Computational Learning rendered in Dynamic Logics (CLariDy)

Applicant name: Nina Gierasimczuk
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Application to Independent Research Fund Denmark - DFF-Research Project 1

APPLICANT

PERSONAL INFORMATION AND APPLIED COUNCIL

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Highest attained academic degree:	PhD
Council:	Independent Research Fund Denmark | Natural Sciences
Date of birth:	04-07-1981

CITIZENSHIP

Citizenship:	Poland
Do you hold a dual citizenship?:	No

OPEN RESEARCHER AND CONTRIBUTOR ID

ORCID:	0000-0001-5081-4676

CONTRIBUTION TO SCIENCE

Give an account of your most significant contributions to science :	I established an original link between modal logic and inductive inference, by showing that finite identifiability and learning by erasing known from computational learning theory can be seen as iterated updates and upgrade of dynamic epistemic modal logic. This bridge turned out to be important for Knowledge Representation and AI, as it opened a way to study truth-tracking properties of upgrade methods on positive, negative, and erroneous data. Further, I characterised identifiability in the limit in terms of general topology, which led to developing topological semantics for learning and to proposing a sound and complete Dynamic Logic for Learning Theory, which extends Subset Space Logics with dynamic observation modalities and a learning operator. This logic is capable of expressing (in a dynamic modal language) conditions of verifiability and decidability in the limit that code the important levels of Borel hierarchy.

PHD DEGREE

PHD DEGREE

Have you obtained a PhD degree?:	Yes
State the date of obtaining the degree, as stated on your PhD diploma:	17-12-2010
Have you had any periods of leave since obtaining your PhD degree?:	No

PLACE OF EMPLOYMENT, ETC.

CURRENT PLACE OF EMPLOYMENT

Are you currently employed?:	☑
Choose place of employment:	Technical University of Denmark
Current position:	Associate professor
Department:	Department of Applied Mathematics and Computer Science

OTHER

DANISH

CVR number:	30060946

PLACE OF EMPLOYMENT DURING THE PROJECT PERIOD

Is the place of employment during the project period the same as your current place of employment?: ☑

PLACE FOR CARRYING OUT THE PROJECT ACTIVITIES

Will the research activities be carried out at the place of employment (the project period)?: ☑

RESEARCH ACTIVITIES ABROAD

Does the project involve research activities outside Denmark (excl. conference participation)? :	Yes
Total number of months for applicant:	1
Total number of months for all PhDs:	0
Total number of months for all Postdocs :	2
Total number of months for other scientific/academic persons:	0

TITLE AND SCIENTIFIC CONTENT

APPLICATION TITLE

Application title: Computational Learning rendered in Dynamic Logics (CLariDy)

BRIEF SCIENTIFIC SUMMARY

The brief scientific summary should be written in English. The summary is used in the recruitment of peer reviewers.: Currently, artificial intelligence is divided between two principal paradigms: symbolic reasoning (grounded in computational logic) and connectionist learning (realised through neural systems). This project seeks to construct a new bridge between the two by rendering black-box neural network learning in dynamic logic. Our focus is on the backpropagation algorithm. First, we will examine the reliability of backpropagation by employing belief-change theory - a branch of Knowledge Representation in AI - to model learning as a constructive, iterative process of conjecture revision. We will develop a general framework for gradual belief change, enabling a rigorous evaluation of the truth-tracking capabilities of backpropagation. Second, we will apply tools from dynamic logic to design a sound and complete modal logic of backpropagation. The logic will support reasoning about learning in neural networks and enable formal verification of constraints on computational learning.

POPULARISED DESCRIPTION OF THE SCIENTIFIC CONTENT

Popularised description of the scientific content: Neurale netværk justerer vægte for at lære regelmæssigheder i de observerede data og for korrekt at forudsige udvidelserne til nye, tidligere usete data. Ulempen er den sorte boks karakter af denne proces. Algoritmer, der bruges til at levere løsninger på samfundsproblemer i den offentlige sfære, er baseret på neurale netværk og big data, og de skjulte skævheder i disse teknologier påvirker store befolkningsgrupper, hvilket fører til skævhed mod visse grupper af mennesker. Logik er på den anden side god til at modellere sofistikeret forklarlig ræsonnement, da logiske formler, der beskriver et systems adfærd, er læsbare og kommer med en veldefineret betydning. Dette projekt har til formål at drage fordel af dynamisk symbolsk logik til at designe og bygge forklarlige, gennemsigtige og troværdige neurale netværkslæringsalgoritmer.

SCIENTIFIC KEYWORDS

Keyword 1:	neuro-symbolic AI
Keyword 2:	dynamic epistemic logic
Keyword 3:	computational learning
Keyword 4:	formal verification
Keyword 5:	modal logic

APPLICATION TO INDEPENDENT RESEARCH FUND DENMARK (DFF) - DFF-RESEARCH PROJECT 1   TYPE: FI_ANSOEGNING_DFF_FORSKNINGSPROJEKT1_UK   WORKFLOW ID: B29AE350-2E76-4208-81B4-A33FEE725A8F

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MAIN AREAS OF SCIENCE

Natural sciences:	80
Technical sciences:	20
Health sciences:	0
Agricultural and veterinary sciences:	0
Social sciences:	0
Humanities:	0
Not classified according to the above categories:	0
Sum:	100%

CLASSIFICATION CODES (OECD)

CLASSIFICATION CODE

Classification code 1:	Computer and information sciences
Classification code 2:	Computer sciences
Classification code 3:	Applied mathematics

CLASSIFICATION CODE 1

ID:	10200
Classification code :	Computer and information sciences
Classification code English:	Computer and information sciences

CLASSIFICATION CODE 2

ID:	10201
Classification code:	Computer sciences
Classification code English:	Computer sciences

CLASSIFICATION CODE 3

ID:	10102
Classification code:	Applied mathematics
Classification code English:	Applied mathematics

ETHICAL ISSUES AND GATHERING DATA

ETHICAL ISSUES

ETHICAL ISSUES

Does your research raise any ethical issues that should be dealt with?:	No ethical issues
If no ethical issues are identified in your project, please provide a brief account in which you justify this.:	The project involves abstract mathematical methodology and computational experiments on standard, publicly available data sets used in machine learning. It does not include experiments on human subjects, animals, or plants. It also does not use any data collection. Of course, the research will be published according to international standards of the peer-review process, and with attention to choosing open access venues.

GATHERING DATA

Does your project involve gathering or purchase of unique research data within the research areas social sciences, medical sciences, the humanities, natural sciences, or technology and production sciences?:	No

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SUBMISSION TO SEVERAL COUNCILS

SUBMISSION TO SEVERAL COUNCILS

Do you request your application also to be assessed by another of Independent Research Fund Denmark's research councils?: ☐

REFERRAL TO OTHER RESEARCH COUNCILS

Do you accept that Independent Research Fund Denmark may refer your application to a different research council than the one you originally applied to, if Independent Research Fund Denmark considers it to be scientifically relevant?: ☑

OTHER APPLICATIONS

PREVIOUS APPLICATION(S)

Is this application a resubmission of one or several previous applications, whether in the same or in a revised form?: Yes

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PREVIOUS APPLICATION 1

Project title:	Computational Learning rendered in Dynamic Logics
Year of application:	2024
Case number:	5241-00055A
Describe any changes made :	The present project is a more focused selection of task of the previous application (DFF Project 2) to overcome the shortcomings pointed out by the reviewers, and to fit within the smaller funding framework of DFF Project 1.

In comparison, in the present proposal:
- the focus is solely on backpropagation algorithm (with a sharper explanation of the relationship between various types of neural learning);
- the team is smaller (no PhD student, the selection of collaborators is narrower and more focused);
- the tasks are described in more detail and are reduced to 2 work-packages (previously 4);
- the qualifications of the PI and the named Postdoc are elaborated upon in more detail, in particular, it's demonstrated how the actual earlier work of the PI and Postdoc will be useful and used in the project;
- the roles of the team members are clearly specified within the description of the work packages.

OTHER SOURCES

Have you applied for funding for activities covered by this application from other sources, including foundations, councils or programme committees?: No

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PREVIOUS GRANTS

PREVIOUS GRANTS

Have you previously received any funding for activities related to the present application?: No

Have you previously received any funding for activities not related to the present application?: No

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BUDGET

Uploaded by: Nina Gierasimczuk
Uploaded, date and time: 4/28/2025 10:21 PM

BUDGET INFORMATION

DURATION OF THE PROJECT

Starting date:	01-02-2026
End Date:	31-01-2029
Duration in months:	36

SALARY EXPENSES

Will you be salaried by the grant applied for?: Not salaried by the grant applied for

AMOUNT APPLIED FOR

Amount for scientific/academic salaries:	1.801.337 kr.
Amount for technical/administrative salaries:	0 kr.
Amount for equipment:	0 kr.
Amount for operating expenses:	395.000 kr.
Amount applied for excl. overhead/administration expenses:	2.196.337 kr.
Amount for overhead/administration expenses:	966.389 kr.
Amount applied for incl. overhead/administration expenses:	3.162.726 kr.

ADMINISTRATOR

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PERSONAL INFORMATION

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Computational Learning rendered in Dynamic Logics
(CLariDy)

BACKGROUND. In recent years, modern machine learning systems have achieved unprecedented success in learning from data with minimal human guidance. Consider, for example, large language models such as GPT and Llama [1, 24, 51], which have taken the world by storm with their ability to learn to converse in natural language solely from data scraped from the Internet, or AlphaGo [48], which learned to play the game of Go at a human expert level by repeatedly playing against itself. These breakthroughs are owed to neural networks—brain-inspired computational models that excel at learning from unstructured data.

This technological progress has widespread consequences. While solutions to societal problems in the public sphere increasingly rely on neural networks [42], these algorithms come with no guarantees of safety, correctness, or reliability. Neural systems can carry biases and misconceptions, make logical mistakes, and spread disinformation [26, 49]. But due to their 'black-box' nature they lack transparency; their mistakes are difficult to predict or control. This presents a paramount problem that spans artificial intelligence (AI), theoretical computer science (TCS), and cognitive science:

How can we evaluate and reason about the behavior of neural networks?

OBJECTIVES. The goal of this project is to study the logic of the most widely used neural network learning algorithm: **backpropagation** [16, 23, 34, 45]. Backpropagation is an efficient implementation of gradient descent on neural networks. In each round, the neural network gives its answer y' to input x, and each weight of the net is updated according to its contribution to the gradient of the error between y' and the actual true answer y. We aim to answer two concrete questions:

Q1) How reliable is learning by backpropagation in neural networks?

Q2) What is the logic of learning by backpropagation in neural networks?

STATE-OF-THE-ART. In theoretical computer science, logic is often used to reason about and guide the behavior of computational systems. In the field of neuro-symbolic AI in particular, systems are being developed that use logic to control and explain the outputs of neural network learning [5, 14, 33, 46]. These systems include Logic Tensor Networks [6], Distributed Alignment Search [28], DeepProbLog [40], Logic Explained Networks [7, 19], and neural network fibring [27]. The point is to combine the complementary strengths of neural networks and logic—in contrast with neural networks, symbolic (logic) systems provide transparent access to their reasoning by means of a human-interpretable language and compositional semantics. However, the logical subsystems used in neuro-symbolic AI are often standard logics that suffer from the so-called *frame problem* [41, 47], i.e., the underlying languages are unable to express or model actions that change systems over time.

METHODOLOGY. In order to study the logic of backpropagation, we will need to escape the frame problem. There are two ways to do this that are pertinent to this project. To address Q1, we will use belief-change theory [2, 32] to model learning as a constructive iterated process of conjecture change. To address Q2, we will use tools from dynamic logic [25, 31, 43] to design logics enriched by explicit learning operators. Accordingly, this project will be partitioned into two work packages: *Evaluating the Reliability of Backpropagation* and *Developing a Dynamic Logic for Backpropagation*.

Work Package 1 (WP1): Evaluating the Reliability of Backpropagation

In belief-change theory (the so-called AGM framework [2, 32]), an agent's knowledge is represented by a knowledge base and incoming new information is represented by a logical formula. The theory aims to answer the question: What are the rational ways to change the state of knowledge to accommodate the new information? This question was addressed by the development of AGM rationality postulates that spell out normative expectations on an agent's belief revision in the face of new information (see, e.g., [20]). But these postulates do not answer the question of the long-term efficacy of belief-revision strategies: How reliable are they as learning strategies? To address this question, **NG**[1], together with co-authors (**A. Baltag** and **S. Smets**), has studied truth-tracking properties of belief update strategies and compared their learning power [10, 11, 29]. This led to the re-interpretation of belief-change theory as a framework for inductive inference by giving it a long-term horizon of learning. Very recently, **T. Aravanis** extended the belief-change theory to cover elements of neural network learning, providing an interpretation of the backpropagation as a gradual belief-change operator [3]. As it turns out, another strategy of learning in neural networks, the so-called Hebbian learning (studied by **CSK** in [36]) also resembles certain belief revision policies, i.e. the lexicographic and conservative upgrades (previously studied by **NG** in [11]).

In this work package, the above-mentioned researchers will join forces to develop a framework for gradual belief-change—a common ground on which various neural network learning strategies can be compared with respect to their truth-tracking properties (i.e., their reliability). The expected output of WP1 is a collection of theorems that reveal the truth-tracking power and reliability of Hebbian learning and backpropagation as gradual belief-change operators, and a comparison with different existing belief-revision policies. We will submit these results for publication in the following venues: LoRI, TARK, WoLLIC, and journals JoLLI, the *Journal of Applied Non-Classical Logics*, *Networks*, the *Journal of Applied Logic*, and the *Journal of Approximate Reasoning*.

Work Package 2 (WP2): Developing a Dynamic Logic for Back-Propagation

Dynamic logic was originally developed as a formal tool for reasoning about and verifying imperative programs [17, 25, 31, 43]. Nowadays, dynamic logic is seen as a general set of ideas and tools for

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[1]Note that in the following, **NG** stands for Nina Gierasimczuk (the PI) and **CSK** stands for Caleb Schultz Kisby (the named Postdoc); the names of the collaborators on this project are in bold-face.

reasoning about diverse kinds of dynamic scenarios: programming effects [44], quantum computation [13], multi-agent communication [22], epistemic planning in AI [4], social networks [8, 18], and even the above-mentioned belief-change theory [50]. All of these logics come with semantics, but also syntax: a formal language and a proof theory. This makes dynamic logics suitable for rigorous verification of certain properties of the dynamic updates they model. Dynamic logic is also a natural choice for reasoning about learning. In fact, **NG** introduced several logics with dynamic operators that denote various learning actions. For example, the sabotage logic of learning [30] uses supervision operators that represent a teacher's efforts to guide an agent towards correct conjectures by deleting edges in a graph of hypotheses (the setting was further extended in [12] to cover other types of teacher interventions). Further, in [9], together with co-authors, **NG** developed a sound and complete dynamic logic for learning theory, in which observations lead to hypothesis elimination and revision in a topological space. In the context of neural networks, **CSK** developed a dynamic modal logic for Hebbian learning, whose dynamic operators denote an update of weights in a neural network [35, 36].

