Curriculum Vitae

Jolan Philippe

Contents

1 Curriculum Vitae (short) 1
- 1.1 Academic background . . . 1
- 1.2 Professional background . . . 2
- 1.3 Teaching . . . 3
- 1.4 International publications . . . 3
- 1.5 Languages . . . 3

2 Teaching activities 4
- 2.1 Teaching synthesis . . . 4
- 2.2 Details about teaching at IMT Atlantique . . . 4
- 2.3 Details about teaching at Université de Nantes . . . 5

3 Research activities 6
- 3.1 Summary of contributions . . . 6
- 3.2 List of publications from 2017 to 2024 . . . 7
  - 3.2.1 International conferences with published proceedings . . . 7
  - 3.2.2 International workshops with published proceedings . . . 8
  - 3.2.3 Thesis . . . 9
  - 3.2.4 Project deliverables . . . 9
  - 3.2.5 Posters . . . 9
  - 3.2.6 Diverse . . . 10
  - 3.2.7 Ongoing submissions . . . 10

4 Scientific activities 10
- 4.1 Participation in projects . . . 10
- 4.2 Complete list of talks . . . 11
- 4.3 Relectures . . . 13
- 4.4 Collective responsabilities . . . 13

5 Additional parts 13

1 Curriculum Vitae (short)

Last name:	PHILIPPE
First name:	Jolan
Birth:	September 27^{th}, 1995 in Gien
Nationality :	French
Family status:	In a civil union, without children
Personal address:	5T rue de la Verdière, 44850 SAINT-MARS-DU-DÉSERT (France) +33 (0)7.84.56.41.25
Last diploma obtained:	PhD in computer science from IMT Atlantique
Occupation:	Postdoctorate at IMT Atlantique, Nantes STACK team
Professional address:	IMT Atlantique, 4 rue Alfred Kastler 44300 NANTES (France)
E-mail:	jolan.philippe@imt-atlantique.fr
Website:	https://jolanphilippe.github.io/

1.1 Academic background

2019-2022 : **Ph.D. in Computer Science** from IMT Atlantique.

Thesis: "*Contribution to the analysis of the design-space of a distributed transformation engine.*"

Jury:

President:	Pr Thomas Ledoux (IMT Atlantique)
Referee:	Dr Jesus Sanchez Cuadrado (Universidad de Murcia)
Referee:	Pr Matthias Tichy (University of Ulm)
Main supervisor:	Dr Gerson Sunye (Université de Nantes)
Co-supervisor:	Dr Massimo Tisi (IMT Atlantique)
Co-supervisor:	Dr Hélène Coullon (IMT Atlantique)

2017-2019 : **Master of Science**, *Computer Science*, Northern Arizona University - GPA: 3.67/4

Master thesis : *Systematic Development of Efficient Programs on Parallel Data Structures*, research work done at the *School of Informatics, Computing & Cyber Systems* (Flagstaff AZ, USA) under the supervision of Pr. Frédéric Loulergue.

2016-2017 : **Master degree**, *Computer Science, specialty Master of IT methods applied to business management (MIAGE)* from Université d'Orléans (France) — with honors, valedictorian.

2013-2016 : **Bachelor**, *Computer Science* from Université d'Orléans (France) - with honors, valedictorian.

1.2 Professional background

From February 2023: Contractual postdoctoral fellow at IMT Atlantique - STACK team. One-year contract funded by the ANR project SeMaFoR .
Work carried out in collaboration between IMT Atlantique (STACK team, and TASC), Sorbonne University (LIP6 laboratory), and the SMILE group. In addition to the research work around the themes of the SeMaFoR project, I had the opportunity to teach several teaching units, at different branches, as a temporary worker (56h15).

September 2019–December 2022: Contract doctoral student at IMT Atlantique - Naomod and STACK team. Contract funded by the Marie Skłodowska-Curie actions through the European project Lowcomote, Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms.
Work carried out in collaboration between IMT Atlantique (Naomod team), the University of York, the Universidad Autónoma de Madrid, the University of L'Aquila, the Johannes Kepler Universität Linz, British Telecom, the companies Intex, Uground, CLMS UK and IncQueryLabs. In addition to the research work, I was able to teach a total of 61 hours and 15 minutes to IMT Atlantique students of the FISE engineering training and 10 hours to the Master 2 at the University of Nantes.

September 2017-July 2019: Research assistant at Northern Arizona University - SICCS Software Engineering Research Laboratory.
The job came with the opportunity to take specialized courses to train me in research, refine my skills, and deepen my understanding of the distributed systems field.

November 2016-August 2017: Part-time research engineer at the Université d'Orléans - LMV team. Contract funded by the Girafon project.

April 2016-August 2016: Intern, at Acatus / Atimic.
The internship consisted of testing solutions implemented in J2EE, in particular by handling the Spring framework.

