

# MDE Intelligence: 6<sup>th</sup> Workshop on Artificial Intelligence and Model-driven Engineering

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**Abstract.** Artificial Intelligence (AI) has become part of everyone’s life. More recently, AI has started to impact all aspects of the system and software development lifecycle, from specification to design, testing, deployment, and maintenance, with the main goal of helping engineers produce higher-quality systems and software more efficiently while being able to handle ever more complex systems. We believe there is a clear need for AI-empowered MDE, which will push the limits of “classic” MDE and provide the proper techniques to develop the next generation of highly complex software systems engineers will have to design tomorrow.

This workshop will be the opportunity to discuss how to choose, evaluate and adapt AI techniques to Model-Driven Engineering (AI for MDE) as a way to improve current system and software modelling and generation processes while, at the same time, increasing the benefits and reducing the costs of adopting MDE. Furthermore, AI is software (and complex software, in fact) that can benefit from an MDE approach in its design and development, especially with the challenge of designing trustworthy and frugal AI software. Thus, MDE for AI is also in the scope of the proposed workshop. We aim to take a broad view of AI, including any technique that provides human cognitive capabilities and helps create “intelligent” software. Finally, intelligence is multiple and diverse, so measuring it as a task is not easy. On the other hand, we feel this is a very important subject and time to discuss in the context of MBSE. We are proposing hence to initiate such a discussion on the occasion of this new edition. One possible, not to say expected, output for such a discussion would be the outline and some concrete inputs to propose for Models 2025 a new special session, a “competition” session to determine the most intelligent MBSE tool or service.

## 1 Motivation

MDE and AI are two separate fields in computer science that can clearly benefit from cross-pollination and collaboration. There are at least two ways in which such integration—which we call MDE Intelligence—can manifest:

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\*\* Primary contact

- *AI for MDE*. MDE can benefit from integrating AI concepts and ideas, for example, by increasing the power and flexibility of model transformations through search-based approaches or by increasing the ability to abstract from partially formed, manual sketches into fully shaped and formally specified meta-models and editors.
- *MDE for AI*. Conversely, AI can benefit from integrating concepts and ideas from MDE. For example, domain-specific languages and model transformations allow domain experts to directly express and manipulate their problems while providing an auditable conversion pipeline. Together, this can improve trust in and safety of AI technologies. Similarly, MDE technologies can contribute to the goal of fair and explainable AI.

### Objectives

This workshop aims to bring together researchers from MDE and AI backgrounds and researchers and practitioners from other domains with problems that might be addressed by combining such approaches to explore opportunities for cross-pollination, collaboration, and exciting new research avenues. Specifically, we have three objectives:

1. Further enlarge the community of researchers and practitioners interested in combining AI and MDE towards “MDE Intelligence”;
2. Highlight recent results in combining AI and MDE techniques;
3. And collect and collate challenges and case studies to help the community develop a common set of problems and a shared language.

### Intended audience

This workshop aims to bring together MDE practitioners and researchers, who are the typical members of the MODELS conference, with researchers in the wider AI community. In addition, the workshop is aimed at researchers and practitioners from other research fields and industries (including from outside computer science) who could benefit from MDE Intelligence. Examples include biology, geography, health, education, manufacturing, etc.

### Topics of interest

Topics of interest include (but are not limited to) the following domains:

- AI for MDE:
  - Application of large language models (LLMs), Generative AI and machine learning to modelling problems;
  - Machine learning and Generative AI for (meta-heuristic) search (meta)models, concrete syntax, model transformations, etc.;
  - AI planning applied to (meta-)modelling, and model management;
  - AI-supported modelling (e.g., bots, recommenders, UI adaptation, etc.)
  - Model inferencers and automatic, dataset-based model generators;
  - Self-adapting code generators;
  - Semantic reasoning, knowledge graphs, or domain-specific ontologies;
  - AI-supported model-based digital twins;
  - Probabilistic, descriptive or predictive models;

- AI techniques for data, process, and model mining and categorisation;
  - Natural language processing applied to modelling, including Large Language Models (LLM) and Generative AI;
  - Data quality and privacy issues in AI for MDE;
  - Reinforcement learning to optimize modelling tasks.
- MDE for AI:
    - Domain-specific modelling approaches for AI planning, machine learning, agent-based modelling, etc.;
    - Model-driven processes for AI system development;
    - MDE techniques for explainable and fair AI;
    - Using models for knowledge representation;
    - Code generation for AI libraries and platforms;
    - Architectural languages for AI-enhanced systems;
    - MDE for federated learning;
    - Model-based testing/analysis of AI components.
  - General topics in MDE Intelligence
    - AI in teaching MDE;
    - AI for MDE UX;
    - Tools, frameworks, modeling standards;
    - Experience reports, case studies, and empirical studies;
    - Challenges.