In order to design a dynamic logic for neural network learning, we must interpret its language over neural network structures. Such a semantics can be developed in several ways. We will explore the existing approaches together with **Z. Christoff**, a pioneering researcher of dynamic logics for (social) network structures [8, 18]. Of course, neural networks have their specific architecture that will favor some semantics over others. To address this specificity, we need to work out the static and the dynamic components of the logic. Regarding the former, we will collaborate closely with **H. Leitgeb**, who originally developed ways to model (nonmonotonic) reasoning by inhibition (neural) nets [37, 38, 39]. Regarding the latter, we will work with **A. d'Avila Garcez**, who discovered ways of using logic to guide the loss-function (used in backpropagation) in neural network learning [6, 27]. Further, our dynamic logic might require temporal and hybrid operators (as it did in the **NG**'s logical analysis of finite identifiability in [21]), and so we secured the collaboration of **P. Blackburn**, a leading expert on modal logic [15].

Dynamic logic normally considers unary operators $[P]$ denoting one-step updates. In machine learning terms, these operators perform *unsupervised* update. But back-propagation is a *supervised* learning process, so we explore the role of 'supervised' operators $[P; Q]$, which denote a single round of back-propagation, where P is the input and Q is its expected answer. We plan on building on the dynamic logic of Hebbian learning (developed by **CSK** in [35, 36]); this approach is inspired by existing work on the connections between Hebbian learning and backpropagation, established in [52]. We will also draw on the discoveries of our work in WP1. The expected output of WP2 is a sound and complete dynamic logic of gradient descent via backpropagation, and a collection of theorems concerning its complexity and meta-logical properties. We plan to submit to: AAAI, AAMAS, IJCAI, ICLR, and to the journals: *Artificial Intelligence*, the *Journal of AI Research*, and *Neurosymbolic AI*.

THE TEAM. The proper research team at the host institution will consist of two researchers: Nina Gierasimczuk (the PI) and Caleb Schultz Kisby (the named Postdoc). **NG** is an expert on the dynamic logic approach to characterizing and analyzing computational learning. As witnessed by her CV, her experience fits this project and this role perfectly. Her contributions to Dynamic Logic awarded her membership in the Steering Committee for the Dalí Dynamic Logic conference. She was invited to present her research on connecting logic and learning at numerous venues, among them at Advances in Modal Logic (AiML), Computer Science Logic (CSL), and the Non-Monotonic Reasoning (NMR) Workshop at the conference for Knowledge Representation (KR). **CSK** is a PhD candidate in Computer Science (expected defense: October 2025), leading the dynamic logic approach to modeling neural network learning. As his CV shows, he is actively involved in the neuro-symbolic AI community. He was invited to present his work connecting logic and neural networks at the AAAI Conference and at the International FLAIRS Conference. The PI and Postdoc have already begun this collaboration, and jointly designed a course on the state-of-the-art dynamic logic approaches to computational learning. The course proposal was accepted at the North American Summer School in Logic, Language and Information (NASSLLI'25) that will take place in Seattle, USA in June 2025.

EXTERNAL COLLABORATORS.

- **Prof. Theofanis Aravanis** (Department of Mechanical Engineering, University of Peloponnese, GR). His research interests lie in the field of AI, knowledge representation and reasoning, belief change, logic programming, and machine learning. He developed the first belief-change account of elements of learning by backpropagation. Involved in WP1.

- **Prof. Alexandru Baltag** (Institute for Logic, Language, and Computation, University of Amsterdam, NL). His research focuses on logics for modelling update and actions for multi-agent information flow—in fact, he was one of the originators of dynamic epistemic logic. Alongside the PI, he helped develop the topological characterization of learning in the limit. Involved in WP1.

- **Prof. Patrick Blackburn** (Department of Philosophy, Roskilde University, DK). His research centers on logic and its applications in computer science. He is particularly interested in modal-hybrid-temporal-description families of logics. He is an expert on the semantic approach to modal, temporal, and hybrid logics. Involved in WP2.

- **Prof. Zoé Christoff** (Bernoulli Institute for Mathematics, Computer Science, and Artificial Intelligence, University of Groningen, NL). Her research focuses on the formal modeling of collective Artificial Intelligence. She is a leading expert on dynamic logics that model learning, update and information flow in social networks. Involved in WP2.

- **Prof. Artur d'Avila Garcez** (Department of Computer Science at City, University of London, UK). He is one of the founders of neuro-symbolic AI, a field that aims to integrate neural and symbolic (logic) systems while preserving the advantages of both. He invented Logic Tensor Networks,

which support logical control over neural network learning. Involved in WP2.

- **Prof. Hannes Leitgeb** (Munich Center for Mathematical Philosophy, Ludwig Maximilian University of Munich, DE). His general area of research is formal philosophy, the application of logical and mathematical methods in philosophy. He is an expert in interpreting logic directly on neural networks. Involved in WP2.

- **Prof. Sonja Smets** (Institute for Logic, Language, and Computation, University of Amsterdam, NL). Her research is centered around the logical laws of the dynamics of information in the context of networks and quantum systems. Alongside the PI, she co-developed the truth-tracking approach to learning in the limit. Involved in WP1.

THE TIMELINE. The project will last 3 years, see Fig. 1. Year 1 will begin with the work on WP1. T. Aravanis ([TA] in Fig. 1) will visit DTU in the second half of Year 1. In the first part of Year 2, **NG** and **CSK** will go to the Netherlands to visit A. Baltag and S. Smets in Amsterdam ([AMS] in Fig. 1) in connection to WP1, and Z. Christoff in Groningen ([GRO] in Fig. 1) to begin the work on WP2. In the second half of Year 2, **NG** will finish writing up the results of WP1, and **CSK** will continue on WP2 by visiting H. Leitgeb in Munich ([MUN] in Fig. 1). In the first part of Year 3, A. Garcez ([AG] in Fig. 1) will visit DTU. The main visits will be ca. 2 weeks long. However, the team will remain in constant electronic contact. In the final months, all project members will convene at DTU for an international workshop to discuss results and plan next steps.
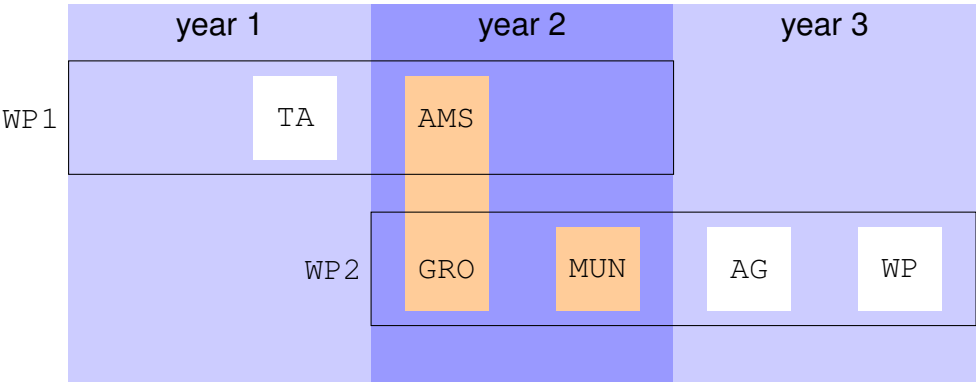

Figure 1: The timeline of CLariDy: white items signify the visits of external collaborators to Denmark, while orange items stand for the team visits abroad. WP stands for the workshop.

IMPACT. This project will build a new bridge between symbolic and sub-symbolic representations of agency in Artificial Intelligence by studying neural network learning through two strong rule-based approaches: Knowledge Representation and Logical Verification. This work is likely to open new avenues for explainability, interpretability and fairness in AI. It may also lead to predictions for cognitive science, as neural network learning is highly relevant to studies of the human brain.

5

References

[1] Josh Achiam, Steven Adler, Sandhini Agarwal, Lama Ahmad, Ilge Akkaya, Florencia Leoni Aleman, Diogo Almeida, Janko Altenschmidt, Sam Altman, Shyamal Anadkat, et al. GPT-4 technical report. *arXiv:2303.08774*, 2023.

[2] Carlos E. Alchourrón, Peter Gärdenfors, and David Makinson. On the logic of theory change: Partial meet contraction and revision functions. *The Journal of Symbolic Logic*, 50(2):510–530, 1985.

[3] Theofanis Aravanis. Towards machine learning as AGM-style belief change. *International Journal of Approximate Reasoning*, 183:109437, 2025.

[4] Guillaume Aucher and Thomas Bolander. Undecidability in epistemic planning. In *Proceedings of IJ-CAI'13*, 2013.

[5] Sebastian Bader and Pascal Hitzler. Dimensions of neural-symbolic integration - A structured survey. *arXiv: cs/0511042*, 2005.

[6] Samy Badreddine, Artur d'Avila Garcez, Luciano Serafini, and Michael Spranger. Logic Tensor Networks. *Artificial Intelligence*, 303:103649, 2022.

[7] Abhista Partal Balasubramaniam and Nina Gierasimczuk. Logical explanations for neural networks assisted by neuroevolution. In *Proceedings of 14th Tbilisi Symposium on Logic, Language and Computation (TbiLLC'23), Telavi, Georgia, Sept 18-22, 2023*, 2023.

[8] Alexandru Baltag, Zoé Christoff, Rasmus K. Rendsvig, and Sonja Smets. Dynamic epistemic logics of diffusion and prediction in social networks. *Studia Logica*, 107(3):489–531, 2019.

[9] Alexandru Baltag, Nina Gierasimczuk, Aybüke Özgün, Ana Lucia Vargas Sandoval, and Sonja Smets. A dynamic logic for learning theory. *Journal of Logical and Algebraic Methods in Programming*, 109:100485, 2019.

[10] Alexandru Baltag, Nina Gierasimczuk, and Sonja Smets. Belief revision as a truth-tracking process. In K. Apt, editor, *TARK'11: Proceedings of the 13th Conference on Theoretical Aspects of Rationality and Knowledge, Groningen, The Netherlands, July 12-14, 2011*, pages 187–190. ACM, New York, NY, USA, 2011.

[11] Alexandru Baltag, Nina Gierasimczuk, and Sonja Smets. Truth-tracking by belief revision. *Studia Logica*, 107(5):917–947, 2019.

[12] Alexandru Baltag, Dazhu Li, and Mina Young Pedersen. On the right path: A modal logic for supervised learning. In Patrick Blackburn, Emiliano Lorini, and Meiyun Guo, editors, *Logic, Rationality, and Interaction*, pages 1–14. Springer Berlin Heidelberg, 2019.

[13] Alexandru Baltag and Sonja Smets. The logic of quantum programs. In P. Selinger, editor, *Proceedings of the 2nd International Workshop on Quantum Programming Languages (QPL2004)*, volume 33 of *TUCS General Publication*, pages 39–56. Turku Center for Computer Science, June 2004.

[14] Tarek R. Besold, Artur d'Avila Garcez, Sebastian Bader, Howard Bowman, Pedro Domingos, Pascal Hitzler, Kai-Uwe Kühnberger, Luis C. Lamb, de Penning Leo Lima, Priscila Machado Vieira, et al. Neural-symbolic learning and reasoning: A survey and interpretation. In *Neuro-Symbolic Artificial Intelligence: The State of the Art*, pages 1–51. IOS press, 2021.

[15] Patrick Blackburn, Maarten De Rijke, and Yde Venema. *Modal Logic*. Number 53 in Cambridge Tracts in Theoretical Computer Science. Cambridge University Press, Cambridge, MA, USA, 2001.

[16] Arthur E. Bryson. A gradient method for optimizing multi-stage allocation processes. In *Proc. of a Harvard Symposium on Digital Computers and Their Applications*, 1962.

[17] Rodney Matineau Burstall. Program proving as hand simulation with a little induction. *Information Processing*, 74:308–312, 1974.

[18] Zoé Christoff and Jens Ulrik Hansen. A logic for diffusion in social networks. *Journal of Applied Logic*, 13(1):48–77, 2015.

[19] Gabriele Ciravegna, Pietro Barbiero, Francesco Giannini, Marco Gori, Pietro Lió, Marco Maggini, and Stefano Melacci. Logic explained networks. *Artificial Intelligence*, 314:103822, 2023.

[20] Mukesh Dalal. Investigations into a theory of knowledge base revision: preliminary report. In *Proceedings of the Seventh AAAI National Conference on Artificial Intelligence*, AAAI'88, pages 475–479. AAAI Press, 1988.

[21] Cédric Dégremont and Nina Gierasimczuk. Finite identification from the viewpoint of epistemic update. *Information and Computation*, 209(3):383–396, 2011.

[22] Hans van Ditmarsch, Wiebe Van der Hoek, and Barteld Kooi. *Dynamic Epistemic Logic*. Springer, The Netherlands, 2007.

[23] Stuart Dreyfus. The numerical solution of variational problems. *Journal of Mathematical Analysis and Applications*, 5(1):30–45, 1962.

[24] Abhimanyu Dubey, Abhinav Jauhri, Abhinav Pandey, Abhishek Kadian, Ahmad Al-Dahle, Aiesha Letman, Akhil Mathur, Alan Schelten, Amy Yang, Angela Fan, et al. The Llama 3 herd of models. *arXiv:2407.21783*, 2024.

[25] Robert W. Floyd. Assigning meanings to programs. *Proceedings of Symposium on Applied Mathematics*, 19:19–32, 1967.

[26] Isabel O. Gallegos, Ryan A. Rossi, Joe Barrow, Md Mehrab Tanjim, Sungchul Kim, Franck Dernoncourt, Tong Yu, Ruiyi Zhang, and Nesreen K. Ahmed. Bias and fairness in Large Language Models: A survey. *Computational Linguistics*, pages 1–79, 2024.

