MMiSS Example Lecture

Features of the MMiSSLaTeX Style

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Introduction

MMiSSLaTeX

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- Main features

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- Conclusions

Lectures Held so Far

- Bremen
- Freiburg
- Berlin
- Hagen/Kaiserslautern
- Munich
- Saarbrücken

Lectures Held so Far

- Bremen
  - Information security 1 (in German)
  - Object-oriented Software Development
  - Techniques of Correct Software Development
  - Safety-Critical Systems 4: Engineering of Embedded Software
  - Logic (in German)
- Freiburg
- Berlin
- Hagen/Kaiserslautern
- Munich

Lectures Held so Far

- Bremen
- Freiburg
  - Computer-Supported Modeling and Reasoning
  - Automata-Based System Analysis
- Berlin
- Hagen/Kaiserslautern
- Munich
- Saarbrücken

Lectures Held so Far

- Bremen
- Freiburg
- Berlin
  - Distributed Algorithms (in German)
  - Model Checking
- Hagen/Kaiserslautern
- Munich
- Saarbrücken

Lectures Held so Far

- Bremen
- Freiburg
- Berlin
- Hagen/Kaiserslautern
  - Advanced Aspects of Object-Oriented Programming (in German)
  - Software Architecture (in German)
- Munich
- Saarbrücken

Lectures Held so Far

- Bremen
- Freiburg
- Berlin
- Hagen/Kaiserslautern
- Munich
  - Temporal Logic
  - Formal Object-Oriented Software Development
  - Foundations of System Development
  - Model Checking
- Saarbrücken

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- Bremen
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- Berlin
- Hagen/Kaiserslautern
- Munich
- Saarbrücken
  - Security (in German)
  - Formal Software Development (in German)

Demonstrations

Animated Derivation Trees

Derivation (proof) trees are a well-known concept in logic:

$$\dfrac{\dfrac{[A \vee B]^1 \quad \dfrac{\dfrac{[A]^2}{B \vee A}\vee\text{-IR} \quad \dfrac{[B]^2}{B \vee A}\vee\text{-IL}}{B \vee A}\vee\text{-E}^2}{A \vee B \to B \vee A}\to\text{-I}^1$$

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But such trees are difficult to understand by merely looking at them! One has to see how they are constructed.

`proof-trees`: a package for animated derivation trees.

Specifying Pause Levels for Each Tree

A

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$A \quad B$

Specifying Pause Levels for Each Tree

$$\frac{A \quad B}{A \wedge B} \wedge\text{-I}$$

Specifying Pause Levels for Each Tree

$$\frac{A \quad B}{A \wedge B}\,\wedge\text{-I}$$

Source:

```
\MMinferA%
  {3}{3}%
  {\andi}%
  {A\land B}%
  {\MMonslides{=1}{A}
     \MMandproof
   \MMonslides{=2}{B}
  }
```

For each tree, one can specify the pause level range. For the subtrees, this range can be overridden.

Rules Discharging Assumptions

Derivation trees are built using rules, e.g. $\wedge$-I.

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- Number tags are administered using symbolic labels, making it easy to compose trees.
- Brackets are synchronised with the application of the rule.

Alternative Animations

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$$A \to B \to A$$

Want to prove $A \to B \to A$.

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Want to prove $A \to B \to A$.

Should use $\to$-I. Assumption A should eventually be discharged.

Should use $\to$-I. No assumption B involved.

Have derived $B \to A$ assuming A. Now we can apply $\to$-I.

Ad-hoc Animation

The aim of the `proof-tree` package is to provide convenient input syntax for frequently requested scenarios of animation, but ad-hoc animation remains possible:

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$$\frac{[P]}{\vdots}\ \rightarrow\text{-I}$$

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$$\frac{\begin{array}{c}[P]\\ \vdots\\ P\end{array}}{P}\ \rightarrow\text{-I}$$

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$$\frac{[P]}{P \to P}\,{\to}\text{-I}$$

A More Complex Example

$$Q$$

A More Complex Example

$$\frac{Q}{P \vee Q}\ \vee\text{-IR}$$

A More Complex Example

$$\neg(P \vee Q) \qquad \frac{Q}{P \vee Q}\ \vee\text{-IR}$$

A More Complex Example

$$\dfrac{\neg(P \vee Q) \qquad \dfrac{\dfrac{}{Q}}{P \vee Q}\vee\text{-IR}}{\bot}\rightarrow\text{-E}$$

