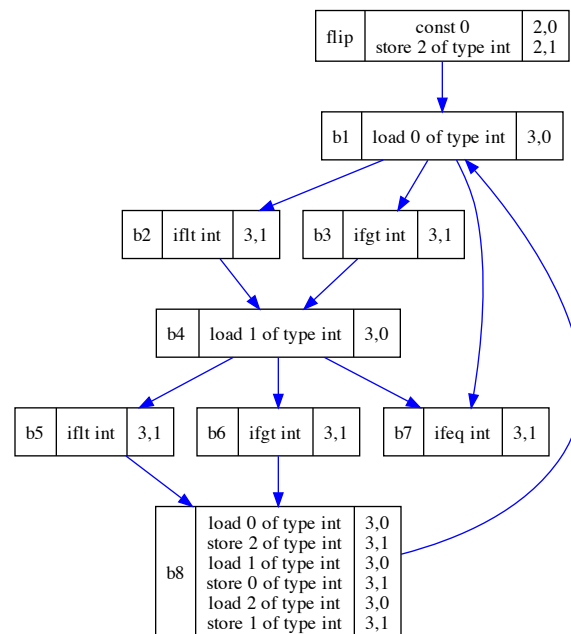


An Invel Example

Flip

```
1 public class Main {
2     public static void main(String[] args) {
3         Flip.flip(2, 4);
4     }
5 }
6
7 public class Flip {
8     public static void flip(int i, int j) {
9         int t = 0;
10        while (i != 0 && j != 0) {
11            t = i;
12            i = j;
13            j = t;
14        }
15    }
16 }
```

1 Method Flip.flip



- The block *flip* has b_1 as successor and its first instruction is not a call instruction. We have

$$\begin{aligned}
& (const^{\mathbb{P}\mathbb{L}} 0);^{\mathbb{P}\mathbb{L}} (store^{\mathbb{P}\mathbb{L}} 2) \\
&= (Unchanged(2, 0) \cup \{0 = \hat{s}^0\});^{\mathbb{P}\mathbb{L}} (Unchanged(\{0, 1\} \setminus 2, \emptyset) \cup \{\hat{s}^0 = \hat{l}^2\}) \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, 0 = \hat{s}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \hat{s}^0 = \hat{l}^2\} \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, 0 = \hat{l}^2\}.
\end{aligned}$$

Hence, $flip_{CLP}$ consists of the following clause:

$$flip(\tilde{l}^0, \tilde{l}^1) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, 0 = \hat{l}^2\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

- The block b_1 has b_2 , b_3 and b_7 as successors and its first instruction is not a call instruction. We have

$$\begin{aligned}
load^{\mathbb{P}\mathbb{L}} 0 &= Unchanged(3, 0) \cup \{\tilde{l}^0 = \hat{s}^0\} \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}.
\end{aligned}$$

Hence, b_{1CLP} consists of the following clauses:

$$\begin{aligned}
b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_2(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0) \\
b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_3(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0) \\
b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_7(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0).
\end{aligned}$$

- The block b_2 has b_4 as successor and its first instruction is not a call instruction. We have

$$\begin{aligned}
iflt \text{ of } type^{\mathbb{P}\mathbb{L}} \mathbf{int} &= Unchanged(3, 0) \cup \{\hat{s}^0 \leq -1\} \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \leq -1\}.
\end{aligned}$$

Hence, b_{2CLP} consists of the following clause:

$$b_2(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \leq -1\}, b_4(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

- The block b_3 has b_4 as successor and its first instruction is not a call instruction. We have

$$\begin{aligned}
ifgt \text{ of } type^{\mathbb{P}\mathbb{L}} \mathbf{int} &= Unchanged(3, 0) \cup \{\hat{s}^0 \geq 1\} \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \geq 1\}.
\end{aligned}$$

Hence, b_{3CLP} consists of the following clause:

$$b_3(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \geq 1\}, b_4(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

