

# Marco VIRGOLIN

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## CONTACT

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ADDRESS: Centrum Wiskunde & Informatica, Science Park 123, 1098 XG Amsterdam, NL  
PHONE: +31 628 735831  
EMAIL: [marco.virgolin@cwi.nl](mailto:marco.virgolin@cwi.nl)  
WEBSITE: [marcovirgolin.github.io](https://marcovirgolin.github.io)

## RESEARCH INTERESTS

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Machine Learning, Evolutionary Computation, Explainable AI, Human-Machine Interaction

## EDUCATION

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SEP '21 – NOW	<b>Scientific Staff Member (Tenure Track)</b> @ <i>Centrum Wiskunde &amp; Informatica</i> , Amsterdam, NL
JUN '20 – AUG '21	<b>Postdoctoral Fellow</b> @ <i>Chalmers University of Technology</i> , Gothenburg, SE Supervisor: Prof. dr. Mattias WAHDE
NOV '19 – MAR '20	<b>Project Researcher</b> @ <i>Centrum Wiskunde &amp; Informatica</i> , Amsterdam, NL Supervisor: Prof. dr. Peter A.N. BOSMAN
NOV '15 – JUN '20	<b>Ph.D. in Evolutionary Machine Learning</b> @ <i>Centrum Wiskunde &amp; Informatica</i> , Amsterdam, NL Promotors: Prof. dr. Peter A.N. BOSMAN, Prof. dr. Cees WITTEVEEN Co-promotor: Dr. Tanja ALDERLIESTEN
MAR '15	<b>Master in Computer Engineering</b> @ <i>University of Trieste</i> , Trieste, IT 110/110 <i>cum laude</i>   Advisor: Prof. dr. Alberto BARTOLI
JUN '14 – AUG '14	<b>Internship in Machine Learning for Cybersecurity</b> @ <i>Machine Learning Lab, University of Trieste</i> , Trieste, IT Supervisor: Prof. dr. Alberto BARTOLI
OCT '12	<b>Bachelor in Information Technology Engineering</b> @ <i>University of Trieste</i> , Trieste, IT Advisor: Prof. dr. Maurizio FERMEGLIA

## PUBLICATIONS

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1. **M. Virgolin** and Solon P. Pissis. Symbolic regression is NP-hard. *Preprint on arXiv*, (2022).
2. D. Liu, **M. Virgolin**, T. Alderliesten, and P.A.N. Bosman. Evolvability degeneration in multi-objective genetic programming for symbolic regression. **Best paper award**. *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '22)*, pp. 973–981, ACM (2022).
3. T. Uriot, **M. Virgolin**, T. Alderliesten, and P.A.N. Bosman. On genetic programming representations and fitness functions for interpretable dimensionality reduction. *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '22)*, pp. 458–466, ACM (2022).
4. M. Wahde and **M. Virgolin**. DAISY: An Implementation of Five Core Principles for Transparent and Accountable Conversational AI. *International Journal of Human-Computer Interaction* (2022)
5. **M. Virgolin**, A. De Lorenzo, T. Alderliesten, and P.A.N. Bosman. Adults as augmentations for children in facial emotion recognition with contrastive learning. *Preprint on arXiv*, (2022).
6. **M. Virgolin** and S. Fracaros. On the robustness of counterfactual explanations to adverse perturbations. *Preprint on arXiv*, (2022).

