$		$?^{\nwarrow 0}$	0	1	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	0	1	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			
$?^{\nearrow 1}$		$?^{\nwarrow 1}$	0	1	$?^{\nwarrow 1}$	$?^{\nwarrow 1}$	$?^{\nwarrow}$	1	0	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$			

Table 4: The transition function of the automaton, part 3 of 9 (? by 1).

	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nwarrow}$	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$
0	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{-}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w0}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{w1}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{\wedge}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0_{\vee}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{r}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{w\neg}$	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0^{\nwarrow}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 0}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 1}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow}$		$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$?$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 0}$		$0^{\nwarrow 0}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	0	1	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 1}$		$0^{\nwarrow 1}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	1	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			

Table 5: The transition function of the automaton, part 4 of 9 (0 by ?).

	0	0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nwarrow}$	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$
0	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{-}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w0}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{w1}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{\wedge}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0_{\vee}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{r}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{w\neg}$	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0^{\nwarrow}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 0}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 1}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow}$		$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$?$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 0}$		$0^{\nwarrow 0}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	0	1	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 1}$		$0^{\nwarrow 1}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	1	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			

Table 6: The transition function of the automaton, part 5 of 9 (0 by 0).

	1	1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nwarrow}$	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$
0	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{-}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w0}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
0_{w1}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{\wedge}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0_{\vee}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{r}		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
0_{w}	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0_{w\neg}$	0	$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$0^{\nearrow 0}$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$	0	0	0
$0^{\nwarrow}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 0}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nwarrow 1}$		0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow}$		$0^{\nwarrow}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	$?$	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 0}$		$0^{\nwarrow 0}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	$0^{\nwarrow 0}$	0	1	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			
$0^{\nearrow 1}$		$0^{\nwarrow 1}$	0	1	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nwarrow 0}$	1	0	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$			

Table 7: The transition function of the automaton, part 6 of 9 (0 by 1).

	$?$	$-$	$w0$	$w1$	$\wedge$	$\vee$	r	w	$w\neg$	$?^{\nwarrow}$	$?^{\nwarrow 0}$	$?^{\nwarrow 1}$	$?^{\nearrow}$	$?^{\nearrow 0}$	$?^{\nearrow 1}$
1	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_{-}		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{w0}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_{w1}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_{\wedge}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1_{\vee}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{r}		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{w}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_{w\neg}$	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1^{\nwarrow}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 0}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 1}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow}$		$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$?$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 0}$		$1^{\nwarrow 0}$	0	1	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	0	1	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 1}$		$1^{\nwarrow 1}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	1	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			

Table 8: The transition function of the automaton, part 7 of 9 (1 by ?).

	0	0_{-}	0_{w0}	0_{w1}	$0_{\wedge}$	$0_{\vee}$	0_{r}	0_{w}	$0_{w\neg}$	$0^{\nwarrow}$	$0^{\nwarrow 0}$	$0^{\nwarrow 1}$	$0^{\nearrow}$	$0^{\nearrow 0}$	$0^{\nearrow 1}$
1	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_{-}		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{w0}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_{w1}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_{\wedge}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1_{\vee}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{r}		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{w}	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_{w\neg}$	1	$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1^{\nwarrow}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 0}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 1}$		1_{-}	1_{w0}	1_{w1}	$1_{\wedge}$	$1_{\vee}$	1_{r}	1_{w}	$1_{w\neg}$	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow}$		$1^{\nwarrow}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$?$	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 0}$		$1^{\nwarrow 0}$	0	1	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	0	1	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 1}$		$1^{\nwarrow 1}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	1	0	$1^{\nearrow}$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			

Table 9: The transition function of the automaton, part 8 of 9 (1 by 0).