- The block b_4 has b_5 , b_6 and b_7 as successors and its first instruction is not a call instruction. We have

$$\begin{aligned}
load^{\mathbb{P}\mathbb{L}} 1 &= Unchanged(3, 0) \cup \{\tilde{l}^1 = \hat{s}^0\} \\
&= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}.
\end{aligned}$$

Hence, b_{4CLP} consists of the following clauses:

$$\begin{aligned}
b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_5(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0) \\
b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_6(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0) \\
b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) &\leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_7(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0).
\end{aligned}$$

- The block b_5 has b_8 as successor and its first instruction is not a **call** instruction. We have

$$\begin{aligned} iflt \text{ of } type^{\mathbb{P}\mathbb{L}} \text{ int} &= Unchanged(3,0) \cup \{s^0 \leq -1\} \\ &= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 \leq -1\}. \end{aligned}$$

Hence, b_{5CLP} consists of the following clause:

$$b_5(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, s^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 \leq -1\}, b_8(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

- The block b_6 has b_8 as successor and its first instruction is not a **call** instruction. We have

$$\begin{aligned} ifgt \text{ of } type^{\mathbb{P}\mathbb{L}} \text{ int} &= Unchanged(3,0) \cup \{s^0 \geq 1\} \\ &= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 \geq 1\}. \end{aligned}$$

Hence, b_{6CLP} consists of the following clause:

$$b_6(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, s^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 \geq 1\}, b_8(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

- The block b_7 has no successor and its first instruction is not a **call** instruction. We have

$$\begin{aligned} ifeq \text{ of } type^{\mathbb{P}\mathbb{L}} \text{ int} &= Unchanged(3,0) \cup \{s^0 = 0\} \\ &= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 = 0\}. \end{aligned}$$

Hence, b_{7CLP} consists of the following clause:

$$b_7(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, s^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 = 0\}.$$

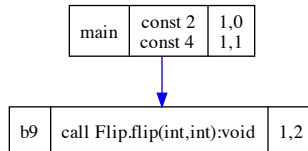
- The block b_8 has b_1 as successor and its first instruction is not a **call** instruction. We have

$$\begin{aligned} &(load^{\mathbb{P}\mathbb{L}} 0);^{\mathbb{P}\mathbb{L}} (store^{\mathbb{P}\mathbb{L}} 2);^{\mathbb{P}\mathbb{L}} (load^{\mathbb{P}\mathbb{L}} 1);^{\mathbb{P}\mathbb{L}} (store^{\mathbb{P}\mathbb{L}} 0);^{\mathbb{P}\mathbb{L}} (load^{\mathbb{P}\mathbb{L}} 2);^{\mathbb{P}\mathbb{L}} (store^{\mathbb{P}\mathbb{L}} 1) \\ &= (Unchanged(3,0) \cup \{\tilde{l}^0 = \hat{s}^0\});^{\mathbb{P}\mathbb{L}} (Unchanged(\{0,1,2\} \setminus 2, \emptyset) \cup \{s^0 = \hat{l}^2\});^{\mathbb{P}\mathbb{L}} \\ &\quad (Unchanged(3,0) \cup \{\tilde{l}^1 = \hat{s}^0\});^{\mathbb{P}\mathbb{L}} (Unchanged(\{0,1,2\} \setminus 0, \emptyset) \cup \{s^0 = \hat{l}^0\});^{\mathbb{P}\mathbb{L}} \\ &\quad (Unchanged(3,0) \cup \{\tilde{l}^2 = \hat{s}^0\});^{\mathbb{P}\mathbb{L}} (Unchanged(\{0,1,2\} \setminus 1, \emptyset) \cup \{s^0 = \hat{l}^1\}) \\ &= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, s^0 = \hat{l}^2\};^{\mathbb{P}\mathbb{L}} \\ &\quad \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, s^0 = \hat{l}^0\};^{\mathbb{P}\mathbb{L}} \\ &\quad \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^2 = \hat{s}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^2 = \hat{l}^2, s^0 = \hat{l}^1\} \\ &= \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^0 = \hat{l}^2\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^2 = \hat{l}^2, \tilde{l}^2 = \hat{l}^1\} \\ &= \{\tilde{l}^1 = \hat{l}^1, \tilde{l}^0 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0\};^{\mathbb{P}\mathbb{L}} \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^2 = \hat{l}^2, \tilde{l}^2 = \hat{l}^1\} \\ &= \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0, \tilde{l}^0 = \hat{l}^1\}. \end{aligned}$$

