

The ILTP Library in Intuitionistic Linear Logic

October 10, 2018

Abstract

Here we present the results of the for the ILLTP-* and KLE-* benchamrks in <https://github.com/carlosolarte/Linear-Logic-Prover-in-Maude>.

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1 General Information

- Test run on a QEMU Virtual CPU, 2GHz, 64 bits, 2GB of RAM running Ubuntu.
- Timeout: 2min.
- Maude version: 2.7.1 built: Oct 2 2017.

- The search procedure considers proofs using up to 10 times the copy rule (focusing on one of the formulas of the classical context). Since this procedure is not complete, failures cannot be considered as non-provable sequents. For this reason, we reprocessed the problems that returned “failed” with a prover where the copy rule can be used an unboundedly number of times. The sequents marked as **fail** here can be then considered as non-theorems (since the prover explored all the possibilities).

2 Statistics

2.1 Translation 0/1

	KLE	LCL	SYJ	SYN
Problems	88	2	252	20
Unsolved (timeouts)	13	2	223	13
Solved (Theorems)	75	0	29	7
Non-Theorems	0	0	0	0
Min Time	30	-	26	17
Avg Time	736.66	-	20733.45	320.71
Max Time	19336	-	117105	795

2.2 Call-by-Name

	KLE	LCL	SYJ	SYN
Problems	88	2	252	20
Unsolved (timeouts)	13	2	218	9
Solved (Theorems)	75	0	34	11
Non-Theorems	0	0	0	5
Min Time	23	-	26	24
Avg Time	1172.12	-	9162.94	335.67
Max Time	28552	-	80827	845

2.3 Call-by-Value

	KLE	LCL	SYJ	SYN
Problems	88	2	252	20
Unsolved (timeouts)	12	2	227	9
Solved (Theorems)	75	0	25	7
Non-Theorems	1	0	0	4
Min Time	45	0	30	17
Avg Time	1210.4	-	16127.2	268.86
Max Time	58637	-	112706	769

3 Translation 0/1

3.1 KLE Problems

file: KLE/KLE001+1.p (41 ms)

$$\frac{\frac{a : \cdot \vdash a}{\cdot : \cdot \vdash !(a) \multimap a} \star}{\cdot : \cdot \vdash !(a) \multimap a} !$$

$$\frac{\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)} !}{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)} !} \quad \frac{\frac{a, b, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b} \star}{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b} \star} \multimap$$
[illegible][illegible]

3

$$\begin{array}{c}
\frac{\frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash a \quad a, b, !(a \& b)) \multimap !(c) : \cdot \vdash b}{\star} \\
\frac{\frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash a \& b}{!} \quad \frac{\frac{a, b, c, !(a \& b)) \multimap !(c) : \cdot \vdash c}{\star}}{\frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash !(a \& b)}{!} \quad \frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash c}{\star} \multimap} \\
\frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash !(a \& b)) \multimap !(c) \vdash c}{D_C} \\
\frac{\frac{a, b, !(a \& b)) \multimap !(c) : \cdot \vdash c}{\star} \quad \frac{\frac{a, !(a \& b)) \multimap !(c) : \cdot \vdash !(b) \multimap c}{!} \quad \frac{a, !(a \& b)) \multimap !(c) : \cdot \vdash !(b) \multimap c}{\star}}{\frac{!(a \& b)) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \multimap c}{!} \quad \frac{!(a \& b)) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \multimap c}{\star}} \multimap} \\
\frac{!(a \& b)) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \multimap c)}{\star} \\
\frac{\cdot : !(a \& b)) \multimap !(c) \vdash !(a) \multimap !(b) \multimap c)}{\star}
\end{array}$$

file: KLE/KLE006+1.p (322 ms)

$$\begin{array}{c}
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash a}{!} \quad \frac{a, b, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b}{\star}}{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)}{!} \quad \frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)}{\star} \multimap} \\
\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \vdash b}{D_C} \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b}{!} \quad \frac{a, c, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash c}{\star}}{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(b)}{!} \quad \frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(b)}{\star} \multimap} \\
\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(b) \multimap !(c) \vdash c}{D_C} \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash c}{\star} \quad \frac{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap c}{!} \quad \frac{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap c}{\star}}{\frac{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \multimap c}{!} \quad \frac{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(b) \multimap c}{\star}} \multimap} \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap c)}{\star} \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap c)}{\star} \\
\frac{\cdot : !(a) \multimap !(b) \vdash !(b) \multimap !(c) \multimap !(a) \multimap c)}{\star}
\end{array}$$

file: KLE/KLE007+1.p (289 ms)

$$\begin{array}{c}
\frac{\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash c}{!} \quad \frac{a, c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash a}{\star}}{\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c)}{!} \quad \frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c)}{\star} \multimap} \\
\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c) \multimap !(a) \vdash a}{D_C} \\
\frac{\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash a}{!} \quad \frac{b, c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash b}{\star}}{\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(a)}{!} \quad \frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(a)}{\star} \multimap} \\
\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(a) \multimap !(b) \vdash b}{D_C} \\
\frac{\frac{c, !(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash b}{\star} \quad \frac{!(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c) \multimap b}{!} \quad \frac{!(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c) \multimap b}{\star}}{\frac{!(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c) \multimap !(a) \multimap b}{!} \quad \frac{!(a) \multimap !(b), !(c) \multimap !(a) : \cdot \vdash !(c) \multimap !(a) \multimap b}{\star}} \multimap} \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(c) \multimap !(a) \multimap !(c) \multimap b)}{\star} \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(c) \multimap !(a) \multimap !(c) \multimap b)}{\star} \\
\frac{\cdot : !(a) \multimap !(b) \vdash !(c) \multimap !(a) \multimap !(c) \multimap b)}{\star}
\end{array}$$

file: KLE/KLE008+1.p (226 ms)

$$\begin{array}{c}
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash a} \quad \frac{}{a, b, c, !(a) \multimap !(b) : \cdot \vdash b} \\
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash !(a)} ! \quad \frac{}{a, c, !(a) \multimap !(b) : !(b) \vdash b} \star \\
\frac{}{a, c, !(a) \multimap !(b) : !(a) \multimap !(b) \vdash b} \multimap \\
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash b} D_C \quad \frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash c} \star \\
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash b \& c} \quad \frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash !(b \& c)} ! \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(a) \& !(c)) \multimap !(b \& c)} \star \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(!(a) \& !(c)) \multimap !(b \& c))} ! \\
\frac{}{\cdot : !(!(a) \multimap !(b)) \vdash !(!(!(a) \& !(c)) \multimap !(b \& c))} \star
\end{array}$$

file: KLE/KLE009+1.p (266 ms)

$$\begin{array}{c}
\frac{}{a, b, c, !(a) \multimap !(b) : \cdot \vdash c} \quad \frac{}{a, b, c, !(a) \multimap !(b) : \cdot \vdash b} \star \\
\frac{}{a, b, c, !(a) \multimap !(b) : \cdot \vdash c \& b} \quad \frac{}{a, b, c, !(a) \multimap !(b) : \cdot \vdash !(c \& b)} ! \\
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash !(a)} ! \quad \frac{}{a, c, !(a) \multimap !(b) : !(b) \vdash !(c \& b)} \star \\
\frac{}{a, c, !(a) \multimap !(b) : !(a) \multimap !(b) \vdash !(c \& b)} \multimap \\
\frac{}{a, c, !(a) \multimap !(b) : \cdot \vdash !(c \& b)} D_C \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(c) \& !(a)) \multimap !(c \& b)} \star \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(!(c) \& !(a)) \multimap !(c \& b))} ! \\
\frac{}{\cdot : !(!(a) \multimap !(b)) \vdash !(!(!(c) \& !(a)) \multimap !(c \& b))} \star
\end{array}$$

file: KLE/KLE010+1.p (511 ms)

file: KLE/KLE011+1.p (300 ms)

$$\begin{array}{c}
\frac{}{c, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash c} \quad \frac{}{c, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash !(c)} ! \\
\frac{}{c, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash !(c) \oplus !(b)} \oplus_1 \\
\frac{}{a, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash a} \quad \frac{}{a, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash !(a)} ! \\
\frac{}{a, !(c) \oplus !(a), !(a) \multimap !(b) : !(a) \multimap !(b) \vdash !(c) \oplus !(b)} \multimap \\
\frac{}{a, !(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash !(c) \oplus !(b)} D_C \\
\frac{}{!(c) \oplus !(a), !(a) \multimap !(b) : !(c) \oplus !(a) \vdash !(c) \oplus !(b)} D_C \\
\frac{}{!(c) \oplus !(a), !(a) \multimap !(b) : \cdot \vdash !(c) \oplus !(b)} \quad \frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(c) \oplus !(a)) \multimap !(c) \oplus !(b)} \star \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(!(!(c) \oplus !(a)) \multimap !(c) \oplus !(b))} ! \\
\frac{}{\cdot : !(!(a) \multimap !(b)) \vdash !(!(!(c) \oplus !(a)) \multimap !(c) \oplus !(b))} \star
\end{array}$$

file: KLE/KLE012+1.p (213 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap !(0) : \cdot \vdash a} \\
\frac{}{a, !(a) \multimap !(0) : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, !(a) \multimap !(0) : !(0) \vdash b} \quad \star \\
\hline
\frac{a, !(a) \multimap !(0) : !(a) \multimap !(0) \vdash b}{a, !(a) \multimap !(0) : \cdot \vdash b} D_C \\
\frac{}{!(a) \multimap !(0) : \cdot \vdash !(a) \multimap b} \star \\
\frac{}{!(a) \multimap !(0) : \cdot \vdash !(!(a) \multimap b)} ! \\
\hline
\frac{}{\cdot : !(!(a) \multimap !(0)) \vdash !(!(a) \multimap b)} \star
\end{array}$$

file: KLE/KLE013+1.p (timeout!)

file: KLE/KLE014+1.p (44 ms)

$$\begin{array}{c}
\frac{}{a, b : \cdot \vdash b} \\
\frac{}{b : \cdot \vdash !(a) \multimap b} \star \\
\frac{}{b : \cdot \vdash !(!(a) \multimap b)} ! \\
\hline
\cdot : !(b) \vdash !(!(a) \multimap b) \star
\end{array}$$

file: KLE/KLE015+1.p (timeout!)

file: KLE/KLE016+1.p (251 ms)

$$\begin{array}{c}
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash b} \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash !(b)} ! \quad \frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : !(0) \vdash 0} \star \\
\hline
\frac{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : !(b) \multimap !(0) \vdash 0}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash 0} D_C \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash a} \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(a)} ! \quad \frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : !(b) \multimap !(0) \vdash 0} \star \\
\hline
\frac{a, b, !(a) \multimap !(!(b) \multimap !(0)) : !(a) \multimap !(b) \multimap !(0) \vdash 0}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash 0} D_C \\
\frac{}{b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(a) \multimap 0} \star \\
\frac{}{b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(!(a) \multimap 0)} ! \\
\frac{}{!(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(b) \multimap !(!(a) \multimap 0)} \star \\
\frac{}{!(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(!(b) \multimap !(!(a) \multimap 0))} ! \\
\hline
\cdot : !(!(a) \multimap !(b) \multimap !(0)) \vdash !(b) \multimap !(a) \multimap 0 \star
\end{array}$$

file: KLE/KLE017+1.p (timeout!)

file: KLE/KLE018+1.p (499 ms)

$$\begin{array}{c}
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash b} \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash !(b)} ! \quad \frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : !(0) \vdash 0} \star \\
\hline
\frac{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : !(b) \multimap !(0) \vdash 0}{a, b, !(a) \multimap !(!(b) \multimap !(0)), !(b) \multimap !(0) : \cdot \vdash 0} D_C \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash a} \\
\frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(a)} ! \quad \frac{}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : !(b) \multimap !(0) \vdash 0} \star \\
\hline
\frac{a, b, !(a) \multimap !(!(b) \multimap !(0)) : !(a) \multimap !(b) \multimap !(0) \vdash 0}{a, b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash 0} D_C \\
\frac{}{b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(a) \multimap 0} \star \\
\frac{}{b, !(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(!(a) \multimap 0)} ! \\
\frac{}{!(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(b) \multimap !(!(a) \multimap 0)} \star \\
\frac{}{!(a) \multimap !(!(b) \multimap !(0)) : \cdot \vdash !(!(b) \multimap !(!(a) \multimap 0))} ! \\
\hline
\cdot : !(!(a) \multimap !(b) \multimap !(0)) \vdash !(b) \multimap !(a) \multimap 0 \star
\end{array}$$

file: KLE/KLE019+1.p (329 ms)


```
file: KLE/KLE029+1.p (788 ms)
```

```
file: KLE/KLE032+1.p (425 ms)
```

[illegible]

```
file: KLE/KLE033+1.p (904 ms)
```

[illegible]

```
file: KLE/KLE035+1.p (391 ms)
```

[illegible]

```
file: KLE/KLE036+1.p (3524 ms)
```

```
file: KLE/KLE037+1.p (728 ms)
```



```
file: KLE/KLE046+1.p (94 ms)
```

$$\begin{array}{c}
\frac{\overline{a, !(a) \oplus !(a) : \cdot \vdash a} \quad \overline{a, !(a) \oplus !(a) : \cdot \vdash a}}{\overline{!(a) \oplus !(a) : !(a) \oplus !(a) \vdash a}} \star \\
\frac{\overline{!(a) \oplus !(a) : \cdot \vdash a}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a)) \multimap a}} \star \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a)) \multimap a}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a)) \multimap a}} ! \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a)) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a) \oplus !(a))}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a)) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a) \oplus !(a))}} ! \\
\end{array}$$

file: KLE/KLE047+1.p (96 ms)

$$\begin{array}{c}
\frac{\overline{a, !(a) \oplus !(b) : \cdot \vdash a}}{\overline{\cdot : \cdot \vdash !(!(a) \& !(!(a) \oplus !(b))) \multimap a}} \star \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \& !(!(a) \oplus !(b))) \multimap a}}{\overline{\cdot : \cdot \vdash !(!(a) \& !(!(a) \oplus !(b))) \multimap a}} ! \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \& !(!(a) \oplus !(b))) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a \& !(a) \oplus !(b)))}}{\overline{\cdot : \cdot \vdash !(!(a) \& !(!(a) \oplus !(b))) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a \& !(a) \oplus !(b)))}} ! \\
\end{array}$$

file: KLE/KLE048+1.p (102 ms)

$$\begin{array}{c}
\frac{\overline{a, !(a) \oplus !(a \& !(b)) : \cdot \vdash a} \quad \overline{a, b, !(a) \oplus !(a \& !(b)) : \cdot \vdash a}}{\overline{!(a) \oplus !(a \& !(b)) : !(a) \oplus !(a \& !(b)) \vdash a}} \star \\
\frac{\overline{!(a) \oplus !(a \& !(b)) : \cdot \vdash a}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a \& !(b))) \multimap a}} \star \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a \& !(b))) \multimap a}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a \& !(b))) \multimap a}} ! \\
\frac{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a \& !(b))) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a \oplus !(a \& b)))}}{\overline{\cdot : \cdot \vdash !(!(a) \oplus !(a \& !(b))) \multimap a} \& \overline{\cdot : \cdot \vdash !(!(a) \multimap !(a \oplus !(a \& b)))}} ! \\
\end{array}$$

file: KLE/KLE049+1.p (131 ms)



```
file: KLE/KLE053+1.p (93 ms)
```

[illegible]

```
file: KLE/KLE054+1.p (94 ms)
```

$$\begin{array}{c}
\frac{\overline{b : \cdot \vdash b}}{b : \cdot \vdash !(b)} ! \\
\frac{\overline{b, !(a) \oplus !(b) : \cdot \vdash b}}{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b} * \quad \frac{\overline{b : \cdot \vdash !(a) \oplus !(b)}}{b : \cdot \vdash !(b) \multimap !(a) \oplus !(b)} \oplus_1 \\
\frac{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b}{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b} ! \quad \frac{b : \cdot \vdash !(b) \multimap !(a) \oplus !(b)}{b : \cdot \vdash !(b) \multimap !(a) \oplus !(b)} * \\
\frac{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b \& !(b) \multimap !(a) \oplus !(b)}{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b \& !(b) \multimap !(a) \oplus !(b)} ! \\
\frac{b : \cdot \vdash !(!(a) \oplus !(b)) \multimap b \& !(b) \multimap !(a) \oplus !(b)}{\cdot : !(b) \vdash !(!(a) \oplus !(b)) \multimap b \& !(b) \multimap !(a) \oplus !(b)} *
\end{array}$$

```
file: KLE/KLE055+1.p (265 ms)
```

