


# Dr. Marcin Abram

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## PROFESSIONAL EXPERIENCE

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### Visiting Assistant Professor

*August 2023 – (expected) May 2024*

at the University of Southern California, Los Angeles, CA, USA

**Research Focus:** Federated learning protocols and continuous learning. Scientific machine learning.

**Supervisory Roles:** One Ph.D. project (for over three years; the Ph.D. student is graduating in January 2024), two capstone undergraduate projects, a semester-long research internship for eight students.

### Visiting Researcher

*July 2020 – (expected) May 2024*

at the USC Information Sciences Institute (ISI), Los Angeles, CA, USA

(1) Member of the ISI's *Machine Intelligence and Data Science* (MINDS) group.

**Research Focus:** Scientific machine learning, self-supervised learning, scientific data representation.

**Results:** A sponsored research award (\$20,000). Publication in a prestigious Nature-partner journal.

(2) Member of the *Secure Heterogeneous Learning Federation with Information-Theoretic Guarantees*.

**Research Focus:** Distributed machine learning, federated learning protocols.

**Results:** We have developed a novel consolidation schema offering improved robustness and efficiency.

### Postdoctoral Scholar

*July 2020 – August 2023*

at the University of Southern California, Los Angeles, CA, USA

**Research Focus:** Knowledge distillation, out-of-domain generalization, neural networks interpretability.

**Leadership Roles:** A group leader for the *Emulating Quantum Dynamics with Neural Networks* project. Supervising work of two Ph.D. students. Scientific workshop organization. Mentoring several students.

**Management Experience:** Ph.D. Qualifying Exam and Ph.D. Screening Exam Committees.

**Results:** A publication in *Frontiers in Materials*. One student graduated with a Ph.D. title.

### Lead Research Scientist

*July 2018 – May 2020*

at Fetch.ai, Cambridge, UK

**Research Focus:** Developing decentralized consensus protocols. Analyzing new vector attacks for decentralized systems. Developing machine learning applications for decentralized and distributed systems.

**Leadership:** Leading group of four researchers. Representing the company in meetings with investors.

**Results:** Two articles, one commercial patent, and presentations at several conferences.

**Technology:** TensorFlow, Docker, Distributed Ledger Technology, Secure Multi-Party Computation.

### Machine Learning Engineer

*August 2016 – June 2018*

at TypeScore, London, UK

**Responsibility:** Raw data collection. Machine learning model selection, training, and evaluation.

**Results:** Fully automated data pipeline. Our AUC & F1 scores outperformed the state-of-the-art results.

**Technology:** Python, Tensorflow, Docker, MongoDB, Elasticsearch, Google Cloud, RESTfull API.

## EDUCATION

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### Jagiellonian University, Kraków, Poland

#### Ph.D. in Physics

2011 – 2016

- ◇ In my studies, I focused on developing high-performance computing techniques and numerical methods for high-fidelity scientific simulations. As a result of my work, I published six peer-reviewed articles in leading international journals and presented the results of my work at several international conferences.
- ◇ Dissertation title: *Nonstandard Representation of Correlated-Fermion Models and its Application to Description of Magnetism and Unconventional Superconductivity*. Degree conferred with Distinction.

#### B.Sc. in Computer Science (3-year program)

2009 – 2012

- ◇ I have obtained this degree independently from my M.Sc. in Physics. The outcomes of my final project contributed to my group's research and resulted in a peer-reviewed publication in a prestigious international journal.

#### M.Sc. in Theoretical Physics (5-year program)

2006 – 2011

- ◇ Realized as a part of the interdisciplinary Studies in Mathematics and Natural Sciences program, extending the standard offering of the physics program with additional classes from the math, computer science, and natural science curricula.
- ◇ Dissertation title: *Selected methods of correlated particles applied to atomic systems in optical lattices*.