Hence, b_{8CLP} consists of the following clause:

$$b_8(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0, \tilde{l}^0 = \hat{l}^1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2).$$

2 Method Main.main



- The block *main* has b_9 as successor and its first instruction is not a **call** instruction. We have

$$\begin{aligned}
(const^{\mathbb{PL}} 2);^{\mathbb{PL}} (const^{\mathbb{PL}} 4) &= (Unchanged(1, 0) \cup \{2 = \hat{s}^0\});^{\mathbb{PL}} (Unchanged(1, 1) \cup \{4 = \hat{s}^1\}) \\
&= \{\tilde{l}^0 = \hat{l}^0, 2 = \hat{s}^0\};^{\mathbb{PL}} \{\tilde{l}^0 = \hat{l}^0, \hat{s}^0 = \hat{s}^0, 4 = \hat{s}^1\} \\
&= \{\tilde{l}^0 = \hat{l}^0, 2 = \hat{s}^0, 4 = \hat{s}^1\}.
\end{aligned}$$

Hence, $main_{CLP}$ consists of the following clause:

$$main(\tilde{l}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, 2 = \hat{s}^0, 4 = \hat{s}^1\}, b_9(\hat{l}^0, \hat{s}^0, \hat{s}^1).$$

- The block b_9 consists of only one instruction which is a **call** instruction and it has no successor. Hence, b_9_{CLP} consists of the following clause:

$$b_9(\tilde{l}^0, \hat{s}^0, \hat{s}^1) \leftarrow \{\}, flip(\hat{s}^0, \hat{s}^1).$$

3 The CLP(\mathbb{PL}) Program

Flip.flip	
(r_1)	$flip(\tilde{l}^0, \tilde{l}^1) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, 0 = \hat{l}^2\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
(r_2)	$b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_2(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_3)	$b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_3(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_4)	$b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^0 = \hat{s}^0\}, b_7(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_5)	$b_2(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \leq -1\}, b_4(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
(r_6)	$b_3(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \geq 1\}, b_4(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
(r_7)	$b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_5(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_8)	$b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_6(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_9)	$b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \tilde{l}^1 = \hat{s}^0\}, b_7(\hat{l}^0, \hat{l}^1, \hat{l}^2, \hat{s}^0)$
(r_{10})	$b_5(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \leq -1\}, b_8(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
(r_{11})	$b_6(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 \geq 1\}, b_8(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
(r_{12})	$b_7(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \hat{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, \tilde{l}^2 = \hat{l}^2, \hat{s}^0 = 0\}$
(r_{13})	$b_8(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0, \tilde{l}^2 = \hat{l}^1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2)$
Main.main	
(r_{14})	$main(\tilde{l}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^0, 2 = \hat{s}^0, 4 = \hat{s}^1\}, b_9(\hat{l}^0, \hat{s}^0, \hat{s}^1)$
(r_{15})	$b_9(\tilde{l}^0, \hat{s}^0, \hat{s}^1) \leftarrow \{\}, flip(\hat{s}^0, \hat{s}^1)$

4 Proving Non-Termination

Let P_{CLP} be the CLP(\mathbb{PL}) program in Sect. 3. We have $T_{P_{CLP}}^\beta \uparrow 0 = \emptyset$. Moreover,

- the set $T_{P_{CLP}}^\beta \uparrow 1$ includes the following clauses:

$$\begin{aligned}
(u_1) \quad & flip(\tilde{l}^0, \tilde{l}^1) \leftarrow \{\tilde{l}^0 = \hat{l}^0, \tilde{l}^1 = \hat{l}^1, 0 = \hat{l}^2\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \\
(u_2) \quad & b_8(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^1 = \hat{l}^0, \tilde{l}^2 = \hat{l}^1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2)
\end{aligned}$$

where (u_1) is obtained by unfolding (r_1) with *id* and (u_2) by unfolding (r_{13}) with *id*,