A More Complex Example

$$\dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\,\vee\text{-IR}}{\bot}\,\rightarrow\text{-E}}{\neg Q}\,\rightarrow\text{-I}^4$$

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$$\dfrac{\dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\,\vee\text{-IR}}{\bot}\,\rightarrow\text{-E}}{\neg Q}\,\rightarrow\text{-I}^4}{\neg Q \rightarrow P}$$

A More Complex Example

$$\dfrac{\dfrac{\neg Q \to P \qquad \dfrac{\dfrac{\dfrac{[Q]^4}{P \vee Q}\vee\text{-IR} \qquad \neg(P \vee Q)}{\bot}\to\text{-E}}{\neg Q}\to\text{-I}^4}{P}\to\text{-E}$$

A More Complex Example

$$\dfrac{P \qquad \dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\,\vee\text{-IR}}{\bot}\,\rightarrow\text{-E}}{\neg Q}\,\rightarrow\text{-I}^4 \qquad \neg Q \rightarrow P}{P}\,\rightarrow\text{-E}$$

A More Complex Example

$$\dfrac{\dfrac{P}{P \vee Q}\,\vee\text{-IL} \qquad \dfrac{\dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\,\vee\text{-IR}}{\bot}\,\rightarrow\text{-E}}{\neg Q}\,\rightarrow\text{-I}^4 \qquad \neg Q \rightarrow P}{P}\,\rightarrow\text{-E}$$

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$$\dfrac{\dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[P]^3}{P \vee Q}\,\vee\text{-IL}}{\bot}\,\rightarrow\text{-E}}{\neg P}\,\rightarrow\text{-I}^3 \qquad \dfrac{\neg Q \rightarrow P \qquad \dfrac{\dfrac{\neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\,\vee\text{-IR}}{\bot}\,\rightarrow\text{-E}}{\neg Q}\,\rightarrow\text{-I}^4}{P}\,\rightarrow\text{-E}$$

A More Complex Example

$$
\dfrac{
  \dfrac{
    \dfrac{
      \neg(P \vee Q) \qquad \dfrac{[P]^3}{P \vee Q}\ \vee\text{-IL}
    }{\bot}\ \rightarrow\text{-E}
  }{\neg P}\ \rightarrow\text{-I}^3
  \qquad
  \dfrac{
    \neg Q \rightarrow P \qquad
    \dfrac{
      \dfrac{
        \neg(P \vee Q) \qquad \dfrac{[Q]^4}{P \vee Q}\ \vee\text{-IR}
      }{\bot}\ \rightarrow\text{-E}
    }{\neg Q}\ \rightarrow\text{-I}^4
  }{P}\ \rightarrow\text{-E}
}{\bot}\ \rightarrow\text{-E}
$$

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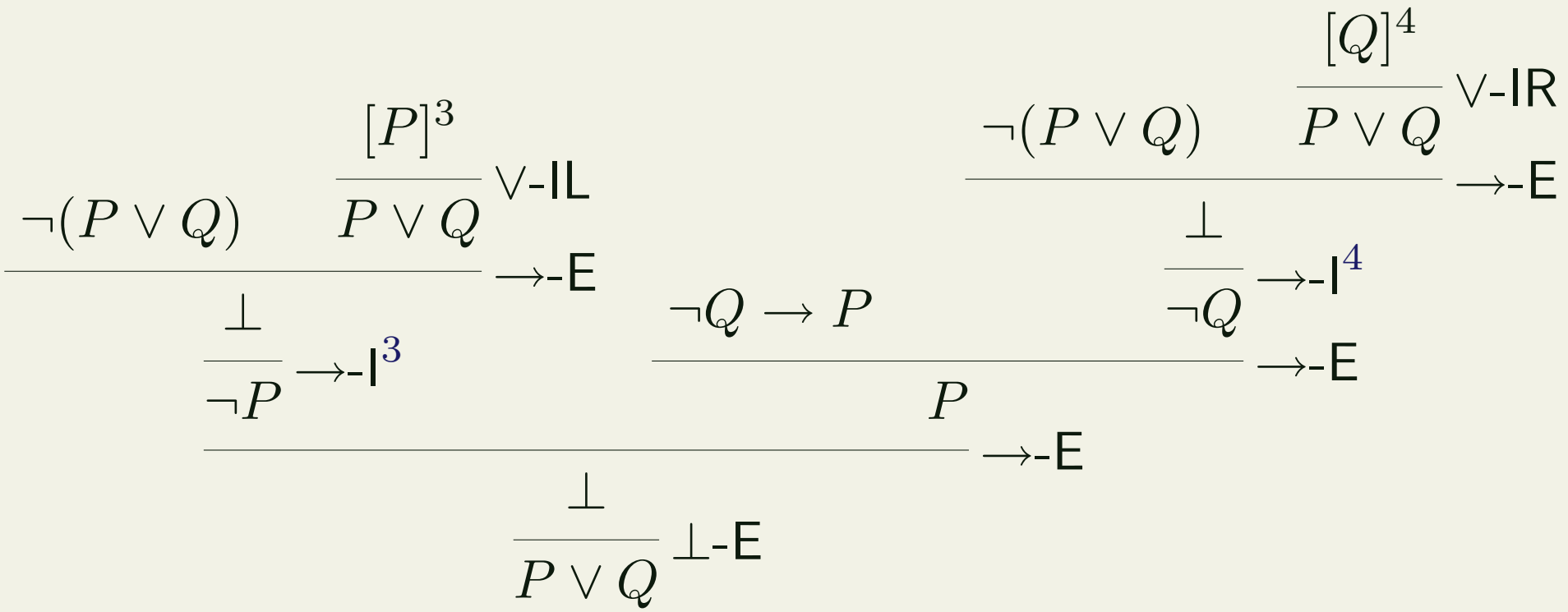