[27] Artur D'Avila Garcez, Luis C. Lamb, and Dov M. Gabbay. *Neural-symbolic cognitive reasoning*. Springer Science & Business Media, 2008.

[28] Atticus Geiger, Zhengxuan Wu, Christopher Potts, Thomas Icard, and Noah Goodman. Finding alignments between interpretable causal variables and distributed neural representations. In *Causal Learning and Reasoning*, pages 160–187. PMLR, 2024.

[29] Nina Gierasimczuk. *Knowing One's Limits. Logical Analysis of Inductive Inference*. PhD thesis, Universiteit van Amsterdam, The Netherlands, 2010.

[30] Nina Gierasimczuk, Lena Kurzen, and Fernando R. Velázquez-Quesada. Learning and teaching as a game: A sabotage approach. In Xiangdong He, John F. Horty, and Eric Pacuit, editors, *LORI'09: Proceedings of 2nd International Workshop on Logic, Rationality, and Interaction, Chongqing, China, October 8-11, 2009*, volume 5834 of *Lecture Notes in Computer Science*, pages 119–132. Springer, The Netherlands, 2009.

[31] C. A. R. Hoare. An axiomatic basis for computer programming. *Commun. ACM*, 12(10):576–580, oct 1969.

[32] Hirofumi Katsuno and Alberto O. Mendelzon. Propositional knowledge base revision and minimal change. *Artificial Intelligence*, 52(3):263–294, 1991.

[33] Henry Kautz. The third AI summer: AAAI Robert S. Engelmore Memorial Lecture. *AI Magazine*, 43(1):105–125, 2022.

[34] Henry J. Kelley. Gradient theory of optimal flight paths. *ARS Journal*, 30(10):947–954, 1960.

[35] Caleb Kisby, Saúl Blanco, and Lawrence S. Moss. The logic of Hebbian learning. In Roman Barták, Fazel Keshtkar, and Michael Franklin, editors, *Proceedings of the Thirty-Fifth International Florida Artificial Intelligence Research Society Conference, FLAIRS 2022, Hutchinson Island, Jensen Beach, Florida, USA, May 15-18, 2022*, 2022.

[36] Caleb Schultz Kisby, Saúl Blanco, and Lawrence S. Moss. What do Hebbian learners learn? Reduction axioms for iterated Hebbian learning. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 38, pages 14894–14901, 2024.

[37] Hannes Leitgeb. Nonmonotonic reasoning by inhibition nets. *Artificial Intelligence*, 128(1-2):161–201, 2001.

[38] Hannes Leitgeb. Nonmonotonic reasoning by inhibition nets II. *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, 11(supp02):105–135, 2003.

[39] Hannes Leitgeb. Neural network models of conditionals. *Introduction to formal philosophy*, pages 147–176, 2018.

[40] Robin Manhaeve, Sebastijan Dumančić, Angelika Kimmig, Thomas Demeester, and Luc De Raedt. Neural probabilistic logic programming in deepproblog. *Artificial Intelligence*, 298:103504, 2021.

[41] Drew McDermott. A critique of pure reason. *Computational intelligence*, 3(3):151–160, 1987.

[42] Cathy O'Neil. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Crown Publishing Group, USA, 2016.

[43] Vaughan R. Pratt. Dynamic logic. In L. Jonathan Cohen, Jerzy Łoś, Helmut Pfeiffer, and Klaus-Peter Podewski, editors, *Logic, Methodology and Philosophy of Science VI*, volume 104 of *Studies in Logic and the Foundations of Mathematics*, pages 251–261. Elsevier, 1982.

[44] John C. Reynolds. Separation logic: A logic for shared mutable data structures. In *Proceedings of the

17th Annual IEEE Symposium on Logic in Computer Science, LICS '02, pages 55–74, USA, 2002. IEEE Computer Society.

[45] David E. Rumelhart, Geoffrey E. Hinton, and Ronald J. Williams. Learning representations by back-propagating errors. *Nature*, 323:533–536, 1986.

[46] Md Kamruzzaman Sarker, Lu Zhou, Aaron Eberhart, and Pascal Hitzler. Neuro-symbolic artificial intelligence: Current trends. *AI Communications*, 34(3):197–209, 2021.

[47] Murray Shanahan. The frame problem. In Edward N. Zalta, editor, *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, Spring 2016 edition, 2016.

[48] David Silver, Julian Schrittwieser, Karen Simonyan, Ioannis Antonoglou, Aja Huang, Arthur Guez, Thomas Hubert, Lucas Baker, Matthew Lai, Adrian Bolton, et al. Mastering the game of Go without human knowledge. *Nature*, 550(7676):354–359, 2017.

[49] Alex Tamkin, Miles Brundage, Jack Clark, and Deep Ganguli. Understanding the capabilities, limitations, and societal impact of Large Language Models. *arXiv preprint arXiv:2102.02503*, 2021.

[50] Johan van Benthem. Dynamic logic for belief revision. *Journal of Applied Non-Classical Logics*, 17(2):129–155, 2007.

[51] Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Lukasz Kaiser, and Illia Polosukhin. Attention is all you need. *CoRR*, abs/1706.03762, 2017.

[52] Xiaohui Xie and H. Sebastian Seung. Equivalence of backpropagation and contrastive Hebbian learning in a layered network. *Neural Computation*, 15(2):441–454, 02 2003.

Budget overview

The budget figures are collected from the uploaded spreadsheet file

	DFF-financing	Co-financing	Other sources
Applicant			
Scientific/academic staff excluding postdocs and PhD students			
Postdoc(s)	1.801.337		
PhD-student(s)			
Total scientific/academic	1.801.337		
Technical/administrative staff			
Equipment expenses			
Operating expenses	395.000		
Other expenses			
Total - excl. overhead	2.196.337		
Overheads	966.389	*n/a*	*n/a*
Total (DKK)	**3.162.726**		

	Total (DKK)
	1.801.337
	1.801.337
	395.000
	2.196.337
	966.389
	3.162.726

Participants

The budget figures are collected from the uploaded spreadsheet file

Type	Institution	Position and Name	Total number of months on the project	DFF financing	Co-financing and external financing (DKK)	Total amount excl. Overheads (DKK)	Description (tasks and salary expenses, max. 300 characters)
Applicant	Technical University of Denmark	Associate Professor, Nina Gierasimczuk	36				
Postdoc	Technical University of Denmark	Postdoc, Caleb Schultz-Kisby	36	1.801.337		1.801.337	
Other scientific/academic staff (VIP)	University of Peloponnese	Assistant Professor, Theofanis Aravanis	24				
Other scientific/academic staff (VIP)	University of Amsterdam	Associate Professor, Alexandru Baltag	24				
Other scientific/academic staff (VIP)	Roskilde University	Professor, Patrick Blackburn	24				
Other scientific/academic staff (VIP)	University of Groningen	Associate Professor, Zoé Christoff	24				
Other scientific/academic staff (VIP)	University of London	Professor, Artur d'Avila Garcez	24				
Other scientific/academic staff (VIP)	Ludwig Maximilian University of Munich	Professor, Hannes Leitgeb	24				
Other scientific/academic staff (VIP)	University of Amsterdam	Professor, Sonja Smets	24				
			240	DKK 1.801.337		DKK 1.801.337	

Expenses excl. payroll costs - details

Expense type	Institution	DFF financing (excl. overheads)	Co-financing and external financing	Total (excl. overheads)	Description, max. 300 characters
Operating expenses	Technical University of Denmark	20.000	-	20.000	Visit(s) of T. Aravanis to Denmark (flight from Greece and accommodation). At least one 1 week-long visit.
Operating expenses	Technical University of Denmark	20.000	-	20.000	Visit(s) of A. D'Avila Garcez to Denmark (flight from the UK and accommodation). At least one 1 week-long visit.
Operating expenses	Technical University of Denmark	125.000	-	125.000	International Workshop organization in Denmark (3 days long). All collaborators visit DK (flights and accommodation). Venue costs. DTU Event team will help with the organization.
Operating expenses	Technical University of Denmark	20.000	-	20.000	Travel budget for P. Blackburn, to participate in the events and visits (to present the results of the collaboration).
Operating expenses	Technical University of Denmark	150.000	-	150.000	Travel budget (conference participation and reserahc visits to the project members) for Nina Gierasimczuk (PI) and Caleb Schultz-Kisby (postdoc); 25k DKK per year per person.
Operating expenses	Technical University of Denmark	40.000	-	40.000	Visit(s) of N. Gierasimczuk and C. Schultz-Kisby to the Nethelands (Amsterdam and Groningen). Flights and accommodation. At least one 1 week-long visit.
Operating expenses	Technical University of Denmark	20.000	-	20.000	Visit(s) of C. Schultz Kisby to Munich (flight and accommodation). At least one 1 week-long visit.
			-		
			-		
			-		
Total		**DKK 395.000**		**DKK 395.000**	

NINA GIERASIMCZUK

Researcher unique identifiers: ORCID: 0000-0001-5081-4676, Research ID: B-9777-2012

SHORT CURRICULUM VITAE

EDUCATION

Dec 17th, 2010   PhD Degree in Computer Science
Institute for Logic, Language and Computation, University of Amsterdam

Jun 24th, 2005   Master Degree in Logic
Institute of Philosophy, University of Warsaw

EMPLOYMENT

2018 – now   Associate Professor
Department of Applied Mathematics and Computer Science, Technical University of Denmark

2016 – 2018   Assistant Professor
Department of Applied Mathematics and Computer Science, Technical University of Denmark

SCIENTIFIC FOCUS AREAS

dynamic logic, modal logic, computational learning theory, mathematical and computational logic, cognitive science of reasoning, multi-agent learning, action modelling and learning

ACADEMIC AWARDS AND GRANTS

2021 – 2024   DTU Compute grant for a PhD Student (DKK 1,5M):
'Logical Approaches to Dynamic Structures in AI'

2016 – 2020   Polish National Science Centre (NCN) OPUS Grant 2016 (PI, $\sim$DKK 1M):
'Social models of semantics learning. Acquisition and Evolution of Quantifier Meaning'

2014 – 2017   Dutch Research Council (NWO) VENI Grant (PI, $\sim$DKK 2M):
'Learning from each other. Formal analysis of multi-agent learning'

2009 – 2010   Foundation for Polish Science Award for Young Researchers ($\sim$DKK 90K, twice)

MANAGEMENT EXPERIENCE

– PI of a group consisting of 2 post-docs, 1 research assistant and 1 senior member (NCN OPUS Grant 2016-2020)
– Treasurer of the Association for Logic, Language and Information (under its auspices are: European Summer School in Logic, Language and Information; North American Summer School in Logic, Language and Information and E. W. Beth Dissertation Prize in Logic)
– Managing of a large university course *Introduction to AI* (300 students, 9 Teaching Assistants)
– PC co-chairing of scientific events: Non-monotonic Reasoning Workshop (NMR'24), Nordic Summer School in Logic (NSL'24), Dalí Workshop (2023), and organisation of over 16 academic events in Denmark, The Netherlands, and Poland

SUPERVISION

COMPLETED: 3 PhD students: A.H. From (co-supervised with J. Villadsen), A. Occhipinti Liberman (with T. Bolander), D. Kalociński (with M. Mostowski), 2 Postdocs, 21 MSc, 17 BSc

ONGOING: 1 PhD student, 4 MSc students

INTERNATIONAL RELATIONS

- International Relations Officer of the Board of the Scandinavian Logic Society (SLS)
- Member of the Board of The Association for Logic, Language and Information (FoLLI)
- Research visit at the Department of AI, University of Groningen (NL), 2022
- Visiting Scholar, Institute for Logic, Language and Computation, University of Amsterdam, 2021
- Dagstuhl Seminars (DE): *Logic and Learning* 2019 and *Epistemic Planning* 2017

- Lorentz Center Workshops (NL): *Explainable AI: Ethics, Epistemology, and Formal Methods* 2021; *Dynamics of Multi-Agent Systems* 2018; *Models of Bounded Reasoning in Individuals and Groups* 2018; *The Invention of Lying: Language, Logic, and Cognition* 2017
- Selected research visits: The Center for the Study of Language and Information, Stanford University (USA); Carnegie Mellon University, Pittsburgh (USA); Artificial Intelligence, Radboud University Nijmegen (NL); Institut de Recherche en Informatique de Toulouse (FR)

INVITED LECTURES

84 invited lectures at International Academic Conferences, including Keynote Lectures at: Advanced in Modal Logic (AiML), Computer Science Logic Conference (CSL), Workshop on Logic, Language, Information and Computation (WoLLIC), The Meeting of the Association for Symbolic Logic North America (ASL), Dagstuhl Seminars and Lorentz Center Workshops

COMMITTEES AND EDITORSHIPS

2024 –   Associate Editor at Annals of Mathematics and Artificial Intelligence

2024 –   Associate Editor at Nordic Machine Intelligence

2024 –   Steering committee of International Workshop on Non-Monotonic Reasoning (NMR)

2023 –   Associate Editor at the Journal of Logic, Language and Information

2023 –   Editorial Board of Fundamenta Informaticae

2021 –   Steering committee of DaLí Workshop Dynamic Logic: New Trends and Applications

2017 – 2019   Committee member, E. W. Beth Dissertation Prize in Logic

Special Issue editor in the Journal of Logic, Language and Information and Fundamenta Informaticae

PC member of over 43 international conferences: European Conference on AI (2025); International Conference on Principles of Knowledge Representation and Reasoning (2024); Computer Science Logic Conference (2024); Advances in Modal Logic (2018, 2024); AAAI Conference on Artificial Intelligence (2021); International Conference on Autonomous Agents and Multiagent Systems (2018, 2019); International Joint Conference on Artificial Intelligence (2016, 2018, 2021); Theoretical Aspects of Rationality and Knowledge (2015-17, 2023-25); Workshop on Logic, Language, Information and Computation (2016, 2020-23)

Reviewing for journals: Theoretical Computer Science; Journal of Artificial Intelligence Research; Review of Symbolic Logic; Studia Logica; Journal of Logic, Language and Information; Synthese

TEACHING

2020 Teaching Qualification Certificate: Education in University Teaching at DTU (UDTU)

Regular courses at DTU Master and Bachelor in CS and Engineering, and Bachelor in Software Technology: Introduction to AI (since 2018, 5ECTS, 300 students); Logical Theories for Uncertainty and Learning (since 2016, 5ECTS, 80 students); Software Technology (since 2022, 10ECTS, 80 students)

Specialisation courses at DTU (5ECTS): Meta's Cicero and DeepMind's Negotiation Algorithms (2025); Introduction to active inference in AI (2024); Dependence Logic (2022), Logic and Neural Networks (2022), Algebraic and Topological Semantics of Modal Logic (2022), Modal Logic (2021), Belief Revision (2021)

Courses at summer schools: Nordic Spring School in Logic (NSSL'13,'22); Summer School on Foundations of Programming and Software Systems (FoPSS) at FLoC'18; North American Summer School in Logic, Language and Information (NASSLLI'14,'15,'25); European Summer School in Logic, Language and Information (ESSLLI'12,'13)

NINA GIERASIMCZUK

Google Scholar h-index: 18; citations: 679 (Apr 28th, 2025);
13 journal articles, 3 book chapters, 22 conference papers, 1 book review, 2 edited volumes

Selective list of relevant publications

Peer-reviewed journal articles (alphabetical order of authors; equal contributions)

[1] **Nina Gierasimczuk**, Dariusz Kalociński, Franciszek Rakowski, and Jakub Uszyński. Convexity and monotonicity in language coordination: Simulating the emergence of semantic universals in populations of cognitive agents. *Journal of Logic, Language and Information*, pages 1–32, 2023.