1.3 Teaching [1]

2024 **Temporary worker at IMT Atlantique - Nantes (France)**
- L/PW in the *Object-Oriented Programming* class Master 1 MOST (10h)

2023 **Temporary worker at IMT Atlantique - Nantes (France)**
- L/PW in the *Services* module
3^{rd} year of engineering diploma cycle (22h30)
- L/PW in the *Distributed architectures* module, 1^{st} year of engineering diploma cycle, training by apprenticeship (18h45)
- PW in the *Algorithmics and discrete mathematics* module, 1^{st} year of engineering diploma cycle (replacement, 5h)

2022 **Temporary worker at IMT Atlantique - Nantes (France)**
- PW in the *Algorithmics and discrete mathematics* module, 1^{st} year of engineering diploma cycle (20h)

2021 **Temporary worker at IMT Atlantique - Nantes (France)**
- PW in the *Databases and Interactive Software* module, 1^{st} year of engineering diploma cycle (18h45)

2020 **Temporary worker at IMT Atlantique - Nantes (France)**
- PW in the *Algorithmics and discrete mathematics* module, 1^{st} year of engineering diploma cycle (22h30)

Temporary worker at Université de Nantes (France)
- Support for research projects in the *Capstone* module, Master 2 in computer science (10h)

1.4 International publications[2]

- 6 publications in international conferences (SAC'19, HPCS'19, PDCAT'19, ICA3PP'19, SLE'21, SANER'24)
- 2 publications in international workshops (MODELS'20, FTfJP'23)
- 1 ongoing submission in an international journal (TAAS)

1.5 Languages

I have a good professional and scientific level in English. I spent more than two years at Northern Arizona University, in Flagstaff, USA, as part of my research engineering contract and obtaining my Master of Science. During this period, the main language of communication was English. Likewise, meetings and communications with members of the STACK team are mainly in English.
French: native; Spanish: school level.

[1] A more detailed description will follow this CV. L: lecture, PW: practical work (lab).
[2] A more detailed description will follow this CV.

2 Teaching activities

2.1 Teaching synthesis

Since September 2020, I have given a total of 127.5 hours of teaching, equivalent to 133.62 practical work hours (EQTD). Proof of these hours is attached at the end of this document. Details of these hours are given below.

Table 2 presents the list of all the teachings in which I have intervened as temporary worker. The abbreviations used regarding the levels (courses) are detailed in the table 1.

M1 MOST	1^{st} year, Master Management and Optimization of Supply Chains and Transport
FISE A1	1^{st} year of engineering diploma cycle (equivalent to 3^{rd} year of Bachelor degree)
FISE A3 LOGIN	3^{rd} year of engineering diploma cycle (equivalent to 2^{nd} year of Master degree), major in Software engineering and innovation
FIL A1	1^{st} year of engineering diploma cycle, training by apprenticeship (equivalent to 3^{rd} year of Bachelor degree)
M2 ALMA	2^{nd} year, Master in Computer Science, major in Software architecture

Table 1: Used abbreviations

Label	Year	School	Hours	Level	Students
Object Oriented Programming	2024	IMT Atlantique	Lecture, PW (10h, 13 EQTD)	M1 MOST	10
Services	2023	IMT Atlantique	Lecture, PW, Exam. (22h30, 21.25 EQTD)	FISE A3 LOGIN	22
Distributed Architectures	2023	IMT Atlantique	LEcture, PW, Exam. (28h45, 20 EQTD)	FIL A1	30
Algorithmic and discrete mathematics	2020	IMT Atlantique	PW, Exam. (22h30, 22.5 EQTD)	FISE A1	22
	2022	IMT Atlantique	PW, Exam. (20h, 14 EQTD)	FISE A1	22
	2023	IMT Atlantique	PW, Exam. (5h, 5 EQTD)	FISE A1	22
Databases and Interactive Software	2021	IMT Atlantique	PW, Exam. (18h45, 27.87 EQTD)	FISE A1	22
Research project (Capstone)	2020	Univ. Nantes	Project (10h, 10 EQTD)	M2 ALMA	4

Table 2: Teaching provided as a temporary teacher

2.2 Details about teaching at IMT Atlantique

Object Oriented Programming - M1 MOST

This course serves as an introduction to object-oriented programming for MOST master's students. In 1^{st} year, this master's degree aims to provide training in the fundamentals of management and optimization of supply chains. The courses in this master's degree are entirely given in English. This course is part of a larger module, around operational research. This module includes two other courses, around which object-oriented programming is structured: meta-heuristics, and a TSP lab. The object-oriented programming course presents the notion of classes, instances, inheritance, encapsulation and polymorphism. The practicals are carried out in Python, which explains the absence of other notions such as interfaces or anonymous classes.

Distributed architectures - FIL A1 - [Support] / Services - FISE A3 LOGIN - [Support]

The "Distributed Architectures" course and the "Services" course share the same educational content. These courses were structured in a similar way over the first three sessions,

with a combination of lectures, tutorials and practices to deepen the concepts covered. The key concepts covered were REST APIs, GraphQL and gRPC. I was responsible for presenting the lecture on gRPC for the two modules: "Distributed Architectures" and "Service". The following sessions were devoted to finalizing practical work through a project for managing cinema screening reservations for a user. Finally, the last session was dedicated to the presentation of the projects carried out by the students. In collaboration with the module manager, I was responsible for evaluating the students' oral presentations as well as the code produced during these projects.