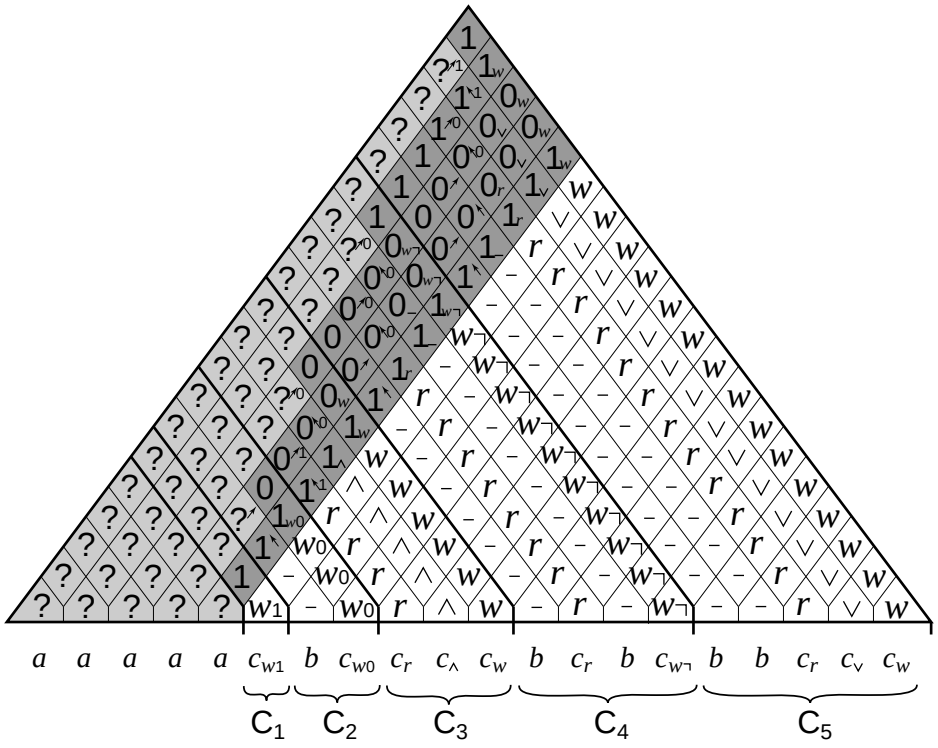

Figure 6: Sample computation of the automaton for CVP.

automaton that determines whether such a syntactically valid description denotes a circuit evaluating to one (in Section 4), we can easily notice that the intersection of these two languages is exactly the language of yes-instance of CVP under the encoding used. Now the results on computational equivalence of linear conjunctive grammars and triangular trellis automata [5], together with the closure of the languages they generate under intersection [3], directly imply that this **P**-complete language is generated by a certain linear conjunctive grammar, or, equivalently, accepted by a certain triangular trellis automaton. A complete linear conjunctive grammar for CVP is provided in Appendix A, and all strings of length less than 20 generated by this grammar are listed in Appendix B.

The result of this purely technical paper, besides partially satisfying our curiousity about the generative capabilities of linear conjunctive grammars, has numerous theoretical implications, which will be discussed in an upcoming article.

	1	1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nwarrow$	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$
1	1	$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_-		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_{w0}	1	$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
1_{w1}	1	$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_\wedge$		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1_\vee$		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_r		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
1_w	1	$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1_{w\neg}$	1	$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$0^{\nearrow 0}$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$	1	1	1
$1^\nwarrow$		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 0}$		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nwarrow 1}$		1_-	1_{w0}	1_{w1}	$1_\wedge$	$1_\vee$	1_r	1_w	$1_{w\neg}$	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^\nearrow$		$1^\nwarrow$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$?$	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 0}$		$1^{\nwarrow 0}$	0	1	$1^{\nwarrow 0}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	0	1	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			
$1^{\nearrow 1}$		$1^{\nwarrow 1}$	0	1	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	$1^{\nwarrow 1}$	1	0	$1^\nearrow$	$1^{\nearrow 0}$	$1^{\nearrow 1}$			

Table 10: The transition function of the automaton, part 9 of 9 (1 by 1).

A A complete grammar for CVP

The following linear conjunctive grammar is comprised of the grammar defined in Section 3, the grammar produced out of the automaton constructed in Section 4 using the methods of [5] (the only deviation from the methods of [5] is in that some entries of the transition table of the original automaton were left undefined, and no rules corresponding to these entries were created; this helped to make the grammar a somewhat shorter, without altering the language it generates), new start symbol S with a single rule $S \to S'\&S''$, which effectively forces both the syntactical and semantic conditions to hold at the same time.

The set of terminal symbols is $\Sigma = \{a, b, c_r, c_\wedge, c_\vee, c_w, c_{w\neg}, c_{w0}, c_{w1}\}$. The set of nonterminals is the union of $\{S\}$, $\{S', \mathit{Count}, \mathit{Skip}, \mathit{Check}, \mathit{Check}_1, \mathit{Check}_2, \mathit{Check}_3\}$ and $\{S''$, ?, 0, 1, $-$, 0_-, 1_-, $w0$, 0_{w0}, 1_{w0}, $w1$, 0_{w1}, 1_{w1}, $\wedge$, $0_\wedge$, $1_\wedge$, $\vee$, $0_\vee$, $1_\vee$, r, 0_r, 1_r, w, 0_w, 1_w, $w\neg$, $0_{w\neg}$, $1_{w\neg}$, $?^\nwarrow$, $0^\nwarrow$, $1^\nwarrow$, $?^{\nwarrow 0}$, $0^{\nwarrow 0}$, $1^{\nwarrow 0}$, $?^{\nwarrow 1}$, $0^{\nwarrow 1}$, $1^{\nwarrow 1}$, $?^\nearrow$, $0^\nearrow$, $1^\nearrow$, $?^{\nearrow 0}$, $0^{\nearrow 0}$, $1^{\nearrow 0}$, $?^{\nearrow 1}$, $0^{\nearrow 1}$, $1^{\nearrow 1}\}$; the total number of nonterminals is $1 + 7 + (45 + 1) = 54$.