### **Relevance to the MODELS community**

Investigating ways in which AI and MDE can be combined and further improved is highly relevant for the researchers and practitioners who will attend MODELS. As in its previous editions, the workshop will provide opportunities to explore the primary topics of the main conference in the context of AI techniques (*e.g.*, decision support, digital twins, planning, optimization, etc.).

### **Context**

This will be the sixth edition of the workshop at MODELS, continuing an established and successful workshop series around a topic of growing interest and building on the success of the previous editions.

The organizers have an excellent track record organizing workshops and conferences and all of them are part of Program Committees regularly. A previous edition of MDE Intelligence at MODELS 2020 led to a SoSyM theme section on AI-enhanced MDE, partly co-edited by the workshop organisers. Moreover, some of the workshop organizers are currently co-editing a new SoSyM theme section on Foundations and Applications of AI and MDE.

### **Need**

Research in MDE so far has, primarily, tended to focus on a fairly prescriptive approach whereby models need to be fully spelled out and model transformations given as deterministic programs translating models into other representations. However, this is a very limited perspective, and research in other domains is exploring much more interesting and relevant problems where much more powerful translations and synthesis use AI techniques to produce new models and programs based on automated analysis. We believe that, for the MDE community

to remain competitive, it needs to tap into these techniques, e.g., just see the current discussions on the impact of Large Language Models, Generative AI and similar approaches on all aspects of our society.

## 2 Organization

### Details on the organizers

**Dominik Bork** is an Assistant Professor for Business Systems Engineering at TU Wien (Austria). Dominik is highly connected and integrated in the research community, e.g., as organizer of workshops at MODELS, ER, CAiSE, PoEM, and RCIS. More information can be found at: <https://model-engineering.info>.

**Lola Burgueño** is an Associate Professor at the University of Málaga (Málaga, Spain). Apart from having organized the four previous editions of the MDE Intelligence workshop, she has (co-)chaired and (co-)organized 20 events at MODELS, STAF, SPLASH and ICSSOC. She is also a member of the SoSyM editorial board. More information can be found at: <http://lolaburgueno.github.io>.

**Jordi Cabot** is an FNR Pearl Chair and the head of the Software Engineering RDI Unit at the Luxembourg Institute of Science and Technology. He is also an Affiliate Professor in Computer Science at the University of Luxembourg. His research interests include software modeling and low-code technologies, pragmatic formal model verification, analysis of open source/open data communities and the role AI can play in software development (and vice versa). For more information, visit: <https://jordicabot.com>.

**Sébastien Gérard** is CEA Fellow and he leads the flagship program, Digital Collaborative and Cognified Engineering of the CEA LIST institute. His research interests include complex systems, model-based engineering, cognification, knowledge engineering and visual modeling, collaborative tools, digital transformation, and its impact on society. he has represented the CEA at the OMG for over 20 years, leads the open-source project Papyrus ([www.eclipse.org/papyrus](http://www.eclipse.org/papyrus)), and represents CEA List on the board of directors of the Eclipse foundation. Sébastien co-directs the Modelia initiative ([www.modelia.eu](http://www.modelia.eu)) with Jordi Cabot. <https://list.cea.fr/en/page/facilitating-the-design-of-complex-systems>.

**Aurora Ramírez** is Assistant Professor at the University of Córdoba (Córdoba, Spain). Her research focuses on the application of artificial intelligence, especially machine learning and search techniques, to software design and testing. She was co-chair of the ACM Student Research Competition at ICSE'20, and program chair of an international summer school on AI applied to software engineering (SMILESENG) in 2022. More information can be found at: <https://www.uco.es/users/aramirez/en/>.

### Workshop Program Committee

The Program Committee list can be found in the CfP attached to the proposal. We aim to recruit people from the modelling community with an interest in the areas which fall into the scope of the workshop, and also experts outside our community working on AI.

**Willingness to merge**

In the previous editions, the workshop has proven to be healthy with 20 submissions and 50 participants. If possible, we would prefer not to merge.

**3 Workshop format****Planned deadlines**

We have planned the deadlines in alignment with the deadlines proposed on the conference website.

**Intended paper format**

Papers will follow the same style and format of the main tracks of the conference. We will call for:

- Research papers: 8 pages.
- Vision papers, experience papers or demos: 5 pages.

**Evaluation process**

Papers will be evaluated following a single-blind peer-review process supported by our program committee. All submitted papers will be reviewed by at least three reviewers. We will use EasyChair as the conference management system.

**Intended publication of accepted papers**

We would like to be part of the joint workshop proceedings, assuming such will be organized by the conference again. Otherwise, we would arrange for publication in CEUR-WS.

**Intended workshop format**

We plan to invite a keynote speaker from the AI community to enlighten the audience with their experience and thoughts. The keynote will be followed by brief paper presentations (limited to 10 minutes plus questions). After the paper presentation session, the workshop will break into four working groups (one led by each organiser). The topics for discussion in each group will initially be proposed by the organisers, with input from the discussants, based on the papers submitted but will be open to adjustment at the workshop. After these discussions, the groups will report back in panel and the organisers will facilitate a larger-group discussion.