Algorithmic and discrete mathematics - FISE A1 - [Support]

The course was structured around coherent practical sessions. Before each session, students had to familiarize themselves independently with the concepts to be covered. The sessions began with a brief assessment of the course content to check their understanding. Then the sessions involved the use of the game PyRat to put into practice the algorithms studied, in particular to move a character in a maze, offering a concrete vision of the application of graph algorithms in Python. These algorithms included graph traversal methods, Dijkstra's algorithm for shortest paths, solving the traveling salesman problem to optimize routes, and the introduction of greedy and heuristic concepts. The final session allowed students to create their own strategy based on previous learning, thus serving as a final assessment for the course. This combined approach of self-study and practice in PyRat provided real-world experience promoting a deep understanding of algorithmic concepts and their application in real-world contexts. I supervised these practical work sessions and evaluated the students' oral presentations as well as the code produced during these projects.

Databases and Interactive Software - FISE A1 - [Support]

The "Database and Interactive Software" course was divided into two parts: the first focused on databases, while the second covered human-machine interfaces (HMI). I took charge of the practical work relating to databases. The main objective was to raise students' awareness of information systems and their structures. During this course, students learned about SQL query language, normalization theory, and conceptual modeling. In addition to the classroom sessions, the students completed a project where they had to model a database for an email application, test it and perform queries. My participation was focused on supervising these practical work sessions relating to databases.

2.3 Details about teaching at Université de Nantes

Projet de recherche (Capstone) - M2 ALMA

I supervised a group of four students as part of the Capstone research project module by organizing bi-monthly meetings. The research project focused on the implementation of OCL (Object Constraint Language) using Scala and Spark. During these regular

meetings, we discussed the progress of the project, identified the challenges encountered and developed strategies to overcome them. My role was to provide technical support and guide the members of the group in their research.

Private lessons and academic support

I have had the privilege of supporting pupils and students at different academic levels, particularly in mathematics for middle and high school levels (Baccalaureate in Science). In addition, I provided specific support in statistics to 3rd year's Bachelor degree and 1st year's Master degree psychology students at the University of Nantes. Furthermore, I also contributed to the understanding of the functional specifications for 1st year's Master degree MIAGE students.

3 Research activities

3.1 Summary of contributions

Since my university studies, I have been interested in distributed systems and their potential, focusing on their functional and semantic aspects, as well as their capacity for reconfiguration. My interest extended to the formalization of algorithmic skeletons for distributed computing, notably by exploring the Bird-Meertens Formalism (BMF). This work gave rise to contributions combining a formal part and an implementation part, leading to the creation of PySke, a Python library for lists and trees. Under the supervision of Frédéric Loulergue at Northern Arizona University, and in collaboration with the Orléans Fundamental Computer Science Laboratory (LIFO), we first formalized algorithmic skeletons on non-linear structures (graphs and trees), in the Coq proof assistant. We extended SyDPaCC, a Coq library, by proving the equivalence of executing the pattern *map* on binary trees. Work still in progress aims to prove the same results on the *reduce* pattern. The results of this research were published in a short paper at the SAC international conference. The second part of the work on skeletons consisted of creating PySke, a Python library offering a set of skeletons for lists and trees (binary, or of arbitrary size). PySke offers a lazy execution mode, allowing the optimization of successive skeleton calls. Three publications were produced around this library. This work was published at the HPCS, PDCAT and ICA3PP conferences. All of my work around the use of calculation patterns has been brought together in a Master's thesis manuscript.

During my doctorate, my research focused on the design of a distributed model transformation engine. This area, rich in potential, offers a wide spectrum of opportunities to improve performance in terms of calculation time and memory consumption. The design landscape for such an engine is diverse, and decisions made during this design can have a significant impact on its use. Indeed, a model transformation engine can be oriented towards an incremental solution for often modified models or towards a formally specified solution for reasoning rather than pure performance. Existing solutions already offer engines with varied objectives, using various approaches such as distribution, laziness,

increment and correction. However, comparing these solutions is not trivial and may prove irrelevant in certain cases. In order to explore this design space, we developed a new transformation engine, integrating variability and enabling in-depth analysis of this space. Starting from CoqTL, a language with formal specifications, we designed SparkTE, a configurable distributed transformation engine built on the Spark platform. Our objective was to analyze the impact of decisions taken at different levels: the programming models used to define expressions, the different semantics to define the calculation of a transformation, and the impact of engineering choices. This research was the result of rigorous exploration, under the supervision of Dr. Gerson Sunye, Dr. Massimo Tisi and Dr. Hélène Coullon. The significant results of this thesis have been shared and discussed within the academic community at conferences in the field of software engineering and modeling, notably at MODELS and SLE. All of this work has been consolidated into a doctoral thesis, providing a substantial contribution to this evolving field.

Currently, as part of my post-doctoral fellowship, under the supervision of Dr. Hélène Coullon and Dr. Charles Prud'Homme, within the SeMaFoR project, I am focusing on the decentralized resolution of the problem of reconfiguring Fog resources in systems distributed. Fog represents an IT architecture where resources are deployed at the network boundaries, closer to end users than the Cloud. My work culminated in the creation of Ballet, a tool for automating reconfiguration choreographies in DevOps teams working on large-scale distributed systems. Ballet offers a module for planning a reconfiguration, proposing a plan based on the life cycle of the components, and an engine for executing these plans. These advances were presented at specialized conferences such as the GDR VELVET days, or the SANER conference.

In short, my research has explored a wide range of topics, from algorithmic formalization to the design of distributed tools and the automation of reconfiguration processes, aiming to improve the understanding and management of complex distributed systems.

3.2 List of publications from 2017 to 2024

These publications are part of the themes that I was able to address during my research work. The order of authors represents the share of contribution of each, except for project deliverables. For the latter, the authors all contributed equally, the order was decided arbitrarily.