[2] Alexandru Baltag, **Nina Gierasimczuk**, Aybüke Özgün, Ana Lucia Vargas Sandoval, and Sonja Smets. A dynamic logic for learning theory. *Journal of Logical and Algebraic Methods in Programming*, 109:100485, 2019.

[3] Alexandru Baltag, **Nina Gierasimczuk**, and Sonja Smets. Truth-tracking by belief revision. *Studia Logica*, 107(5):917–947, 2019.

[4] Thomas Bolander and **Nina Gierasimczuk**. Learning to act: qualitative learning of deterministic action models. *Journal of Logic and Computation*, 28(2):337–365, 2018.

[5] **Nina Gierasimczuk** and Dick de Jongh. On the complexity of conclusive update. *The Computer Journal*, 56(3):365–377, 2013.

[6] Cédric Dégremont and **Nina Gierasimczuk**. Finite identification from the viewpoint of epistemic update. *Information and Computation*, 209(3):383–396, 2011.

[7] **Nina Gierasimczuk**. Bridging learning theory and dynamic epistemic logic. *Synthese*, 169(2):371–384, 2009.

Peer-reviewed conference articles (alphabetical order except papers with students: 1, 2, 3, and 7; equal contributions)

[1] Abhista P. Balasubramaniam and **Nina Gierasimczuk**. Logical explanations for neural networks assisted by neuro-evolution. In *14th Tbilisi Symposium on Logic, Language and Computation (TbiLLC'23), Telavi, Georgia, Sept 18-22, 2023*, 2023.

[2] Panagiotis Papadamos and **Nina Gierasimczuk**. Cognitive bias and belief revision. In Rineke Verbrugge, editor, *Proceedings of the 19th Conference on Theoretical Aspects of Rationality and Knowledge, TARK'23, Oxford, United Kingdom, Jun 28-30, 2023*, volume 379 of *EPTCS*, pages 441–454, 2023.

[3] Katrine Bjørn Pedersen Thoft and **Nina Gierasimczuk**. Learning by intervention in simple causal domains. In *DaLí'23: Dynamic Logic. New trends and applications, Tbilisi, Georgia, Sept 15-16, 2023*, pages 8–22, 2023.

[4] Alexandru Baltag, **Nina Gierasimczuk**, Aybüke Özgün, Ana Lucia Vargas Sandoval, and Sonja Smets. A dynamic logic for learning theory. In *DaLí'17: Dynamic Logic. New Trends and Applications, Brasilia, Brazil, Sept 23-24, 2017*, pages 35–54. Springer, 2018.

[5] Alexandru Baltag, **Nina Gierasimczuk**, and Sonja Smets. On the solvability of inductive problems: A study in epistemic topology. In R. Ramanujam, editor, *Proceedings Fifteenth Conference on Theoretical Aspects of Rationality and Knowledge, TARK'15, Carnegie Mellon University, Pittsburgh, USA, Jun 4-6, 2015*, volume 215 of *EPTCS*, pages 81–98, 2015.

[6] Thomas Bolander and **Nina Gierasimczuk**. Learning actions models: Qualitative approach. In Wiebe van der Hoek, Wesley H. Holliday, and Wen-Fang Wang, editors, *Logic, Rationality, and Interaction - 5th International Workshop, LORI'15 Taipei, Taiwan, Oct 28-31, 2015, Proceedings*, volume 9394 of *Lecture Notes in Computer Science*, pages 40–52. Springer, 2015.

[7] Sanne Kosterman and **Nina Gierasimczuk**. Collective learning in games through social networks. In *Proceedings of the International Workshop on Social Influence Analysis (SocInf 2015) at IJCAI 2015, Buenos Aires, Argentina, Jul 27th, 2015*, pages 35–41, 2015.

[8] Alexandru Baltag, **Nina Gierasimczuk**, and Sonja Smets. Belief revision as a truth-tracking process. In K. Apt, editor, *TARK'11: Proceedings of the 13th Conference on Theoretical Aspects of Rationality and Knowledge, Groningen, The Netherlands, Jul 12-14, 2011*, pages 187–190. ACM, New York, NY, USA, 2011.

[9] **Nina Gierasimczuk** and Jakub Szymanik. Invariance properties of quantifiers and multiagent information exchange. In Makoto Kanazawa, András Kornai, Marcus Kracht, and Hiroyuki Seki, editors, *The Mathematics of Language - 12th Biennial Conference, MOL 12, Nara, Japan, Sept 6-8, 2011*, volume 6878 of *Lecture Notes in Computer Science*, pages 72–89. Springer, 2011.

[10] Cédric Dégremont and **Nina Gierasimczuk**. Can doxastic agents learn? On the temporal structure of learning. In *Logic, Rationality, and Interaction: Second International Workshop, LORI'09, Chongqing, China, Oct 8-11, 2009*, pages 90–104. Springer Berlin Heidelberg, 2009.

[11] **Nina Gierasimczuk**. Identification through inductive verification. application to monotone quantifiers. In *TBiLLC'07: 7th International Tbilisi Symposium on Logic, Language, and Computation. Revised Selected Papers*, volume 5422 of *Lecture Notes in Computer Science*, pages 193–205, Berlin, Heidelberg, 2009. Springer-Verlag.

[12] **Nina Gierasimczuk**. Learning by erasing in dynamic epistemic logic. In Adrian Horia Dediu, Armand Mihai Ionescu, and Carlos Martin-Vide, editors, *LATA'09: Proceedings of 3rd International Conference on Language and Automata Theory and Applications, Tarragona, Spain, Apr 2-8, 2009*, volume 5457 of *Lecture Notes in Computer Science*, pages 362–373. Springer, The Netherlands, 2009.

[13] **Nina Gierasimczuk**, Lena Kurzen, and Fernando R Velázquez-Quesada. Learning and teaching as a game: A sabotage approach. In *Logic, Rationality, and Interaction: Second International Workshop, LORI 2009, Chongqing, China, Oct 8-11, 2009*, pages 119–132. Springer Berlin Heidelberg, 2009.

PEER-REVIEWED BOOK CHAPTERS (alphabetical order of authors; equal contributions)

[1] Thomas Bolander, **Nina Gierasimczuk**, and Andrés Occhipinti Liberman. Learning to act and observe in partially observable domains. In Nick Bezhanishvili, Rosalie Iemhoff, and Fan Yang, editors, *Outstanding Contributions to Logic: Dick de Jongh on intuitionistic and provability logics*, 35 pages, Springer, 2023 (to appear, arXiv preprint: arXiv:2109.06076).

[2] **Nina Gierasimczuk**, Dick de Jongh, and Vincent F. Hendricks. Logic and learning. In Alexandru Baltag and Sonja Smets, editors, *Outstanding Contributions to Logic: Johan van Benthem on Logical and Informational Dynamics*, pages 267–288, Springer, 2014.

[3] **Nina Gierasimczuk** and Dick de Jongh. On the minimality of definite tell-tale sets in finite identification of languages. In Davide Grossi, Lena Kurzen, and Fernando R. Velázquez-Quesada, editors, *2009 Yearbook of Logic and Interactive Rationality (LIRA) Seminar*, pages 21–33, ILLC, Amsterdam, 2010.

INVITED NON-PEER-REVIEWED ARTICLES (single authorship)

[1] **Nina Gierasimczuk**. Inductive inference and epistemic modal logic. In Bartek Klin and Elaine Pimentel, editors, *31st EACSL Annual Conference on Computer Science Logic, CSL'23, Warsaw, Poland, Feb 13-16, 2023*, volume 252 of *LIPIcs*, pages 2:1–2:16. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 2023.

[2] **Nina Gierasimczuk**. Learning and modal logic: There and back again. In Nicola Olivetti, Rineke Verbrugge, Sara Negri, and Gabriel Sandu, editors, *13th Conference on Advances in Modal Logic, AiML 2020, Helsinki, Finland, Aug 24-28, 2020*, page 9. College Publications, 2020.

[3] **Nina Gierasimczuk**. Book review: Neil Tennant, Changes of Mind: An essay on rational belief revision. *Studia Logica*, 103:227–231, 2015.

PEER-REVIEWED EDITED VOLUMES

[1] **Nina Gierasimczuk** and Jesse Heyninck, editors. *Proceedings of the 22nd International Workshop on Nonmonotonic Reasoning (NMR 2024) co-located with 21st International Conference on Principles of Knowledge Representation and Reasoning (KR 2024), Hanoi, Vietnam, November 2-4, 2024*, volume 3835 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2024.

[2] **Nina Gierasimczuk** and Fernando R. Velázquez-Quesada, editors. *Dynamic Logic. New Trends and Applications - 5th International Workshop, DaLí 2023, Tbilisi, Georgia, September 15-16, 2023, Revised Selected Papers*, volume 14401 of *Lecture Notes in Computer Science*. Springer, 2024.

Curriculum Vitae of Alexandru Baltag   **(**sites.google.com/site/thealexandrubaltagsite/**)**

Alexandru Baltag is an Associate Professor in the Institute for Logic, Language and Computation at the University of Amsterdam since 2011. His research agenda is centered around formal logic and covers the design of logical systems used for the logic-philosophical analysis of communication, the flow of information, knowledge update and belief upgrade in multi-agent settings. One of his main contributions is the development of the concept of 'epistemic program', together with a specific mechanism for information updating in multi-agent systems: the so-called 'product update'. This has formed the basis of a series of ground-braking papers, starting with his 1998-paper in the 7th Conference on Theoretical Aspects of Rationality and Knowledge, which is now widely considered as one of the seminal papers that inaugurated the fast-growing area known as Dynamic Epistemic Logic (DEL). He has developed this work further, including its connections to Belief Revision Theory, Game Theory, Formal Learning Theory, Quantum Theory and Epistemology. For his co-authored work on "The Topology of Surprise", he received the Reiter Best Paper Award at the main Knowledge Representation conference, KR, in 2022.

Alexandru Baltag is currently the leader of the Amsterdam Dynamics Group which hosts 4 professors, 4 PhD students and several visiting researchers. He is currently a member of the steering group of the Dutch Institute for Emergent Phenomena, representing the institute for Logic, Language and Computation in an interdisciplinary collaboration in the Netherlands. Between 2001 and 2011 he was a University Lecturer at Oxford University, in the Department of Computer Science. He received his PhD in Mathematics in 1998 at Indiana University under the supervision of the logician Jon Barwise. His PhD studies were supported by a Fullbright fellowship awarded by the Fulbright Foundation and a Swayn Fellowship for Academic Excellence awarded by Indiana University. Between 1998 and 2001, he was a post-doctoral researcher at the Dutch Center for Mathematics and Computer Science. He was awarded with a 3-year fellowship of the Tsinghua-Amsterdam Joint Research Centre for Logic and he was the main Project Leader of a China-Exchange Grant of the Netherlands Royal Academy. He has been the main Project Leader of the Marie Curie Grant WADOXA that employed one post-doctoral researcher at the University of Amsterdam and he has been the Regional Coordinator (for the Netherlands) of the MESHS 'Grant PROBATIVUS' 2014 in collaboration with Lille University, France. He was co-PI in 2022-2023 of a Seed Funding project on `Responsible Artificial Agency: A Logical Perspective', funded by the research priority area Humane AI of the University of Amsterdam.

He has been involved in the supervision of nine PhD students (of which one is on-going), several post-doctoral researchers and he attracted many visiting PhD students. He co-authored research papers with different international scholars, including with over 20 PhD students (both local and international students).

Selected List of Publications:

1) A. Baltag and S. Smets, Logics for Data Exchange and Communication, in A. Ciabattoni, D. Gabelaia and I. Sedlár, *Advances in Modal Logi*c, Vol. 15, College Publication, pp.147-169, 2024.

2) A. Baltag and S. Smets, Logic meets Wigner's Friend (and their Friends) in *International Journal of Theoretical Physics*, vol 63(4), number 97, 2024.

3) A Baltag, N Bezhanishvili, D Fernández-Duque The topological mu-calculus: completeness and decidability, *Journal of the ACM*, Volume 70, Issue 5 Article No.: 33, Pages 1 – 38, 2023.

4) A Baltag, J van Benthem, D Westerståhl, Compositionality in Context In *Outstanding Contributions to Logic* (volume 25), Samson Abramsky on Logic and Structure in Computer Science and Beyond, 773-812, Springer, 2023.

5) A Baltag, LS Moss, S Solecki, Logics for epistemic actions: completeness, decidability, expressivity, *Logics* , 1(2), 97-147, 2023

6) A Baltag, A Özgün, ALV Sandoval, Arbitrary public announcement logic with memory , *Journal of Philosophical Logic* 52 (1), 53-110, 2023.

7) A Baltag, N Bezhanishvili, A Özgün, S Smets, Justified belief, knowledge, and the topology of evidence, *Synthese* 200 (6), 512, 2022.

8) A Baltag, N Bezhanishvili, D Fernández-Duque, The topology of surprise, in G. Kern-Isberner, G. Lakemeyer, T. Meyer (eds), *Proceedings of the 19th International Conference on Principles of Knowledge Representation and Reasoning* (KR). Series KR, 2334-1033, pp.33-42, 2022. KR Ray Reiter Best Paper Award 2022.