The set of rules contains the $1+(6+8+9+11)+(1+1665\cdot 9^2) = 134901$ rules listed below; it should be noted that the overwhelming majority ($1665 \cdot 9^2$) of

these rules were obtained using a formal transformation, and most of them can be shown to generate the empty language. Consequently, the grammar presented in this appendix can be considerably simplified.

$$
\begin{array}{l}
S \to S'\&S'' \\
S' \to a\ Count\ c_{w0}\ \&\ a\ Check \\
S' \to a\ Count\ c_{w1}\ \&\ a\ Check \\
S' \to a\ Count\ c_{w\neg}\ \&\ a\ Check \\
S' \to a\ Count\ c_{w}\ \&\ a\ Check \\
S' \to a\ c_{w0} \\
S' \to a\ c_{w1} \\
Count \to a\ Count\ b \\
Count \to a\ Count\ c_{\vee} \\
Count \to a\ Count\ c_{w\wedge} \\
Count \to a\ Count\ c_{r} \\
Count \to Skip\ c_{w0} \\
Count \to Skip\ c_{w1} \\
Count \to Skip\ c_{w\neg} \\
Count \to Skip\ c_{w} \\
Skip \to Skip\ b \\
Skip \to Skip\ c_{\vee} \\
Skip \to Skip\ c_{w\wedge} \\
Skip \to Skip\ c_{r} \\
Skip \to Skip\ c_{w0} \\
Skip \to Skip\ c_{w1} \\
Skip \to Skip\ c_{w\neg} \\
Skip \to Skip\ c_{w} \\
Skip \to \epsilon \\
Check \to Check_1\ c_{w0} \\
Check \to Check_1\ c_{w1} \\
Check \to Check_2\ c_{w\neg} \\
Check \to Check_3\ c_{w} \\
Check_1 \to Check_1\ b \\
Check_1 \to S' \\
Check_2 \to Check_2\ b \\
Check_2 \to Check_1\ cr \\
Check_3 \to Check_3\ b \\
Check_3 \to Check_2\ c_{\vee} \\
Check_3 \to Check_2\ c_{\wedge}
\end{array}
$$

$$
\begin{array}{l}
S'' \to 1 \\
? \to s\ ?\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 0\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 1\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ \_\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ 0_{\_}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ 1_{\_}\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w0\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w0}\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1_{w0}\&?\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ w1\&?\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 0_{w1}\&?\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 1_{w1}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow 1} \to s\ \wedge\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow 1} \to s\ 0_{\wedge}\&?\ t \quad (\forall s,t \in \Sigma)
\end{array}
$$

$$
\begin{array}{l}
?^{\nwarrow 1} \to s\ 1_{\wedge}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow 1} \to s\ \vee\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow 1} \to s\ 0_{\vee}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow 1} \to s\ 1_{\vee}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ r\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ 0_{r}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nwarrow} \to s\ 1_{r}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ w\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 0_{w}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 1_{w}\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w\neg\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w\neg}\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1_{w\neg}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ ?^{\nwarrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 0^{\nwarrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 1^{\nwarrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ ?^{\nearrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 0^{\nearrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 1^{\nearrow}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ ?^{\nearrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 0^{\nearrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 1^{\nearrow 0}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ ?^{\nearrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 0^{\nearrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
? \to s\ 1^{\nearrow 1}\&?\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ ?\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow} \to s\ \_\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow} \to s\ 0_{\_}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow} \to s\ 1_{\_}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w0\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1_{w0}\&0\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ w1\&0\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 0_{w1}\&0\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 1_{w1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 0} \to s\ \wedge\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 0} \to s\ 0_{\wedge}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 0} \to s\ 1_{\wedge}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 1} \to s\ \vee\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 1} \to s\ 0_{\vee}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 1} \to s\ 1_{\vee}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 0} \to s\ r\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nwarrow 0} \to s\ 0_{r}\&0\ t \quad (\forall s,t \in \Sigma)
\end{array}
$$

$$
\begin{array}{l}
0^{\nwarrow 0} \to s\ 1_{r}\&0\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ w\&0\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 0_{w}\&0\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 1_{w}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w\neg\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w\neg}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1_{w\neg}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow} \to s\ ?^{\nwarrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow} \to s\ 0^{\nwarrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow} \to s\ 1^{\nwarrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ ?^{\nearrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0^{\nearrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1^{\nearrow}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ ?^{\nearrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0^{\nearrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1^{\nearrow 0}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ ?^{\nearrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0^{\nearrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1^{\nearrow 1}\&0\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ ?\&1\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 0\&1\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 1\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow} \to s\ \_\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow} \to s\ 0_{\_}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow} \to s\ 1_{\_}\&1\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w0\&1\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w0}\&1\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 1_{w0}\&1\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ w1\&1\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 0_{w1}\&1\ t \quad (\forall s,t \in \Sigma) \\
1 \to s\ 1_{w1}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ \wedge\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 0_{\wedge}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 1_{\wedge}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ \vee\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 0_{\vee}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 1_{\vee}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ r\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 0_{r}\&1\ t \quad (\forall s,t \in \Sigma) \\
1^{\nwarrow 1} \to s\ 1_{r}\&1\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ w\&1\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 0_{w}\&1\ t \quad (\forall s,t \in \Sigma) \\
?^{\nearrow} \to s\ 1_{w}\&1\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ w\neg\&1\ t \quad (\forall s,t \in \Sigma) \\
0 \to s\ 0_{w\neg}\&1\ t \quad (\forall s,t \in \Sigma)
\end{array}
$$