A More Complex Example

$$\dfrac{\dfrac{\dfrac{[\neg(P \vee Q)]^2 \quad \dfrac{[P]^3}{P \vee Q}\vee\text{-IL}}{\bot}\to\text{-E}}{\neg P}\to\text{-I}^3 \qquad \dfrac{\neg Q \to P \qquad \dfrac{\dfrac{[\neg(P \vee Q)]^2 \quad \dfrac{[Q]^4}{P \vee Q}\vee\text{-IR}}{\bot}\to\text{-E}}{\neg Q}\to\text{-I}^4}{P}\to\text{-E}}{\dfrac{\bot}{P \vee Q}\bot\text{-E}}\dfrac{}{P \vee Q}\text{classical}^2$$

A More Complex Example

$$\dfrac{\dfrac{\dfrac{\dfrac{[\neg(P \vee Q)]^2 \quad \dfrac{[P]^3}{P \vee Q}\vee\text{-IL}}{\bot}\to\text{-E}}{\neg P}\to\text{-I}^3 \qquad \dfrac{[\neg Q \to P]^1 \qquad \dfrac{\dfrac{[\neg(P \vee Q)]^2 \quad \dfrac{[Q]^4}{P \vee Q}\vee\text{-IR}}{\bot}\to\text{-E}}{\neg Q}\to\text{-I}^4}{P}\to\text{-E}}{\bot}\to\text{-E}}{\dfrac{\dfrac{\dfrac{\bot}{P \vee Q}\bot\text{-E}}{P \vee Q}\text{classical}^2}{(\neg Q \to P) \to P \vee Q}\to\text{-I}^1}$$

Overlays in General

Byproduct of the `proof-tree` package: LaTeX environment `MMpause` for specifying that a certain chunk of text appears at specified pause levels, but unlike the usual `pause` command provided by PPower4 [GS02], the original pause levels are restored afterwards.

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We are working on good support for other frequent animation scenarios, e.g. rollout itemize-environments.

Blackboard Style

Demonstration: A lecture on algebraic specification . . .

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Implementation: The source for the slides and the "shooting script" is the same. Material to appear only in the "shooting script" is enclosed in an environment `blackboard`. A preprocessor produces `tex`-files for slides or the "shooting script" as desired.

Tool Embedding

Arbitrary applications can be started from the lecture slides via shell scripts, merely by following links in the slides.

Examples: editors, compilers, theorem provers.

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Start Xterm

```
\begin{center}
\MMstartApplication{Start Xterm}{start_xterm.sh}
\end{center}
```

Start Xemacs

Start Netscape

Conclusions

Experiences/Feedback

- MMiSSLaTeX is easy to use due to widespread familiarity with LaTeX.
- Students and colleagues have commented favourably on the quality of the slides.
- Comment of a student in Bremen: don't overdo the use of multi-media!

Generic Markup Commands

- Crucial: convenient, generic commands based on logical structure (truism for LaTeX users).


animated derivation trees


rollout-itemize environment

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- MMiSSLaTeX is just one input format for our repository.

References

[GS02] Klaus Guntermann and Christian Spannagel. *PPower4 Manual*. TU Darmstadt, 2002. Download.