7. M. Wahde and **M. Virgolin**. Conversational agents: theory and applications. *To appear as book chapter in Handbook on Computer Learning and Intelligence*, World Scientific (2022).
8. **M. Virgolin**, M. Bellone, K. Wolff, and M. Wahde. A mobile interactive robot for social distancing in hospitals. *IEEE International Conference on Robotic Computing (IRC)*, pp. 87-91, IEEE (2021).
9. A. Dushatskiy, **M. Virgolin**, A. Bouter, D. Thierens, and P.A.N. Bosman. Parameterless gene-pool optimal Mixing evolutionary algorithms. *Preprint on arXiv*, (2021).
10. W. La Cava, P. Orzechowski, B. Burlacu, F. Olivetti de Franca, **M. Virgolin**, Y. Jin, M. Kommenda, and J. H. Moore. Contemporary symbolic regression methods and their relative performance. *NeurIPS Datasets and Benchmarks Track*, (2021).
11. **M. Virgolin**, A. De Lorenzo, F. Randone, E. Medvet, and M. Wahde. Model learning with personalized interpretability estimation (ML-PIE). *Proceedings of the Genetic and Evolutionary Computation Conference Companion (GECCO '21)*, pp. 1355-1364, ACM (2021).
12. **M. Virgolin**. Genetic programming is naturally suited to evolve bagging ensembles. *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '21)*, pp. 830-839, ACM (2021).
13. M. Wahde and **M. Virgolin**. The five Is: Key principles for interpretable and safe conversational AI. *Preprint on arXiv*, (2021).
14. T. den Ottelander, A. Dushatskiy, **M. Virgolin**, and P.A.N. Bosman. Local search is a remarkably strong baseline for neural architecture search. **Best paper award**. *Evolutionary Multi-Criterion Optimization*, pp. 465-479, Springer (2021).
15. **M. Virgolin**, T. Alderliesten, C. Witteveen, and P.A.N. Bosman. Improving model-based genetic programming for symbolic regression of small expressions. *Evolutionary Computation*, **29** (2), pp. 211-237, MIT Press (2021).
16. **M. Virgolin**, A. de Lorenzo, E. Medvet, and F. Randone. Learning a formula of interpretability to learn interpretable formulas. *Parallel Problem Solving from Nature - PPSN XVI*, pp. 79-93, Springer (2020).
17. **M. Virgolin**. Design and application of gene-pool optimal mixing evolutionary algorithms for genetic programming. *Doctoral dissertation, Delft University of Technology, Delft, the Netherlands* (2020).
18. **M. Virgolin**, Z. Wang (shared co-first authorship), B.V. Balgobind, I.W.E.M. van Dijk, J. Wiersma, P.S. Kroon, G.O. Janssens, M. van Herk, D.C. Hodgson, L. Zdravec Zaletel, C.R.N. Rasch, A. Bel, P.A.N. Bosman, and T. Alderliesten. Surrogate-free machine learning-based organ dose reconstruction for pediatric abdominal radiotherapy. *Physics in Medicine & Biology* (2020).
19. **M. Virgolin**, Z. Wang (shared co-first authorship), B.V. Balgobind, I.W.E.M. van Dijk, J. Wiersma, D.C. Hodgson, A. Bryce-Atkinson, M. van Herk, C.R.N. Rasch, L. Zdravec Zaletel, P.S. Kroon, G.O. Janssens, A. Bel, P.A.N. Bosman, and T. Alderliesten. Highly-individualized dose reconstruction for pediatric abdominal radiotherapy with machine learning. *Proffered paper at ESTRO 2020, Radiotherapy and Oncology* (2020).
20. **M. Virgolin**, T. Alderliesten, and P.A.N. Bosman. On explaining machine learning models by evolving crucial and compact features. *Swarm and Evolutionary Computation* **53**, pp. 100640, Elsevier (2020).
21. **M. Virgolin**, Z. Wang, T. Alderliesten, and P.A.N. Bosman. Machine learning for the prediction of pseudorealistic pediatric abdominal phantoms for radiation dose reconstruction. *Journal of Medical Imaging*, **7** (4), pp. 1-25, SPIE (2020).
22. **M. Virgolin**, Z. Wang, T. Alderliesten, and P.A.N. Bosman. Machine learning for automatic construction of pediatric abdominal phantoms for radiation dose reconstruction. *In Proceedings of SPIE Medical Imaging 2020: Imaging Informatics for Healthcare, Research, and Applications*, International Society for Optics and Photonics, (2020).
23. **M. Virgolin**, T. Alderliesten, and P.A.N. Bosman. Linear scaling with and within semantic backpropagation-based genetic programming for symbolic regression. *In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '19)*, pp. 1084-1092, ACM (2019).
24. Z. Wang, B.V. Balgobind, **M. Virgolin**, I.W.E.M. van Dijk, J. Wiersma, C.M. Ronckers, P.A.N. Bosman, A. Bel, and T. Alderliesten. How do patient characteristics and anatomical features correlate to accuracy of organ dose reconstruction for Wilms' tumor radiation treatment plans when using a surrogate patient's CT scan? *Journal of Radiological Protection* **39** (2), pp. 598-619, IOP Publishing (2019).