## PUBLICATIONS AND PATENTS

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1. X. Li, H. Tang, S. Chen, Z. Wang, A. Maravi and M. Abram, *Context Matters: Data-Efficient Augmentation of Large Language Models for Scientific Applications*, a working paper, arXiv:2312.07069 (2023).
2. D. Stripelis, M. Abram, and J.-L. Ambite, *Performance weighting for robust federated learning against corrupted sources*, a working paper, arXiv:2205.01184 (2022).
3. M. Abram, K. Burghardt, R. Dingreville, G. Ver Steeg, and A. Galstyan, *Inferring topological transitions in pattern-forming processes with self-supervised learning*, *npj Computational Materials* **8**, 205 (2022).
4. Y. Yao, C. Cao, D. Khanna, M. Agarwal, S. Haas, and M. Abram, *Emulating quantum dynamics with neural networks via knowledge distillation*, *Frontiers in Materials* **9**, 1060744 (2022).
5. J. Ward, M. Abram, and D. Honerkamp, *Distributed computer system and method of operation thereof*, European Patent no. EP3929742, Bulletin 2021/52 (December 29, 2021).
6. Y. Ye, D. Qiu, J. Ward, and M. Abram, *Model-free real-time autonomous energy management for a residential multi-carrier energy system: A deep reinforcement learning approach*, Proceedings of the Twenty-Ninth International Joint Conference on Artificial Intelligence (IJCAI) (2020).
7. M. Abram, D. Galindo, D. Honerkamp, J. Ward, and J.-M. Wong, *Democratising blockchain: A minimal agency consensus model* (a working paper presented at Tokenomics 2019, Paris), Tokenomics 2019, arXiv:2006.05390 (2020).
8. M. Abram, M. Zegrodnik, and J. Spalek, *Antiferromagnetism, charge density wave, and d-wave superconductivity in the extended  $t$ - $J$ - $U$  model*, *Journal of Physics: Condensed Matter* **29**, 365602 (2017).
9. M. Abram, M. M. Wysokiński, and J. Spalek, *Tricritical wings in  $UGe_2$ : A microscopic interpretation*, *Journal of Magnetism and Magnetic Materials* **400**, 27–30 (2016).
10. M. M. Wysokiński, M. Abram, and J. Spalek, *Criticalities in the itinerant ferromagnet  $UGe_2$* , *Physical Review B* **91**, 081108(R) (2015).

## PUBLICATIONS AND PATENTS (CONTINUATION)

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11. M. M. Wysokiński, M. Abram, and J. Spałek, *Ferromagnetism in  $UGe_2$ : A microscopic model*, Physical Review B **90**, 081114(R) (2014).
12. A. Kapanowski and M. Abram, *Model of hard spheroplatelets near a hard wall*, Physical Review E **89**, 062503 (2014).
13. M. Abram,  *$t$ - $t'$ - $J$ - $U$  Model in mean-field approximation: Coexistence of superconductivity and antiferromagnetism*, Acta Physica Polonica A **126**, 25 (2014).
14. M. Abram, J. Kaczmarczyk, J. Jędrak, and J. Spałek, *d-wave superconductivity and its coexistence with antiferromagnetism in  $t$ - $J$ - $U$  model: Statistically consistent Gutzwiller approach*, Physical Review B **88**, 094502 (2013).

## FELLOWSHIPS, SCHOLARSHIPS, AND MERIT AWARDS (SELECTION)

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<b>A sponsored research award (\$20,000)</b>	2021
A sponsored research award for the <i>Using Machine Learning to Understand Material Science</i> project.	
<b>Outstanding Reviewer Award</b>	2020
Awarded by the IOP Journal to the top 1% of the reviewers in a given year.	
<b>The Exceptional Doctoral Performance Award</b>	2013 – 2015
<b>Scholarship: Interdisciplinary Ph.D. studies in English Program</b>	2012 – 2015
<b>Scholarship: Study Abroad</b>	January – June 2010
Erasmus Scholarship in Niels Bohr Institute in Copenhagen, Denmark.	
<b>Academic Achievement Scholarship</b>	2008 – 2009
<b>Finalist (top 60 in the country) in the LV Polish Physics Olympiad</b>	April 2006
<b>Finalist (the 9th place in the country) in the XLIX Polish Astronomy Olympiad</b>	March 2006

## RELEVANT TEACHING EXPERIENCE (SELECTION)

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◇ <i>Electricity and Magnetism</i> , University of Southern California, Los Angeles, USA	Fall 2023, Spring 2024
◇ <i>Statistical Physics</i> , University of Southern California, Los Angeles, USA	Spring 2023
◇ <i>Classical Mechanics</i> , University of Southern California, Los Angeles, USA	Fall 2020, Fall 2021, Fall 2022
◇ <i>Machine Learning for Data Science</i> , University of Southern California, Los Angeles, USA	Spring 2021
◇ <i>Physics Laboratory</i> , Jagiellonian University, Kraków, Poland	Spring 2015
◇ <i>Statistical Physics</i> , Jagiellonian University, Kraków, Poland	Spring 2013, Spring 2014
◇ <i>Physics with Biophysics Elements</i> , Jagiellonian University, Kraków, Poland	Spring 2021
◇ <i>Physics Classes for Gifted High-School Students</i> (Outreach Program), Kraków, Poland	2012 – 2014
◇ <i>Math tutor for the Center for the Blind and Visually Impaired</i> , Kraków, Poland	2012 – 2014

## ADDITIONAL SERVICE (SELECTION)

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Reviewer for *New Journal of Physics* (3), *Journal of Physics: Material* (3), *Journal of Physics: Condensed Matter* (6), *Physica Scripta* (1), *Machine Learning: Science and Technology* (7), *IOP SciNotes* (2) and, *Superconductor Science and Technology* (2).