9) A Baltag, D Li, MY Pedersen, A modal logic for supervised learning, *Journal of Logic, Language and Information* 31 (2), 213-234, 2022.

10) A. Baltag and J. van Benthem, A Simple logic of functional dependence, in *Journal of Philosophical logic*, Volume 50, pages 939–1005, 2021.

11) A. Baltag and S. Smets, Learning what Others Know, in L. Kovacs and E. Albert (eds.), LPAR23 proceedings, *EPiC Series in Computing*, 2020.

12) A. Baltag, N. Bezhanishvili, A. Ozgun, S. Smets. A Topological Approach to Full Belief. *Journal of Philosophical Logic*, 48(2), pp.205-244, 2019.

13) A. Baltag, Z. Christoff, R. Rendsvig, S. Smets. Dynamic Epistemic Logics of Diffusion and Prediction in Social Networks, *Studia Logica*, 107, pp. 489–531, 2019.

14) A. Baltag, N. Gierasimczuk and S. Smets, Truth-tracking by belief revision. *Studia Logica*, 107, pp. 917–947, 2019.

15) A. Baltag, N. Bezhanishvili, SF Gonzalez, The McKinsey-Tarski theorem for topological evidence logics, WOLLIC proceedings, pp. 177-194, *Lecture Notes in Computer Science (LNCS)*, 11541, 2019.

16) A. Baltag, N. Gierasimczuk, A. Ozgun, A. V. Sandoval, S. Smets. A Dynamic Logic for Learning Theory. In *Journal of Logical and Algebraic Methods in Programming, vol. 109, 100485,* 2019.

17) A. Baltag, N. Gierasimczuk, A. Özgün, A. V. Sandoval and S. Smets, A Dynamic Logic for Learning Theory, Proceedings of DALI Workshop*, Lecture Notes in Computer Science (LNCS),* vol. 10669*,* Springer 2018.

Short Curriculum Vitae - Patrick Blackburn

Education:
- *Habilitation*, Department of Computational Linguistics, University of the Saarland, Germany, 19th July 2000.
- *PhD*, Centre for Cognitive Science, University of Edinburgh, Scotland, 24th November 1990.
- *MSc*, Logic and Scientific Method, Sussex University, England, 28th January 1987.
- *BA*, Major: Philosophy, Minor: Mathematics, University of Waikato, New Zealand, 10th April 1981.

Current employment: Professor of Philosophy, Roskilde University, Denmark (since 2011)

Previous employment:
- *Research Director*, INRIA (French National Research Organization in Computer Science), Nancy, France. December 2000 – August 2011.

Honours:
- *Knight of the Order of Dannebrog*, Monarchy of Denmark, 2019.
- Member of *Academia Europaea*, 2014 - Present, Section for: Philosophy, Theology and Religious Studies.

Management experience:
- Co-PI (with Peter Øhrstrøm) of "The Primacy of Tense", DFF project, 2016-2021.
- Head of INRIA project *Talaris*, 2007-2011, Nancy, France, 15 researchers.

Scientific focus areas: Philosophical and Computational Logic · Semantics and Pragmatics of Natural Language · Cognitive and Social Dimensions of Reasoning.

International Relations:
- Academic visits and co-operation with scholars in Argentina, Spain, Portugal, France, New Zealand, Holland, China, Japan and elsewhere.
- President and founder of the *Association of Computational Linguistics Special Interest Group in Computational Semantics* (SIGSEM), November 1999 – 2007.
- Steering committee of the *Foundation for Logic, Language and Information* (FoLLI), 2002– 2010.

PhD Supervision:
- Marianne Træbing Secher, *Coping with Certain Non-Knowledge,* IKH, Roskilde University. Thesis due: January 2025.
- Julie Lundbak Kofod, *What on Earth was Arthur Prior Thinking: About Physics and Hybrid Logic?*, IKH, Roskilde University. 2022. (Co- supervisor: Torben Braüner).
- Irina Polyanskaya, *Second-Order False Beliefs Reasoning by Children with Autism: A Correlation and Training Study*, IMT, Roskilde University, Denmark. 2019. (Co-supervisor: Torben Braüner).
- Luciana Benotti, *Implicature as an Interactive Process*, Department of Computer Science, University Henri Poincaré, Nancy, France, 2010.

- Guillaume Hoffman, *Model Building for Natural Language Processing*, Department of Computer Science, University Henri Poincaré, Nancy, France, 2010. (Co-supervisor: Carlos Areces).
- Dmitry Sustretov, *Topological Semantics for Hybrid Logic*, Department of Computer Science, University Henri Poincaré, Nancy, France, 2010.
- Sergio Mera, *Modal Memory Logics*, Department of Computer Science, University Henri Poincaré, Nancy, France and Department of Computer Science, University of Buenos Aires, Argentina, 2009. (Co-superviser: Carlos Areces).
- Daniel Gorin, *Resolution for Hybrid Logic*, Department of Computer Science, University Henri Poincaré, Nancy, France and Department of Computer Science, University of Buenos Aires, Argentina, 2009. (Co- supervisor: Carlos Areces).
- Sébastien Hinderer, *Automatisation de la construction sémantique dans le lambda-calul simplement typé avec plusieurs types de base* (Automating Semantic Construction in Simple Multi-Sorted Type Theory), Department of Computer Science, University Henri Poincaré, Nancy, France, 2008.
- Balder ten Cate, *Model Theory for Extended Modal Languages*, Department of Philosophy, University of Amsterdam, The Netherlands, 2005. Winner of the 2006 Ackermann Best Thesis Award (awarded by EACSL, the European Association for Theoretical Computer Science). (Co-supervisor: Johan van Benthem).
- Johan Bos, *Underspecification and Resolution in Discourse Semantics*, Department of Computational Linguistics, University of the Saarland, Germany, 2001. (Co-supervisor: Manfred Pinkal).

Impact: Citations 11409, h-index 36, i10-index 70 (Google Scholar, 6th October 2023)

Selected Publications:
"Hybrid Partial Type Theory", Manzano, Huertas, **Blackburn**, Martins, and Aranda, *The Journal of Symbolic Logic*, published online 29th March, 2023, pp. 1-43.

"An Axiom System for Hybrid Logic with Propositional Quantifiers", **Blackburn**, Braüner, and Kofod, *Proceedings of the 29th Workshop on Logic, Language, Information and Computation*, LNCS 13943, Springer, 2023, pp. 143-159.

"Ethics consideration sections in natural language processing papers", Benotti and **Blackburn**, *Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing*, 2022.

"Grounding as a collaborative process", Benotti and **Blackburn**, *Proceedings of the 16th Conference of the European Chapter of the Association for Computational Linguistics*, 2021.

Handbook of Modal Logic, edited by **Blackburn**, Van Benthem, and Wolter, Elsevier, 2006.

Modal Logic, **Blackburn**, De Rijke, and Venema, *Cambridge Tracts in Theoretical Computer Science (Vol. 53). Cambridge University Press*, 2001.

ZOÉ CHRISTOFF   (October 2024)

CONTACT

Bernoulli Institute for Mathematics, Computer Science & Artificial Intelligence, University of Groningen
Website: www.zoechristoff.com, *E-mail:* z.l.christoff@rug.nl

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AREAS OF EXPERTISE

Logics of social networks, dynamic epistemic logic, collective intelligence, social network analysis.

ACADEMIC EMPLOYMENT

Since 09/2020	**Assistant Professor in Cognitive Artificial Intelligence (tenured)** Department of Artificial Intelligence, University of Groningen
01/2017 – 08/2020	**Postdoctoral Researcher**, Department of Philosophy, University of Bayreuth
01/2016 - 12/2016	**Postdoctoral Researcher**, Department of Computer Science, University of Liverpool
05/2012 – 12/2015	**PhD Candidate in Logic**, Institute for Logic, Language and Computation , Amsterdam Thesis title: *Dynamic Logics of Networks. Information Flow and the Spread of Opinion.* Advisors: Johan van Benthem and Sonja Smets

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SELECTED GRANTS AND FELLOWSHIPS

Dutch Research Council (NWO) SSH VENI Grant 2020 (individual, EUR 250.000), awarded to the project "Social Networks and Democracy" (2021–2024).

Rosalind Franklin Fellowship 2020, tenure-track fellowship for international researchers co-funded by the European Union.

The Royal Netherlands Academy of Arts and Sciences (KNAW) China Exchange Program Travel grant (co–applicant, $\sim$ EUR 50.000, 2014–2016).

SELECTED INVITED TALKS

BrAIght Future Congress, Groningen (2024); Triennal International Conference of the Italian Society for Logic and Philosophy of Science (SILFS), Urbino (2023). LMAS-2023: 2nd International Workshop on Logics of Multi-Agent Systems, Chongqing (2023); ENCODE Workshop Logic and Deliberation, Rotterdam (2021); Conference on Deliberation, Belief Aggregation, and Epistemic Democracy (DBAED) II, Paris (2019); Social Models of Meaning Acquisition (SOMMA) Workshop, Warsaw (2019). Conference on Games, Networks and Social Epistemology, New York (2017).

SELECTED PROGRAM COMMITTEES

LOFT 2024/2022/2018,Conference on Logic and the Foundations of Game and Decision Theory; WOLLIC 2024, 30th Workshop on Logic, Language, Information and Computation; RADICAL 2023, Third International Workshop on Recent Advances in Concurrency and Logic; DaLi 2023/2019, Dynamic Logics - New Trends and Applications; IJCAI-ECAI 2023/2022/2018, IJCAI 2021, International Joint Conference on Artificial Intelligence; IJCAI-PRICAI 2020, 29th International Joint Conference on Artificial Intelligence and the 17th Pacific Rim International Conference on Artificial Intelligence; TARK 2023, XIXth Conference on the Theoretical Aspects of Knowledge and Rationality; TbiLLC 2023, 14th International Tbilisi Symposium on Language, Logic, and Computation; LORI-VI, 6th International Conference on Logic, Rationality and Interaction.

SELECTED PUBLICATIONS

Refereed journal papers:

Dynamic Logics of Diffusion and Link Changes, with Edoardo Baccini and Rineke Verbrugge, *Studia Logica*, online first: 17 July 2024.

The Wisdom of Small Crowds: Myside Bias and Group Discussion, with Edoardo Baccini, Stephan Hartmann and Rineke Verbrugge, Journal of Artificial Societies and Social Similations (JASSS), 26-4, October 2023.

Priority Merge and Intersection Modalities (with Norbert Gratzl and Olivier Roy), *Review of Symbolic Logic*, February 2021.

Dynamic Epistemic Logic of Diffusion and Prediction in Threshold Models (with Alexandru Baltag, Rasmus K. Rendsvig and Sonja Smets), *Studia Logica*, Volume 107, Issue 3, pp. 489–531, June 2019.

Social Network Diffusion with Recalcitrant Agents (with Pavel Naumov), *Journal of Logic and Computation (JLC)*, Volume 29, Issue 1, pp. 53–70, January 2019.

Reflecting on Social Influence in Networks (with Jens U. Hansen and Carlo Proietti), extended version, in E. Lorini, L. Perrussel, and R. Mühlenbernd (Eds.), Special Issue: Information Dynamics in Artificial Societies, *Journal of Logic, Language and Information (JOLLI)*, Volume 25: 3, pp.299–333, 2016.

A Logic for Diffusion in Social Networks (with Jens U. Hansen), *Journal of Applied Logic (JAL)*, Volume 13, Issue 1, pp. 48–77, March 2015.

Refereed conference papers:

On the Graph Theory of Majority Illusions, with Maaike Los and Davide Grossi, in Malvone, V., Murano, A. (eds), *Proceedings of the 20th European Conference on Multi-Agent Systems (EUMAS 2023)*. Lecture Notes in Computer Science, vol 14282.

Comparing Dynamic Operators for Social Networks, with Edoardo Baccini, in R. Verbrugge (ed.), *Proceedings of Theoretical Aspects of Rationality and Knowledge (TARK) 2023*, EPTCS 379, pp. 66–81, July 2023.

Limited Voting for More Diversity?, with Maaike Los and Davide Grossi, the 9th International Conference on Computational Social Choice (COMSOC 2023), Beersheba, July 3-5 2023.

Proportional Budget Allocation: A Systematization (with Maaike Los and Davide Grossi), proceedings of IJCAI-ECAI 2022, 31st Joint International Conference on Artificial Intelligence, July 23-29, Vienna.

Opinion Diffusion in Similarity-Driven Networks (with Edoardo Baccini and Rineke Verbrugge), Logic and the Foundations of Game and Decision Theory (LOFT) 2022 Conference.

Cascading Abilities in Networks (with Thomas Ågotnes), Logic and the Foundations of Game and Decision Theory (LOFT) 2022 Conference.

Revisiting Epistemic Logic with Names (with Marta Bílková and Olivier Roy), in J. Halpern and A. Perea (eds), *Proceedings of the Eighteenth Conference on Theoretical Aspects of Rationality and Knowledge (TARK XVIII–2021)*, EPTCS 335, pp. 39–54, 2021.

Stability in Binary Opinion Diffusion (with Davide Grossi), in A. Baltag, J. Seligman, and T. Yamada (Eds.): *Proceedings of LORI VI – 6th International Conference on Logic, Rationality and Interaction*, Springer, Heidelberg, pp. 166–180, 2017.

Binary Aggregation with Delegable proxy: An Analysis of Liquid Democracy (with Davide Grossi), *Proceedings of TARK 2017 – 16th Conference on Theoretical Aspects of Rationality and Knowledge*, EPTCS 251, pp. 134–150, 2017.

A Two-tiered Formalization of Social Influence (with Jens U. Hansen), in D. Grossi, O. Roy, and H. Huang (Eds.): *Proceedings of Logic Rationality and Interaction, 4th International Workshop, LORI-IV*, Hangzhou, China, October 9–12 2013, LNCS 8196, 68–81, Springer, Heidelberg, 2013.

A Logic for Social Influence through Communication, in E. Lorini (Ed.): *Proceedings of Eleventh European Workshop on Multi-Agent Systems (EUMAS 2013)*, CEUR Vol–1113, 31–39, 2013.

Invited book chapter:

Logical Models of Informational Cascades (with Alexandru Baltag, Jens U. Hansen, and Sonja Smets), in J. van Benthem and F. Liu (Eds.): *Logic across the University: Foundations and Applications*, *Studies in Logic*, Volume 47, 405–432, College Publications, London, 2013.

