Igor Khmelnitsky

Email: igor.khme@gmail.com
LinkedIn: Igor-khmelnitsky
GitHub: github.com/IgorKhm

Education

École Normale Supérieure (ENS) Paris-Saclay, Université Paris-Saclay — Paris, France
Ph.D. in Computer Science, Advisor: Prof. Alain Finkel and Prof. Serge Haddad. — 2018 – Current

- Thesis: "Verification of infinite-state systems and machine learning"
- To be completed around October 2021

Technion – Israel Institute of Technology — Haifa, Israel
M.S. in Mathematics, Advisor: Prof. Roy Meshulam — 2015 – 2018

- Thesis: "D-collapsibility and its applications"

Technion – Israel Institute of Technology — Haifa, Israel
B.S. in Mathematics with specialization in Computer Science — 2011 – 2015

Experience

Programming Projects — Paris, France
Project developed during the PhD — 2018 – current

- `LeaRNNify - PDV`[1]: *A tool preforming verification of Recurrent neural networks's acc--ording to a given regular language. This tool is written in Python using the PyTorch library and is based on the ideas developed in [3].*
- `MinCov`[2]: *Python implementation of an algorithm computing the clover for a given Petri net. This tool is based on the ideas developed in [5].*

Intel — Haifa, Israel
Student position during my Bachelor's studies (2 days a week) — 2013 – 2015

- *Involved in two projects. Both were in-house tools used to help with chip verification. Written mainly in C#.*
- *Member of the "Tools and Practices" committee.*

Skills

- **Programming:**

  Python: *Used as my weapon of choice in all recent projects. From `MinCov` an implementation of a verification algorithm, to `LeaRNNify - PDV` a machine learning project.*

  Cython: *Recently started translating small sections of my Python code to Cython in order to get performance boosts for critical computations.*

  C#: *During my free time I've statrted working on a game using Unity, where the code is written in C#.*

  C, C++: *Used during my undergraduate studies and my work in Intel.*

- **Machine Learning:** *Learning and using **PyTorch** for the last year. In `LeaRNNify - PDV` I helped develop a tool learning and verifying Recurrent Neural Networks.*
- **Scientific Programming:**

  SageMath: *Used SageMath for my M.S. thesis in order to find simplicial complexes with specific properties.*

  Matlab: *Used during my undergraduate studies.*

[1] github.com/LeaRNNify/Property-directed-verification
[2] github.com/IgorKhm/MinCov

Scholarships and Awards

- Full Ph.D. Scholarship from ENS Paris-Saclay 2018 – 2021
- Excellent Instructor - Award 2018
- Excellent Faculty Instructor - Award 2017
- Excellent Instructor - Award 2016
- Full M.S. Scholarship from Technion – Israel Institute of Technology 2015 – 2018

Publications

[1] B. Barbot, B. Bollig, A. Finkel, S. Haddad, I. Khmelnitsky, M. Leucker, D. Neider, R. Roy, and L. Ye, *Extracting context-free grammars from recurrent neural networks using tree-automata learning and a* search*, (Submitted to an international conference), 2021.

[2] A. Finkel, S. Haddad, and I. Khmelnitsky, "Coverability, termination, and finiteness in recursive Petri nets", 2021, (Submitted to a special issue journal for Petri Nets 2019).

[3] I. Khmelnitsky, D. Neider, R. Roy, B. Barbot, B. Bollig, A. Finkel, S. Haddad, M. Leucker, and L. Ye, *Property-directed verification and robustness certification of recurrent neural networks*, (Accepted to ATVA21), 2021.

[4] A. Finkel, S. Haddad, and I. Khmelnitsky, "Commodification of accelerations for the Karp and Miller Construction", *Discrete Event Dynamic Systems*, pp. 1–20, 2020.

[5] A. Finkel, S. Haddad, and I. Khmelnitsky, "Minimal coverability tree construction made complete and efficient", in *Foundations of Software Science and Computation Structures(FOSSACS)*, 2020, pp. 237–256.

[6] S. Haddad and I. Khmelnitsky, "Dynamic recursive petri nets", in *Application and Theory of Petri Nets and Concurrency*, 2020, pp. 345–366.

[7] A. Finkel, S. Haddad, and I. Khmelnitsky, "Coverability and termination in recursive petri nets", in *Application and Theory of Petri Nets and Concurrency*, 2019, pp. 429–448.

[8] A. Finkel, S. Haddad, and I. Khmelnitsky, "Réification des accélérations pour la construction de Karp et Miller", in *Actes du 12ème Colloque sur la Modélisation des Systèmes Réactifs (MSR'19)*, Angers, France: HAL, 2019.

Academic Projects and Activities

- Member of LeaRNNify[3] 2020 – current
  A research project at the interface of formal methods and artificial intelligence. Its aim is to bring together two different kinds of algorithmic learning, namely grammatical inference and learning of neural networks.
- Member of scientific committee and organiser of ForMal[4] spring school, 2018 – 2019
  Spring school focused on the topics of Formal Methods and Machine Learning.

[3] www.learnnify.org

[4] www.formal-paris-saclay.fr

Teaching

- **Teaching Assistant** at ENS Paris-Saclay 2019 – 2020
  Discrete mathematics
  Architecture and systems
- **Teaching Assistant** at Technion 2015 – 2018
  Linear algebra
  Combinatorial algorithms

Languages

• **English:**	Fluent
• **Hebrew:**	Native
• **Russian:**	Oral fluency
• **French:**	Beginner