3.2.1 International conferences with published proceedings

1. Jolan Philippe, Antoine Omond, Hélène Coullon, Charles Prud'Homme, and Issam Raïs. "Fast Choreography of Cross-DevOps Reconfiguration with Ballet: A Multi-Site OpenStack Case Study". In: *2024 IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER)*. Rovaniemi, Finland: IEEE Computer Society, Mar. 2024
   Note : A-rank conference, Acceptance : 25.6% (244 submissions)

2. Jolan Philippe, Massimo Tisi, Hélène Coullon, and Gerson Sunyé. "Executing Certified Model Transformations on Apache Spark". In: *Proceedings of the 14th ACM*

SIGPLAN International Conference on Software Language Engineering. SLE 2021. Chicago, IL, USA: Association for Computing Machinery, 2021, pp. 36–48. URL: https://doi.org/10.1145/3486608.3486901
Note : B-rank conference, Acceptance : 47% (44 submissions)

3. Frédéric Loulergue and Jolan Philippe. "Automatic Optimization of Python Skeletal Parallel Programs". In: *Algorithms and Architectures for Parallel Processing*. Ed. by Sheng Wen, Albert Zomaya, and Laurence T. Yang. Cham: Springer International Publishing, 2020, pp. 183–197. URL: https://doi.org/10.1007/978-3-030-38991-8_13
Note : B-rank conference, Acceptance : 29% (251 submissions)

4. Frédéric Loulergue and Jolan Philippe. "New List Skeletons for the Python Skeleton Library". In: *2019 20th International Conference on Parallel and Distributed Computing, Applications and Technologies (PDCAT)*. 2019, pp. 392–397. URL: https://doi.org/10.1109/PDCAT46702.2019.00077
Note : B-rank conference, Acceptance : 30.7% (257 submissions)

5. Jolan Philippe and Frédéric Loulergue. "PySke: Algorithmic Skeletons for Python". In: *2019 International Conference on High Performance Computing and Simulation (HPCS)*. 2019, pp. 40–47. URL: https://doi.org/10.1109/HPCS48598.2019.9188151
Note : B-rank conference, unavailable acceptance rate.

6. Jolan Philippe and Frédéric Loulergue. "Parallel Programming with Coq: Map and Reduce Skeletons on Trees". In: *Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing*. SAC '19. Limassol, Cyprus: Association for Computing Machinery, 2019, pp. 1578–1581. URL: https://doi.org/10.1145/3297280.3299742
Note : A-rank conference, Acceptation : 24.2% (1067 submissions)

3.2.2 International workshops with published proceedings

1. Frédéric Loulergue and Jolan Philippe. "Towards Verified Scalable Parallel Computing with Coq and Spark". In: *Proceedings of the 25th ACM International Workshop on Formal Techniques for Java-like Programs*. FTfJP 2023. Seattle, WA, USA: Association for Computing Machinery, 2023, pp. 11–17. URL: https://doi.org/10.1145/3605156.3606450
Note : Workshop at ECOOP conference (A*)

2. Jolan Philippe, Hélène Coullon, Massimo Tisi, and Gerson Sunyé. "Towards Transparent Combination of Model Management Execution Strategies for Low-Code Development Platforms". In: *Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings*. MODELS '20. Virtual Event, Canada: Association for Computing Machinery,

2020. URL: https://doi.org/10.1145/3417990.3420206
Note : Workshop at MODELS conference (A)

3.2.3 Thesis

1. Jolan Philippe. "Contribution to the Analysis of the Design-Space of a Distributed Transformation Engine". PhD thesis. IMT Atlantique, 2022. URL: https://doi.org/10.5281/zenodo.8192984

2. Jolan Philippe. "Systematic development of Efficient programs on Parallel data structures". Northern Arizona University, 2019. URL: https://www.proquest.com/openview/02f765dad0386577b4d338b8e9abbad4

3.2.4 Project deliverables

1. Benedek Horváth, Jolan Philippe, Apurvanand Sahay, and Qurat ul ain Ali. *Multi-paradigm Distributed Transformation Engine*. Publicly produced for the project Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms (Lowcomote), funded by Marie Skłodowska-Curie Actions (project number 813884). 2022. URL: https://www.lowcomote.eu/data/deliverables/D54.pdf

2. Sorour Jahanbin, Qurat ul ain Ali, Jolan Philippe, and Benedek Horváth. *Scalable Low-Code Artefact Persistence and Query*. Publicly produced for the project Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms (Lowcomote), funded by Marie Skłodowska-Curie Actions (project number 813884). 2022. URL: https://www.lowcomote.eu/data/deliverables/D53.pdf

3. Benedek Horváth, Jolan Philippe, and Apurvanand Sahay. *Concepts for multi-paradigm distributed transformation*. Publicly produced for the project Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms (Lowcomote), funded by Marie Skłodowska-Curie Actions (project number 813884). 2020. URL: https://www.lowcomote.eu/data/deliverables/D52.pdf

3.2.5 Posters

1. Jolan Philippe and Frédéric Loulergue. "Towards Automatically Optimizing PySke Programs". In: *2019 International Conference on High Performance Computing and Simulation (HPCS)*. 2019, pp. 1045–1046. URL: https://doi.org/10.1109/HPCS48598.2019.9188160