- the set $T_{P_{CLP}}^\beta \uparrow 2$ includes the following clauses:

$$\begin{aligned} (u_3) \quad & b_9(\tilde{l}^0, \tilde{s}^0, \tilde{s}^1) \leftarrow \{\tilde{s}^0 = \hat{l}^0, \tilde{s}^1 = \hat{l}^1, 0 = \hat{l}^2\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \\ (u_4) \quad & b_6(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \tilde{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^0 = \hat{l}^1, \tilde{l}^1 = \hat{l}^0, \tilde{s}^0 \geq 1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \end{aligned}$$

where (u_3) is obtained by unfolding (r_{15}) with (u_1) and (u_4) by unfolding (r_{11}) with (u_2) ,

- the set $T_{P_{CLP}}^\beta \uparrow 3$ includes the following clauses:

$$\begin{aligned} (u_5) \quad & main(\tilde{l}^0) \leftarrow \{2 = \hat{l}^0, 4 = \hat{l}^1, 0 = \hat{l}^2\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \\ (u_6) \quad & b_4(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^0 = \hat{l}^1, \tilde{l}^1 = \hat{l}^0, \tilde{l}^1 \geq 1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \end{aligned}$$

where (u_5) is obtained by unfolding (r_{14}) with (u_3) and (u_6) by unfolding (r_8) with (u_4) ,

- the set $T_{P_{CLP}}^\beta \uparrow 4$ includes the following clause, obtained by unfolding (r_6) with (u_6) :

$$(u_7) \quad b_3(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2, \tilde{s}^0) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^0 = \hat{l}^1, \tilde{l}^1 = \hat{l}^0, \tilde{l}^1 \geq 1, \tilde{s}^0 \geq 1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2)$$

- the set $T_{P_{CLP}}^\beta \uparrow 5$ includes the following clause, obtained by unfolding (r_3) with (u_7) :

$$(u_8) \quad b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \{\tilde{l}^0 = \hat{l}^2, \tilde{l}^0 = \hat{l}^1, \tilde{l}^1 = \hat{l}^0, \tilde{l}^0 \geq 1, \tilde{l}^1 \geq 1\}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) .$$

Consider:

$$\begin{aligned} (u_5) \quad & main(\tilde{l}^0) \leftarrow \overbrace{\{2 = \hat{l}^0, 4 = \hat{l}^1, 0 = \hat{l}^2\}}^{c'}, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) \\ (u_8) \quad & b_1(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \leftarrow \underbrace{\{\tilde{l}^0 = \hat{l}^2, \tilde{l}^0 = \hat{l}^1, \tilde{l}^1 = \hat{l}^0, \tilde{l}^0 \geq 1, \tilde{l}^1 \geq 1\}}_c, b_1(\hat{l}^0, \hat{l}^1, \hat{l}^2) . \end{aligned}$$

Let $e(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2)$ be the projection of c onto $\tilde{l}^0, \tilde{l}^1, \tilde{l}^2$. We have:

$$e(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) = \{\tilde{l}^0 \geq 1, \tilde{l}^1 \geq 1\} .$$

Therefore, the following formula is satisfiable:

$$\forall(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \ e(\tilde{l}^0, \tilde{l}^1, \tilde{l}^2) \Rightarrow [\exists(\hat{l}^0, \hat{l}^1, \hat{l}^2) \ c \wedge e(\hat{l}^0, \hat{l}^1, \hat{l}^2)] .$$

The following formula is also satisfiable:

$$\exists \tilde{l}^0, \exists(\hat{l}^0, \hat{l}^1, \hat{l}^2), \ c' \wedge e(\hat{l}^0, \hat{l}^1, \hat{l}^2) .$$