$0 \to s\ 1_{w\neg}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow 0}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow 1}\&1\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&-\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&-\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&-\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&-\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&-\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&-\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&-\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&-\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&-\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&-\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&-\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&-\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&-\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&-\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&-\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&-\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&-\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&-\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&-\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&-\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&-\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&-\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&-\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&-\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&-\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ -\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 0_-\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 1_-\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ \wedge\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 0_\wedge\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 1_\wedge\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ \vee\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 0_\vee\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 1_\vee\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ r\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 0_r\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 1_r\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ w\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 0_w\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 1_w\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0_-\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ -\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 0_-\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 1_-\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 1_{w0}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ \wedge\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ 0_\wedge\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ 1_\wedge\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ \vee\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ 0_\vee\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ 1_\vee\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ r\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ 0_r\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ 1_r\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ w\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ 0_w\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ 1_w\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1_-\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\&w0\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&w0\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&w0\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&w0\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&w0\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&w0\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&w0\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&w0\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&w0\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&w0\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&w0\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&w0\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&w0\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&w0\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&w0\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&w0\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&w0\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&w0\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&w0\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&w0\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow 0}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow 1}\&w0\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ -\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ 0_-\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ 1_-\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$

$$0 \to s\ 1_{w0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ w1\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0_{w1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1_{w1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ \wedge\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 0_\wedge\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 1_\wedge\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ \vee\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ 0_\vee\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ 1_\vee\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ r\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 0_r\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 1_r\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ w\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 0_w\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 1_w\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ w\neg\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0_{w\neg}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1_{w\neg}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ ?^{\nwarrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ 0^{\nwarrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ 1^{\nwarrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ ?^{\nwarrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ 0^{\nwarrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ 1^{\nwarrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1^{\nearrow}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1^{\nearrow^0}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1^{\nearrow^1}\&0_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ ?\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow} \to s\ -\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow} \to s\ 0_-\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow} \to s\ 1_-\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ w0\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0_{w0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1_{w0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ w1\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0_{w1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1_{w1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ \wedge\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 0_\wedge\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 1_\wedge\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ \vee\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 0_\vee\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 1_\vee\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ r\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 0_r\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nwarrow 1} \to s\ 1_r\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ w\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 0_w\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 1_w\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ w\neg\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0_{w\neg}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1_{w\neg}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^0} \to s\ ?^{\nwarrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^0} \to s\ 0^{\nwarrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^0} \to s\ 1^{\nwarrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^1} \to s\ ?^{\nwarrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^1} \to s\ 0^{\nwarrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1^{\nearrow^1} \to s\ 1^{\nwarrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ ?^{\nearrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0^{\nearrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1^{\nearrow}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ ?^{\nearrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0^{\nearrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1^{\nearrow^0}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ ?^{\nearrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0^{\nearrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1^{\nearrow^1}\&1_{w0}\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ ?\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 0\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 1\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$- \to s\ -\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$- \to s\ 0_-\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$- \to s\ 1_-\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w0 \to s\ w0\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w0 \to s\ 0_{w0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w0 \to s\ 1_{w0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w1 \to s\ w1\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w1 \to s\ 0_{w1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w1 \to s\ 1_{w1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\wedge \to s\ \wedge\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\wedge \to s\ 0_\wedge\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\wedge \to s\ 1_\wedge\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\vee \to s\ \vee\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\vee \to s\ 0_\vee\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$\vee \to s\ 1_\vee\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$r \to s\ r\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$r \to s\ 0_r\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$r \to s\ 1_r\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w \to s\ w\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w \to s\ 0_w\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w \to s\ 1_w\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w\neg \to s\ w\neg\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w\neg \to s\ 0_{w\neg}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$w\neg \to s\ 1_{w\neg}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ ?^{\nwarrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 0^{\nwarrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 1^{\nwarrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^0} \to s\ ?^{\nwarrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^0} \to s\ 0^{\nwarrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^0} \to s\ 1^{\nwarrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^1} \to s\ ?^{\nwarrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^1} \to s\ 0^{\nwarrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow^1} \to s\ 1^{\nwarrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ ?^{\nearrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 0^{\nearrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 1^{\nearrow}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ ?^{\nearrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 0^{\nearrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 1^{\nearrow^0}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ ?^{\nearrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 0^{\nearrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$? \to s\ 1^{\nearrow^1}\&w1\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow} \to s\ -\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow} \to s\ 0_-\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow} \to s\ 1_-\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ w0\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0_{w0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1_{w0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ w1\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 0_{w1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$1 \to s\ 1_{w1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ \wedge\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 0_\wedge\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 1_\wedge\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ \vee\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ 0_\vee\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 1} \to s\ 1_\vee\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ r\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 0_r\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nwarrow 0} \to s\ 1_r\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ w\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 0_w\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$?^{\nearrow} \to s\ 1_w\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ w\neg\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0_{w\neg}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1_{w\neg}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ ?^{\nwarrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ 0^{\nwarrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^0} \to s\ 1^{\nwarrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ ?^{\nwarrow^1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ 0^{\nwarrow^1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0^{\nearrow^1} \to s\ 1^{\nwarrow^1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1^{\nearrow}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 1^{\nearrow^0}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ ?^{\nearrow^1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$
$$0 \to s\ 0^{\nearrow^1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$$

