From the Lowlands of the UML to the Highlands of MLM

An Evolutionary, Tool-Supported Multi-Level Method for Teaching Multi-Level Modeling

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Overview of Presentation

1. Motivation and Our Experiences

2. Underlying Assumptions and Selected Requirements

3. Multi-level Model for Teaching MLM

    1. Focus on Course Planning and Management

    2. Suggested MLM Learning Path

    3. Student Progress Monitoring

4. Conclusion and Future Research

Teaching MLM helps increase its dissemination

- Despite being around for over 20 years, multi-level modelling (MLM) is faced with a dissemination and adoption problem

- One solution strategy: consolidation and demonstration efforts (see MULTI Challenges)

- Supplementary solution strategy: increase overall MLM literacy …

  □ … of academics by, e.g., offering tutorials

  □ … of students (future professionals/academics) by

    - offering courses on MLM

    - integrating MLM into university curricula

Proposal: Develop Method for MLM Teaching

- we suspect that MLM is currently not part of many university curricula

> "There is no common curriculum that represents the basics of MLM. We even have doubts that MLM is being taught to a considerable extent at all. This creates a serious threat to the future development of the field."
>
> (JEUSFELD AND FRANK 2021, p. 537)

- … furthermore, lack of research/effort to establish common curriculum

- to address this, we propose a method to support teaching MLM
  - □ … to provide guidance for lecturers trying to teach MLM
  - □ … to spark more discussions within the community on teaching approaches

Our Experiences with Teaching Modeling/MLM

- **Modeling education, in our experience, faces severe challenges** (cf. MAIER AND SCHWARZ 2024)

  - □ students come from different educational backgrounds

  - □ students struggle with modeling fundamentals, such as, differentiating classes from objects

- **our experiences suggest:**

  - □ teaching should pursue gradual increase in abstraction

  - □ support needed for individual learning paths

  - □ need for problem-oriented approach, students need to experiment with multi-level models

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> See also our presentation of the latest release of XModeler^ML that partly addresses these concerns by…
> - providing support for **bottom-up modeling**
> - allowing for a **seamless transition** between two-level and multi-level modeling modes
>
> Presentation of XModeler^ML v3 on **Wednesday, 4.45pm** in **ROOM**

Selected Requirements for Teaching Method

- method proposed stays intentionally generic, tries to abstract over existing heterogeneity of MLM approaches for software development

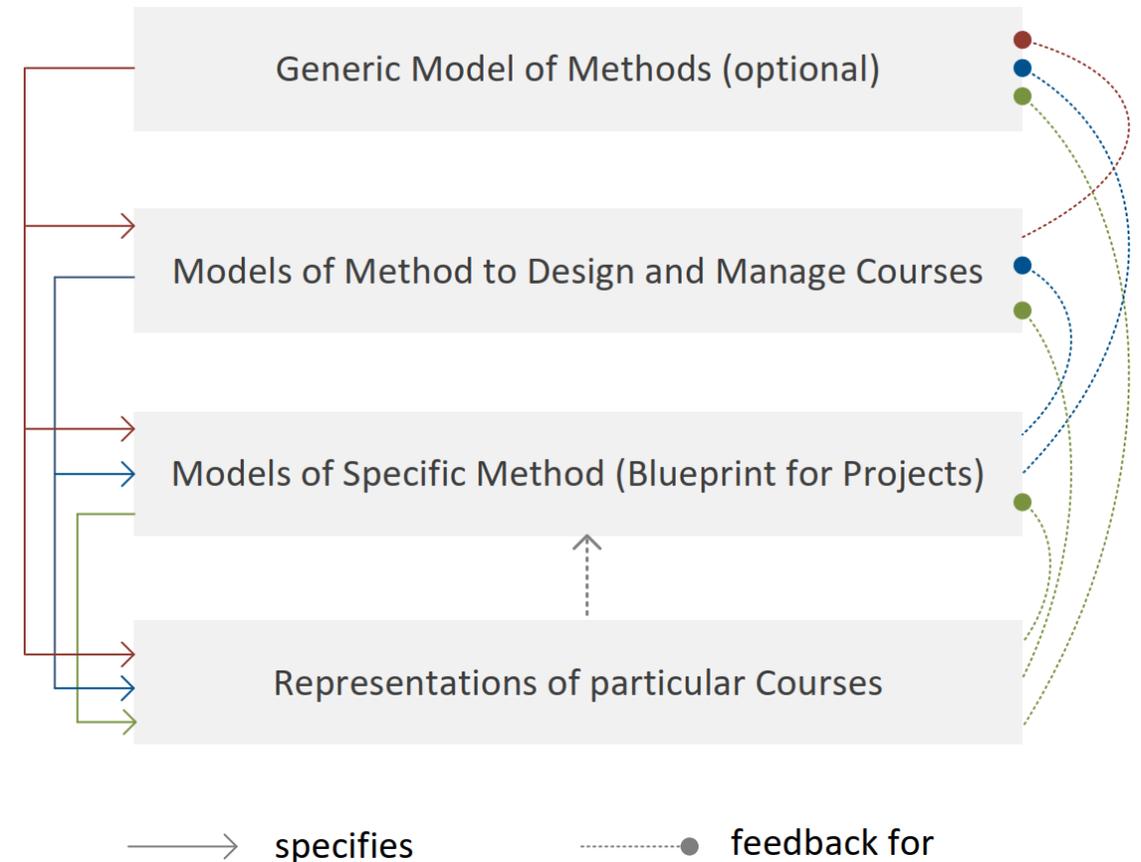- based on our experience, we suggest a set of mandatory and optional requirements