**Number of expected participants**

Based on previous experience we expect around 50-60 participants.

**Required equipment**

Standard projection equipment. Whiteboard and markers if possible.

**4 Additional Material**

Workshop webpage (2023 edition): <https://mde-intelligence.github.io/>

# 6TH INTERNATIONAL WORKSHOP ON MDE INTELLIGENCE

Co-located with MODELS 2024

<https://mde-intelligence.github.io/>  @modelsconf #mdeintelligence

## MOTIVATION

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Model-driven engineering (MDE) and artificial intelligence (AI) are two separate fields in computer science, which can clearly benefit from cross-pollination and collaboration. There are at least two ways in which such integration—which we call MDE Intelligence—can manifest:

1. *Artificial Intelligence for MDE*. MDE can benefit from integrating AI concepts and ideas to increase its power: flexibility, user experience, quality, etc. For example, using model transformations through search-based approaches, or by increasing the ability to abstract from partially formed, manual sketches into fully-shaped and formally specified meta-models and editors.
2. *MDE for Artificial Intelligence*. AI is software, and as such, it can benefit from integrating concepts and ideas from MDE that have been proven to improve software development. For example, using domain-specific languages allows domain experts to directly express and manipulate their problems while providing an auditable conversion pipeline. Together this can improve trust in and safety of AI technologies. Similarly, MDE technologies can contribute to the goal of explainable AI.

## OBJECTIVES

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This workshop aims to bring together researchers from MDE and AI backgrounds as well as researchers and practitioners from other domains with problems that might be addressed by a combination of such approaches to explore opportunities for cross-pollination, collaboration, and exciting new research avenues. Specifically, we have three objectives:

1. Grow a community of researchers and practitioners interested in combining AI and MDE towards “MDE Intelligence”;
2. Highlight recent results in combining AI and MDE techniques; and
3. Collect and collate challenges and case studies to help the community to develop a common set of problems and a shared language.

## TOPICS





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Topics of interest for the workshop include, but are not limited to:

- AI for MDE:
  - Generative AI, LLMs and ML applied to modeling problems.
  - ML of (meta-)models, concrete syntax, model transformations, etc.;
  - AI planning applied to (meta-)modelling, and model management;
  - AI-supported modelling (e.g., bots, recommenders, UI adaptation, etc.)
  - Semantic reasoning, knowledge graphs or domain-specific ontologies;
  - AI-supported model-based digital twins;
  - Data quality and privacy issues in AI for MDE.
- MDE for AI:
  - Domain-specific modeling approaches for AI planning, machine learning, etc.;
  - Model-driven processes for AI system development;
  - MDE techniques for explainable and fair AI;
  - Using models for knowledge representation;
  - Code-generation for AI libraries and platforms;
  - MDE for federated learning.
- General
  - Tools, and general challenges;
  - Experience reports, case studies, and empirical studies;

## IMPORTANT DATES

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- Abstract deadline  1.07.2024
- Deadline for submissions  5.07.2024
- Notification to authors  9.08.2024
- Camera ready version  14.08.2024

## ORGANISATION COMMITTEE

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- Dominik Bork (TU Wien, Vienna, Austria)
- Lola Burgueño (University of Malaga, Spain)
- Jordi Cabot (LIST, Luxembourg)
- Sébastien Gérard (CEA LIST, France)
- Aurora Ramirez (University of Cordoba, Spain)

## PROGRAM COMMITTEE (not confirmed)

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- Robert Clarisó (UOC, Spain)
- Istvan David (McMaster University)
- Shekoufeh Kolahtouz Rahimi (University of Isfahan)
- Gunter Mussbacher (McGill University)
- Shaukat Ali (Simula Research Laboratory)
- Nelly Bencomo (Aston University)
- Francisco Chicano (University of Málaga)
- Daniel Strüber (Radboud University Nijmegen, the Netherlands)
- Adrian Rutle (Western Norway University of Applied Sciences)
- Daniel Varro (Budapest University of Technology and Economics)
- Bentley James Oakes (Polytechnic Montreal)
- Gabriele Taentzer (Philipps-Universität Marburg)
- Bernhard Rumpe (RWTH Aachen University)
- Betty Cheng (Michigan State University)
- Daniel Struber (Radboud University Nijmegen)
- Marina Tropmann-Frick (Hamburg University of Applied Sciences)

## SUBMISSIONS

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You are invited to submit to one of the following categories:

- Research papers: 8 pages.
- Vision papers, experience papers or demos: 5 pages.

Submitted papers must conform to the ACM format like the main tracks of the conference.

Submissions must be uploaded through EasyChair in the following link: TBC