2. Jolan Philippe and Frédéric Loulergue. "Towards the Generation of Correct Java Programs (Research Poster)". In: *2018 International Conference on High Performance Computing and Simulation (HPCS)*. 2018, pp. 1055–1056. URL: https://doi.org/10.1109/HPCS.2018.00166

3. Jolan Philippe, Wadoud Bousdira, and Frédéric Loulergue. "Formalization of a Big Graph API in Coq". In: *2017 International Conference on High Performance Computing and Simulation (HPCS)*. 2017, pp. 893–894. URL: https://doi.org/10.1109/HPCS.2017.140

3.2.6 Diverse

1. Jolan Philippe. *Evaluation of Combinations of Model Management Execution Strategies for Low-Code Development Platforms*. 2021. URL: https://doi.org/10.5281/zenodo.10126465

2. Jolan Philippe. *Digital Signatures using Elliptic Curve with Extended Galois Fields*. 2019. URL: https://inria.hal.science/hal-03709246/

3. Jolan Philippe and Gowanlock Michael. *2D-Clustering through Approximation Method using Geometric Calculation*. 2018. URL: https://doi.org/10.5281/zenodo.10126470

3.2.7 Ongoing submissions

1. Invitation to submit in a special issue of the journal *ACM Transactions on Autonomous and Adaptive Systems (TAAS)*, "SeMaFoR - Towards the Self-Management of Fog Resources with Collaborative Decentralized Controllers"

4 Scientific activities

4.1 Participation in projects

- As a postdoctoral fellow for the **ANR SeMaFoR** project, I contribute to WP3: Decentralized Reconfigurations, under the supervision of Hélène Coullon and Charles Prud'homme. The SeMaFoR project aims to bring significant advances in the collaborative exploitation of Fog resources. I am responsible, for the task concerning my postdoctoral position, of the task around the inference and planning of reconfiguration programs.

- My thesis was funded by the **Marie Skłodowska-Curie actions**, through the **Lowcomote** project. Lowcomote is a European project which aims to train a generation of professionals in the design, development and operation of low-code platforms. In this project, I participated in the writing of several deliverables, as well as in the general coordination of the project by volunteering to represent the project's doctoral students and the administration of its website.

- I was a research engineer in the **Girafon** project, funded by the Center Val de Loire Region (**APR-IA**), which aimed to propose algorithms for querying, exploiting and analyzing large graphs, using rich query language and distributed computing.

For my part, I contributed to the task "Structured parallel programming on large graphs".

4.2 Complete list of talks

Presentations at conferences and workshops with international audiences

- "Fast Choreography of Cross-DevOps Reconfiguration with Ballet: A Multi-Site OpenStack Case Study", March 13^{th}, 2024. International conference: Software Analysis, Evolution and Reengineering (SANER), Rovaniemi (Finland)
- "Multi-Paradigm Distribution for Model Management Operations", December 15^{th}, 2022. Lowcomote Industrial Workshop, Online
- "Executing Certified Model Transformations on Apache Spark", October 17^{th}, 2021. International conference : Software Language Engineering (SLE), Online
- "Towards Transparent Combination of Model Management Execution Strategies for Low-Code Development Platforms", October 19^{th}, 2020. Workshop international : Low-code, International Conference on Model Driven Engineering Languages and Systems (MODELS), Online
- "Automatic Optimization of Python Skeletal Parallel Programs", December 9^{th}, 2019. Internationale conference : Algorithms and Architectures for Parallel Processing (ICA3PP), Deakin University - Melbourne (Australia)
- "New List Skeletons for the Python Skeleton Library", December 6^{th}, 2019. International conference: Parallel and Distributed Computing, Applications and Technologies (PDCAT), Gold Coast (Australia)
- "Towards Automatically Optimizing PySke Programs", July 18^{th}, 2019. Poster session, Internationale conference : High Performance Computing & Simulation (HPCS), Dublin (Ireland) [poster]
- "PySke: Algorithmic Skeletons for Python", July 16^{th},. Internationale conference : High Performance Computing & Simulation (HPCS), Dublin (Ireland)
- "Coq2Java : From MiniML to Java code, Formalization of a compiler", July 17^{th}, 2018. International conference: High Performance Computing & Simulation (HPCS), Orléans (France) [poster]
- "Verified Skeletons on Trees", July 13^{th}, 2018. Poster session, International conference: High-Level Parallel Programming and Applications (HLPP), Orléans (France) [poster]

- "Formalization of a Big Graph API in Coq", July 20^{th}, 2017. Poster session, International conference: High Performance Computing & Simulation (HPCS), Genoa (Italia) [poster]