$$\begin{array}{c}
\frac{\frac{\frac{b, !(b) \multimap !(0) : \cdot \vdash b}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} ! \quad \frac{\frac{b, !(b) \multimap !(0) : !(0) \vdash !(a \& b)}{b, !(b) \multimap !(0) : !(b) \multimap !(0) \vdash !(a \& b)} \star}{\frac{b, !(b) \multimap !(0) : !(b) \multimap !(0) \vdash !(a \& b)}{b, !(b) \multimap !(0) : \cdot \vdash !(a \& b)} D_C} \multimap \\
\frac{\frac{\frac{a, b, !(b) \multimap !(0) : \cdot \vdash b}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \& !(b)) \multimap b} \star \quad \frac{\frac{!(b) \multimap !(0) : \cdot \vdash !(b) \multimap !(a \& b)}{!(b) \multimap !(0) : \cdot \vdash !(!(b) \multimap !(a \& b))} \star}{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(b) \multimap !(a \& b))}{!(b) \multimap !(0) : \cdot \vdash !(!(!(a) \& !(b)) \multimap b) \& !(b) \multimap !(a \& b))} !} \star \\
\frac{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(!(a) \& !(b)) \multimap b) \& !(b) \multimap !(a \& b))}{!(b) \multimap !(0) : \cdot \vdash !(!(!(a) \& !(b)) \multimap b) \& !(b) \multimap !(a \& b))} !}{\cdot : !(b) \multimap !(0) \vdash !(!(!(a) \& !(b)) \multimap b) \& !(b) \multimap !(a \& b))} \star
\end{array}$$

file: KLE/KLE056+1.p (306 ms)

$$\begin{array}{c}
\frac{\frac{\frac{b, !(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash b}{b, !(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash !(b)} ! \quad \frac{\frac{b, !(a) \oplus !(b), !(b) \multimap !(0) : !(0) \vdash a}{b, !(a) \oplus !(b), !(b) \multimap !(0) : !(b) \multimap !(0) \vdash a} \star}{\frac{b, !(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash a}{b, !(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash a} D_C} \star \\
\frac{\frac{\frac{a, !(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash a}{!(a) \oplus !(b), !(b) \multimap !(0) : !(a) \oplus !(b) \vdash a} D_C \quad \frac{\frac{!(a) \oplus !(b), !(b) \multimap !(0) : \cdot \vdash a}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a} \star}{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a} !} \star \\
\frac{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a} !}{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a} !} \star \\
\frac{\frac{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a}{!(b) \multimap !(0) : \cdot \vdash !(!(a) \oplus !(b)) \multimap a} !}{\cdot : !(b) \multimap !(0) \vdash !(!(a) \oplus !(b)) \multimap a} \star
\end{array}$$

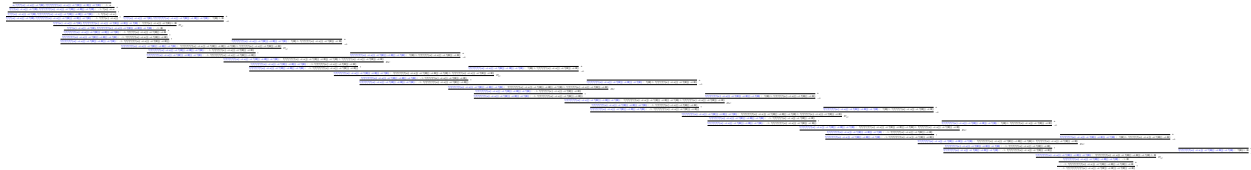
file: KLE/KLE057+1.p (87 ms)

$$\begin{array}{c}
\frac{\frac{a, !(a) \multimap !(0) : \cdot \vdash a}{a, !(a) \multimap !(0) : \cdot \vdash !(a)} ! \quad \frac{\frac{a, !(a) \multimap !(0) : !(0) \vdash 0}{a, !(a) \multimap !(0) : !(a) \multimap !(0) \vdash 0} \star}{\frac{a, !(a) \multimap !(0) : !(a) \multimap !(0) \vdash 0}{a, !(a) \multimap !(0) : \cdot \vdash 0} D_C} \multimap \\
\frac{\frac{a, !(a) \multimap !(0) : \cdot \vdash 0}{a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0} \star}{\frac{a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0}{a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0} !} \star \\
\frac{\frac{a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0}{\cdot : \cdot \vdash !(a) \multimap !(!(a) \multimap !(0)) \multimap 0} \star}{\cdot : \cdot \vdash !(a) \multimap !(!(a) \multimap !(0)) \multimap 0} !} \star \\
\frac{\cdot : \cdot \vdash !(a) \multimap !(!(a) \multimap !(0)) \multimap 0}{\cdot : \cdot \vdash !(a) \multimap !(!(a) \multimap !(0)) \multimap 0} !} \star
\end{array}$$

file: KLE/KLE058+1.p (497 ms)



file: KLE/KLE059+1.p (323 ms)



file: KLE/KLE065+1.p (31 ms)

$$\begin{array}{c}
 \hline
 a, !(b) \oplus !(!(b) \multimap !(0)) : \cdot \vdash a \\
 \hline
 \cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a \quad \star \\
 \hline
 \cdot : \cdot \vdash !(!(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a) \quad !
 \end{array}$$

file: KLE/KLE066+1.p (149 ms)

$$\begin{array}{c}
 \frac{b, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))), !(b) \multimap !(0) : \cdot \vdash b}{b, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))), !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))), !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))), !(b) \multimap !(0) : \cdot \vdash a} \quad \star \\
 \hline
 \frac{a, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))) : \cdot \vdash a}{!(a) \oplus !(!(b) \& !(!(b) \multimap !(0))) : \cdot \vdash a} \quad D_C \quad \frac{b, !(a) \oplus !(!(b) \& !(!(b) \multimap !(0))), !(b) \multimap !(0) : \cdot \vdash a}{!(a) \oplus !(!(b) \& !(!(b) \multimap !(0))) : \cdot \vdash a} \quad \star \\
 \hline
 \frac{!(a) \oplus !(!(b) \& !(!(b) \multimap !(0))) : \cdot \vdash a}{\cdot : \cdot \vdash !(!(a) \oplus !(!(b) \& !(!(b) \multimap !(0)))) \multimap a} \quad \star \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(a) \oplus !(!(b) \& !(!(b) \multimap !(0)))) \multimap a}{\cdot : \cdot \vdash !(!(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a)} \quad ! \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a)}{\cdot : \cdot \vdash !(!(!(a) \oplus !(!(b) \& !(!(b) \multimap !(0)))) \multimap a)} \quad !
 \end{array}$$

file: KLE/KLE067+1.p (147 ms)

$$\begin{array}{c}
 \frac{a, b, !(b) \multimap !(0) : \cdot \vdash b}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash b}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \\
 \hline
 \frac{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \\
 \hline
 \frac{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)}{a, b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \quad \frac{b, !(b) \multimap !(0) : \cdot \vdash !(b)}{b, !(b) \multimap !(0) : \cdot \vdash !(b)} \quad ! \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a}{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a} \quad \star \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a}{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a} \quad \star \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a}{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a} \quad \star \\
 \hline
 \frac{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a}{\cdot : \cdot \vdash !(!(a) \& !(!(b) \oplus !(!(b) \multimap !(0)))) \multimap a} \quad \star
 \end{array}$$

file: KLE/KLE068+1.p (timeout!)

file: KLE/KLE069+1.p (timeout!)

file: KLE/KLE070+1.p (355 ms)



file: KLE/KLE071+1.p (294 ms)



file: KLE/KLE072+1.p (334 ms)



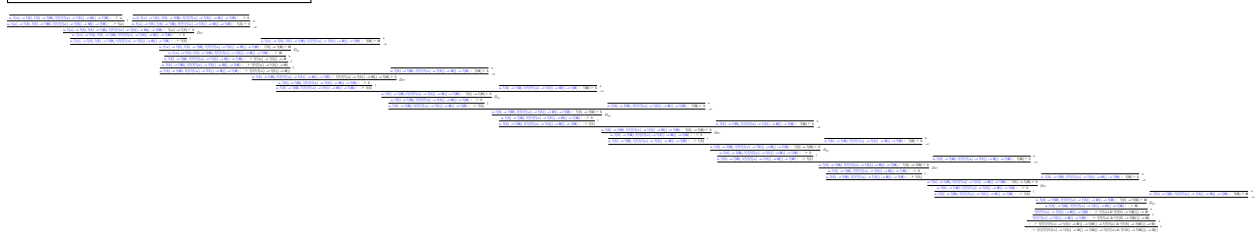
file: KLE/KLE073+1.p (297 ms)



file: KLE/KLE074+1.p (timeout!)

file: KLE/KLE075+1.p (timeout!)

file: KLE/KLE076+1.p (483 ms)



file: KLE/KLE077+1.p (336 ms)

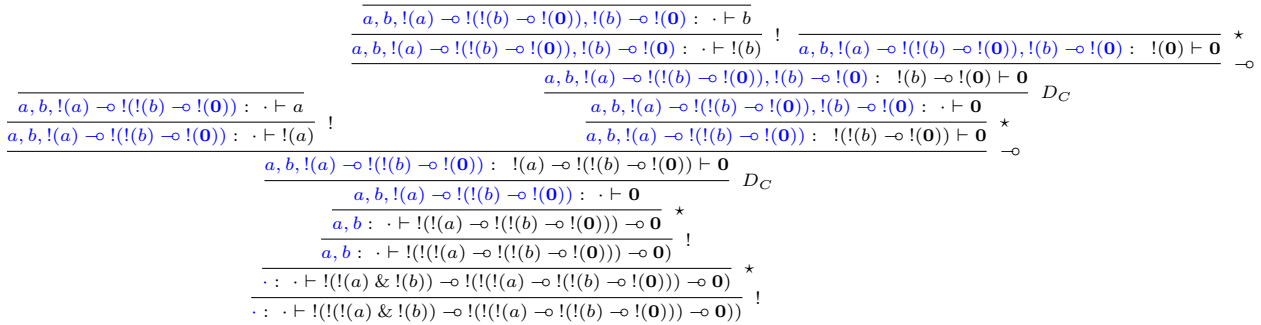


file: KLE/KLE078+1.p (timeout!)

file: KLE/KLE079+1.p (431 ms)



file: KLE/KLE080+1.p (124 ms)



file: KLE/KLE081+1.p (290 ms)



file: KLE/KLE082+1.p (374 ms)

file: KLE/KLE083+1.p (timeout!)

file: KLE/KLE084+1.p (timeout!)

file: KLE/KLE085+1.p (timeout!)

file: KLE/KLE086+1.p (timeout!)

file: KLE/KLE087+1.p (307 ms)

file: KLE/KLE088+1.p (timeout!)

3.2 LCL Problems

file: LCL/LCL181+1.p (timeout!)

file: LCL/LCL230+1.p (timeout!)

3.3 SYJ Problems

file: SYJ/SYJ101+1.p (26 ms)

$$\frac{a : \cdot \vdash a}{\cdot : !(a) \vdash a} \star$$

file: SYJ/SYJ102+1.p (86 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap !(0) : \cdot \vdash a} \\
\frac{}{a, !(a) \multimap !(0) : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, !(a) \multimap !(0) : !(0) \vdash 0} \quad \star \\
\hline
a, !(a) \multimap !(0) : !(a) \multimap !(0) \vdash 0 \quad \multimap \\
\hline
\frac{}{a, !(a) \multimap !(0) : \cdot \vdash 0} \quad D_C \\
\frac{}{a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0} \quad \star \\
\hline
a : \cdot \vdash !(!(a) \multimap !(0)) \multimap 0 \quad ! \\
\hline
\cdot : !(a) \vdash !(!(a) \multimap !(0)) \multimap 0 \quad \star
\end{array}$$

file: SYJ/SYJ103+1.p (timeout!)

file: SYJ/SYJ104+1.p (226 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap !(b) : \cdot \vdash a} \\
\frac{}{a, !(a) \multimap !(b) : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, b, !(a) \multimap !(b) : \cdot \vdash b} \quad \star \\
\hline
a, !(a) \multimap !(b) : !(a) \multimap !(b) \vdash b \quad \multimap \\
\hline
\frac{}{a, !(a) \multimap !(b) : \cdot \vdash b} \quad D_C \\
\frac{}{!(a) \multimap !(b) : \cdot \vdash !(a) \multimap b} \quad \star \\
\hline
!(a) \multimap !(b) : \cdot \vdash !(!(a) \multimap b) \quad ! \\
\hline
\cdot : !(a) \multimap !(b) \vdash !(!(a) \multimap b) \quad \star
\end{array}$$

file: SYJ/SYJ105+1.002.p (349 ms)

file: SYJ/SYJ105+1.002.p (349 ms)

file: SYJ/SYJ105+1.003.p (timeout!)

file: SYJ/SYJ105+1.004.p (timeout!)

file: SYJ/SYJ106+1.p (1814 ms)

file: SYJ/SYJ107+1.001.p (841 ms)

file: SYJ/SYJ107+1.002.p (117105 ms)

file: SYJ/SYJ107+1.003.p (timeout!)

file: SYJ/SYJ107+1.004.p (timeout!)

file: SYJ/SYJ201+1.002.p (timeout!)

file: SYJ/SYJ201+1.003.p (timeout!)

file: SYJ/SYJ201+1.004.p (timeout!)

file: SYJ/SYJ201+1.005.p (timeout!)

file: SYJ/SYJ201+1.006.p (timeout!)

file: SYJ/SYJ201+1.007.p (timeout!)

file: SYJ/SYJ201+1.008.p (timeout!)

file: SYJ/SYJ201+1.009.p (timeout!)

file: SYJ/SYJ201+1.010.p (timeout!)

file: SYJ/SYJ201+1.011.p (timeout!)

file: SYJ/SYJ201+1.012.p (timeout!)

file: SYJ/SYJ201+1.013.p (timeout!)

file: SYJ/SYJ201+1.014.p (timeout!)

file: SYJ/SYJ201+1.015.p (timeout!)

file: SYJ/SYJ201+1.016.p (timeout!)

file: SYJ/SYJ201+1.017.p (timeout!)

file: SYJ/SYJ201+1.018.p (timeout!)

file: SYJ/SYJ201+1.019.p (timeout!)

file: SYJ/SYJ201+1.020.p (timeout!)

file: SYJ/SYJ202+1.001.p (39 ms)

$$\frac{\frac{\frac{o11, o21 : \cdot \vdash o11}{o11, o21 : \cdot \vdash !(o11)} !}{o11, o21 : \cdot \vdash !(o11) \oplus !(o21)} \oplus_1}{\cdot : !(o11), !(o21) \vdash !(o11) \oplus !(o21)} \star$$

file: SYJ/SYJ202+1.002.p (timeout!)

file: SYJ/SYJ202+1.003.p (timeout!)

file: SYJ/SYJ202+1.004.p (timeout!)

file: SYJ/SYJ202+1.005.p (timeout!)

file: SYJ/SYJ202+1.006.p (timeout!)

file: SYJ/SYJ202+1.007.p (timeout!)

file: SYJ/SYJ202+1.008.p (timeout!)

file: SYJ/SYJ202+1.009.p (timeout!)

file: SYJ/SYJ202+1.010.p (timeout!)

file: SYJ/SYJ202+1.011.p (timeout!)

file: SYJ/SYJ202+1.012.p (timeout!)

file: SYJ/SYJ202+1.013.p (timeout!)

file: SYJ/SYJ202+1.014.p (timeout!)

file: SYJ/SYJ202+1.015.p (timeout!)

file: SYJ/SYJ202+1.016.p (timeout!)