Curriculum Vitae
Artur d'Avila Garcez, MEng, MSc, DIC, PhD, FBCS, FHEA

a.garcez@city.ac.uk

October 2, 2024

Professional Membership: Fellow of the British Computer Society (since 2011, member since 2005); Member of the EPSRC Peer Review College, UK, 2018-2023; ACM Association for Computing Machinery, New York, NY (since 2014); Neural-Symbolic Learning and Reasoning Association, London, UK (since 2014); IEEE Institute of Electrical and Electronics Engineers (since 2013); AAAI Association for the Advancement of Artificial Intelligence, Menlo Park, CA (Since 2012); City & Guilds College Association, London, UK (since 2001); Computability in Europe Association (since 2009); Member of the BCS Requirements Engineering Specialist Group (RESG) and Specialist Group on Artificial Intelligence (SGAI); Member of IFIP working group 12.9: Computational Intelligence (since 2012).

Research Interests: Non-Classical Logic, Mathematical Logic, Artificial Neural Networks, Statistical Learning Systems, Neural-Symbolic Learning Systems, Mathematical Foundations of the Integration of Reasoning and Learning.

Short Biography: Artur d'Avila Garcez is Professor of Computer Science at City, University of London. He is a Fellow of the British Computer Society (FBCS), Fellow of the UK's Higher Education Academy (FHEA), and president of the steering committee of the Neural-Symbolic Learning and Reasoning association (NeSy). He has co-authored two books: Neural-Symbolic Cognitive Reasoning, Springer (2009) and Neural-Symbolic Learning Systems, Springer (2002), and co-founded the NeSy conference series, the longest standing conference series in neurosymbolic AI. Garcez is a leader in the field of neurosymbolic AI. He designed and implemented arguably the first neurosymbolic system for learning and reasoning. His research in the area has led to more than 250 publications in major journals and conferences in Artificial Intelligence, Logic and Machine Learning, and in the flagship AI and Neural Computation conferences AAAI, NeurIPS, IJCAI, IJCNN, AAMAS and ECAI. Garcez is a founding Editor-in-Chief of the Neurosymbolic AI journal, IOS Press, and holds editorial and senior program committee positions in all the major scientific journals and conferences in Artificial Intelligence and Machine Learning.

Selected Publications: A. S. d'Avila Garcez, L. C. Lamb and D. M. Gabbay. Neural-Symbolic Cognitive Reasoning. Cognitive Technologies, Springer, ISBN 978-3-540-73245-7, To appear 2008.
A. S. d'Avila Garcez, K. Broda and D. M. Gabbay. Neural-Symbolic Learning Systems: Foundations and Applications, Perspectives in Neural Computing, Springer-Verlag, 300pp, ISBN 1-85233-512-2, 2002.

1

A. d'Avila Garcez and L. Lamb. Neurosymbolic AI: The 3rd Wave. Artificial Intelligence Review, Springer, March 2023. Pre-print arXiv:2012.05876, Dec 2020.

S. Badreddine, A. d'Avila Garcez, L. Serafini and M. Spranger. Logic Tensor Networks. Artificial Intelligence Journal, Vol. 303, February 2022.

C. Percy, S. Dragicevic, S. Sarkar and A. d'Avila Garcez. Accountability in AI: From Principles to Industry-specific Accreditation. AI Communications 34(3):181-196, 2021.

S. Tran and A. S. d'Avila Garcez. Deep Logic Networks: Inserting and Extracting Knowledge from Deep Belief Networks. IEEE Transactions on Neural Networks and Learning Systems. DOI: 10.1109/TNNLS.2016.2603784, Nov 2016.

M. Franca, G. Zaverucha and A. S. d'Avila Garcez. Fast Relational Learning using Bottom Clause Propositionalization with Artificial Neural Networks, Machine Learning, 94(1):81-104, Springer, 2014.

D. M. Gabbay and A. S. d'Avila Garcez. Logical Modes of Attack in Argumentation Networks. Studia Logica 93:199-230, 2009.

A. S. d'Avila Garcez, L. C. Lamb and D. M. Gabbay. Connectionist Modal Logic: Representing Modalities in Neural Networks. Theoretical Computer Science, Elsevier. 2007.

Seminars and Invited Talks: Transfer Learning, Knowledge Extraction and Data Visualization. Invited talk at The Alan Turing Institute, London, 25 January 2016.

Neural-Symbolic Systems for Verification, Run-Time Monitoring and Learning. Invited talk at the Department of Computer Science, University of Oxford, UK, 9 March 2017.

Neural-Symbolic Systems for Human-Like Computing. Dagstuhl Seminar on Human-Like Neural-Symbolic Computing, Schloss Dagstuhl, 8 May 2017, Wadern, Germany.

The Need for Knowledge Extraction. Invited talk at Comprehensibility and Explanation in AI and ML, 16th International Conference of the Italian Association for Artificial Intelligence, Bari, Italy, November 2017.

On the Need for Explainable AI. Invited talk at the Data Science Institute, Imperial College London, 13 Feb 2018.

Neurosymbolic Computing: Thinking beyond Deep Learning. Invited talk at IBM Research, Rio de Janeiro, Brazil, 12 July 2018.

Selected Chairmanships and Service:

Co-organiser: Thirteenth Neural-Symbolic Learning and Reasoning (NeSy) Workshop, University of Prague, Prague, Czech Republic, August 2018.

Co-organiser: Neural-Symbolic Learning and Reasoning with Constraints, Tutorial at IJCAI-ECAI'18, 27th International Joint Conference on Artificial Intelligence and 23rd European Conference on Artificial Intelligence, Stockholm, Sweden, July 2018.

Member of the Steering Committee, Human-level Artificial Intelligence (HLAI), HLAI'2018, Prague, Czech Republic, August 2018.

Co-organiser: Dagstuhl seminar 17192 on Human-Like Neural-Symbolic Computing, Wadern, Germany, May 2017.

Founding president of the Steering Committee, Neural-Symbolic Learning and Reasoning Association (NeSy), London, UK, October 2014 - Present.

Co-organiser: Dagstuhl seminar 14381 on Neural-Symbolic Learning and Reasoning: The turn towards the practical, Wadern, Germany, September 2014.

Programme Co-Chair: 6th International Workshop on Neural-Symbolic Learning and Reasoning NeSy10, AAAI'10, Atlanta, Georgia, July 2010.

2

Curriculum Vitae

Hannes Leitgeb

Present Position

Chair of Logic and Philosophy of Language, Alexander von Humboldt Professor, and
(Co-)Director of the Munich Center for Mathematical Philosophy, Faculty of Philosophy, Philosophy of Science and the Study of Religion, Ludwig-Maximilians-University Munich

Areas of Specialization

Logic, Epistemology, Philosophy of Language, Philosophy of Science, Philosophy of Mathematics, Metaphysics, Cognitive Science.

Education

Ph.D., Philosophy, University of Salzburg, 02/07/01; Ph.D., Mathematics, University of Salzburg, 09/07/98; M.Sc., Mathematics, University of Salzburg, 20/02/97.

Academic Positions

Professor, Departments of Philosophy & Mathematics, Univ. of Bristol (01/08/07 – 30/09/10).

Reader, Departments of Philosophy & Mathematics, University of Bristol (01/09/05 – 31/07/07).

Assistant Professor, Department of Philosophy, University of Salzburg (13/10/02 – 31/08/05).

Post-doctoral scholar, Department of Philosophy, University of Salzburg. Project: *Logic and Cognitive Science* (May 1999–August 2002).

Honors and Awards

Member of Leopoldina, Deutsche Akademie der Naturforscher.

Member of Academia Europaea.

Member of L'Académie Internationale de Philosophie des Sciences.

Alexander von Humboldt Professorship (EUR 3,500,000), Alexander von Humboldt Foundation, Germany, February 2010.

Friedrich Wilhelm Bessel Research Award (EUR 45,000), Alexander von Humboldt Foundation, Germany, November 2007.

Philip Leverhulme Prize (£ 70,000), Leverhulme Trust, UK, October 2007.

Editorial Work

Editor-in-Chief of *Erkenntnis* (01/01/11 – 31/12/23)

Coordinating Editor of *Review of Symbolic Logic* (01/01/13–31/12/15).

Editor of *Review of Symbolic Logic* (23/12/10–31/12/12).

Subject Editor of the *Stanford Encyclopedia of Philosophy* for Philosophy of Mathematics (since 01/10/05).

Presentations

More than 290 invited talks since 2005.

1

Publications

91 published articles, 59 of which in peer-reviewed journals.

2 published monographs (with Oxford University Press and Springer), 4 edited books.

Ten selected publications:

- "Axioms for Type-Free Subjective Probability" (with C. Cieslinski and L. Horsten), *Review of Symbolic Logic* 17/2 (2024), 493-508.

- "HYPE: A System of Hyperintensional Logic (With an Application to Semantic Paradoxes)", *Journal of Philosophical Logic* 48/2 (2019), 305-405.

- "Probability for the Revision Theory of Truth" (with C. Campbell-Moore and L. Horsten), *Journal of Philosophical Logic* 48 (2019), 87-112.

- "Neural Network Models of Conditionals", in: S.O. Hansson and V.F. Hendricks (Eds.), *Introduction to Formal Philosophy*, Berlin: Springer, 2018, 147-176.

- "The Stability Theory of Belief", *The Philosophical Review* 123/2 (2014), 131-171.

- "A Probabilistic Semantics for Counterfactuals. Part A", *Review of Symbolic Logic* 5 (2012), 16-84.

- "Mechanizing Induction" (with R. Ortner), in: D. Gabbay, S. Hartmann, and J. Woods (Eds.), *Handbook of the History of Logic*, Vol. 10: *Inductive Logic*, Oxford: North Holland (Elsevier), 2011, 719-772.

- "An Objective Justification of Bayesianism I: Measuring Inaccuracy" (with R. Pettigrew), *Philosophy of Science* 77/2 (2010), 201-235.

- "Dynamic Doxastic Logic: Why, How, and Where to?" (with K. Segerberg), *Synthese KRA* 155/2 (2007), 167-190.

- "Nonmonotonic Reasoning by Inhibition Nets", *Artificial Intelligence* 128/1-2 (2001), 161-201.

(October 4th 2024)

Curriculum Vitae of Sonja Smets   **(sites.google.com/site/thesonjasmetssite/)**

Sonja Smets is a Professor in Logic and Epistemology at the Institute for Logic, Language and Computation (ILLC) at the University of Amsterdam where she holds a dual position in both the Faculty of Science and in the Faculty of Humanities. Her research programme ranges over Logic (in particular non-classical logics, including non-monotonic logics, belief revision, modal and temporal logic, quantum logic); Multi-agent Systems; Formal Epistemology; Philosophy of Science, Philosophy of Quantum Physics, Quantum Information and Computation. In these areas she has contributed over 115 publications in total and co-edited several important volumes. She is a frequent speaker at top international conferences in her research area, with over 150 lectures and she was involved in the organization of several important international workshops. She was awarded an ERC Starting grant for her work on the LogiCIC project from 2012 till 2017 (project on 'The Logical Structure of Correlated Information Change', ERC-2011-STG Nr283963). In 2009 she was awarded with a 5-year VIDI project on "Reasoning about Quantum Interaction", funded by the Innovational Research Incentives Scheme of the Dutch Science Foundation. She has received numerous scientific awards, including the Birkhoff-von Neumann Prize in 2012 for her studies on quantum structures and related epistemic semantics. In 2009 she received the Rosalind Franklin Fellowship Medal, awarded by J. Glynn (R. Franklin's sister) in the presence of H.R.H Queen Máxima of the Netherlands.

Sonja Smets is currently an elected member of the Royal Netherlands Academy of Arts and Sciences (KNAW). She is the former director of the ILLC, i.e. the institute for logic, language and computation at the university of Amsterdam. She is currently the elected president of FOLLI, The Association for Logic, Language and Information and she is a member of the Board of the Beth Foundation at The Royal Netherlands Academy of Arts and Sciences. She is the former president and current vice-president of the International Quantum Structures association.

Sonja Smets obtained her PhD at the Free University of Brussels in 2001. After completing her PhD, she started as a post-doc researcher at the Flemish Fund for Scientific Research in combination with a part-time lecturer position in the Center for Logic and Philosophy of Science at the Free University of Brussels till 2009. In 2005-2006 she was a visiting scholar at the London School of Economics, in 2008 at the University of Amsterdam and at Indiana University. In 2015 she visited Stanford University and in recent years she's been a regular visitor at Tsinghua University in Beijing and in 2024 she visited Chapman University in the United States. In 2009 she worked as an assistant professor with a Rosalind Franklin Research Fellowship at both the Faculty of Philosophy and the Faculty of Mathematics & Natural Sciences (Multi-agent Systems Group in AI) at the University of Groningen. From January 2019 till January 2022, she combined her position at the university of Amsterdam with a Professor II 0.2Fte appointment in the Logic and AI Research Group at the Department of Information Science and Media Studies at the University of Bergen in Norway.

Selected List of Publications:

1)   A. Baltag and S. Smets, Logics for Data Exchange and Communication, in A. Ciabattoni, D. Gabelaia and I. Sedlár, *Advances in Modal Logic*, Vol. 15, College Publication, pp.147-169, 2024.

2)   A. Baltag and S. Smets, Logic meets Wigner's Friend (and their Friends), *International*

Journal of Theoretical Physics, 63, article number 97, 2023.

3) M.Y. Pedersen, M. Slavkovik and S. Smets, Detecting bots with temporal logic. *Synthese*, 202(79), 2023.

4) S. Shi, S. Smets and F. Velázquez-Quesada, Logic of Justified Beliefs Based on Argumentation. *Erkenntnis,* 88,1207-1243, 2023.

5) K. Schulz, S. Smets, FR Velázquez-Quesada, K. Xie, Non-strict Interventionism: the case of right-nested counterfactuals. *Journal of Logic, Language and Information*, 31(2), 235-260, 2022.

6) A. Baltag, N. Bezhanishvili, A. Özgün and S. Smets, Justified Belief, Knowledge and the Topology of Evidence, *Synthese*, 200(6), 512, 2022.

7) A. Baltag, S. Rafiee Rad and S. Smets, Tracking Probabilistic Truths: a logic for statistical learning. in *Synthese*, 199, 3-4, 9041-9087, 2021.

8) F. Berto, S. Smets and A. Solaki, The Logic of Fast and Slow Thinking. *Erkenntnis*, 83(3):733-762, 2021.