Presentations in seminars and working groups

- "Fast Choreography of Cross-DevOps Reconfiguration with Ballet, Multi-Site OpenStack Case Study", December 13^{th}, 2023. Working group in VELVET days, Nantes (France)
- "Fast Choreography of Cross-DevOps Reconfiguration with Ballet, Multi-Site OpenStack Case Study", November 9^{th}, 2023. STACK team seminar, Guérande (France)
- "SeMaFoR Project and Planning for Decentralized Reconfiguration", October 26^{th}, 2023. TASC team seminar, IMT Atlantique - Nantes (France)
- "SeMaFoR Project and Concerto-D for decentralized reconfiguration of Fog systems", July 3^{rd}, 2023. Naomod team seminar, IMT Atlantique - Nantes (France)
- "SeMaFoR Project and Decentralized reconfiguration plan synthesis", June 6^{th}, 2023. DAPI department seminar, Nantes (France)
- "Decentralized reconfiguration plan synthesis", April 20^{th}, 2023. SeMaFoR project plenary, IMT Atlantique - Nantes (France)
- "Contribution to the Analysis of the Design-Space of a Distributed Transformation Engine", January 23^{th}, 2023. LMV team seminar (Langages, Models et Verification) - Lifo, Université d'Orléans (France)
- "Programming Models and Distributed systems", November 18^{th}, 2019. STACK team seminar, Université de Nantes (France)
- "PySke: Algorithmic Skeletons for Python", October 18^{th}, 2019. Working group in GDR LAHMA, LACL - Créteil (France)
- "Algorithmic Skeletons for Distributed Computing", November 16^{th}, 2018. Graduate student seminar, Northern Arizona University - Flagstaff, AZ (USA)
- "BMF and Parallelism", May 25^{th}, 2018. Speech at Summer School on Formal Methods (SSFT), Menlo College - Atherton (USA)
- "Formalization of a Big Graph API in Coq", September 13^{th}, 2017. Northern Arizona STEM Poster Session, Northern Arizona University - Flagstaff, AZ (USA) [poster]

4.3 Relectures

During my thesis and my postdoctoral work, I had the opportunity to participate, as a reviewer, in the evaluation of scientific work submitted to international conferences and journals. The table 3 gives an overview of my participation.

Year	Name	Description
2023	COLA	Journal of Computer Languages
	SBAC-PAD 2023	International Symposium on Computer Architecture and High Performance Computing
	CP 2023	International Conference on Principles and Practice of Constraint Programming
2021	MODELS 2021	International Conference on Model Driven Engineering Languages and Systems
2020	MODELS 2020	International Conference on Model Driven Engineering Languages and Systems
	ECMFA 2020	European Conference on Modelling Foundations and Applications
	ICCS 2020	International Conference on Computational Science

Table 3: List of reviews for international scientific journals or conferences

4.4 Collective responsabilities

Dec 2023	**Help with organizing VELVET days** (Verification Software Engineering for DevOps and Reconfiguration) at IMT Atlantique - Nantes (France)
Since Feb 2023	**Site manager and administrator for STACK** team [site]
July 2022	**Student volunteer** for the STAF conference in Nantes (France) https://staf2022.univ-nantes.io/
Sep 2019 - Mar 2023	**Site manager and administrator for Lowcomote** project [site]
Oct 2019 - Jan 2021	**Representative of the Lowcomote Ph.D. students**
Sep 2019 - Mar 2023	**Site manager and administrator for Naomod** team [site]
Nov 2018 - Août 2019	**Funder and main organizer of "SICCS graduate student seminar"** at Northen Arizona University - Flagstaff AZ (USA)
Juil 2018	**Student volunteer** for the HPCS conference in Orléans (France) https://hpcs2018.cisedu.info/

5 Additional parts

You will find in this part the summary of teaching load at IMT Atlantique until 2023. This file concludes with the reports from the thesis referees.

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

Dossier suivi par : Gwenola Jaouen
Tél : 02.29.00.11.67
Gwenola.jaouen@imt-atlantique.fr
Réf. : DFVS.2023.021/GJ

ATTESTATION

Je soussigné, Philippe PICOUET, Directeur des Formations et de la Vie Scolaire d'IMT Atlantique Bretagne-Pays de la Loire, atteste par la présente que Monsieur PHILIPPE Jolan, Doctorant du 01/09/2019 au 31/01/2023, puis Post-doctorant du 01/02/2023 au 31/07/2024, affecté au Département Automatique Productique Informatique (DAPI), a effectué des enseignements en formation ingénieur au sein de l'Établissement au cours des années scolaires suivantes :

- 2020-2021 : 50,37 heures EQTD, dont 22,50 heures pour l'UE Algorithmique et mathématiques discrètes (Pyrat), et 27,87 heures pour l'UE Base de données IHM,
- 2022-2023 : 14 heures EQTD pour l'UE Algorithmique et mathématiques discrètes (Pyrat),
- 2023-2024 : 46,25 heures, dont 20 heures, pour l'UE Architectures distribuées, 21,25 heures pour l'UE Des services aux micro-services dans des conteneurs, et 5 heures pour l'UE Algorithmique et mathématiques discrètes (Pyrat).

Fait à Brest, le 29 Novembre 2023 pour faire valoir ce que de droit.

Philippe PICOUET
Directeur des Formations
et de la Vie Scolaire

Philippe PICOUET
Directeur des Formations et de la vie scolaire
IMT Atlantique
Bretagne-Pays de la Loire

Conclusion of the study of the manuscript for a defense

Doctorant :

M. Jolan PHILIPPE — Département IMT Atlant que : DAPI

Int tulé de la thèse : Mult -Paradigm Distribut on for Model Management Operat ons

Spécialité : Informat que

Directeur de thèse : M. Gerson SUNYE

Date de soutenance prévue : 19/12/2022

Rapporteur :

(Civilité Prénom - NOM) : M. Jesus SANCHEZ CUADRADO — Titre : Associate professor

Etablissement : Université de Murcia - Espagne

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☐ A few changes need to be made to this dissertation; the defense of this work can proceed without resubmitting this document for examination.