$0 \to s\ 1^{\nearrow 1}\&0_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ -\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ 0_-\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ 1_-\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \wedge\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_\wedge\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_\wedge\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \vee\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_\vee\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_\vee\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ r\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_r\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_r\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ w\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0_w\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1_w\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow 0}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow 1}\&1_{w1}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ -\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 0_-\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 1_-\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ \wedge\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 0_\wedge\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 1_\wedge\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ \vee\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 0_\vee\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 1_\vee\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ r\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 0_r\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 1_r\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ w\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 0_w\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 1_w\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ -\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 0_-\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 1_-\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 1_{w0}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ \wedge\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ 0_\wedge\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\wedge \to s\ 1_\wedge\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ \vee\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ 0_\vee\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_\vee \to s\ 1_\vee\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ r\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ 0_r\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_r \to s\ 1_r\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ w\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ 0_w\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_w \to s\ 1_w\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1_\wedge\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&\vee\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&\vee\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&\vee\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&\vee\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&\vee\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&\vee\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&\vee\ t \quad (\forall s,t \in \Sigma)$

$?^{\nearrow} \to s\ 1^{\nwarrow}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&\vee\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ -\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 0_{-}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 1_{-}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ \wedge\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 0_{\wedge}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 1_{\wedge}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ \vee\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 0_{\vee}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 1_{\vee}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ r\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 0_{r}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 1_{r}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ w\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 0_{w}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 1_{w}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ -\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 0_{-}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 1_{-}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 1_{w0}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ \wedge\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 0_{\wedge}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 1_{\wedge}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ \vee\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 0_{\vee}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 1_{\vee}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ r\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 0_{r}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 1_{r}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ w\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 0_{w}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 1_{w}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1_{\vee}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&r\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_{-}\&r\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_{-}\&r\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&r\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&r\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&r\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&r\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&r\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&r\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&r\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_{\wedge}\&r\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_{\wedge}\&r\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&r\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_{\vee}\&r\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_{\vee}\&r\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&r\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_{r}\&r\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_{r}\&r\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&r\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_{w}\&r\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_{w}\&r\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&r\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&r\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&r\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&r\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ -\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 0_{-}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 1_{-}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ \wedge\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 0_{\wedge}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 1_{\wedge}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ \vee\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 0_{\vee}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 1_{\vee}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ r\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 0_{r}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 1_{r}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ w\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 0_{w}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 1_{w}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ -\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 0_{-}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 1_{-}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 1_{w0}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ \wedge\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 0_{\wedge}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 1_{\wedge}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ \vee\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 0_{\vee}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 1_{\vee}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ r\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 0_{r}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 1_{r}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ w\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 0_{w}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 1_{w}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1_{r}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow_1} \to s\ 1^{\nwarrow_1}\&1_r\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\&w\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&w\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&w\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&w\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&w\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&w\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&w\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&w\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&w\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&w\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&w\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&w\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&w\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&w\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&w\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&w\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&w\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&w\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&w\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&w\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&w\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&w\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&w\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&w\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ ?^{\nwarrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ 0^{\nwarrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ 1^{\nwarrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_1} \to s\ ?^{\nwarrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_1} \to s\ 0^{\nwarrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_1} \to s\ 1^{\nwarrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow_0}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?^{\nearrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0^{\nearrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1^{\nearrow_1}\&w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ -\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ 0_-\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow} \to s\ 1_-\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&0_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ \wedge\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ 0_\wedge\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ 1_\wedge\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_1} \to s\ \vee\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_1} \to s\ 0_\vee\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_1} \to s\ 1_\vee\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ r\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ 0_r\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow_0} \to s\ 1_r\&0_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ w\&0_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0_w\&0_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1_w\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_0} \to s\ ?^{\nwarrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_0} \to s\ 0^{\nwarrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_0} \to s\ 1^{\nwarrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_1} \to s\ ?^{\nwarrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_1} \to s\ 0^{\nwarrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow_1} \to s\ 1^{\nwarrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?^{\nearrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0^{\nearrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1^{\nearrow}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?^{\nearrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0^{\nearrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1^{\nearrow_0}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?^{\nearrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0^{\nearrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1^{\nearrow_1}\&0_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ -\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ 0_-\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow} \to s\ 1_-\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ \wedge\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 0_\wedge\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 1_\wedge\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ \vee\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 0_\vee\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 1_\vee\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_0} \to s\ r\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 0_r\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow_1} \to s\ 1_r\&1_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ w\&1_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0_w\&1_w\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1_w\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_0} \to s\ ?^{\nwarrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_0} \to s\ 0^{\nwarrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_0} \to s\ 1^{\nwarrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_1} \to s\ ?^{\nwarrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_1} \to s\ 0^{\nwarrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow_1} \to s\ 1^{\nwarrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow_0}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?^{\nearrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0^{\nearrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1^{\nearrow_1}\&1_w\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ ?^{\nwarrow_0}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ 0^{\nwarrow_0}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_0} \to s\ 1^{\nwarrow_0}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_1} \to s\ ?^{\nwarrow_1}\&w\neg\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow_1} \to s\ 0^{\nwarrow_1}\&w\neg\ t \quad (\forall s,t \in \Sigma)$