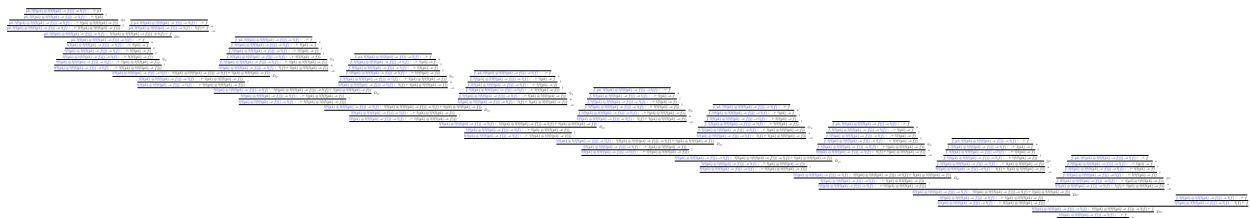
file: SYJ/SYJ202+1.017.p (timeout!)

file: SYJ/SYJ202+1.018.p (timeout!)

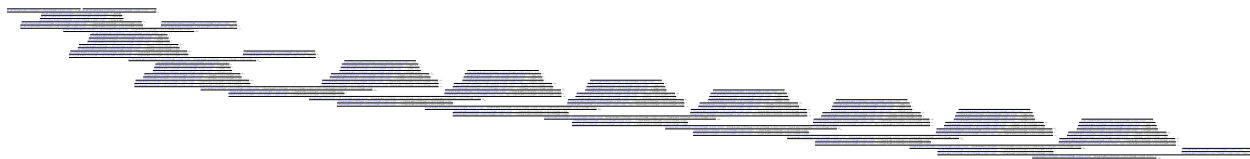
file: SYJ/SYJ202+1.019.p (timeout!)

file: SYJ/SYJ202+1.020.p (timeout!)

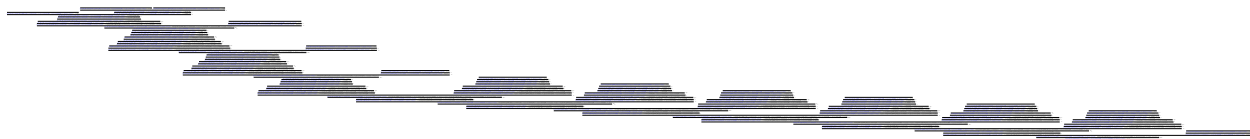
file: SYJ/SYJ203+1.001.p (825 ms)



file: SYJ/SYJ203+1.002.p (4229 ms)



file: SYJ/SYJ203+1.003.p (4231 ms)



```
file: SYJ/SYJ203+1.011.p (timeout!)
```

```
file: SYJ/SYJ203+1.013.p (timeout!)
```

```
file: SYJ/SYJ203+1.015.p (timeout!)
```

```
file: SYJ/SYJ203+1.017.p (timeout!)
```

```
file: SYJ/SYJ203+1.019.p (timeout!)
```

file: SYJ/SYJ204+1.001.p (123 ms)

file: SYJ/SYJ204+1.002.p (607 ms)

[illegible]

file: SYJ/SYJ204+1.006.p (timeout!)

file: SYJ/SYJ204+1.007.p (timeout!)

file: SYJ/SYJ204+1.008.p (timeout!)

file: SYJ/SYJ204+1.009.p (timeout!)

file: SYJ/SYJ204+1.010.p (timeout!)

file: SYJ/SYJ204+1.011.p (timeout!)

file: SYJ/SYJ204+1.012.p (timeout!)

file: SYJ/SYJ204+1.013.p (timeout!)

file: SYJ/SYJ204+1.014.p (timeout!)

file: SYJ/SYJ204+1.015.p (timeout!)

file: SYJ/SYJ204+1.016.p (timeout!)

file: SYJ/SYJ204+1.017.p (timeout!)

file: SYJ/SYJ204+1.018.p (timeout!)

file: SYJ/SYJ204+1.019.p (timeout!)

file: SYJ/SYJ204+1.020.p (timeout!)

file: SYJ/SYJ205+1.001.p (31889 ms)

file: SYJ/SYJ205+1.002.p (93986 ms)

file: SYJ/SYJ205+1.003.p (timeout!)

file: SYJ/SYJ205+1.004.p (timeout!)

file: SYJ/SYJ205+1.005.p (timeout!)

file: SYJ/SYJ205+1.006.p (timeout!)

file: SYJ/SYJ205+1.007.p (timeout!)

file: SYJ/SYJ205+1.008.p (timeout!)

file: SYJ/SYJ205+1.009.p (timeout!)

file: SYJ/SYJ205+1.010.p (timeout!)

file: SYJ/SYJ205+1.011.p (timeout!)

file: SYJ/SYJ205+1.012.p (timeout!)

file: SYJ/SYJ205+1.013.p (timeout!)

file: SYJ/SYJ205+1.014.p (timeout!)

file: SYJ/SYJ206+1.017.p (timeout!)

file: SYJ/SYJ206+1.018.p (timeout!)

file: SYJ/SYJ207+1.001.p (timeout!)

file: SYJ/SYJ207+1.002.p (timeout!)

file: SYJ/SYJ207+1.003.p (timeout!)

file: SYJ/SYJ207+1.004.p (timeout!)

file: SYJ/SYJ207+1.005.p (timeout!)

file: SYJ/SYJ207+1.006.p (timeout!)

file: SYJ/SYJ207+1.007.p (timeout!)

file: SYJ/SYJ207+1.008.p (timeout!)

file: SYJ/SYJ207+1.009.p (timeout!)

file: SYJ/SYJ207+1.010.p (timeout!)

file: SYJ/SYJ207+1.011.p (timeout!)

file: SYJ/SYJ207+1.012.p (timeout!)

file: SYJ/SYJ207+1.013.p (timeout!)

file: SYJ/SYJ207+1.014.p (timeout!)

file: SYJ/SYJ207+1.015.p (timeout!)

file: SYJ/SYJ207+1.016.p (timeout!)

file: SYJ/SYJ207+1.017.p (timeout!)

file: SYJ/SYJ207+1.018.p (timeout!)

file: SYJ/SYJ207+1.019.p (timeout!)

file: SYJ/SYJ207+1.020.p (timeout!)

file: SYJ/SYJ208+1.001.p (timeout!)

file: SYJ/SYJ208+1.002.p (timeout!)

file: SYJ/SYJ208+1.003.p (timeout!)

file: SYJ/SYJ208+1.004.p (timeout!)

file: SYJ/SYJ208+1.005.p (timeout!)

file: SYJ/SYJ208+1.006.p (timeout!)

file: SYJ/SYJ208+1.007.p (timeout!)

file: SYJ/SYJ208+1.008.p (timeout!)

file: SYJ/SYJ208+1.009.p (timeout!)

file: SYJ/SYJ208+1.010.p (timeout!)

file: SYJ/SYJ208+1.011.p (timeout!)

file: SYJ/SYJ208+1.012.p (timeout!)

file: SYJ/SYJ208+1.013.p (timeout!)

file: SYJ/SYJ208+1.014.p (timeout!)

file: SYJ/SYJ208+1.015.p (timeout!)

file: SYJ/SYJ208+1.016.p (timeout!)

file: SYJ/SYJ208+1.017.p (timeout!)

file: SYJ/SYJ208+1.018.p (timeout!)

file: SYJ/SYJ209+1.001.p (timeout!)

file: SYJ/SYJ209+1.002.p (timeout!)

file: SYJ/SYJ209+1.003.p (timeout!)

file: SYJ/SYJ209+1.004.p (timeout!)

file: SYJ/SYJ209+1.005.p (timeout!)

file: SYJ/SYJ209+1.006.p (timeout!)

file: SYJ/SYJ209+1.007.p (timeout!)

file: SYJ/SYJ209+1.008.p (timeout!)

file: SYJ/SYJ209+1.009.p (timeout!)

file: SYJ/SYJ209+1.010.p (timeout!)

file: SYJ/SYJ209+1.011.p (timeout!)

file: SYJ/SYJ209+1.012.p (timeout!)

file: SYJ/SYJ209+1.013.p (timeout!)

file: SYJ/SYJ209+1.014.p (timeout!)

file: SYJ/SYJ209+1.015.p (timeout!)

file: SYJ/SYJ209+1.016.p (timeout!)

file: SYJ/SYJ209+1.017.p (timeout!)

file: SYJ/SYJ209+1.018.p (timeout!)

file: SYJ/SYJ209+1.019.p (timeout!)

file: SYJ/SYJ209+1.020.p (timeout!)

file: SYJ/SYJ210+1.001.p (timeout!)

file: SYJ/SYJ210+1.002.p (timeout!)

file: SYJ/SYJ210+1.003.p (timeout!)

file: SYJ/SYJ210+1.004.p (timeout!)

file: SYJ/SYJ210+1.005.p (timeout!)

file: SYJ/SYJ210+1.006.p (timeout!)

file: SYJ/SYJ210+1.007.p (timeout!)

file: SYJ/SYJ210+1.008.p (timeout!)

file: SYJ/SYJ210+1.009.p (timeout!)

file: SYJ/SYJ210+1.010.p (timeout!)

file: SYJ/SYJ210+1.011.p (timeout!)

file: SYJ/SYJ210+1.012.p (timeout!)

file: SYJ/SYJ210+1.013.p (timeout!)

file: SYJ/SYJ210+1.014.p (timeout!)

file: SYJ/SYJ210+1.015.p (timeout!)

file: SYJ/SYJ210+1.016.p (timeout!)

file: SYJ/SYJ210+1.017.p (timeout!)

file: SYJ/SYJ210+1.018.p (timeout!)

file: SYJ/SYJ210+1.019.p (timeout!)

file: SYJ/SYJ210+1.020.p (timeout!)

file: SYJ/SYJ211+1.001.p (timeout!)

file: SYJ/SYJ211+1.002.p (timeout!)

file: SYJ/SYJ211+1.003.p (timeout!)

file: SYJ/SYJ211+1.004.p (timeout!)

file: SYJ/SYJ211+1.005.p (timeout!)

file: SYJ/SYJ211+1.006.p (timeout!)

file: SYJ/SYJ211+1.007.p (timeout!)

file: SYJ/SYJ211+1.008.p (timeout!)

file: SYJ/SYJ211+1.009.p (timeout!)

file: SYJ/SYJ211+1.010.p (timeout!)

file: SYJ/SYJ211+1.011.p (timeout!)

file: SYJ/SYJ211+1.012.p (timeout!)

file: SYJ/SYJ211+1.013.p (timeout!)

file: SYJ/SYJ211+1.014.p (timeout!)

file: SYJ/SYJ211+1.015.p (timeout!)

file: SYJ/SYJ211+1.016.p (timeout!)

file: SYJ/SYJ211+1.017.p (timeout!)

file: SYJ/SYJ211+1.018.p (timeout!)

file: SYJ/SYJ211+1.019.p (timeout!)

file: SYJ/SYJ211+1.020.p (timeout!)

file: SYJ/SYJ212+1.001.p (1267 ms)

file: SYJ/SYJ212+1.002.p (timeout!)

file: SYJ/SYJ212+1.003.p (timeout!)

file: SYJ/SYJ212+1.004.p (timeout!)

file: SYJ/SYJ212+1.005.p (timeout!)

file: SYJ/SYJ212+1.006.p (timeout!)

file: SYJ/SYJ212+1.007.p (timeout!)

file: SYJ/SYJ212+1.008.p (timeout!)

file: SYJ/SYJ212+1.009.p (timeout!)

3.4 SYN Problems

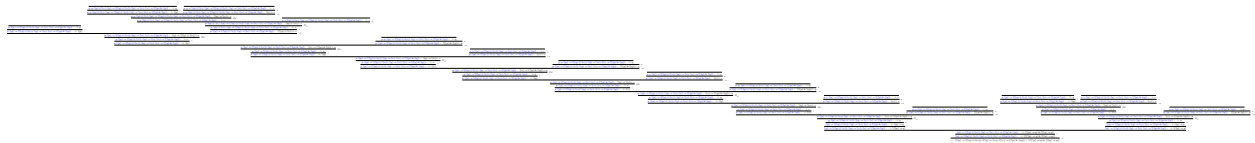
file: SYN/SYN001+1.p (301 ms)



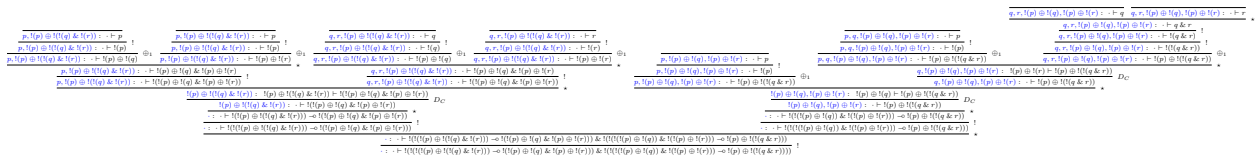
file: SYN/SYN040+1.p (timeout!)

file: SYN/SYN041+1.p (timeout!)

file: SYN/SYN044+1.p (622 ms)



file: SYN/SYN045+1.p (795 ms)



file: SYN/SYN046+1.p (timeout!)

file: SYN/SYN047+1.p (timeout!)

file: SYN/SYN387+1.p (timeout!)

file: SYN/SYN388+1.p (timeout!)

file: SYN/SYN389+1.p (timeout!)

file: SYN/SYN390+1.p (44 ms)

$$\begin{array}{c}
\frac{\frac{\overline{p : \cdot \vdash p}}{\cdot : \cdot \vdash !(p) \multimap p} \star}{\cdot : \cdot \vdash !(!(p) \multimap p)} ! \quad \frac{\frac{\overline{p : \cdot \vdash p}}{\cdot : \cdot \vdash !(p) \multimap p} \star}{\cdot : \cdot \vdash !(!(p) \multimap p)} ! \\
\hline
\frac{\cdot : \cdot \vdash !(!(p) \multimap p) \& !(!(p) \multimap p)}{\cdot : \cdot \vdash !(!(!(p) \multimap p) \& !(!(p) \multimap p))} ! \star
\end{array}$$

file: SYN/SYN391+1.p (382 ms)



file: SYN/SYN392+1.p (timeout!)

file: SYN/SYN393+1.p (timeout!)

file: SYN/SYN416+1.p (timeout!)

file: SYN/SYN915+1.p (17 ms)

$\cdot : \cdot \vdash 1$

file: SYN/SYN916+1.p (timeout!)

file: SYN/SYN977+1.p (timeout!)

file: SYN/SYN978+1.p (84 ms)

$$\begin{array}{c}
\frac{\frac{\overline{a, b : \cdot \vdash b}}{a, b : \cdot \vdash !(a) \multimap b} \star}{a, b : \cdot \vdash !(!(a) \multimap b)} ! \quad \frac{\frac{\overline{a, b : \cdot \vdash a}}{a, b : \cdot \vdash !(b) \multimap a} \star}{a, b : \cdot \vdash !(!(b) \multimap a)} ! \\
\hline
\frac{a, b : \cdot \vdash !(!(a) \multimap b) \& !(!(b) \multimap a)}{a, b : \cdot \vdash !(!(!(a) \multimap b) \& !(!(b) \multimap a))} ! \star \\
\hline
\frac{\cdot : \cdot \vdash !(!(a) \& !(b)) \multimap !(!(!(a) \multimap b) \& !(!(b) \multimap a))}{\cdot : \cdot \vdash !(!(!(a) \& !(b)) \multimap !(!(!(a) \multimap b) \& !(!(b) \multimap a)))} ! \star
\end{array}$$