☐ Significant changes must be made to this thesis.

☐ The thesis cannot be defended as is; the new version will have to be resubmitted for examination.

Dated at Murcia le 7 of Dec. 2022

Signature

Evaluation Report on Mr Jolan Philippe's PhD Thesis, entitled "Contribution to the Analysis of the Design-Space of a Distributed Transformation Engine"

This report evaluates the PhD Thesis of Mr Jolan Philippe, entitled "Contribution to the Analysis of the Design-Space of a Distributed Transformation Engine". The context of this thesis is Model-Driven Engineering (MDE), in particular the development of model transformation engines and their associated characteristics. The thesis is focused on studying how the different choices available in the design of a distributed model transformation engine affect to its characteristics, in particular trying to address the trade-off between correctness and performance. The thesis has produced so far two articles, in an international conference and in a workshop. The conference paper was presented at SLE'21, which is a well-known conference in the modeling community. Moreover, the thesis has produced a set of software artifacts and experiments, which are available as open source.

The topic of the thesis is relevant for the modeling community since there is a need to build better transformation engines (e.g., more efficient) but also keeping in mind the need to guarantee correctness and to allow developers reason about their code (e.g., prove properties of the transformation).

Chapter 2 presents some preliminary information which is needed to set the context of the work and Chapter 3 presents a detailed and comprehensive review of the state-of-the-art related to the topics of the thesis. In particular, three main topics have been studied in depth. First, works related to the efficiency of model transformations are classified according to whether they are focused on model queries or transformations. Another classification dimension is whether the matching phase of a transformation execution is optimized or not. The final classification dimension is related to works addressing distribution. After this, the study of the state-of-the-art moves to works addressing the correctness of model transformations, which will be lated combined with efficiency approaches in the following works (i.e., by building a provably correct transformation engine). Finally, a few works related to the applying variable strategies to improve the performance of model transformations are discussed.

The core work of the thesis is reported in chapters 4, 5 and 6, which are discussed in the following.

Chapter 4 discusses several strategies which can be used to implement distributed model queries (which are an essential part of a model transformation engine which wants to support complex transformations) and establishes a mapping between OCL and Scala/Spark. The study is done by reusing a well-known benchmark of the model transformation community (the TTC'18 case) and implementing the same query in Spark (with a direct translation), Pregel and Map-Reduce. The algorithmic complexity of each implementation is studied analytically, so that the weaknesses and strengths of each one is derived with the idea of motivating the need of transformation engines which are able to determine which strategy is better according to the execution context and the input models. Finally, the implementations are evaluated empirically by running the transformations using different sets of input models on a shared memory machine with an Intel Core i7-8650U having 8 cores at 1.90GHz and a memory of 32GB. The results seem to confirm that no single strategy suits all use cases, which reinforces the idea of having engines with the ability of selecting the best strategy at runtime.

Chapter 5 is the main contribution of the thesis. It presents an evolution of the CoqTL transformation language to favor parallelism. The evolution implements a new version of the main execution function of CoqTL in which the phases are organized in a way that favors parallelism. This part of the thesis is illustrated with a concrete example, a transformation from relational models to class diagrams. Then, this new version of CoqTL is proved to be semantically equivalent to the original. It is interesting that the proof effort is measured, which can also be used by others as a kind of benchmark. On the other hand, to evaluate the performance of this approach, programs written in CoqTL are translated into Scala (and Spark). This is done manually, and the development of a compiler is left for future work (although this would have been a very good addition to the thesis). Using the proposed translation, the performance of the engine is evaluated on a cluster by analyzing the effect of the design decisions in each of the different phases of the transformation engine execution.

Chapter 6 concludes the technical contribution of the thesis with a study of the different implementation options for the transformation engine. The chapter is illustrated with a well known case study proposed in TTC'14, which has been used by several other works to analyze distribution and parallelism of model transormation. In this part of the thesis, instead of a one-to-one mapping from CoqTL to Scala, different execution strategies are identified and tested in the transformation engine to study its effect in the

performance of the engine. The different configurations have been formalized with a feature model and have been implemented as modules of the transformation engine.

Altogether, this thesis performs the first steps in the study of the different aspects that encompass the design and implementation of efficient and correct distributed model transformation engines. In this sense, although a number of interesting enhancements of this work are left as future work, this is a good step towards addressing them and thus improve the state-of-the-art in this topic.

Therefore, I acknowledge that this work complies with the requirements for a doctoral degree and I am in favor of Jolan Philippe's PhD defense.

Jesús Sánchez Cuadrado
Dpto. de Informática y Sistemas, Universidad de Murcia, España

Conclusion of the study of the manuscript
for a defense

Doctorant :

M. Jolan PHILIPPE — Département IMT Atlantique : DAPI

Intitulé de la thèse : Multi-Paradigm Distribution for Model Management Operations

Spécialité : Informatique

Directeur de thèse : M. Gerson SUNYE

Date de soutenance prévue : 31/12/2022

Rapporteur :

(Civilité Prénom - NOM) : M. Mathias TICHY — Titre : Professeur

Etablissement : ULM University Allemagne

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28/11/2022 Ulm

Made at ..... le .....