$?\nearrow^1 \to s\ 1\nwarrow^1 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\nearrow \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\nearrow \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\nearrow \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\nearrow^0 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\nearrow^0 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\nearrow^0 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ ?\nearrow^1 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 0\nearrow^1 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$? \to s\ 1\nearrow^1 \& w\neg\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow \to s\ -\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow \to s\ 0_-\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow \to s\ 1_-\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ \wedge \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ 0_\wedge \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ 1_\wedge \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^1 \to s\ \vee \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^1 \to s\ 0_\vee \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^1 \to s\ 1_\vee \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ r\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ 0_r \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nwarrow^0 \to s\ 1_r \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ w\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 0_w \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 1_w \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ ?\nwarrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ 0\nwarrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ 1\nwarrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ ?\nwarrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ 0\nwarrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ 1\nwarrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ ?\nwarrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ 0\nwarrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ 1\nwarrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\nearrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\nearrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\nearrow \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\nearrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\nearrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\nearrow^0 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ ?\nearrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0\nearrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1\nearrow^1 \& 0_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ -\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ 0_-\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ 1_-\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ \wedge \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 0_\wedge \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 1_\wedge \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ \vee \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 0_\vee \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 1_\vee \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ r\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 0_r \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 1_r \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ w\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 0_w \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 1_w \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ ?\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ 0\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow \to s\ 1\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^0 \to s\ ?\nearrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^0 \to s\ 0\nearrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^0 \to s\ 1\nwarrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ ?\nwarrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 0\nwarrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1\nwarrow^1 \to s\ 1\nwarrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\nearrow \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\nearrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\nearrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\nearrow^0 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ ?\nearrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0\nearrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1\nearrow^1 \& 1_{w\neg}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_-\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_-\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_\wedge \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_\wedge \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_\vee \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_\vee \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_r \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_r \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_w \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_w \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ ?\nwarrow \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 0\nwarrow \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow \to s\ 1\nwarrow \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^0 \to s\ ?\nwarrow^0 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^0 \to s\ 0\nwarrow^0 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^0 \to s\ 1\nwarrow^0 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^1 \to s\ ?\nwarrow^1 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^1 \to s\ 0\nwarrow^1 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$?\nearrow^1 \to s\ 1\nwarrow^1 \& ?\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ -\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 0_-\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_- \to s\ 1_-\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ \wedge \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 0_\wedge \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\wedge \to s\ 1_\wedge \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ \vee \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 0_\vee \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_\vee \to s\ 1_\vee \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ r\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 0_r \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_r \to s\ 1_r \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ w\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 0_w \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_w \to s\ 1_w \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ ?\nwarrow \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ 0\nwarrow \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow \to s\ 1\nwarrow \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ ?\nwarrow^0 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ 0\nwarrow^0 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^0 \to s\ 1\nwarrow^0 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ ?\nwarrow^1 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ 0\nwarrow^1 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$0\nearrow^1 \to s\ 1\nwarrow^1 \& 0\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ -\& 1\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 0_-\& 1\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$1_- \to s\ 1_-\& 1\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\& 1\nwarrow\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\& 1\nwarrow\ t \quad (\forall s,t \in \Sigma)$