"Requirement M1: Like any modeling course, a short course on multi-level modeling should combine lecture elements and exercise elements." (p. 4)

"Requirement M7: A method for teaching MLM should provide different learning paths to facilitate learning processes that fit individual skills." (p. 5)

"Requirement M8: A method for teaching MLM should support the analysis of student learning processes." (p. 5)
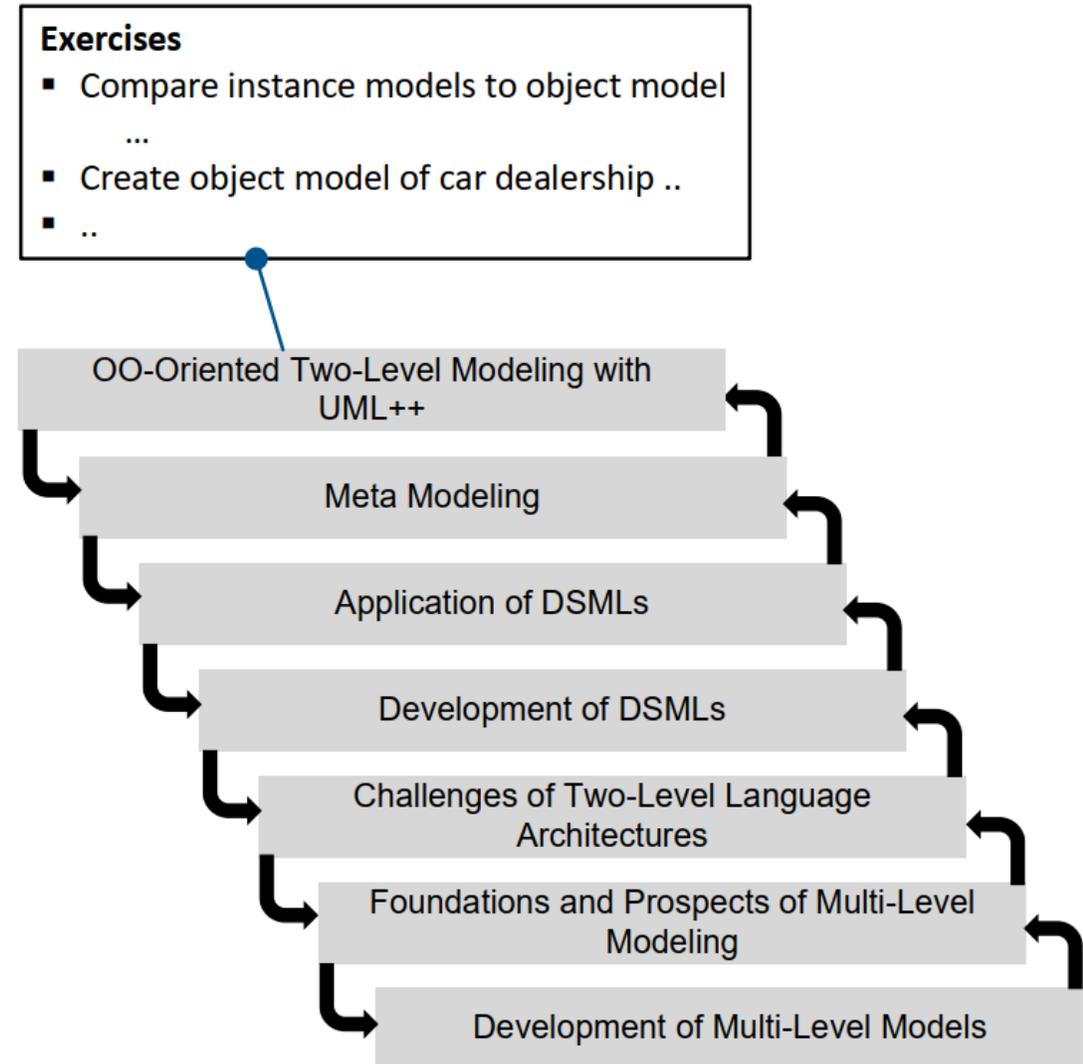
Components of a Teaching Method