4 Call-by-Name

4.1 KLE Problems

file: KLE/KLE001+1.p (26 ms)

$$\frac{\overline{a : \cdot \vdash a}}{\cdot : \cdot \vdash !(a) \multimap a} \star$$

file: KLE/KLE002+1.p (227 ms)

$$\frac{\frac{\overline{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash a}}{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash !(a)} ! \quad \frac{\overline{a, !(a) \multimap b, !(b) \multimap c : b \vdash b}}{a, !(a) \multimap b, !(b) \multimap c : !(a) \multimap b \vdash b} D_C}{\frac{\overline{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash b}}{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash !(b)} ! \quad \frac{\overline{a, !(a) \multimap b, !(b) \multimap c : c \vdash c}}{a, !(a) \multimap b, !(b) \multimap c : !(b) \multimap c \vdash c} D_C}{\frac{\overline{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash c}}{\cdot : !(a) \multimap b, !(b) \multimap c \vdash !(a) \multimap c} \star} \multimap$$

file: KLE/KLE003+1.p (75 ms)

$$\frac{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash a}}{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash !(a)} ! \quad \frac{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash b}}{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash !(b)} ! \quad \frac{\overline{a, b, !(a) \multimap !(b) \multimap c : c \vdash c}}{a, b, !(a) \multimap !(b) \multimap c : !(b) \multimap c \vdash c} D_C}{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash c}}{\cdot : !(a) \multimap !(b) \multimap c \vdash !(b) \multimap !(a) \multimap c} \star} \multimap$$

file: KLE/KLE004+1.p (77 ms)

$$\frac{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash a}}{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash !(a)} ! \quad \frac{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash b}}{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash !(b)} ! \quad \frac{\overline{a, b, !(a) \multimap !(b) \multimap c : c \vdash c}}{a, b, !(a) \multimap !(b) \multimap c : !(b) \multimap c \vdash c} D_C}{\frac{\overline{a, b, !(a) \multimap !(b) \multimap c : \cdot \vdash c}}{\cdot : !(a) \multimap !(b) \multimap c \vdash !(a \& b) \multimap c} \star} \multimap$$

file: KLE/KLE005+1.p (78 ms)

$$\frac{\overline{a, b, !(a \& b) \multimap c : \cdot \vdash a} \quad \overline{a, b, !(a \& b) \multimap c : \cdot \vdash b}}{a, b, !(a \& b) \multimap c : \cdot \vdash a \& b} \star$$

$$\frac{\frac{\overline{a, b, !(a \& b) \multimap c : \cdot \vdash a \& b}}{a, b, !(a \& b) \multimap c : \cdot \vdash !(a \& b)} ! \quad \frac{\overline{a, b, !(a \& b) \multimap c : c \vdash c}}{a, b, !(a \& b) \multimap c : !(a \& b) \multimap c \vdash c} D_C}{\frac{\overline{a, b, !(a \& b) \multimap c : \cdot \vdash c}}{\cdot : !(a \& b) \multimap c \vdash !(a) \multimap !(b) \multimap c} \star} \multimap$$

file: KLE/KLE006+1.p (229 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash a} \\
\frac{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash !(a) \quad ! \quad \frac{}{a, !(a) \multimap b, !(b) \multimap c : b \vdash b}}{} \multimap \\
\frac{a, !(a) \multimap b, !(b) \multimap c : !(a) \multimap b \vdash b}{\frac{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash b}{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash !(b)} !} D_C \\
\frac{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash !(b) \quad ! \quad \frac{}{a, !(a) \multimap b, !(b) \multimap c : c \vdash c}}{} \multimap \\
\frac{a, !(a) \multimap b, !(b) \multimap c : !(b) \multimap c \vdash c}{\frac{a, !(a) \multimap b, !(b) \multimap c : \cdot \vdash c}{\cdot : !(a) \multimap b \vdash !(b) \multimap c \multimap !(a) \multimap c} \star} D_C
\end{array}$$

file: KLE/KLE007+1.p (222 ms)

$$\begin{array}{c}
\frac{}{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash c} \\
\frac{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash !(c) \quad ! \quad \frac{}{c, !(a) \multimap b, !(c) \multimap a : a \vdash a}}{} \multimap \\
\frac{c, !(a) \multimap b, !(c) \multimap a : !(c) \multimap a \vdash a}{\frac{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash a}{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash !(a)} !} D_C \\
\frac{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash !(a) \quad ! \quad \frac{}{c, !(a) \multimap b, !(c) \multimap a : b \vdash b}}{} \multimap \\
\frac{c, !(a) \multimap b, !(c) \multimap a : !(a) \multimap b \vdash b}{\frac{c, !(a) \multimap b, !(c) \multimap a : \cdot \vdash b}{\cdot : !(a) \multimap b \vdash !(c) \multimap a \multimap !(c) \multimap b} \star} D_C
\end{array}$$

file: KLE/KLE008+1.p (81 ms)

$$\begin{array}{c}
\frac{}{a, c, !(a) \multimap b : \cdot \vdash a} \\
\frac{a, c, !(a) \multimap b : \cdot \vdash !(a) \quad ! \quad \frac{}{a, c, !(a) \multimap b : b \vdash b}}{} \multimap \\
\frac{a, c, !(a) \multimap b : !(a) \multimap b \vdash b}{\frac{a, c, !(a) \multimap b : \cdot \vdash b}{\cdot : !(a) \multimap b \vdash !(a \& c) \multimap b \& c} \star} D_C
\end{array}$$

file: KLE/KLE009+1.p (70 ms)

$$\begin{array}{c}
\frac{}{a, c, !(a) \multimap b : \cdot \vdash a} \\
\frac{a, c, !(a) \multimap b : \cdot \vdash !(a) \quad ! \quad \frac{}{a, c, !(a) \multimap b : b \vdash b}}{} \multimap \\
\frac{a, c, !(a) \multimap b : !(a) \multimap b \vdash b}{\frac{a, c, !(a) \multimap b : \cdot \vdash b}{\cdot : !(a) \multimap b \vdash !(c \& a) \multimap c \& b} \star} D_C
\end{array}$$

file: KLE/KLE010+1.p (481 ms)

file: KLE/KLE017+1.p (timeout!)

file: KLE/KLE018+1.p (399 ms)

[The following text is a dense, multi-line sequence of logical expressions and symbols, likely representing a complex proof or derivation. It includes various logical connectives like \rightarrow , \neg , \wedge , \vee , and quantifiers like \forall , \exists . The text is heavily stylized with many horizontal lines and symbols, making it difficult to read in detail. It appears to be a continuation of the logical derivation from the previous block.]

file: KLE/KLE019+1.p (261 ms)

$$\frac{\frac{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash a}{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash !(a)} ! \quad \frac{a, !(a) \rightarrow b, !(b) \rightarrow a : b \vdash b}{a, !(a) \rightarrow b, !(b) \rightarrow a : !(a) \rightarrow b \vdash b} D_C}{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash b} D_C \quad \frac{\frac{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash b}{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash !(b)} ! \quad \frac{b, !(a) \rightarrow b, !(b) \rightarrow a : a \vdash a}{b, !(a) \rightarrow b, !(b) \rightarrow a : !(b) \rightarrow a \vdash a} D_C}{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash a} D_C \quad \star$$

$$\therefore !(a) \rightarrow b, !(b) \rightarrow a \vdash !(a) \rightarrow b \& !(b) \rightarrow a$$

file: KLE/KLE020+1.p (212 ms)

$$\frac{\frac{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash a}{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash !(a)} ! \quad \frac{a, !(a) \rightarrow b, !(b) \rightarrow a : b \vdash b}{a, !(a) \rightarrow b, !(b) \rightarrow a : !(a) \rightarrow b \vdash b} D_C}{a, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash b} D_C \quad \star$$

$$\therefore !(a) \rightarrow b \& !(b) \rightarrow a \vdash !(a) \rightarrow b$$

file: KLE/KLE021+1.p (228 ms)

$$\frac{\frac{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash b}{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash !(b)} ! \quad \frac{b, !(a) \rightarrow b, !(b) \rightarrow a : a \vdash a}{b, !(a) \rightarrow b, !(b) \rightarrow a : !(b) \rightarrow a \vdash a} D_C}{b, !(a) \rightarrow b, !(b) \rightarrow a : \cdot \vdash a} D_C \quad \star$$

$$\therefore !(a) \rightarrow b \& !(b) \rightarrow a \vdash !(b) \rightarrow a$$

file: KLE/KLE022+1.p (198 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} \\
\frac{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(a)}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(a)} ! \quad \frac{}{a, !(a) \multimap b, !(b) \multimap a : b \vdash b} \\
\hline
\frac{a, !(a) \multimap b, !(b) \multimap a : !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} D_C \\
\hline
\cdot : !(a), !(!(a) \multimap b \& !(b) \multimap a) \vdash b \quad \star
\end{array}
\multimap$$

file: KLE/KLE023+1.p (206 ms)

$$\begin{array}{c}
\frac{}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} \\
\frac{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(b)}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(b)} ! \quad \frac{}{b, !(a) \multimap b, !(b) \multimap a : a \vdash a} \\
\hline
\frac{b, !(a) \multimap b, !(b) \multimap a : !(b) \multimap a \vdash a}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} D_C \\
\hline
\cdot : !(b), !(!(a) \multimap b \& !(b) \multimap a) \vdash a \quad \star
\end{array}
\multimap$$

file: KLE/KLE024+1.p (29 ms)

$$\begin{array}{c}
\frac{}{a : \cdot \vdash a} \quad \frac{}{a : \cdot \vdash a} \\
\hline
\cdot : \cdot \vdash !(a) \multimap a \& !(a) \multimap a \quad \star
\end{array}$$

file: KLE/KLE025+1.p (280 ms)

$$\begin{array}{c}
\frac{}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} \quad \frac{}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} \\
\frac{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(b)}{b, !(a) \multimap b, !(b) \multimap a : a \vdash a} ! \quad \frac{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(a)}{a, !(a) \multimap b, !(b) \multimap a : b \vdash b} ! \\
\hline
\frac{b, !(a) \multimap b, !(b) \multimap a : !(b) \multimap a \vdash a}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} D_C \quad \frac{a, !(a) \multimap b, !(b) \multimap a : !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} D_C \\
\hline
\cdot : !(!(a) \multimap b \& !(b) \multimap a) \vdash !(b) \multimap a \& !(a) \multimap b \quad \star
\end{array}
\multimap$$

file: KLE/KLE026+1.p (499 ms)

$$\begin{array}{c}
\frac{}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} \quad \frac{}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} \\
\frac{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(b)}{b, !(a) \multimap b, !(b) \multimap a : a \vdash a} ! \quad \frac{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash !(a)}{a, !(a) \multimap b, !(b) \multimap a : b \vdash b} ! \\
\hline
\frac{b, !(a) \multimap b, !(b) \multimap a : !(b) \multimap a \vdash a}{b, !(a) \multimap b, !(b) \multimap a : \cdot \vdash a} D_C \quad \frac{a, !(a) \multimap b, !(b) \multimap a : !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap a : \cdot \vdash b} D_C \\
\hline
\cdot : !(!(a) \multimap b \& !(b) \multimap a) \vdash !(b) \multimap a \& !(a) \multimap b \quad \star
\end{array}$$

file: KLE/KLE027+1.p (646 ms)

file: KLE/KLE028+1.p (509 ms)

file: KLE/KLE029+1.p (918 ms)

file: KLE/KLE031+1.p (timeout!)

file: KLE/KLE032+1.p (305 ms)

file: KLE/KLE033+1.p (653 ms)

file: KLE/KLE034+1.p (281 ms)

file: KLE/KLE035+1.p (273 ms)

file: KLE/KLE036+1.p (7660 ms)

file: KLE/KLE037+1.p (5603 ms)

$$\frac{\overline{a : \cdot \vdash a} \quad \overline{a : \cdot \vdash a} \quad \overline{a : \cdot \vdash a}}{\cdot : \cdot \vdash !(a \& a) \multimap a \& !(a) \multimap a \& a} \star$$

file: KLE/KLE046+1.p (77 ms)

$$\frac{\overline{a, !(a) \oplus !(a) : \cdot \vdash a} \quad \overline{a, !(a) \oplus !(a) : \cdot \vdash a}}{\frac{!(a) \oplus !(a) : !(a) \oplus !(a) \vdash a}{!(a) \oplus !(a) : \cdot \vdash a} D_C} \star \frac{\overline{a : \cdot \vdash a}}{a : \cdot \vdash !(a)} ! \frac{\cdot : \cdot \vdash !(a)}{a : \cdot \vdash !(a) \oplus !(a)} \oplus_1 \star$$

$$\frac{\cdot : \cdot \vdash !(a) \oplus !(a)}{\cdot : \cdot \vdash !(a) \oplus !(a) \multimap a \& !(a) \multimap !(a) \oplus !(a)} \star$$

file: KLE/KLE047+1.p (45 ms)

$$\frac{\overline{a, !(a) \oplus !(b) : \cdot \vdash a} \quad \overline{a : \cdot \vdash a} \quad \overline{a : \cdot \vdash !(a) \oplus !(b)}}{\cdot : \cdot \vdash !(a \& !(a) \oplus !(b)) \multimap a \& !(a) \multimap a \& !(a) \oplus !(b)} \oplus_1 \star$$

file: KLE/KLE048+1.p (78 ms)

$$\frac{\overline{a, !(a) \oplus !(a \& b) : \cdot \vdash a} \quad \overline{a, b, !(a) \oplus !(a \& b) : \cdot \vdash a}}{\frac{!(a) \oplus !(a \& b) : !(a) \oplus !(a \& b) \vdash a}{!(a) \oplus !(a \& b) : \cdot \vdash a} D_C} \star \frac{\overline{a : \cdot \vdash a}}{a : \cdot \vdash !(a)} ! \frac{\cdot : \cdot \vdash !(a)}{a : \cdot \vdash !(a) \oplus !(a \& b)} \oplus_1 \star$$

$$\frac{\cdot : \cdot \vdash !(a) \oplus !(a \& b)}{\cdot : \cdot \vdash !(a) \oplus !(a \& b) \multimap a \& !(a) \multimap !(a) \oplus !(a \& b)} \star$$

file: KLE/KLE049+1.p (76 ms)

$$\frac{\overline{a, !(a) \multimap b : \cdot \vdash a}}{a, !(a) \multimap b : \cdot \vdash !(a)} ! \frac{\overline{a, !(a) \multimap b : b \vdash b}}{\cdot : !(a) \vdash !(a) \multimap b \multimap b \& !(b) \multimap !(a) \multimap b} \multimap$$

$$\frac{\overline{a, !(a) \multimap b : !(a) \multimap b \vdash b}}{a, !(a) \multimap b : \cdot \vdash b} D_C \frac{\overline{a, b : \cdot \vdash b}}{\cdot : !(a) \vdash !(a) \multimap b \multimap b \& !(b) \multimap !(a) \multimap b} \star$$

file: KLE/KLE050+1.p (36 ms)

$$\begin{array}{c}
\frac{\frac{b, !(b) \multimap \mathbf{0} : \cdot \vdash b}{b, !(b) \multimap \mathbf{0} : \cdot \vdash !(b)} ! \quad \frac{}{b, !(b) \multimap \mathbf{0} : \mathbf{0} \vdash a} \star}{\frac{b, !(b) \multimap \mathbf{0} : \cdot \vdash a}{b, !(b) \multimap \mathbf{0} : !(b) \multimap \mathbf{0} \vdash a} D_C} \multimap \\
\frac{a, b, !(b) \multimap \mathbf{0} : \cdot \vdash b}{\cdot : !(b) \multimap \mathbf{0} \vdash !(a \& b) \multimap b \& !(b) \multimap a \& b} \star
\end{array}$$

file: KLE/KLE056+1.p (297 ms)

$$\begin{array}{c}
\frac{\frac{b, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : \cdot \vdash b}{b, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : \cdot \vdash !(b)} ! \quad \frac{}{b, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : \mathbf{0} \vdash a} \star}{\frac{b, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : !(b) \multimap \mathbf{0} \vdash a}{b, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : \cdot \vdash a} D_C} \multimap \\
\frac{a, !(a) \oplus !(b), !(b) \multimap \mathbf{0} : \cdot \vdash a}{!(a) \oplus !(b), !(b) \multimap \mathbf{0} : !(a) \oplus !(b) \vdash a} D_C \quad \frac{}{a, !(b) \multimap \mathbf{0} : \cdot \vdash a} \star \quad \frac{a, !(b) \multimap \mathbf{0} : \cdot \vdash !(a)}{a, !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \oplus !(b)} \oplus_1}{\cdot : !(b) \multimap \mathbf{0} \vdash !(a) \oplus !(b) \multimap a \& !(a) \multimap !(a) \oplus !(b)} \star
\end{array}$$