Signature

Matthias Tichy

Universität Ulm | 89069 Ulm | Germany

Fakultät für Ingenieurwissenschaften, Informatik und Psychologie
Institut für Softwaretechnik und Programmiersprachen

Prof. Dr. Matthias Tichy
Institutsdirektor

James-Franck-Ring, O27
89081 Ulm, Germany

Tel: +49 731 50-24160
matthias.tichy@uni-ulm.de
https://www.uni-ulm.de/in/sp

28.11.2022

Review of the PhD Thesis of Jolan Philippe
"Contribution to the Analysis of the Design Space of a Distributed Transformation Engine"

Context and Aim of the Thesis

Model Transformation are key artefacts in the area of model-driven engineering. They are used to transform a single model or create a target model from a source model. There exist many different model transformation languages like ATL, Henshin, Viatra. Historically, programs written in those model transformation language have been executed locally in a single thread by the corresponding engine. However, the size of models has been increasing steadily with papers reporting about models bigger than 100k objects and the TTC movie benchmark (published in 2014) containing over 2.5m objects. This gave rise to several approaches that execute model transformations in a parallel and/or distributed fashion aiming for vertical and/or horizontal scalability.

The aim of the thesis by Jolan Philippe is threefold:

1. A manual transformation of model queries – specifically OCL queries – to different distributed programming paradigms/platforms, e.g., Spark and Pregel.
2. A parallel version of the CoqTL transformation language that has been formally proven to be input/output equivalent compared to the standard CoqTL version using the Coq theorem prover.
3. A manual transformation of the parallel CoqTL programs to Spark implementations and the evaluation of different implementation as well as configuration variants.

Structure and Contents

The thesis contains seven chapters with 108 pages, two appendices and an extensive bibliography. Contents of the thesis have been published in two papers – one at the Software Language Engineering conference (2021) and one at the LowCode workshop (2020). Jolan Philippe is first author of both papers.

The first chapter introduces the area of model-driven engineering including model transformations and sketches the three contributions of the thesis.

Jolan Philippe introduces the necessary foundations of his research in the second chapter. This includes a nice overview about models and model transformations – particularly the Atlas Transformation Language, concepts of distributed computing – particularly the Spark platform –, and interactive theorem proving – particularly the Coq proof assistant. The chapter covers the necessary contents in a systematic and coherent manner.

The following Chapter 3 contains a discussion of the state of the art. The first and major part of the chapter reviews the different existing approaches to improve efficiency of model transformation by exploiting task parallelism and data parallelism as well as distributed asynchronous computation. This section properly discusses the different major approaches like the ones by Viatra, IncQuery, Henshin, ATL that are using different paradigms like RETE-networks, the Bulk Synchronous Parallel abstract computer. The latter two sections of the chapter shortly discuss semantics and proving of model transformations as well as feature models to specify the configuration space used for benchmarking.

The following three chapters cover each one of the three contributions as mentioned above. Jolan Philippe presents a distributed implementation of OCL queries base on the Spark platform in Chapter 4. He systematically presents different implementation variants of OCL queries using the different concepts and evaluates them on 6 different data sets. The results show that the size of the dataset has an impact on the scalability of the different implementation variants. It would have been interesting to show in more depth the full set of mapping rules from OCL to the different variants as well as to investigate systematically which properties of the data set affecting the scalability of the different implementations noting that bigger data sets, e.g., data set 5, appear to scale less than smaller data sets, e.g., data set 4.

Chapter 5 presents a parallel version of CoqTL – a transformation language which supports the interactive verification of transformations against contracts. The parallelizable CoqTL transformation is then translated to Scala and executed on the Spark platform. Jolan Philippe presents the refinement proof for parallelizable CoqTL and sketches the translation to Scala and Spark using examples. The evaluation on rather small models (up to 700 elements) shows that the solution scales rather bad. Jolan Philippe correctly identifies that small computations are (at least one of) the reason for the bad scalability and shows that by introducing

different sleep times to emulate more complex calculations the scalability can improve. Valuable next steps based on the results would be a systematic and in-depth description of the translation to Scala and Spark, an evaluation with bigger models, and a translation to Scala that tries to improve the scalability problem, e.g., by grouping computations into bigger chunks to reduce the communication overhead.

Finally, the third major chapter (Chapter 6) covers the presentation and evaluation of different implementation alternatives. This includes for example how to navigate over references between nodes on the input model or how trace links between input and output model elements are handled. The different variants are shown in three feature diagrams with 28 (leaf) features. Jolan Philippe focuses mostly on link navigation and trace management alternatives in the discussion and illustrates those with two code snippets. The evaluation (on models up to 10.000 elements) shows that using HashMaps hugely outperforms the List implementations on the two features "DynamicLinksNavigation" and "TraceLinksNavigation". Reasonable next steps would be to systematically present and evaluate the variants as well as evaluate them on bigger models.

The thesis concludes with a short synthesis as well as a good and extensive overview on limitations and future research directions summarizing the results of the three major chapters in chapter 7.

Summative Assessment

In summary, Jolan Philippe presents a concise PhD thesis which presents an original contribution to the state of research of parallel model transformations. He shows a solid knowledge of the state of the art in the model transformations research field and the ability to independently conduct research. Hence, I believe that the thesis meets the standards required for the degree of a PhD and, thus, I recommend that Jolan Philippe proceeds to defend his PhD thesis.

Matthias Tichy