- **method for teaching, in general, should account for**
    - ☐ process of developing new courses
    - ☐ process of managing current courses

- **as such, relies on concepts for...**
    - ☐ creating/managing course contents and suppl. course materials
    - ☐ monitoring student progress
    - ☐ capturing feedback

- **concepts of method represented as multi-level model**

Generic Model of Methods (optional)

Models of Method to Design and Manage Courses

Models of Specific Method (Blueprint for Projects)

Representations of particular Courses

→ specifies   ⋯⋯• feedback for
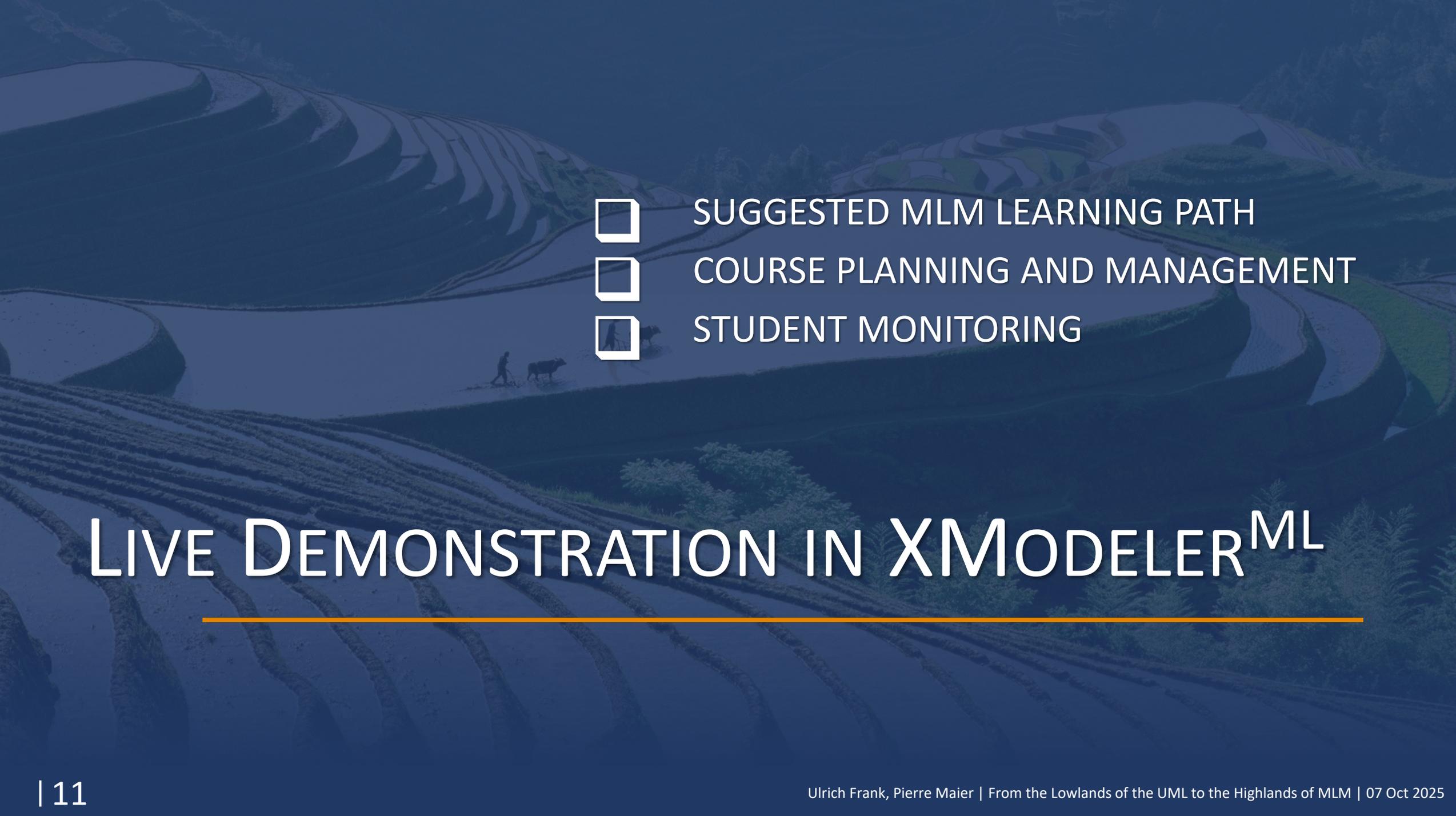
Overview of Core Concepts