file: KLE/KLE057+1.p (74 ms)

$$\begin{array}{c}
\frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash a}{a, !(a) \multimap \mathbf{0} : \cdot \vdash !(a)} ! \quad \frac{}{a, !(a) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}} \star}{\frac{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}} D_C} \multimap \\
\frac{}{\cdot : \cdot \vdash !(a) \multimap !(a) \multimap \mathbf{0} \multimap \mathbf{0}} \star
\end{array}$$

file: KLE/KLE058+1.p (568 ms)

$$\frac{}{}$$

file: KLE/KLE059+1.p (214 ms)

$$\begin{array}{c}
\frac{a, !(a) \oplus !(a) \multimap \mathbf{0}, !(a) \multimap a \multimap \mathbf{0} : \cdot \vdash a}{!(a) \oplus !(a) \multimap \mathbf{0}, !(a) \multimap a \multimap \mathbf{0} : \cdot \vdash !(a) \multimap a} \star}{\frac{!(a) \oplus !(a) \multimap \mathbf{0}, !(a) \multimap a \multimap \mathbf{0} : \cdot \vdash !(a) \multimap a}{!(a) \oplus !(a) \multimap \mathbf{0}, !(a) \multimap a \multimap \mathbf{0} : !(a) \multimap a \multimap \mathbf{0} \vdash \mathbf{0}} D_C} \multimap \\
\frac{}{\cdot : \cdot \vdash !(a) \oplus !(a) \multimap \mathbf{0} \multimap !(a) \multimap a \multimap \mathbf{0} \multimap \mathbf{0}} \star
\end{array}$$

file: KLE/KLE060+1.p (214 ms)

$$\frac{\frac{\frac{a, !(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash a \quad a, !(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash a}{!(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash !(a) \rightarrow a \& !(a) \rightarrow a} \quad \star}{!(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash !(!(a) \rightarrow a \& !(a) \rightarrow a)} \quad !}{\frac{!(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 \vdash 0}{!(a) \oplus !(!(a) \rightarrow 0), !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 : \vdash 0} \quad D_C}{\vdash : \vdash !(a) \oplus !(!(a) \rightarrow 0) \rightarrow !(!(a) \rightarrow a \& !(a) \rightarrow a) \rightarrow 0 \rightarrow 0} \quad \star$$

$$\begin{array}{c}
\frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash a}{a, !(a) \multimap \mathbf{0} : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, !(a) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}} \quad \star \\
\hline
\frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash !(a) \quad a, !(a) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \quad \multimap \\
\hline
\frac{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}} \quad D_C \\
\hline
\frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}}{\cdot : \cdot \vdash !(a \& !(a) \multimap \mathbf{0}) \multimap \mathbf{0}} \quad \star
\end{array}$$

[illegible]

[illegible]

$$a, !(b) \oplus !(!(b) \multimap 0) : \cdot \vdash a$$

$$\cdot : \cdot \vdash !(a \& !(b) \oplus !(!(b) \multimap 0)) \multimap a$$

★

file: KLE/KLE066+1.p (112 ms)

$$\frac{\frac{\frac{b, !(a) \oplus !(b \& !(b) \multimap 0), !(b) \multimap 0 : \cdot \vdash b}{b, !(a) \oplus !(b \& !(b) \multimap 0), !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(a) \oplus !(b \& !(b) \multimap 0), !(b) \multimap 0 : 0 \vdash a}{b, !(a) \oplus !(b \& !(b) \multimap 0), !(b) \multimap 0 : \cdot \vdash a} \star}{\frac{b, !(a) \oplus !(b \& !(b) \multimap 0), !(b) \multimap 0 : \cdot \vdash a}{!(a) \oplus !(b \& !(b) \multimap 0) : \cdot \vdash a} D_C} \star \quad \frac{\frac{a : \cdot \vdash a}{a : \cdot \vdash !(a)} !}{\frac{a : \cdot \vdash !(a) \oplus !(b \& !(b) \multimap 0)}{a : \cdot \vdash !(a) \oplus !(b \& !(b) \multimap 0) \oplus 1} \oplus_1} \star$$

file: KLE/KLE067+1.p (148 ms)

$$\frac{\frac{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{a, b, !(b) \multimap 0 : 0 \vdash 0}{a, b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash 0} D_C} \multimap \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash a}{b, !(b) \multimap 0 : \cdot \vdash a} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash a}{!(b) \multimap 0 : \cdot \vdash a} D_C} \star \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash 0}{b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash 0}{!(b) \multimap 0 : \cdot \vdash 0} D_C} \star$$

file: KLE/KLE068+1.p (timeout!)

file: KLE/KLE069+1.p (timeout!)

file: KLE/KLE070+1.p (286 ms)

$$\frac{\frac{\frac{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{a, b, !(b) \multimap 0 : 0 \vdash 0}{a, b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash 0} D_C} \multimap \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash a}{b, !(b) \multimap 0 : \cdot \vdash a} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash a}{!(b) \multimap 0 : \cdot \vdash a} D_C} \star \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash 0}{b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash 0}{!(b) \multimap 0 : \cdot \vdash 0} D_C} \star$$

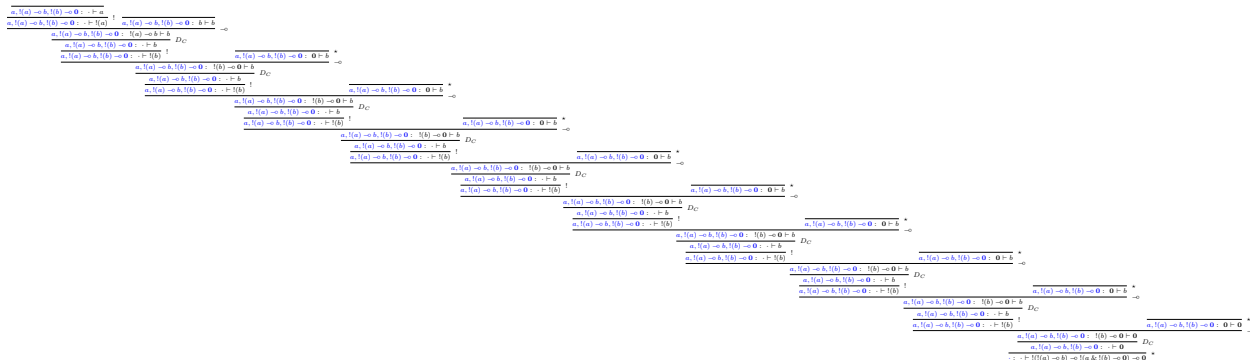
file: KLE/KLE071+1.p (256 ms)

$$\frac{\frac{\frac{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{a, b, !(b) \multimap 0 : 0 \vdash 0}{a, b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{a, b, !(b) \multimap 0 : \cdot \vdash b}{a, b, !(b) \multimap 0 : \cdot \vdash 0} D_C} \multimap \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash a}{b, !(b) \multimap 0 : \cdot \vdash a} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash a}{!(b) \multimap 0 : \cdot \vdash a} D_C} \star \quad \frac{\frac{b, !(b) \multimap 0 : \cdot \vdash b}{b, !(b) \multimap 0 : \cdot \vdash !(b)} ! \quad \frac{b, !(b) \multimap 0 : 0 \vdash 0}{b, !(b) \multimap 0 : \cdot \vdash 0} \star}{\frac{b, !(b) \multimap 0 : \cdot \vdash 0}{!(b) \multimap 0 : \cdot \vdash 0} D_C} \star$$

file: KLE/KLE072+1.p (280 ms)



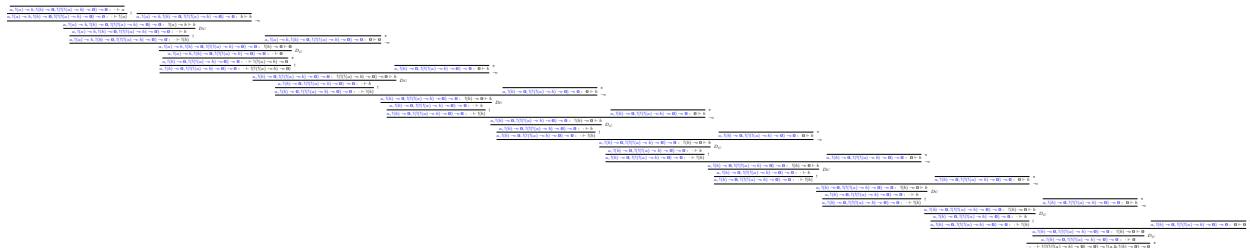
file: KLE/KLE073+1.p (256 ms)



```
file: KLE/KLE074+1.p (timeout!)
```

```
file: KLE/KLE075+1.p (timeout!)
```

file: KLE/KLE076+1.p (352 ms)



file: KLE/KLE077+1.p (250 ms)



```
file: KLE/KLE078+1.p (timeout!)
```

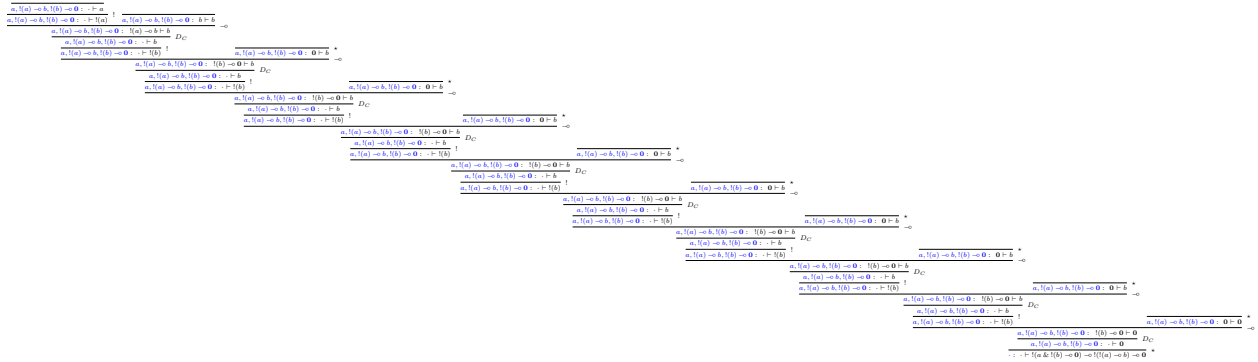
```
file: KLE/KLE079+1.p (346 ms)
```



file: KLE/KLE080+1.p (83 ms)

$$\begin{array}{c}
 \frac{a, b, !(a \rightarrow !(b) \rightarrow 0) : \cdot \vdash a}{a, b, !(a \rightarrow !(b) \rightarrow 0) : \cdot \vdash !(a)} ! \quad \frac{a, b, !(a \rightarrow !(b) \rightarrow 0) : \cdot \vdash b}{a, b, !(a \rightarrow !(b) \rightarrow 0) : \cdot \vdash !(b)} ! \quad \frac{a, b, !(a \rightarrow !(b) \rightarrow 0) : 0 \vdash 0}{a, b, !(a \rightarrow !(b) \rightarrow 0) : !(b) \rightarrow 0 \vdash 0} \star \\
 \hline
 \frac{a, b, !(a \rightarrow !(b) \rightarrow 0) : !(a) \rightarrow !(b) \rightarrow 0 \vdash 0}{a, b, !(a \rightarrow !(b) \rightarrow 0) : \cdot \vdash 0} D_C \\
 \hline
 \cdot : \cdot \vdash !(a \& b) \rightarrow !(a \rightarrow !(b) \rightarrow 0) \rightarrow 0 \star
 \end{array}$$

file: KLE/KLE081+1.p (294 ms)



file: KLE/KLE082+1.p (403 ms)



file: KLE/KLE083+1.p (timeout!)

file: KLE/KLE085+1.p (timeout!)

file: KLE/KLE086+1.p (timeout!)

file: KLE/KLE087+1.p (278 ms)

file: KLE/KLE088+1.p (timeout!)

4.2 LCL Problems

file: LCL/LCL181+1.p (timeout!)

file: LCL/LCL230+1.p (timeout!)

4.3 SYJ Problems

file: SYJ/SYJ101+1.p (26 ms)

$\frac{a : \cdot \vdash a}{\cdot : !(a) \vdash a} \star$

file: SYJ/SYJ102+1.p (66 ms)

$$\begin{array}{c}
 \frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash a}{a, !(a) \multimap \mathbf{0} : \cdot \vdash !(a)} \quad ! \quad \frac{a, !(a) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \star \\
 \hline
 \frac{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}} D_C \\
 \hline
 \frac{\cdot : !(a) \vdash !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{\cdot : !(a) \vdash !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \star
 \end{array}$$

file: SYJ/SYJ103+1.p (timeout!)

file: SYJ/SYJ104+1.p (60 ms)

$$\begin{array}{c}
\frac{}{a, !(a) \multimap b : \cdot \vdash a} \\
\frac{a, !(a) \multimap b : \cdot \vdash !(a)}{a, !(a) \multimap b : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, !(a) \multimap b : b \vdash b} \\
\hline
\frac{a, !(a) \multimap b : !(a) \multimap b \vdash b}{a, !(a) \multimap b : \cdot \vdash b} D_C \\
\hline
\cdot : !(!(a) \multimap b) \vdash !(a) \multimap b \quad \star
\end{array}$$

file: SYJ/SYJ105+1.002.p (311 ms)



file: SYJ/SYJ105+1.003.p (timeout!)

file: SYJ/SYJ105+1.004.p (timeout!)

file: SYJ/SYJ106+1.p (1549 ms)



file: SYJ/SYJ107+1.001.p (489 ms)

$$\begin{array}{c}
\frac{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash b \quad b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash c}{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash b \& c} \quad \star \\
\frac{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash b \& c}{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(b \& c)} \quad ! \\
\frac{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(b \& c)}{b, c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)} \quad \oplus_1 \\
\frac{c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)}{c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)} \quad D_C \\
\frac{c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)}{c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)} \quad D_C \\
\frac{c, !(b) \oplus !(a), !(!(b) \oplus !(a)) \oplus !(b) : \cdot \vdash !(a) \oplus !(b \& c)}{\vdash : !(c), !(!(b) \oplus !(a)) \oplus !(b) \vdash !(a) \oplus !(b \& c)} \quad \star
\end{array}$$

file: SYJ/SYJ107+1.002.p (13734 ms)



file: SYJ/SYJ107+1.003.p (timeout!)

file: SYJ/SYJ107+1.004.p (timeout!)

file: SYJ/SYJ201+1.002.p (timeout!)

file: SYJ/SYJ201+1.003.p (timeout!)

file: SYJ/SYJ201+1.004.p (timeout!)

file: SYJ/SYJ201+1.005.p (timeout!)

file: SYJ/SYJ201+1.006.p (timeout!)

file: SYJ/SYJ201+1.007.p (timeout!)

file: SYJ/SYJ201+1.008.p (timeout!)

file: SYJ/SYJ201+1.009.p (timeout!)

file: SYJ/SYJ201+1.010.p (timeout!)

file: SYJ/SYJ201+1.011.p (timeout!)

file: SYJ/SYJ201+1.012.p (timeout!)

file: SYJ/SYJ201+1.013.p (timeout!)

file: SYJ/SYJ201+1.014.p (timeout!)

file: SYJ/SYJ201+1.015.p (timeout!)

file: SYJ/SYJ201+1.016.p (timeout!)

file: SYJ/SYJ201+1.017.p (timeout!)

file: SYJ/SYJ201+1.018.p (timeout!)

file: SYJ/SYJ201+1.019.p (timeout!)

file: SYJ/SYJ201+1.020.p (timeout!)

file: SYJ/SYJ202+1.001.p (38 ms)

$$\frac{\frac{o11, o21 : \cdot \vdash o11}{o11, o21 : \cdot \vdash !(o11)} !}{o11, o21 : \cdot \vdash !(o11) \oplus !(o21)} \oplus_1$$
$$\therefore !(o11), !(o21) \vdash !(o11) \oplus !(o21) \star$$

file: SYJ/SYJ202+1.002.p (timeout!)