9) M.Y. Pedersen, S. Smets, T. Ågotnes, Modal Logics and Group Polarization. *Journal of Logic and Computation.* 2240-2269, 2021.

10) S. Smets and F. R. Velázquez-Quesada. A closeness- and priority-based logical study of social network creation. In *Journal of Logic, Language and Information.* 29:21-51, 2020.

11) H. van Lee and S. Smets, The Logic of Observation and Belief Revision in Scientific Communities. In *Journal for General Philosophy of Science*, 51:243–266, 2020.

12) A. Baltag and S. Smets, Learning what Others Know, in L. Kovacs and E. Albert (eds.), LPAR23 proceedings, *EPiC Series in Computing*, 2020.

13) M. Young Pedersen, S. Smets, T. Ågotnes. Further Steps Towards a Logic of Polarization in Social Networks. In *CLAR 2020 proceedings*, *LNAI* 12061, 324-345, Springer, 2020.

14) A. Baltag, N. Bezhanishvili, A. Ozgun, S. Smets. A Topological Approach to Full Belief. *Journal of Philosophical Logic*, 48(2), pp.205-244, 2019.

15) A. Baltag, Z. Christoff, R. Rendsvig, S. Smets. Dynamic Epistemic Logics of Diffusion and Prediction in Social Networks, *Studia Logica*, 107, pp. 489–531, 2019.

16) A. Baltag, N. Gierasimczuk and S. Smets, Truth-tracking by belief revision. *Studia Logica*, 107, pp. 917–947, 2019.

17) A. Baltag, N. Gierasimczuk, A. Ozgun, S.Smets, A. Vargas Sandoval. A Dynamic Logic for Learning Theory. In *Journal of Logical and Algebraic Methods in Programming,* Vol. 109, Dec. 2019, 100485.

THEOFANIS ARAVANIS, PhD ⓘD

Assistant Professor (tenured), Dept. of Digital Systems, University of the Peloponnese, Greece

✉ taravanis@uop.gr　　📞 +30 6978 212 529

ACADEMIC EDUCATION

2019: PhD in Logic-Based Artificial Intelligence, University of Patras, Greece

2016: Master in Business Administration (MBA), University of Patras, Greece

2014: MSc in Energy Production and Management, National Technical University of Athens, Greece

2012: Diploma Degree, Dept. of Electrical and Computer Engineering, University of Patras, Greece

POST-DOCTORAL RESEARCH

2023 – 2025: Research Project *SAFE-AORTA* (Development of a clinical decision support system for Abdominal Aortic Aneurysm disease, based on Artificial-Intelligence models)

2024 – 2025: Research Project *OLEAS* (Development of an intelligent system for soil and plant tissue analysis)

2022 – 2023: Research Project *MANFISH* (Development of intelligent systems for the diagnosis and treatment of fish-diseases)

2021 – 2022: Research Project *C-ROADS GREECE* (Development of Intelligent Transportation Systems for Attiki Odos SA, used for real-time normalization of traffic flow)

2019 – 2021: Post-Doctoral Researcher, Biennial Scholarship by the *State Scholarships Foundation* (IKY), University of Patras, Greece

ACADEMIC POSITIONS

2025 – today: Assistant Professor (tenured), Dept. of Digital Systems, University of the Peloponnese, Greece

2023 – 2025: Adj. Assistant Professor, Dept. of Mechanical Engineering, University of the Peloponnese, Greece

2019 – 2023: Adj. Lecturer, Dept. of Mechanical Engineering, University of the Peloponnese, Greece

2017 – 2019: Laboratory Associate, Technological Educational Institute of Western Greece, Greece

RELEVANT PUBLICATIONS IN INTERNATIONAL JOURNALS

1. **Theofanis Aravanis**, "Towards machine learning as AGM-style belief change", *International Journal of Approximate Reasoning*, Vol. 183, 109437, 2025.

2. **Theofanis I. Aravanis**, "On the consistency between belief revision and belief update", *Journal of Artificial Intelligence Research*, Vol. 82, pp. 1743-1771, 2025.

3. **Theofanis Aravanis**, "Darwiche and Pearl's iterated belief revision: Not always Spohn-expressible", *Mathematics*, Vol. 13, Iss. 6, 2025.

4. **Theofanis Aravanis**, "Tailoring disjoint belief structures to the AGM framework", *Journal of Logic and Computation*, 2024.

5. Maria Andrikopoulou, **Theofanis Aravanis**, James P. Delgrande, Panagis Karazeris, and Pavlos Peppas, "Filters-based revision", *Annals of Mathematics and Artificial Intelligence*, 2024.

6. **Theofanis Aravanis**, Grigorios Chrimatopoulos, Michalis Xenos, and Efstratios E. Tzirtzilakis, "Forecasting two-dimensional channel flow using Machine Learning", *Physics of Fluids*, Vol. 36, 2024.

7. **Theofanis Aravanis**, Ioannis Hatzilygeroudis, and Georgios Spiliopoulos, "Ensemble modelling for predicting fish mortality", *Applied Sciences*, Vol. 14, 2024.

8. **Theofanis I. Aravanis**, "Collective belief revision", *Journal of Artificial Intelligence Research*, Vol. 78, pp. 1221-1247, 2023.

9. Konstantinos Kovas, Ioannis Hatzilygeroudis, Konstantinos Dimitropoulos, Georgios Spiliopoulos, Konstantinos Poulos, Evi Abatzidou, **Theofanis Aravanis**, Aristeidis Ilias, Grigorios Kanlis, and John Theodorou, "Using level-based multiple reasoning in a Web-based intelligent system for the diagnosis of farmed fish diseases", *Applied Sciences*, Vol. 13, 2023.

10. **Theofanis Aravanis**, "Deductive belief change", *Annals of Mathematics and Artificial Intelligence*, Vol. 91, pp. 489-515, 2023.

11. **Theofanis Aravanis**, "Generalizing Parikh's criterion for relevance-sensitive belief revision", *ACM Transactions of Computational Logic*, Vol. 24, Article No. 18, 2023.

12. **Theofanis Aravanis** and Pavlos Peppas, "Theory-relational belief revision", *Annals of Mathematics and Artificial Intelligence*, Vol. 90, pp. 573-594, 2022.

13. **Theofanis Aravanis**, "An epistemological study of theory change", *Bulletin of the Section of Logic*, Vol. 51, pp. 1-26, 2022.

14. **Theofanis Aravanis**, "An ASP-based solver for parametrized-difference revision", *Journal of Logic and Computation*, Vol. 32, pp. 630-666, 2021.

15. **Theofanis I. Aravanis**, "Relevance in belief update", *Journal of Artificial Intelligence Research*, Vol. 72, pp. 251-283, 2021.

16. **Theofanis Aravanis**, "On uniform belief revision", *Journal of Logic and Computation*, Vol. 30, pp. 1357-1376, 2020.

17. **Theofanis I. Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "Incompatibilities between iterated and relevance-sensitive belief revision", *Journal of Artificial Intelligence Research*, Vol. 69, pp. 85-108, 2020.

18. **Theofanis I. Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "A study of possible-worlds semantics of relevance-sensitive belief revision", *Journal of Logic and Computation*, Vol. 30, pp. 1125-1142, 2020.

19. **Theofanis I. Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "Full characterization of Parikh's relevance-sensitive axiom for belief revision", *Journal of Artificial Intelligence Research*, Vol. 66, pp. 765-792, 2019.

20. **Theofanis Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "An investigation of parametrized difference revision operators", *Annals of Mathematics and Artificial Intelligence*, 2019.

RELEVANT PUBLICATIONS IN INTERNATIONAL CONFERENCES

1. **Theofanis Aravanis**, Grigorios Chrimatopoulos, Michalis Xenos, and Efstratios E. Tzirtzilakis, "Machine-learning modelling of a fluid flow in a two-dimensional channel", *Proceedings of the 15th International Conference on Information, Intelligence, Systems and Applications* (IISA 2024), 2024.

2. **Theofanis Aravanis**, Aristeidis Ilias, Ioannis Hatzilygeroudis, and Georgios Spiliopoulos, "Predicting fish-mortality: Artificial Neural Networks vs Symbolic Regression", *Proceedings of the 14th International Conference on Information, Intelligence, Systems and Applications* (IISA 2023), 2023.

3. **Theofanis Aravanis**, Andreas Petratos, Georgia Douklia, and Efpraxia Plati, "Search problems in contemporary power grids", *Proceedings of the 22nd International Conference on Engineering Applications of Neural Networks* (EANN 2021), pp. 331-342, 2021.

4. **Theofanis Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "Modelling belief-revision functions at extended languages", *Proceedings of the 24th European Conference on Artificial Intelligence* (ECAI 2020), pp. 601-607, 2020.

5. **Theofanis Aravanis**, Andreas Petratos, and Georgia Douklia, "An ASP-based approach for phase balancing in power electrical systems", *Proceedings of the 21st International Conference on Engineering Applications of Neural Networks* (EANN 2020), pp. 511-520, 2020.

6. **Theofanis Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "Observations on Darwiche and Pearl's approach for iterated belief revision", *Proceedings of the 28th International Joint Conference on Artificial Intelligence* (IJCAI 2019), pp. 1509-1515, 2019.

7. **Theofanis I. Aravanis**, Tryfon-Chrysovalantis I. Aravanis, and Polydoros N. Papadopoulos, "Fault diagnosis in Direct Current electric motors via an Artificial Neural Network", *Proceedings of the 20th International Conference on Engineering Applications of Neural Networks* (EANN 2019), pp. 488-498, 2019.

8. **Theofanis Aravanis**, Konstantinos Demiris, and Pavlos Peppas, "Legal reasoning in Answer Set Programming", *Proceedings of the 2018 IEEE 30th International Conference on Tools with Artificial Intelligence* (ICTAI 2018), pp. 302-306, 2018.

9. **Theofanis Aravanis**, Pavlos Peppas, and Mary-Anne Williams, "Epistemic-entrenchment characterization of Parikh's axiom", *Proceedings of the 26th International Joint Conference on Artificial Intelligence* (IJCAI 2017), pp. 772-778, 2017.

10. **T. I. Aravanis**, E. C. Pyrgioti, and I. F. Gonos, "Lightning-induced overvoltages in the Hellenic electricity distribution network", *Proceedings of the 2016 IEEE 5th International Conference on High Voltage Engineering and Application* (ICHVE 2016), paper P-1-28, 2016.

SERVICESHIPS / AWARDS / MEMBERSHIPS

- **Visiting Researcher** for one (1) month at the University of Technology Sydney (UTS), Australia, 2017

- **Reviewer** for Artificial Intelligence Journal, Journal of Artificial Intelligence Research, Annals of Mathematics and Artificial Intelligence, The Computer Journal, International Journal of Approximate Reasoning, Journal of Logic and Computation, Artificial Intelligence and Law, KR 2024 & 2025, IJCAI-PRICAI 2020, ECAI 2020, JELIA 2019

- **Publicity Chair** of the 20th and 17th International Conferences on Principles of Knowledge Representation and Reasoning (KR 2023 & KR 2020)

- **Supervision** of more than 20 Diploma Theses

- **Outstanding Teaching Award** by the Department of Mechanical Engineering of the University of the Peloponnese (2022 & 2023)

- **Memberships:** Hellenic Artificial Intelligence Society, Technical Chamber of Greece

Caleb Schultz Kisby

RESEARCH INTERESTS

- Logical foundations of artificial intelligence
- Neuro-symbolic AI
- Dynamic logics for belief revision and learning
- Neural network verification and alignment

EDUCATION

2018 – PRESENT	**PhD Candidate**, Indiana University, Bloomington, USA
	PhD in Computer Science (in progress), minor in Logic.
	Jointly advised by Larry Moss and Saúl A. Blanco
2014 – 2018	**Bachelors**, University of South Carolina, Columbia, USA
	BSCS in Computer Science, BS in Mathematics, *Summa Cum Laude*

HONORS AND AWARDS

MAR 2024	Recipient of the SCALE Ambassador Award, for excellence in research during the SCALE Trusted AI Project, US Department of Defense
MAY 2022	"The Logic of Hebbian Learning" nominated for Best Student Paper at FLAIRS 2022
AUG 2019	Recipient of the Paul Purdom Fellowship, awarded to one outstanding PhD student each year with interests in theoretical computer science, Indiana University
JAN 2017	Recipient of the Magellan Scholar Undergraduate Research Grant, USC Columbia

INVITED TALKS

JUN 2025	Course for the North American Summer School for Logic, Language and Information, co-teaching with Nina Gierasimczuk
	Course Title: *Computational Learning in Dynamic Logics*
SEP 2024	Seminar on Logic and Interactive Rationality, ILLC, University of Amsterdam, Online
	The Modeling Power of Neural Networks
JAN 2024	1ˢᵗ General Algebra, Logic & AI Workshop, Chapman University, Orange, USA
	Logical Dynamics of Neural Network Learning

SELECTED CONFERENCE TALKS

FEB 2024	AAAI Conference on Artificial Intelligence, Vancouver, Canada
	Reduction Axioms for Iterated Hebbian Learning
MAY 2022	The International Florida AI Research Society Conference, Jensen Beach, USA
	The Logic of Hebbian Learning

OTHER PROFESSIONAL ACTIVITIES

FEB 2024	Volunteer for the AAAI Conference on Artificial Intelligence, Vancouver, Canada
NOV 2023	Reviewer for the AAAI Workshop on Neuro-Symbolic Learning and Reasoning in the era of Large Language Models
JUL 2023	Participated in the Workshop on Neural-Symbolic Learning and Reasoning, Siena, Italy
JUN 2023	Local Organizer for Algebra and Coalgebra in Computer Science (CALCO), & Mathematical Foundations of Programming Semantics (MFPS), Bloomington, USA
SEP 2019	Reviewer for the Journal of Logic, Language, and Information

Caleb Schultz Kisby

List of Publications

Peer-Reviewed Publications

1. **Caleb Schultz Kisby**, Saúl A. Blanco, and Lawrence S. Moss. What Do Hebbian Learners Learn? Reduction Axioms for Iterated Hebbian Learning. In Proceedings of the AAAI Conference on Artificial Intelligence, Vol. 38, No. 13, March 2024.

2. **Caleb Kisby**, Saúl A. Blanco, and Lawrence S. Moss. The Logic of Hebbian Learning. In The International FLAIRS Conference Proceedings, Vol. 35, May 2022.