Proposal for MLM Learning Path

- "learning path" considered sequence of learning stages
  - □ definition of one proposed learning path
  - □ individual variations possible

Exercises
- Compare instance models to object model
  ...
- Create object model of car dealership ..
- ..

OO-Oriented Two-Level Modeling with UML++

Meta Modeling

Application of DSMLs

Development of DSMLs

Challenges of Two-Level Language Architectures

Foundations and Prospects of Multi-Level Modeling

Development of Multi-Level Models

☐ SUGGESTED MLM LEARNING PATH

☐ COURSE PLANNING AND MANAGEMENT

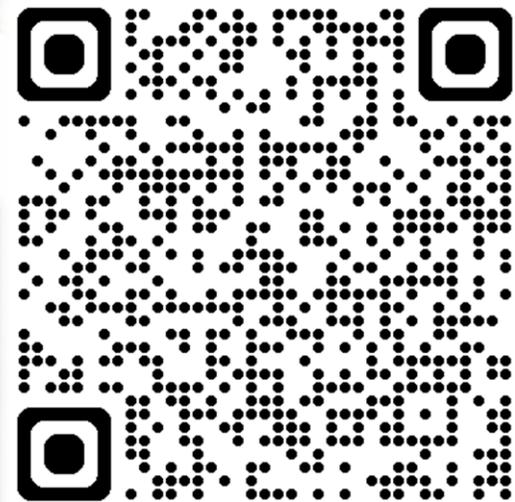☐ STUDENT MONITORING

LIVE DEMONSTRATION IN XMODELER^{ML}

Avenues for Future Research

- proposed multi-level model accounts for most requirements, but leaves room for improvements

- method considered first proposal, must be discussed within communities
  - □ e.g., what different experiences/learning objectives are present?

- need for tool/language-agnostic teaching method that accounts for relevant details
  - □ may still include supplementary tool/language-specific learning paths
  - □ maybe a first step towards more unification within the MLM community?

All the latest updates on MLM research with FMML$^\times$ and XModeler^{ML}

https://www.wi-inf.uni-due.de/LE4MM/