file: SYJ/SYJ202+1.003.p (timeout!)

file: SYJ/SYJ202+1.004.p (timeout!)

file: SYJ/SYJ202+1.005.p (timeout!)

file: SYJ/SYJ202+1.006.p (timeout!)

file: SYJ/SYJ202+1.007.p (timeout!)

file: SYJ/SYJ202+1.008.p (timeout!)

file: SYJ/SYJ202+1.009.p (timeout!)

file: SYJ/SYJ202+1.010.p (timeout!)

file: SYJ/SYJ202+1.011.p (timeout!)

file: SYJ/SYJ202+1.012.p (timeout!)

file: SYJ/SYJ202+1.013.p (timeout!)

file: SYJ/SYJ202+1.014.p (timeout!)


file: SYJ/SYJ202+1.015.p (timeout!)

file: SYJ/SYJ202+1.016.p (timeout!)

file: SYJ/SYJ202+1.017.p (timeout!)

file: SYJ/SYJ203+1.001.p (356 ms)

file: SYJ/SYJ203+1.002.p (2330 ms)



file: SYJ/SYJ203+1.004.p (3158 ms)

file: SYJ/SYJ203+1.005.p (4545 ms)

file: SYJ/SYJ203+1.010.p (timeout!)

file: SYJ/SYJ203+1.011.p (timeout!)

file: SYJ/SYJ203+1.012.p (timeout!)

file: SYJ/SYJ203+1.013.p (timeout!)

file: SYJ/SYJ203+1.014.p (timeout!)

file: SYJ/SYJ203+1.015.p (timeout!)

file: SYJ/SYJ203+1.016.p (timeout!)

file: SYJ/SYJ203+1.017.p (timeout!)

file: SYJ/SYJ203+1.018.p (timeout!)

file: SYJ/SYJ203+1.019.p (timeout!)

file: SYJ/SYJ203+1.020.p (timeout!)

file: SYJ/SYJ204+1.001.p (85 ms)

$$\begin{array}{c}
 \frac{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash p1}{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash !(p1)} ! \quad \frac{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash !(p1)}{p1, !(p1) \multimap !(p1) \multimap p0 : !(p1) \multimap p0 \vdash p0} \multimap \\
 \frac{p1, !(p1) \multimap !(p1) \multimap p0 : !(p1) \multimap p0 \vdash p0}{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash p0} D_C \\
 \cdot : !(p1), !(p1) \multimap !(p1) \multimap p0 \vdash p0 \quad \star
 \end{array}$$

file: SYJ/SYJ204+1.002.p (351 ms)

$$\begin{array}{c}
 \frac{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash p1}{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash !(p1)} ! \quad \frac{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash !(p1)}{p1, !(p1) \multimap !(p1) \multimap p0 : !(p1) \multimap p0 \vdash p0} \multimap \\
 \frac{p1, !(p1) \multimap !(p1) \multimap p0 : !(p1) \multimap p0 \vdash p0}{p1, !(p1) \multimap !(p1) \multimap p0 : \cdot \vdash p0} D_C \\
 \cdot : !(p1), !(p1) \multimap !(p1) \multimap p0 \vdash p0 \quad \star
 \end{array}$$

file: SYJ/SYJ204+1.003.p (503 ms)

file: SYJ/SYJ204+1.004.p (984 ms)

file: SYJ/SYJ204+1.008.p (timeout!)

file: SYJ/SYJ204+1.009.p (timeout!)

file: SYJ/SYJ204+1.010.p (timeout!)

file: SYJ/SYJ204+1.011.p (timeout!)

file: SYJ/SYJ204+1.012.p (timeout!)

file: SYJ/SYJ204+1.013.p (timeout!)

file: SYJ/SYJ204+1.014.p (timeout!)

file: SYJ/SYJ204+1.015.p (timeout!)

file: SYJ/SYJ204+1.016.p (timeout!)

file: SYJ/SYJ204+1.017.p (timeout!)

file: SYJ/SYJ204+1.018.p (timeout!)

file: SYJ/SYJ204+1.019.p (timeout!)

file: SYJ/SYJ204+1.020.p (timeout!)

file: SYJ/SYJ205+1.001.p (2907 ms)

file: SYJ/SYJ205+1.002.p (5855 ms)

file: SYJ/SYJ205+1.003.p (8888 ms)

file: SYJ/SYJ205+1.004.p (18028 ms)

file: SYJ/SYJ205+1.005.p (80827 ms)

file: SYJ/SYJ205+1.006.p (timeout!)

file: SYJ/SYJ205+1.007.p (timeout!)

file: SYJ/SYJ205+1.008.p (timeout!)

file: SYJ/SYJ205+1.009.p (timeout!)

file: SYJ/SYJ205+1.010.p (timeout!)

file: SYJ/SYJ205+1.011.p (timeout!)

file: SYJ/SYJ205+1.012.p (timeout!)

file: SYJ/SYJ207+1.001.p (timeout!)
file: SYJ/SYJ207+1.002.p (timeout!)
file: SYJ/SYJ207+1.003.p (timeout!)
file: SYJ/SYJ207+1.004.p (timeout!)
file: SYJ/SYJ207+1.005.p (timeout!)
file: SYJ/SYJ207+1.006.p (timeout!)
file: SYJ/SYJ207+1.007.p (timeout!)
file: SYJ/SYJ207+1.008.p (timeout!)
file: SYJ/SYJ207+1.009.p (timeout!)
file: SYJ/SYJ207+1.010.p (timeout!)
file: SYJ/SYJ207+1.011.p (timeout!)
file: SYJ/SYJ207+1.012.p (timeout!)
file: SYJ/SYJ207+1.013.p (timeout!)
file: SYJ/SYJ207+1.014.p (timeout!)
file: SYJ/SYJ207+1.015.p (timeout!)
file: SYJ/SYJ207+1.016.p (timeout!)
file: SYJ/SYJ207+1.017.p (timeout!)
file: SYJ/SYJ207+1.018.p (timeout!)
file: SYJ/SYJ207+1.019.p (timeout!)
file: SYJ/SYJ207+1.020.p (timeout!)
file: SYJ/SYJ208+1.001.p (timeout!)
file: SYJ/SYJ208+1.002.p (timeout!)
file: SYJ/SYJ208+1.003.p (timeout!)
file: SYJ/SYJ208+1.004.p (timeout!)
file: SYJ/SYJ208+1.005.p (timeout!)
file: SYJ/SYJ208+1.006.p (timeout!)
file: SYJ/SYJ208+1.007.p (timeout!)
file: SYJ/SYJ208+1.008.p (timeout!)
file: SYJ/SYJ208+1.009.p (timeout!)
file: SYJ/SYJ208+1.010.p (timeout!)
file: SYJ/SYJ208+1.011.p (timeout!)
file: SYJ/SYJ208+1.012.p (timeout!)
file: SYJ/SYJ208+1.013.p (timeout!)
file: SYJ/SYJ208+1.014.p (timeout!)
file: SYJ/SYJ208+1.015.p (timeout!)
file: SYJ/SYJ208+1.016.p (timeout!)

file: SYJ/SYJ208+1.017.p (timeout!)

file: SYJ/SYJ208+1.018.p (timeout!)

file: SYJ/SYJ208+1.019.p (timeout!)

file: SYJ/SYJ209+1.001.p (timeout!)

file: SYJ/SYJ209+1.002.p (timeout!)

file: SYJ/SYJ209+1.003.p (timeout!)

file: SYJ/SYJ209+1.004.p (timeout!)

file: SYJ/SYJ209+1.005.p (timeout!)

file: SYJ/SYJ209+1.006.p (timeout!)

file: SYJ/SYJ209+1.007.p (timeout!)

file: SYJ/SYJ209+1.008.p (timeout!)

file: SYJ/SYJ209+1.009.p (timeout!)

file: SYJ/SYJ209+1.010.p (timeout!)

file: SYJ/SYJ209+1.011.p (timeout!)

file: SYJ/SYJ209+1.012.p (timeout!)

file: SYJ/SYJ209+1.013.p (timeout!)

file: SYJ/SYJ209+1.014.p (timeout!)

file: SYJ/SYJ209+1.015.p (timeout!)

file: SYJ/SYJ209+1.016.p (timeout!)

file: SYJ/SYJ209+1.017.p (timeout!)

file: SYJ/SYJ209+1.018.p (timeout!)

file: SYJ/SYJ209+1.019.p (timeout!)

file: SYJ/SYJ209+1.020.p (timeout!)

file: SYJ/SYJ210+1.001.p (timeout!)

file: SYJ/SYJ210+1.002.p (timeout!)

file: SYJ/SYJ210+1.003.p (timeout!)

file: SYJ/SYJ210+1.004.p (timeout!)

file: SYJ/SYJ210+1.005.p (timeout!)

file: SYJ/SYJ210+1.006.p (timeout!)

file: SYJ/SYJ210+1.007.p (timeout!)

file: SYJ/SYJ210+1.008.p (timeout!)

file: SYJ/SYJ210+1.009.p (timeout!)

file: SYJ/SYJ210+1.010.p (timeout!)

file: SYJ/SYJ210+1.011.p (timeout!)

file: SYJ/SYJ210+1.012.p (timeout!)

```
file: SYJ/SYJ210+1.013.p (timeout!)
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```
file: SYJ/SYJ210+1.014.p (timeout!)
```

```
file: SYJ/SYJ210+1.015.p (timeout!)
```

```
file: SYJ/SYJ210+1.016.p (timeout!)
```

```
file: SYJ/SYJ210+1.017.p (timeout!)
```

```
file: SYJ/SYJ210+1.018.p (timeout!)
```

```
file: SYJ/SYJ210+1.019.p (timeout!)
```

```
file: SYJ/SYJ210+1.020.p (timeout!)
```

```
file: SYJ/SYJ211+1.001.p (timeout!)
```

```
file: SYJ/SYJ211+1.002.p (timeout!)
```

```
file: SYJ/SYJ211+1.003.p (timeout!)
```

```
file: SYJ/SYJ211+1.004.p (timeout!)
```

```
file: SYJ/SYJ211+1.005.p (timeout!)
```

```
file: SYJ/SYJ211+1.006.p (timeout!)
```

```
file: SYJ/SYJ211+1.007.p (timeout!)
```

```
file: SYJ/SYJ211+1.008.p (timeout!)
```

```
file: SYJ/SYJ211+1.009.p (timeout!)
```

```
file: SYJ/SYJ211+1.010.p (timeout!)
```

```
file: SYJ/SYJ211+1.011.p (timeout!)
```

```
file: SYJ/SYJ211+1.012.p (timeout!)
```

```
file: SYJ/SYJ211+1.013.p (timeout!)
```

```
file: SYJ/SYJ211+1.014.p (timeout!)
```

```
file: SYJ/SYJ211+1.015.p (timeout!)
```

```
file: SYJ/SYJ211+1.016.p (timeout!)
```

```
file: SYJ/SYJ211+1.017.p (timeout!)
```

```
file: SYJ/SYJ211+1.018.p (timeout!)
```

```
file: SYJ/SYJ211+1.019.p (timeout!)
```

```
file: SYJ/SYJ211+1.020.p (timeout!)
```

file: SYJ/SYJ212+1.001.p (381 ms)

[illegible]

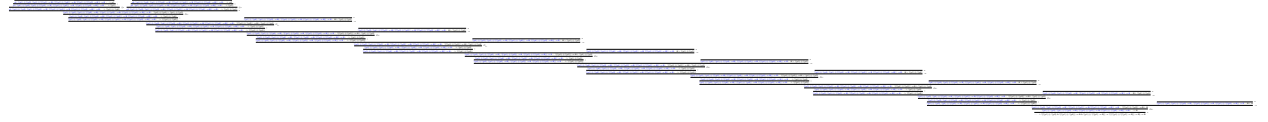
```
file: SYJ/SYJ212+1.003.p (timeout!)
```

```
file: SYJ/SYJ212+1.004.p (timeout!)
```

```
file: SYJ/SYJ212+1.005.p (timeout!)
```


$$\frac{\overline{p : \cdot \vdash p} \quad \overline{p : \cdot \vdash p}}{\cdot : \cdot \vdash !(p) \multimap p \ \& \ !(p) \multimap p} \star$$

file: SYN/SYN391+1.p (540 ms)



file: SYN/SYN392+1.p (timeout!)

file: SYN/SYN393+1.p (timeout!)

file: SYN/SYN416+1.p (fail)

20 file: SYN/SYN915+1.p (fail)

18 file: SYN/SYN916+1.p (fail)

21 file: SYN/SYN977+1.p (fail)

25 file: SYN/SYN978+1.p (31 ms)

$$\frac{\overline{a, b : \cdot \vdash b} \quad \overline{a, b : \cdot \vdash a}}{\cdot : \cdot \vdash !(a \ \& \ b) \multimap !(a) \multimap b \ \& \ !(b) \multimap a} \star$$

5 Call-by-Value

5.1 KLE Problems

file: KLE/KLE001+1.p (45 ms)

$$\frac{\frac{\overline{a : \cdot \vdash a}}{a : \cdot \vdash !(a)} !}{\cdot : \cdot \vdash !(a) \multimap !(a)} \star$$

$$\cdot : \cdot \vdash !(a) \multimap !(a) !$$

file: KLE/KLE002+1.p (304 ms)

$$\begin{array}{c}
\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)} ! \quad \frac{a, b, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b} \star \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash b} D_C}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(b)} ! \quad \frac{\frac{a, c, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash c}{a, c, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} !}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} \star \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(b)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} ! \quad \frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} \star}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} \star \\
\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)} D_C \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(c)}{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(c)} \star}{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(c)} ! \\
\frac{!(a) \multimap !(b), !(b) \multimap !(c) : \cdot \vdash !(a) \multimap !(c)}{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap !(c)} \star \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap !(c)}{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap !(c)} ! \\
\frac{!(a) \multimap !(b) : \cdot \vdash !(b) \multimap !(c) \multimap !(a) \multimap !(c)}{\cdot : !(a) \multimap !(b) \vdash !(b) \multimap !(c) \multimap !(a) \multimap !(c)} \star
\end{array}$$
[illegible]
$$\begin{array}{c}
\frac{a, c, !(a) \multimap !(b) : \cdot \vdash a}{a, c, !(a) \multimap !(b) : \cdot \vdash !(a)} \quad ! \quad \frac{a, b, c, !(a) \multimap !(b) : \cdot \vdash b}{a, c, !(a) \multimap !(b) : !(b) \vdash b} \quad \star \\
\hline
\frac{a, c, !(a) \multimap !(b) : !(a) \multimap !(b) \vdash b}{a, c, !(a) \multimap !(b) : \cdot \vdash b} \quad D_C \quad \frac{a, c, !(a) \multimap !(b) : \cdot \vdash c}{a, c, !(a) \multimap !(b) : \cdot \vdash !(c)} \quad ! \\
\hline
\frac{a, c, !(a) \multimap !(b) : \cdot \vdash !(b) \otimes !(c)}{!(a) \multimap !(b) : \cdot \vdash !(a) \otimes !(c) \multimap !(b) \otimes !(c)} \quad \star \\
\hline
\frac{!(a) \multimap !(b) : \cdot \vdash !(a) \otimes !(c) \multimap !(b) \otimes !(c)}{!(a) \multimap !(b) : \cdot \vdash !(a) \otimes !(c) \multimap !(b) \otimes !(c)} \quad ! \\
\hline
\frac{\cdot : !(a) \multimap !(b) \vdash !(a) \otimes !(c) \multimap !(b) \otimes !(c)}{\cdot : !(a) \multimap !(b) \vdash !(a) \otimes !(c) \multimap !(b) \otimes !(c)} \quad \star
\end{array}$$