$1_{w0} \to s\ 1_{w0}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ \wedge\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 0_{\wedge}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 1_{\wedge}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ \vee\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 0_{\vee}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 1_{\vee}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ r\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 0_{r}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 1_{r}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ w\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 0_{w}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 1_{w}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nwarrow}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_{-}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_{-}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_{\wedge}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_{\wedge}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_{\vee}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_{\vee}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_{r}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_{r}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_{w}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_{w}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&?^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ -\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 0_{-}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 1_{-}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ \wedge\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 0_{\wedge}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 1_{\wedge}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ \vee\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 0_{\vee}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{\vee} \to s\ 1_{\vee}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ r\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 0_{r}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{r} \to s\ 1_{r}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ w\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 0_{w}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w} \to s\ 1_{w}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ w\neg\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 0_{w\neg}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0_{w\neg} \to s\ 1_{w\neg}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ -\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 0_{-}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{-} \to s\ 1_{-}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ w0\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 0_{w0}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w0} \to s\ 1_{w0}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ w1\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 0_{w1}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w1} \to s\ 1_{w1}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ \wedge\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 0_{\wedge}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\wedge} \to s\ 1_{\wedge}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ \vee\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 0_{\vee}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{\vee} \to s\ 1_{\vee}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ r\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 0_{r}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{r} \to s\ 1_{r}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ w\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 0_{w}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w} \to s\ 1_{w}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ w\neg\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 0_{w\neg}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1_{w\neg} \to s\ 1_{w\neg}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nwarrow 0}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ -\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 0_{-}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$- \to s\ 1_{-}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ w0\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 0_{w0}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w0 \to s\ 1_{w0}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ w1\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 0_{w1}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w1 \to s\ 1_{w1}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ \wedge\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 0_{\wedge}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\wedge \to s\ 1_{\wedge}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ \vee\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 0_{\vee}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$\vee \to s\ 1_{\vee}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ r\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 0_{r}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$r \to s\ 1_{r}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ w\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 0_{w}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w \to s\ 1_{w}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ w\neg\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 0_{w\neg}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$w\neg \to s\ 1_{w\neg}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&?^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ -\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 0_{-}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{-} \to s\ 1_{-}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ w0\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 0_{w0}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w0} \to s\ 1_{w0}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ w1\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 0_{w1}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{w1} \to s\ 1_{w1}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ \wedge\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0_{\wedge} \to s\ 0_{\wedge}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{\wedge} \to s\ 1_{\wedge}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{\vee} \to s\ \vee\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{\vee} \to s\ 0_{\vee}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{\vee} \to s\ 1_{\vee}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_r \to s\ r\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_r \to s\ 0_r\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_r \to s\ 1_r\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_w \to s\ w\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_w \to s\ 0_w\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_w \to s\ 1_w\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{w\neg} \to s\ w\neg\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{w\neg} \to s\ 0_{w\neg}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0_{w\neg} \to s\ 1_{w\neg}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ ?^{\nwarrow}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ 0^{\nwarrow}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ 1^{\nwarrow}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{-} \to s\ -\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{-} \to s\ 0_{-}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{-} \to s\ 1_{-}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w0} \to s\ w0\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w0} \to s\ 0_{w0}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w0} \to s\ 1_{w0}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w1} \to s\ w1\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w1} \to s\ 0_{w1}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w1} \to s\ 1_{w1}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\wedge} \to s\ \wedge\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\wedge} \to s\ 0_{\wedge}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\wedge} \to s\ 1_{\wedge}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\vee} \to s\ \vee\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\vee} \to s\ 0_{\vee}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{\vee} \to s\ 1_{\vee}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_r \to s\ r\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_r \to s\ 0_r\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_r \to s\ 1_r\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_w \to s\ w\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_w \to s\ 0_w\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_w \to s\ 1_w\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w\neg} \to s\ w\neg\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w\neg} \to s\ 0_{w\neg}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1_{w\neg} \to s\ 1_{w\neg}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nwarrow 1}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ -\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 0_{-}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 1_{-}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ w0\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 0_{w0}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w0}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ w1\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 0_{w1}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 1_{w1}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ \wedge\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 0_{\wedge}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 1_{\wedge}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ \vee\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 0_{\vee}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 1_{\vee}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ r\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 0_r\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 1_r\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ w\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ 0_w\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ 1_w\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ w\neg\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 0_{w\neg}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w\neg}\&?^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ ?^{\nwarrow}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ 0^{\nwarrow}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow} \to s\ 1^{\nwarrow}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow} \to s\ -\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow} \to s\ 0_{-}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow} \to s\ 1_{-}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ w0\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 0_{w0}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w0}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ w1\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 0_{w1}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 1_{w1}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ \wedge\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 0_{\wedge}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 1_{\wedge}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ \vee\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 0_{\vee}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 1_{\vee}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ r\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 0_r\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nwarrow 1} \to s\ 1_r\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ w\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ 0_w\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$? \to s\ 1_w\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ w\neg\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 0_{w\neg}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w\neg}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nearrow}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ -\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ 0_{-}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ 1_{-}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ w0\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 0_{w0}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w0}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ w1\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 0_{w1}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$1 \to s\ 1_{w1}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ \wedge\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ 0_{\wedge}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 0} \to s\ 1_{\wedge}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ \vee\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 0_{\vee}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow 1} \to s\ 1_{\vee}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ r\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 0_r\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$