25. Z. Wang, **M. Virgolin**, P.A.N. Bosman, B.V. Balgobind, A. Bel, and T. Alderliesten. Automatic radiotherapy plan emulation for 3D dose reconstruction to enable big data analysis for historically treated patients. *In Proceedings of SPIE Medical Imaging 2019: Imaging Informatics for Healthcare, Research, and Applications* **10954**, pp. 203–211, International Society for Optics and Photonics (2019).
26. E. Medvet, **M. Virgolin**, M. Castelli, P.A.N. Bosman, I. Gonçalves, and T. Tusar. Unveiling evolutionary algorithm representation with DU maps. *Genetic Programming and Evolvable Machines* **19** (3), pp. 351–389, Springer (2018).
27. **M. Virgolin**, T. Alderliesten, A. Bel, C. Witteveen, and P.A.N. Bosman (2018). Symbolic regression and feature construction with GP-GOMEA applied to radiotherapy dose reconstruction of childhood cancer survivors. *In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '18)*, pp. 1395–1402, ACM (2018).
28. **M. Virgolin**, I.W.E.M. van Dijk, J. Wiersma, C.M. Ronckers, C. Witteveen, A. Bel, T. Alderliesten, and P.A.N. Bosman. On the feasibility of automatically selecting similar patients in highly individualized radiotherapy dose reconstruction for historic data of pediatric cancer survivors. *Medical Physics* **45** (4), pp. 1504–1517, Wiley (2018).
29. **M. Virgolin**, T. Alderliesten, C. Witteveen, and P.A.N. Bosman. Scalable genetic programming by gene-pool optimal mixing and input-space entropy-based building-block learning. *In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '17)*, pp. 1041–1048, ACM (2017).
30. A. Bartoli, A. De Lorenzo, E. Medvet, F. Tarlao, and **M. Virgolin**. Evolutionary learning of syntax patterns for genic interaction extraction. *In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '15)*, pp. 1183–1190, ACM (2015).

## SERVICES

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- Reviewer for the following journals:
  - IEEE Transactions on Evolutionary Computation (since 2019)
  - Genetic Programming and Evolvable Machines (since 2020)
  - Soft Computing (since 2020)
  - Computer Methods and Programs in Biomedicine (since 2021)
- Reviewer for the following books:
  - 2nd edition of the Handbook on Computer Learning and Intelligence (2021)
- Program committee member for the following conferences and events:
  - Genetic and Evolutionary Computation Conference (2022)
  - European Conference on Genetic Programming (2022)
  - Journal Track @ European Conference on Machine Learning PKDD (2021, 2022)
  - Parallel Problem Solving in Nature Conference (2020, 2022)
  - Trustworthy and Socially Responsible Machine Learning Workshop @ NeurIPS (2022)
  - Workshop and Tutorial on eXplainable Knowledge Discovery in Data Mining (XKDD) @ European Conference on Machine Learning PKDD (2021, 2022)
  - Workshop Evolutionary and Population-based Optimization @ AlxIA (2020, 2021)
- Other services:
  - Co-organizer of the *Joint Lectures on Evolutionary Algorithms* (2021, 2022)
  - Session chair for the symposium “*Back to the Future and Beyond – Traversing the Ever-Evolving Landscape of Evolutionary Algorithms*” (2019)
  - Electronic media chair for the Genetic and Evolutionary Computation Conference (2017)