59


```
file: KLE/KLE019+1.p (384 ms)
```

[illegible]

```
file: KLE/KLE020+1.p (265 ms)
```

$$\begin{array}{c}
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} \quad ! \quad \frac{\frac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash b}{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} \quad !}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \quad !(b) \vdash !(b)} \quad \star}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \quad !(a) \multimap !(b) \vdash !(b)} \quad \multimap \\
\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \quad !(a) \multimap !(b) \vdash !(b)}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} \quad D_C}{\frac{!(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a) \multimap !(b)}{!(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(!(a) \multimap !(b))} \quad \star}{\cdot : \quad !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(!(a) \multimap !(b))} \quad \star
\end{array}$$

```
file: KLE/KLE021+1.p (256 ms)
```

$$\begin{array}{c}
\frac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash a}{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} ! \\
\frac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash b}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} ! \\
\frac{!}{\frac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)}{b, !(a) \multimap !(b), !(b) \multimap !(a) : !(a) \vdash !(a)} \star} \multimap \\
\frac{b, !(a) \multimap !(b), !(b) \multimap !(a) : !(b) \multimap !(a) \vdash !(a)}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} D_C \\
\frac{!}{\frac{!(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b) \multimap !(a)}{!(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(!(b) \multimap !(a))} !} \star \\
\frac{\cdot : !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(!(b) \multimap !(a))}{\cdot : !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(!(b) \multimap !(a))} \star
\end{array}$$

```
file: KLE/KLE022+1.p (238 ms)
```

$$\frac{\frac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} ! \quad \frac{\frac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash b}{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} !}{a, !(a) \multimap !(b), !(b) \multimap !(a) : !(b) \vdash !(b)} \star}{\frac{a, !(a) \multimap !(b), !(b) \multimap !(a) : !(a) \multimap !(b) \vdash !(b)}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} D_C} \star$$

```
file: KLE/KLE023+1.p (251 ms)
```

$$\frac{\frac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash b}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(b)} ! \quad \frac{\frac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash a}{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} !}{b, !(a) \multimap !(b), !(b) \multimap !(a) : !(a) \vdash !(a)} \star}{\frac{b, !(a) \multimap !(b), !(b) \multimap !(a) : !(b) \multimap !(a) \vdash !(a)}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \cdot \vdash !(a)} D_C} \star$$

```
file: KLE/KLE024+1.p (55 ms)
```

$$\frac{\frac{\frac{a : \cdot \vdash a}{a : \cdot \vdash !(a)} !}{\cdot : \cdot \vdash !(a) \multimap !(a)} \star}{\cdot : \cdot \vdash !(!(a) \multimap !(a))} ! \quad \frac{\frac{\frac{a : \cdot \vdash a}{a : \cdot \vdash !(a)} !}{\cdot : \cdot \vdash !(a) \multimap !(a)} \star}{\cdot : \cdot \vdash !(!(a) \multimap !(a))} ! \quad \frac{\cdot : \cdot \vdash !(!(a) \multimap !(a)) \otimes !(!(a) \multimap !(a))}{\cdot : \cdot \vdash !(!(a) \multimap !(a)) \otimes !(!(a) \multimap !(a))} \otimes$$

```
file: KLE/KLE025+1.p (370 ms)
```

[illegible]

```
file: KLE/KLE026+1.p (798 ms)
```

The Gantt chart illustrates the project schedule for the 'Development of a New Product' project. The chart is divided into three main sections: 'Phase 1: Planning and Design', 'Phase 2: Development and Testing', and 'Phase 3: Deployment and Support'. Each section contains multiple tasks with their respective durations and start/end dates. The chart uses a color-coded system to represent different project phases and tasks.

Task Name	Start Date	End Date	Duration (Days)
Project Kick-off	2023-01-01	2023-01-05	5
Define Project Scope	2023-01-06	2023-01-10	5
Identify Stakeholders	2023-01-11	2023-01-15	5
Develop Project Charter	2023-01-16	2023-01-20	5
Conduct Initial Meeting	2023-01-21	2023-01-25	5
Define Project Objectives	2023-01-26	2023-01-30	5
Identify Key Deliverables	2023-01-31	2023-02-04	5
Develop Project Plan	2023-02-05	2023-02-09	5
Identify Risks	2023-02-10	2023-02-14	5
Develop Risk Register	2023-02-15	2023-02-19	5
Conduct Initial Meeting	2023-02-20	2023-02-24	5
Define Project Scope	2023-02-25	2023-03-01	6
Identify Stakeholders	2023-03-02	2023-03-06	5
Develop Project Charter	2023-03-07	2023-03-11	5
Conduct Initial Meeting	2023-03-12	2023-03-16	5
Define Project Objectives	2023-03-17	2023-03-21	5
Identify Key Deliverables	2023-03-22	2023-03-26	5
Develop Project Plan	2023-03-27	2023-03-31	5
Identify Risks	2023-04-01	2023-04-05	5
Develop Risk Register	2023-04-06	2023-04-10	5
Conduct Initial Meeting	2023-04-11	2023-04-15	5
Define Project Scope	2023-04-16	2023-04-20	5
Identify Stakeholders	2023-04-21	2023-04-25	5
Develop Project Charter	2023-04-26	2023-04-30	5
Conduct Initial Meeting	2023-05-01	2023-05-05	5
Define Project Objectives	2023-05-06	2023-05-10	5
Identify Key Deliverables	2023-05-11	2023-05-15	5
Develop Project Plan	2023-05-16	2023-05-20	5
Identify Risks	2023-05-21	2023-05-25	5
Develop Risk Register	2023-05-26	2023-05-30	5
Conduct Initial Meeting	2023-05-31	2023-06-04	5
Define Project Scope	2023-06-05	2023-06-09	5
Identify Stakeholders	2023-06-10	2023-06-14	5
Develop Project Charter	2023-06-15	2023-06-19	5
Conduct Initial Meeting	2023-06-20	2023-06-24	5
Define Project Objectives	2023-06-25	2023-06-29	5
Identify Key Deliverables	2023-06-30	2023-07-04	5
Develop Project Plan	2023-07-05	2023-07-09	5
Identify Risks	2023-07-10	2023-07-14	5
Develop Risk Register	2023-07-15	2023-07-19	5
Conduct Initial Meeting	2023-07-20	2023-07-24	5
Define Project Scope	2023-07-25	2023-07-29	5
Identify Stakeholders	2023-07-30	2023-08-03	5
Develop Project Charter	2023-08-04	2023-08-08	5
Conduct Initial Meeting	2023-08-09	2023-08-13	5
Define Project Objectives	2023-08-14	2023-08-18	5
Identify Key Deliverables	2023-08-19	2023-08-23	5
Develop Project Plan	2023-08-24	2023-08-28	5
Identify Risks	2023-08-29	2023-09-02	5
Develop Risk Register	2023-09-03	2023-09-07	5
Conduct Initial Meeting	2023-09-08	2023-09-12	5
Define Project Scope	2023-09-13	2023-09-17	5
Identify Stakeholders	2023-09-18	2023-09-22	5
Develop Project Charter	2023-09-23	2023-09-27	5
Conduct Initial Meeting	2023-09-28	2023-10-02	5
Define Project Objectives	2023-10-03	2023-10-07	5
Identify Key Deliverables	2023-10-08	2023-10-12	5
Develop Project Plan	2023-10-13	2023-10-17	5
Identify Risks	2023-10-18	2023-10-22	5
Develop Risk Register	2023-10-23	2023-10-27	5
Conduct Initial Meeting	2023-10-28	2023-11-01	5
Define Project Scope	2023-11-02	2023-11-06	5
Identify Stakeholders	2023-11-07	2023-11-11	5
Develop Project Charter	2023-11-12	2023-11-16	5
Conduct Initial Meeting	2023-11-17	2023-11-21	5
Define Project Objectives	2023-11-22	2023-11-26	5
Identify Key Deliverables	2023-11-27	2023-12-01	5
Develop Project Plan	2023-12-02	2023-12-06	5
Identify Risks	2023-12-07	2023-12-11	5
Develop Risk Register	202		

```
file: KLE/KLE027+1.p (1838 ms)
```

The Gantt chart illustrates the project schedule for the 'Development of a New Product' project. The project is organized into a hierarchical structure with five main phases: Project Initiation, Project Planning, Project Execution, Project Monitoring, and Project Closure. Each phase is further broken down into sub-tasks and specific activities. The chart uses a color-coded system to distinguish between different types of tasks: blue for initiation, green for planning, yellow for execution, orange for monitoring, and red for closure. The timeline spans from the start of the project to the end, with various milestones and dependencies indicated by arrows and labels. The chart is a detailed representation of the project's schedule, showing the sequence and duration of tasks.

```
file: KLE/KLE028+1.p (565 ms)
```

file: KLE/KLE032+1.p (505 ms)

[illegible]

```
file: KLE/KLE034+1.p (371 ms)
```

[illegible]

file: KLE/KLE035+1.p (381 ms)

[illegible]

file: KLE/KLE036+1.p (433 ms)

[illegible]

file: KLE/KLE037+1.p (400 ms)

$$\begin{array}{c}
\frac{a, !(a) \multimap \mathbf{0} : \cdot \vdash a}{a, !(a) \multimap \mathbf{0} : \cdot \vdash !(a)} \quad ! \quad \frac{}{a, !(a) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}} \star \\
\hline
\frac{a, !(a) \multimap \mathbf{0} : !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}} D_C \\
\hline
\frac{\cdot : \cdot \vdash !(a) \otimes !(a) \multimap \mathbf{0} \multimap \mathbf{0}}{\cdot : \cdot \vdash !(a) \otimes !(a) \multimap \mathbf{0} \multimap \mathbf{0}} \star \\
\hline
\frac{}{\cdot : \cdot \vdash !(a) \otimes !(a) \multimap \mathbf{0} \multimap \mathbf{0}} !
\end{array}$$

A complex phylogenetic tree showing the relationships between various species. The tree is rooted on the left and branches out to the right. The species names are listed along the branches, and the numbers 1 through 10 are placed at the tips of the branches. The tree is highly branched, indicating a large number of species and a complex evolutionary history.

[illegible]



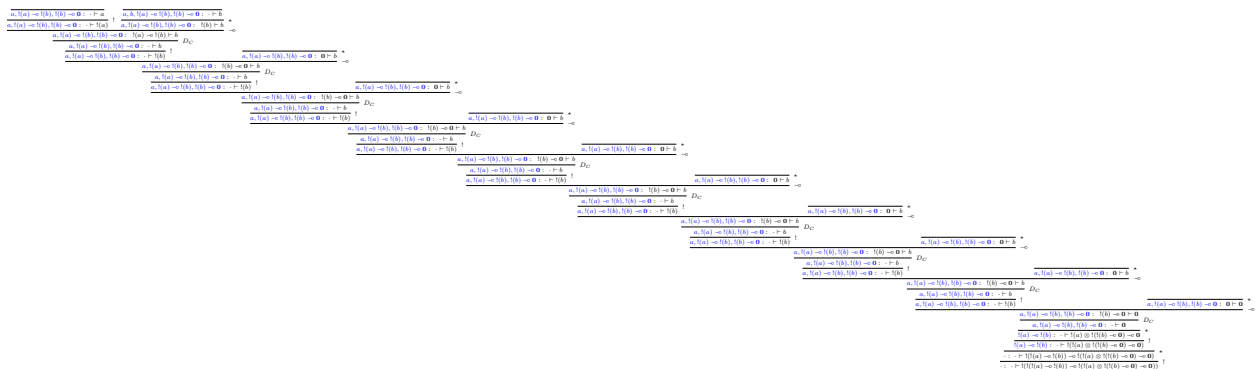
```
file: KLE/KLE071+1.p (104 ms)
```

$$\begin{array}{c}
\frac{a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : \cdot \vdash a}{a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : \cdot \vdash !(a)} ! \\
\frac{}{a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : \cdot \vdash !(a) \oplus !(b \multimap \mathbf{0})} \oplus_1 \frac{}{a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}} \star \\
\hline
a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} \vdash \mathbf{0} \quad D_C \\
\hline
\frac{a, b, !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}}{a, b : \cdot \vdash !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} \multimap \mathbf{0}} \star \\
\hline
\frac{a, b : \cdot \vdash !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0} \multimap \mathbf{0}}{a, b : \cdot \vdash !(a) \otimes (b \multimap !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0})} ! \\
\hline
\frac{\cdot : \cdot \vdash !(a) \otimes (b \multimap !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0})}{\cdot : \cdot \vdash !(a) \otimes (b \multimap !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0})} \star \\
\hline
\cdot : \cdot \vdash !(a) \otimes (b \multimap !(a) \oplus !(b \multimap \mathbf{0}) \multimap \mathbf{0}) !
\end{array}$$

```
file: KLE/KLE072+1.p (327 ms)
```



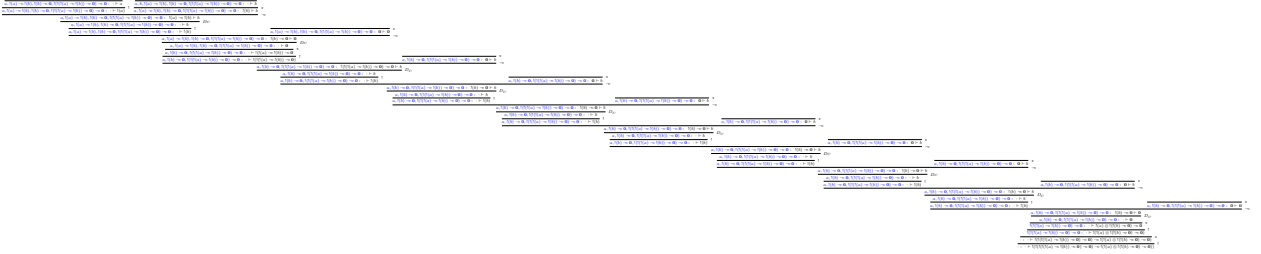
```
file: KLE/KLE073+1.p (285 ms)
```



file: KLE/KLE074+1.p (timeout!)

file: KLE/KLE075+1.p (timeout!)

file: KLE/KLE076+1.p (408 ms)

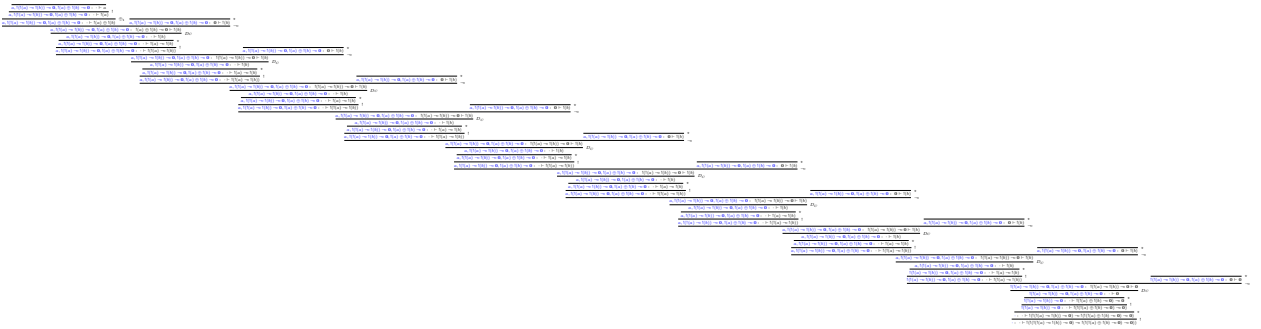


file: KLE/KLE077+1.p (225 ms)

$$\begin{array}{c}
 \frac{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash a}{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a)} ! \\
 \frac{\phantom{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a)} \oplus_1 \frac{\phantom{a, !(a) \oplus !(b) \multimap \mathbf{0} : \mathbf{0} \vdash !(b)} \star}{a, !(a) \oplus !(b) \multimap \mathbf{0} : \mathbf{0} \vdash !(b)} \star}{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \oplus !(b)} \multimap \\
 \frac{\phantom{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \oplus !(b)} D_C}{a, !(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(b)} \\
 \frac{\phantom{!(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \multimap !(b)} \star}{!(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \multimap !(b)} \star \\
 \frac{\phantom{!(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a) \multimap !(b)} !}{!(a) \oplus !(b) \multimap \mathbf{0} : \cdot \vdash !(a \multimap !(b))} ! \\
 \frac{\phantom{\cdot : \cdot \vdash !(a \oplus !(b) \multimap \mathbf{0}) \multimap !(a \multimap !(b))} \star}{\cdot : \cdot \vdash !(a \oplus !(b) \multimap \mathbf{0}) \multimap !(a \multimap !(b))} \star \\
 \frac{\phantom{\cdot : \cdot \vdash !(a \oplus !(b) \multimap \mathbf{0}) \multimap !(a \multimap !(b))} !}{\cdot : \cdot \vdash !(a \oplus !(b) \multimap \mathbf{0}) \multimap !(a \multimap !(b))} !
 \end{array}$$

file: KLE/KLE078+1.p (timeout!)