$?^{\nwarrow} \to s\ 1_r\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_w\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_w\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w\neg\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w\neg}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w\neg}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ ?^{\nwarrow}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 0^{\nwarrow}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow} \to s\ 1^{\nwarrow}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$?^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&?^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ \ -\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_-\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_-\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ \wedge\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_\wedge\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_\wedge\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ \vee\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_\vee\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_\vee\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ r\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_r\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_r\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_w\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_w\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w\neg\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w\neg}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w\neg}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ \ -\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ 0_-\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ 1_-\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ \wedge\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ 0_\wedge\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 0} \to s\ 1_\wedge\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \vee\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_\vee\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_\vee\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ r\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_r\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_r\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_w\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_w\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w\neg\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w\neg}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w\neg}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nearrow 0}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ \ -\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ 0_-\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ 1_-\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ \wedge\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_\wedge\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_\wedge\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ \vee\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ 0_\vee\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 1} \to s\ 1_\vee\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ r\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 0_r\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nwarrow 0} \to s\ 1_r\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_w\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_w\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w\neg}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ ?^{\nwarrow}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 0^{\nwarrow}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow} \to s\ 1^{\nwarrow}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&0^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \ -\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_-\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_-\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w0\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w0}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 1_{w0}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w1\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_{w1}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_{w1}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \wedge\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_\wedge\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_\wedge\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ \vee\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_\vee\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_\vee\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ r\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 0_r\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nwarrow 1} \to s\ 1_r\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ w\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 0_w\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1 \to s\ 1_w\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ w\neg\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$0 \to s\ 0_{w\neg}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$

$0 \to s\ 1_{w\neg}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ ?^{\nwarrow}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 0^{\nwarrow}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow} \to s\ 1^{\nwarrow}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ ?^{\nwarrow 0}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 0^{\nwarrow 0}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 0} \to s\ 1^{\nwarrow 0}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ ?^{\nwarrow 1}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 0^{\nwarrow 1}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$
$1^{\nearrow 1} \to s\ 1^{\nwarrow 1}\&1^{\nearrow 1}\ t \quad (\forall s,t \in \Sigma)$

B All circuits of $\leqslant 4$ gates evaluating to one

Following is the list of all strings of length less than 20 that encode circuits evaluating to one, or, equivalently, the list of literal representations of all circuits containing 4 gates or less. These are:

- 1 circuit of 1 gate, represented with a string of length 2,
- 3 circuits of 2 gates, each represented with a string of length 5,
- 18 circuits of 3 gates, each represented with a string of length 9, and
- 198 circuits of 4 gates, each represented with a string of length 14.

$a\ c_{w1}$ (see Figure 5(e) on page 13 and Figure 6 on page 18)
$a\ a\ c_{w0}\ b\ c_{w1}$
$a\ a\ c_{w0}\ c_r\ c_{w\neg}$
$a\ a\ c_{w1}\ b\ c_{w1}$
$a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w$
$a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w$
$a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w$
$a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w$
$a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}$
$a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ c_r\ b\ c_{w\neg}$

$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w0}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w0}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w0}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$

$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ c_r\ b\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w0}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ c_r\ c_\vee\ b\ c_w$

$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w0}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w0}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w0}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ b\ c_{w1}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ b\ c_r\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ b\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ b\ c_r\ b\ c_{w\neg}$ (see Figures 5(b) and 6)
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\wedge\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w0}\ c_r\ c_\vee\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ c_r\ c_\wedge\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w0}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ c_\wedge\ b\ c_w$

$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ b\ c_{w1}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ b\ c_r\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ c_\wedge\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ b\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ c_\wedge\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\wedge\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ b\ c_r\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\wedge\ c_w$
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$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ c_\wedge\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ b\ c_{w1}\ c_r\ c_\vee\ c_w\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ b\ c_r\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ b\ c_r\ b\ c_{w\neg}$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w0}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ b\ c_r\ b\ c_{w\neg}$
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$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ b\ c_\wedge\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ b\ c_{w1}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ b\ b\ b\ c_{w1}$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ b\ c_r\ b\ c_{w\neg}$
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$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ b\ c_r\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ b\ b\ b\ c_{w1}$

$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ b\ b\ c_r\ c_{w\neg}$
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$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ b\ c_{w\neg}\ c_r\ c_\vee\ b\ c_w$
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$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ c_\wedge\ c_w\ b\ c_r\ b\ c_{w\neg}$
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$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ c_r\ b\ c_\vee\ c_w$
$a\ a\ a\ a\ c_{w1}\ c_r\ c_{w\neg}\ c_r\ c_\vee\ c_w\ c_r\ c_\vee\ b\ c_w$

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