3. **Caleb Kisby**, Saúl A. Blanco, Alex Kruckman, and Lawrence S. Moss. Logics for Sizes with Union or Intersection. In Proceedings of the AAAI Conference on Artificial Intelligence, Vol. 34, No. 03, February 2020.

4. Lawrence Gates, **Caleb Kisby**, and David Leake. CBR Confidence as a Basis for Confidence in Black Box Systems. In Case-Based Reasoning Research and Development, ICCBR 2019, Springer, pp. 95–109, September 2019.

**LUDDY SCHOOL OF
INFORMATICS, COMPUTING,
AND ENGINEERING**

INDIANA UNIVERSITY

April 24, 2025

To Members of the DFF Funding Board:

Dear Colleagues,

I am one of the PhD co-supervisors for Caleb **Schultz Kisby** at Indiana University, Bloomington. Mr. Schultz Kisby is nearing completion of his PhD program in Computer Science.

In agreement with the other co-supervisor, Prof. Lawrence Moss, we fully anticipate that Mr. Schultz Kisby will submit his PhD thesis by October 29, 2025.

Please do not hesitate to contact me if I can provide any additional assistance.

Sincerely,

Saúl A. Blanco Rodríguez
Assistant Professor
Department of Computer Science

Mathematics Department
831 East 3rd St
Bloomington, IN 47405 USA

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lmoss@iu.edu

April 24, 2025

Dear Members of the DFF Funding Board,

I am the PhD co-supervisor with Saúl Blanco of Caleb Schultz Kisby here at Indiana University. Caleb's PhD will be in Computer Science. I fully expect him to submit his PhD thesis by October 29, 2025.

Sincerely,

Lawrence S. Moss

Lawrence S. Moss

Director, Indiana University Program
in Pure and Applied Logic

Professor of Mathematics

Adjunct Professor: Computer Science,
Linguistics, and Philosophy
Member, Cognitive Science Program

Theofanis Aravanis, PhD
Assistant Professor
Department of Digital Systems
University of the Peloponnese, Greece
taravanis@uop.gr

April 25, 2025

TO WHOM IT MAY CONCERN

Letter of Support for the DFF Project 1 Proposal
"Computational Learning rendered in Dynamic Logics (CLariDy)"
Hosted at the Department of Applied Mathematics and Computer Science,
Technical University of Denmark

Dear Sir or Madam,

It is with great enthusiasm that I express my full support for Dr. Nina Gierasimczuk's proposal titled *"Computational Learning rendered in Dynamic Logics (CLariDy)"*, submitted for consideration under the Independent Research Fund Denmark's (DFF) Project 1 framework.

My name is Theofanis Aravanis, and I am currently serving as an Assistant Professor at the University of the Peloponnese. My background is in logic-based Artificial Intelligence (AI), belief-change theory, and machine learning. My most recent work explores the intersections between AGM-style belief revision and contemporary neural-network learning mechanisms — a research direction that aligns remarkably well with the aims and methods of the CLariDy project.

This project tackles one of the most significant challenges in current AI research: how to formally reason about and verify learning processes in opaque neural architectures. The proposed use of dynamic modal logic to capture and guide learning behaviors —both from a verification and a characterization perspective— represents a novel and highly promising approach.

Given my own contributions to the field of belief dynamics and my growing interest in its neural analogues, I see several avenues for meaningful collaboration. I look forward to contributing to the development of learning-as-belief-change frameworks, and to exploring the integration of dynamic logics into machine-learning pipelines in both symbolic and neuro-symbolic domains.

I am honored to be considered a collaborator on this exciting and intellectually rich project and am confident that CLariDy will make significant contributions to the fields of AI, logic, and cognitive modeling.

Yours sincerely,

Theofanis Aravanis, PhD

UNIVERSITY OF AMSTERDAM

The Institute for Logic, Language and Computation

Date	Contact person	Phone
25 April 2025	A. Baltag	+31 (0)20 525 6508

Email
a.baltag@uva.nl

Subject: Letter of Support

To the Independent Research Fund Denmark (DFF),

I am writing to express my strong support for the proposed research project (DFF Project 1) with the title : "Computational Learning rendered in Dynamic Logic (CLariDy)", proposed under leadership of Prof. Gierasimczuk. I am myself one of the originators of Dynamic Epistemic Logic, a method that is central in this proposal. I have previously collaborated with the Prof. Gierasimczuk on the application of this logical method to formal learning theory and as such I am particularly excited about the potential of this project.

I have had the opportunity to meet and discuss the new modal logic approach to Hebbian learning directly with Mr. Caleb Schultz Kisby and I am very pleased to see that this research proposal will extend this innovative line of research in AI. In the proposed research project, I am particularly drawn to work-package WP1 on interpreting NN learning as upgrade and study its truth-tracking capacities. Both work-packages WP1 and WP2 align closely with my research interests and expertise.

I am eager to collaborate on this line of work with Prof. Gierasimczuk and with Mr. Schultz Kisby. I look forward to meeting and working with them during workshops at DTU in Copenhagen and possible visits by the project team to the Institute for Logic, Language and Computation (ILLC) in Amsterdam.

I am very enthusiastic about the possibility of contributing to this important and innovative project.

Yours sincerely,

Alexandru Baltag

Dr. Alexandru Baltag

Patrick Blackburn
Centre for Philosophy and Science Studies
Department of Communication and Arts
University of Roskilde
Universitetsvej 1
4000-DK Roskilde
Denmark

patrickb@ruc.dk
+45 2729 4449

25 April, 2025

RE: Project **CLariDy**

Dear Nina,

I am thrilled to be invited to contribute to your proposed DFF project, *Computational Learning rendered in Dynamic Logics (CLariDy)*.

I find the starting point of your project compelling, particularly the focus on improving how we reason about, understand, and guide computational learning processes. Your approach, using *dynamic* forms of modal logic for this purpose, is both innovative and promising. The two work packages you've outlined offer a clear and practical roadmap for making significant progress in this area.

Furthermore, the international team you've assembled is impressive, and the PostDoc researcher is undoubtedly one of the most promising young talents in the field. I am truly excited to be part of this.

Finally, it's rare to see so many fresh and insightful ideas in a single research proposal. I greatly look forward to discussing these with you and the rest of the team, and to contributing to their development.

Best regards,

Patrick Blackburn
Professor of Formal Philosophy, Roskilde University, Denmark

Zoé Christoff
Assistant Professor in Cognitive Artificial Intelligence
Faculty of Science and Engineering
University of Groningen
The Netherlands

www.zoechristoff.com
z.l.christoff@rug.nl

Groningen, April 25, 2025

Dear Members of the Independent Research Fund Denmark Board,

With this letter, I want to express my support for Professor Gierasimczuk's project "Computational Learning rendered in Dynamic Logics (CLariDy)".

Let me first say a few words about the project's principal investigator, Professor Gierasimczuk. For the past decade, she has been the one at the forefront of the research pushing the frontiers of these two fields to be able to provide a unified perspective on learning. She built on the mathematical foundations of formal learning theory to prove whether the methods to represent how agents incorporate new information are appropriate to *learn*, in the sense of stabilizing on the correct hypothesis. While dynamic epistemic logic had been focusing on operators capturing "one step dynamics", formal learning theorists were instead interested in what is possible *in the long run*. Professor Gierasimczuk was able to fruitfully reconcile both perspectives in the past and I am very confident that she will be able to apply this specific expertise to reach the goals of this project, reaching again beyond the typical limitations of how most people think of neural networks, learning and logic. In this sense, this project looks at the same time like a natural continuation of her line of work and like a promising use of her specific interdisciplinary expertise.

Both of the project's work packages apply dynamic logic to neural network processes. They compare known learning processes from dynamic epistemic logic with neural network learning processes, and on the other hand, build new logical operators to capture neural networks learning specifically. This second direction is where my own expertise in logics of social network relates closely to the project. Indeed, to this day, logicians have developed tools to model and reason about dynamics in social networks, but we have yet to apply (or adapt) these new approaches specifically to neural networks. Being one of the logicians having developed such tools, I am personally convinced that this direction is feasible and that it will provide valuable insight towards the understanding, and therefore towards the explainability, of neural networks.

In addition to the fact that her own expertise fits the project particularly well, Prof. Gierasimczuk will be joined by an already very qualified future postdoc researcher, Caleb Schultz Kisby. Moreover, the collaboration network involved is also very strong, involving experts within Denmark and international ones.

In a nutshell, the project "Computational Learning rendered in Dynamic Logics (CLariDy)" aims to tackle objectives that are timely and original, while, at the same time, its workplan remains feasible and realistic since it relies on a combination of existing tools and techniques on which the applicant is a worldwide expert. The output delivered by this project would not only be of great scientific significance but also of great societal value, given the fast pace development of neural network applications. Therefore, I strongly believe that this project should be funded.

Sincerely,

Zoé Christoff
Assistant Professor in Cognitive AI
University of Groningen

TO WHOM IT MAY CONCERN
25 April 2025

Letter of support for the project "Computational Learning rendered in Dynamic Logics", Independent Research Fund Denmark's (DFF) Project 1.

Dear sirs,

I am writing to express my strongest support for Dr Nina Gierasimczuk's application "Computational Learning rendered in Dynamic Logics".

My name is Artur Garcez. I am a professor of Computer Science and director of the Research Centre for Machine Learning at City, University of London. I have had conversations about closely related topics with Dr Nina Gierasimczuk's collaborator in the project Caleb Schultz Kisby.

Neurosymbolic AI is concerned with the integration of neural networks and symbolic AI for the purpose of learning and reasoning. The success of deep neural networks with its impact in industry and society and its, now much better understood limitations, such as lack of robustness, fairness and high energy consumption, point to neurosymbolic AI as a highly relevant area of research in the next decade. In this area, it is very important and difficult to find researchers who have an appreciation for the breadth of the research work, as well as the required deeper understanding of reasoning and machine learning techniques and algorithms. This breadth is exemplified very well in the project proposal.
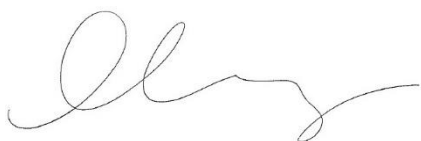
In particular, the research on the verification of neural computational systems is now urgent. The proposed use of Hopfield networks and related generative models in WP2 is highly relevant. The extension of the algorithms and systems currently available to handle first-order logic is a long-term challenge that the project team is very well equipped to address.

In our work here in London, we also combine logic and neural networks into hybrid systems and extending this work towards new application domains and larger, dynamically developing systems offers much potential for cooperation and new applications addressing some of the main challenges of deep learning, not least offering guarantees to the behaviour of such neural network-based systems.

I look forward to the opportunity to work with the project team on advancing the application of such energy-based models and addressing the challenges of expressiveness in deep learning.

Yours faithfully,

Prof Artur d'Avila Garcez, FBCS, FHEA
Director - Research Centre for Adaptive Computing and Machine Learning
President of the Neural-Symbolic Learning and Reasoning Association
City, University of London

LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

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Professor Nina Gierasimczuk
Dept. of Applied Mathematics and Computer Science
Technical University of Denmark
Copenhagen, Denmark

Ihr Zeichen, Ihre Nachricht vom   Unser Zeichen
                                         DA/24   München, 25.04.2025

Dear Professor Gierasimczuk,

This is just to confirm that I would be very happy and honored indeed to collaborate with you and your colleagues in the Danish DFF project on *Computational Learning Rendered in Dynamic Logics* you are in the process of applying for. The project looks amazing to me, and it would be wonderful to contribute to it.

With best wishes,

Prof. Dr. Dr. Hannes Leitgeb
Chair of Logic and Philosophy of Language
(Co-)Director of the Munich Center of Mathematical Philosophy
LMU Munich

UNIVERSITY OF AMSTERDAM

The Institute for Logic, Language and Computation

ILLC

Science Park 105/107
1098 XG Amsterdam

P.O. Box 94242
1090 GE Amsterdam

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Date	Contact person	Phone
25 April 2025	S.J.L.Smets	+31 (0)20 525 6508

Email
s.j.l.smets@uva.nl

Subject: Letter of Support

Dear members of the council of the Independent Research Fund Denmark (DFF),

With this letter I express my strong support for the research project on "Computational Learning rendered in Dynamic Logic (CLariDy)", proposed to the Independent Research Fund Denmark (DFF Project 1). This project proposal has an exceptionally strong research team, consisting of Prof. Nina Gierasimczuk and Mr. Caleb Schultz Kisby as postdoctoral researcher together with a local and international team of top researchers. Note that both Prof. Gierasimczuk's work on logics for computational learning and Mr. Caleb Schultz Kisby's PhD work on a dynamic modal logic approach to Hebbian learning, have been inspiring and foundational in the field. I am very eager to contribute to this project, particularly on the topic of Learning using Dynamic Logics.

I will be able to contribute to different work-packages but more closest to my line of work are Work-Package WP1, building on belief-revision theory. This area aligns best with my research interests and expertise, and I am confident that my background will allow me to make significant contributions to this work. It is particularly nice that my earlier joint work with Prof. Nina Gierasimczuk and Prof. Alexandru Baltag on topological characterizations of belief revision methods can form the basis to explore neural network learning.

Furthermore, I am very keen on collaborating with all team members involved in this project. I would be delighted to collaborate with the team if they visit the Institute for Logic, Language and Computation (ILLC) in Amsterdam and I look forward to visiting DTU in Copenhagen myself for workshops that will be organized by the project members.

I am confident that my involvement in this project will be mutually beneficial and will contribute to the advancement of research at the intersection of logic and neural network learning. I look forward to the possibility of contributing to this exciting project.

Yours sincerely,

Prof. Dr. Sonja Smets
Professor of Logic and Epistemology

Confirmation of budget

This template must be used when applying the Independent Research Fund Denmark. The template must be printed, filled in, signed and stamped and subsequently uploaded as an appendix to your E-grant form / application in PDF-format.

Applicant, Dr. Nina Gierasimczuk
confirms with my signature:

_____
Signature

that the information provided in the application regarding the budget is correct, and that the following total sum is applied for from Independent Research Fund Denmark:

3.162.726

Applied for amount (DKK) including overhead/administration expenses.
The amount must correspond to the amount provided in the E-grant form

The administrating institution

The administrating institution, defined as the institution or enterprise which pays for and defrays the project's/applicant's expenses during the project period, confirms with the management's signature and stamp, that the budget is approved and that the project can be carried out at the institution/ organisation / company:

_____
Signature and stamp of institution/organisation/company

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