file: KLE/KLE079+1.p (359 ms)



file: KLE/KLE080+1.p (109 ms)

file: KLE/KLE087+1.p (234 ms)

file: SYJ/SYJ107+1.002.p (374 ms)

file: SYJ/SYJ107+1.004.p (timeout!)

file: SYJ/SYJ201+1.002.p (timeout!)

file: SYJ/SYJ201+1.003.p (timeout!)

file: SYJ/SYJ201+1.004.p (timeout!)

file: SYJ/SYJ201+1.005.p (timeout!)

file: SYJ/SYJ201+1.006.p (timeout!)

file: SYJ/SYJ201+1.007.p (timeout!)

file: SYJ/SYJ201+1.008.p (timeout!)

file: SYJ/SYJ201+1.009.p (timeout!)

file: SYJ/SYJ201+1.010.p (timeout!)

file: SYJ/SYJ201+1.011.p (timeout!)

file: SYJ/SYJ201+1.012.p (timeout!)

file: SYJ/SYJ201+1.013.p (timeout!)

file: SYJ/SYJ201+1.014.p (timeout!)

file: SYJ/SYJ201+1.015.p (timeout!)

file: SYJ/SYJ201+1.016.p (timeout!)

file: SYJ/SYJ201+1.017.p (timeout!)

file: SYJ/SYJ201+1.018.p (timeout!)

file: SYJ/SYJ201+1.019.p (timeout!)

file: SYJ/SYJ201+1.020.p (timeout!)

file: SYJ/SYJ202+1.001.p (38 ms)

$$\frac{\frac{o11, o21 : \cdot \vdash o11}{o11, o21 : \cdot \vdash !(o11)} !}{\frac{o11, o21 : \cdot \vdash !(o11) \oplus !(o21)}{\cdot : !(o11), !(o21) \vdash !(o11) \oplus !(o21)} \oplus_1} *$$

file: SYJ/SYJ202+1.002.p (367 ms)

file: SYJ/SYJ202+1.003.p (timeout!)

file: SYJ/SYJ202+1.004.p (timeout!)

file: SYJ/SYJ202+1.005.p (timeout!)

file: SYJ/SYJ202+1.006.p (timeout!)

file: SYJ/SYJ202+1.007.p (timeout!)

file: SYJ/SYJ202+1.008.p (timeout!)

file: SYJ/SYJ202+1.009.p (timeout!)

file: SYJ/SYJ202+1.010.p (timeout!)

file: SYJ/SYJ202+1.011.p (timeout!)

file: SYJ/SYJ202+1.012.p (timeout!)

file: SYJ/SYJ202+1.013.p (timeout!)

file: SYJ/SYJ202+1.014.p (timeout!)

file: SYJ/SYJ202+1.015.p (timeout!)

file: SYJ/SYJ202+1.016.p (timeout!)

file: SYJ/SYJ202+1.017.p (timeout!)

file: SYJ/SYJ202+1.018.p (timeout!)

file: SYJ/SYJ202+1.019.p (timeout!)

file: SYJ/SYJ202+1.020.p (timeout!)

file: SYJ/SYJ203+1.001.p (307 ms)

$$\frac{\frac{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash p1}{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} !}{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} \oplus_1 \frac{\frac{f, p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash f}{f, p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} !}{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : !f \vdash !f} \star \multimap$$
$$\frac{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : !f \vdash !f}{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} D_C$$
$$\frac{\frac{p1,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f}{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} \star}{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} \oplus_1 \frac{\frac{f,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash f}{f,!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f} !}{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : !f \vdash !f} \star \multimap$$
$$\frac{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f}{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : !f \vdash !f} D_C$$
$$\frac{!(p1) \oplus !(l(p1) \multimap !f) \multimap !f : \cdot \vdash !f}{\cdot : !(p1) \oplus !(l(p1) \multimap !f) \multimap !f \vdash !f} \star$$

file: SYJ/SYJ203+1.002.p (1997 ms)

=====

file: SYJ/SYJ203+1.003.p (18495 ms)

=====

file: SYJ/SYJ203+1.004.p (timeout!)

file: SYJ/SYJ203+1.005.p (timeout!)

file: SYJ/SYJ203+1.006.p (timeout!)

file: SYJ/SYJ203+1.007.p (timeout!)

file: SYJ/SYJ203+1.008.p (timeout!)

file: SYJ/SYJ204+1.001.p (107 ms)

file: SYJ/SYJ204+1.002.p (573 ms)

file: SYJ/SYJ204+1.003.p (2568 ms)

file: SYJ/SYJ204+1.004.p (13079 ms)

```
file: SYJ/SYJ204+1.014.p (timeout!)
```


file: SYJ/SYJ204+1.015.p (timeout!)

file: SYJ/SYJ204+1.016.p (timeout!)

file: SYJ/SYJ204+1.017.p (timeout!)

file: SYJ/SYJ204+1.018.p (timeout!)

file: SYJ/SYJ204+1.019.p (timeout!)

file: SYJ/SYJ204+1.020.p (timeout!)

file: SYJ/SYJ205+1.001.p (35352 ms)

file: SYJ/SYJ205+1.002.p (107317 ms)

file: SYJ/SYJ205+1.003.p (timeout!)

file: SYJ/SYJ205+1.004.p (timeout!)

file: SYJ/SYJ205+1.005.p (timeout!)

file: SYJ/SYJ205+1.006.p (timeout!)

file: SYJ/SYJ205+1.007.p (timeout!)

file: SYJ/SYJ205+1.008.p (timeout!)

file: SYJ/SYJ205+1.009.p (timeout!)

file: SYJ/SYJ205+1.010.p (timeout!)

file: SYJ/SYJ205+1.011.p (timeout!)

file: SYJ/SYJ205+1.012.p (timeout!)

file: SYJ/SYJ205+1.013.p (timeout!)

file: SYJ/SYJ205+1.014.p (timeout!)

file: SYJ/SYJ205+1.015.p (timeout!)

file: SYJ/SYJ205+1.016.p (timeout!)

file: SYJ/SYJ205+1.017.p (timeout!)

file: SYJ/SYJ205+1.018.p (timeout!)

file: SYJ/SYJ205+1.019.p (timeout!)

file: SYJ/SYJ205+1.020.p (timeout!)

file: SYJ/SYJ206+1.001.p (47 ms)

file: SYJ/SYJ207+1.007.p (timeout!)

file: SYJ/SYJ207+1.008.p (timeout!)

file: SYJ/SYJ207+1.009.p (timeout!)

file: SYJ/SYJ207+1.010.p (timeout!)

file: SYJ/SYJ207+1.011.p (timeout!)

file: SYJ/SYJ207+1.012.p (timeout!)

file: SYJ/SYJ207+1.013.p (timeout!)

file: SYJ/SYJ207+1.014.p (timeout!)

file: SYJ/SYJ207+1.015.p (timeout!)

file: SYJ/SYJ207+1.016.p (timeout!)

file: SYJ/SYJ207+1.017.p (timeout!)

file: SYJ/SYJ207+1.018.p (timeout!)

file: SYJ/SYJ207+1.019.p (timeout!)

file: SYJ/SYJ207+1.020.p (timeout!)

file: SYJ/SYJ208+1.001.p (timeout!)

file: SYJ/SYJ208+1.002.p (timeout!)

file: SYJ/SYJ208+1.003.p (timeout!)

file: SYJ/SYJ208+1.004.p (timeout!)

file: SYJ/SYJ208+1.005.p (timeout!)

file: SYJ/SYJ208+1.006.p (timeout!)

file: SYJ/SYJ208+1.007.p (timeout!)

file: SYJ/SYJ208+1.008.p (timeout!)

file: SYJ/SYJ208+1.009.p (timeout!)

file: SYJ/SYJ208+1.010.p (timeout!)

file: SYJ/SYJ208+1.011.p (timeout!)

file: SYJ/SYJ208+1.012.p (timeout!)

file: SYJ/SYJ208+1.013.p (timeout!)

file: SYJ/SYJ208+1.014.p (timeout!)

file: SYJ/SYJ208+1.015.p (timeout!)

file: SYJ/SYJ208+1.016.p (timeout!)

file: SYJ/SYJ208+1.017.p (timeout!)

file: SYJ/SYJ208+1.018.p (timeout!)

file: SYJ/SYJ208+1.019.p (timeout!)

file: SYJ/SYJ209+1.001.p (timeout!)

file: SYJ/SYJ209+1.002.p (timeout!)

file: SYJ/SYJ209+1.003.p (timeout!)
file: SYJ/SYJ209+1.004.p (timeout!)
file: SYJ/SYJ209+1.005.p (timeout!)
file: SYJ/SYJ209+1.006.p (timeout!)
file: SYJ/SYJ209+1.007.p (timeout!)
file: SYJ/SYJ209+1.008.p (timeout!)
file: SYJ/SYJ209+1.009.p (timeout!)
file: SYJ/SYJ209+1.010.p (timeout!)
file: SYJ/SYJ209+1.011.p (timeout!)
file: SYJ/SYJ209+1.012.p (timeout!)
file: SYJ/SYJ209+1.013.p (timeout!)
file: SYJ/SYJ209+1.014.p (timeout!)
file: SYJ/SYJ209+1.015.p (timeout!)
file: SYJ/SYJ209+1.016.p (timeout!)
file: SYJ/SYJ209+1.017.p (timeout!)
file: SYJ/SYJ209+1.018.p (timeout!)
file: SYJ/SYJ209+1.019.p (timeout!)
file: SYJ/SYJ209+1.020.p (timeout!)
file: SYJ/SYJ210+1.001.p (timeout!)
file: SYJ/SYJ210+1.002.p (timeout!)
file: SYJ/SYJ210+1.003.p (timeout!)
file: SYJ/SYJ210+1.004.p (timeout!)
file: SYJ/SYJ210+1.005.p (timeout!)
file: SYJ/SYJ210+1.006.p (timeout!)
file: SYJ/SYJ210+1.007.p (timeout!)
file: SYJ/SYJ210+1.008.p (timeout!)
file: SYJ/SYJ210+1.009.p (timeout!)
file: SYJ/SYJ210+1.010.p (timeout!)
file: SYJ/SYJ210+1.011.p (timeout!)
file: SYJ/SYJ210+1.012.p (timeout!)
file: SYJ/SYJ210+1.013.p (timeout!)
file: SYJ/SYJ210+1.014.p (timeout!)
file: SYJ/SYJ210+1.015.p (timeout!)
file: SYJ/SYJ210+1.016.p (timeout!)
file: SYJ/SYJ210+1.017.p (timeout!)
file: SYJ/SYJ210+1.018.p (timeout!)

file: SYJ/SYJ210+1.019.p (timeout!)

file: SYJ/SYJ210+1.020.p (timeout!)

file: SYJ/SYJ211+1.001.p (timeout!)

file: SYJ/SYJ211+1.002.p (timeout!)

file: SYJ/SYJ211+1.003.p (timeout!)

file: SYJ/SYJ211+1.004.p (timeout!)

file: SYJ/SYJ211+1.005.p (timeout!)

file: SYJ/SYJ211+1.006.p (timeout!)

file: SYJ/SYJ211+1.007.p (timeout!)

file: SYJ/SYJ211+1.008.p (timeout!)

file: SYJ/SYJ211+1.009.p (timeout!)

file: SYJ/SYJ211+1.010.p (timeout!)

file: SYJ/SYJ211+1.011.p (timeout!)

file: SYJ/SYJ211+1.012.p (timeout!)

file: SYJ/SYJ211+1.013.p (timeout!)

file: SYJ/SYJ211+1.014.p (timeout!)

file: SYJ/SYJ211+1.015.p (timeout!)

file: SYJ/SYJ211+1.016.p (timeout!)

file: SYJ/SYJ211+1.017.p (timeout!)

file: SYJ/SYJ211+1.018.p (timeout!)

file: SYJ/SYJ211+1.019.p (timeout!)

file: SYJ/SYJ211+1.020.p (timeout!)

file: SYJ/SYJ212+1.001.p (553 ms)



file: SYJ/SYJ212+1.002.p (timeout!)

file: SYJ/SYJ212+1.003.p (timeout!)

file: SYJ/SYJ212+1.004.p (timeout!)

file: SYJ/SYJ212+1.005.p (timeout!)

file: SYJ/SYJ212+1.006.p (timeout!)

file: SYJ/SYJ212+1.007.p (timeout!)

file: SYJ/SYJ212+1.008.p (timeout!)

file: SYJ/SYJ212+1.009.p (timeout!)

file: SYJ/SYJ212+1.010.p (timeout!)

```
file: SYN/SYN001+1.p (274 ms)
```

$$\frac{\frac{p, !(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash p}{p, !(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (p)} !}{\frac{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (p) \multimap ! (p)}{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (l(p) \multimap ! (p))} *} \otimes \frac{\frac{p, !(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash p}{p, !(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (p)} !}{\frac{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (p) \multimap ! (p)}{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (l(p) \multimap ! (p))} *} \otimes \frac{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p))}{!(l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \cdot \vdash ! (l(p) \multimap ! (p)) \otimes !(l(p) \multimap ! (p)) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}}^* \multimap D_C$$

The Gantt chart illustrates the project schedule for the 'Development of a New Product' project. The project is organized into a hierarchical structure with multiple levels of tasks. The top level includes 'Project Initiation', 'Project Planning', 'Project Execution', 'Project Monitoring', and 'Project Closure'. Each of these top-level tasks is further broken down into sub-tasks, which are then further detailed into specific activities. The chart uses a color-coded system: blue for initiation and planning, green for execution, yellow for monitoring, and red for closure. The timeline spans from the start of the project to the end, with various milestones and dependencies indicated by arrows and task bars.

[illegible]

```
file: SYN/SYN390+1.p (46 ms)
```

```
file: SYN/SYN391+1.p (454 ms)
```



file: SYN/SYN392+1.p (timeout!)

file: SYN/SYN393+1.p (timeout!)

file: SYN/SYN416+1.p (**fail**)

18 file: SYN/SYN915+1.p (17 ms)

$\cdot : \cdot \vdash 1$

file: SYN/SYN916+1.p (**fail**)

23 file: SYN/SYN977+1.p (**fail**)

33 file: SYN/SYN978+1.p (93 ms)

$$\begin{array}{c}
 \frac{\frac{a, b : \cdot \vdash b}{a, b : \cdot \vdash !(b)} !}{\frac{a, b : \cdot \vdash !(a) \multimap !(b)}{a, b : \cdot \vdash !(!(a) \multimap !(b))} !} \star \quad \frac{\frac{\frac{a, b : \cdot \vdash a}{a, b : \cdot \vdash !(a)} !}{a, b : \cdot \vdash !(b) \multimap !(a)} \star}{\frac{a, b : \cdot \vdash !(!(b) \multimap !(a))}{a, b : \cdot \vdash !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))} !} \otimes \\
 \frac{a, b : \cdot \vdash !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))}{\cdot : \cdot \vdash !(a) \otimes !(b) \multimap !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))} \star \\
 \frac{\cdot : \cdot \vdash !(a) \otimes !(b) \multimap !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))}{\cdot : \cdot \vdash !(!(a) \otimes !(b) \multimap !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)))} !
 \end{array}$$

References

- [1] Jean-Yves Girard (1987): *Linear Logic*. *Theoretical Computer Science* 50, pp. 1–102.
- [2] Chuck Liang & Dale Miller (2009): *Focusing and polarization in linear, intuitionistic, and classical logics*. *Theor. Comput. Sci.* 410(46), pp. 4747–4768, doi:10.1016/j.tcs.2009.07.041.