## AWARDS

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- **SIGEO Best Dissertation Award** for my Ph.D. dissertation “*Design and Optimization of Gene-pool Optimal Mixing Evolutionary Algorithms for Genetic Programming*”
- **HUMIES Silver Award** for our work on using genetic programming for radiotherapy dose reconstruction (2021)

- Best Paper Award for “*Local search is a remarkably strong baseline for neural architecture search*” at EMO (2021)
- Best Paper Award for “*Evolvability Degeneration in Multi-Objective Genetic Programming for Symbolic Regression*” at GECCO (2022)
- Student Travel Award for GECCO ‘19 in Prague, Czech Republic, GECCO ‘18 in Kyoto, Japan, and GECCO ‘17 in Berlin, Germany

## GRANTS

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- Co-applicant for “*Interpretability and accountability of conversational AI in healthcare*” with prof. M. Wahde, dr. K. Wolff, and dr. M. Bellone. Fund of 300,000 SEK by Area of Advance Health Engineering, Chalmers University of Technology (2021)

## NOTABLE TALKS

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1. *A bird-eye view on glass-box model generation* – Invited lecture at UvA course *Interpretability & Explainability in AI*, Amsterdam, June 2022
2. *Model learning with personalized interpretability estimation (ML-PIE)* – GECCO 2021, Lille, France, July 2021
3. *Genetic programming is naturally suited to evolve bagging ensembles* – GECCO 2021, Lille, France, July 2021
4. *Highly-individualized dose reconstruction for pediatric abdominal radiotherapy with machine learning* – ESTRO 2020, Vienna, Austria, November 2020
5. *Giving sight to recombination for more scalable genetic programming* – MIT Computer Science & Artificial Intelligence Lab, Boston, Massachusetts, USA, February 2020
6. *Evolutionary machine learning for 3D radiation dose reconstruction* – Delft AI Meetup Delft, the Netherlands, January 2020
7. *Linear scaling with and within semantic backpropagation-based genetic programming for symbolic regression* – the Genetic and Evolutionary Computation Conference, Prague, Czech Republic, July 2019
8. *Explainable, evolutionary machine learning for highly individualized radiation dose reconstruction* – Amsterdam Data Science 2018 Highlights, Amsterdam, the Netherlands, December 2018
9. *Symbolic regression and feature construction with GP-GOMEA applied to radiotherapy dose reconstruction of childhood cancer survivors* – the Genetic and Evolutionary Computation Conference, Kyoto, July 2018
10. *Automatic retrieval of similar patients by machine learning for 3D dose reconstruction* – Scientific Project Day, Universitair Medisch Centrum Utrecht, Utrecht, the Netherlands, October 2017
11. *Scalable GP by gene-pool optimal mixing and input-space entropy-based building-block learning* – the Genetic and Evolutionary Computation Conference, Berlin, July 2017

## TEACHING EXPERIENCE

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JUNE 2022	<b>Guest Lecturer</b> <i>University of Amsterdam, Amsterdam, NL. Guest lecturer on Explainable AI for the course “Interpretability and Explainability in AI”</i>
APRIL–JULY 2022	<b>Co-Teacher</b> <i>Delft University of Technology, Delft, NL. Assistance for exercise hours, design and correction of (part of) practicals and exam questions, and lecturer on Genetic Programming, for the course “Evolutionary Algorithms”</i>
2022	<b>Co-supervisor of Master Thesis</b> <i>Delft University of Technology, Delft, NL. Co-supervision with M.Sc. A. Dushatskiy and Prof. dr. P.A.N. Bosman of Master Thesis by N. Cleintuar “Title TBD”</i>
2022	<b>Co-supervisor of Master Thesis</b> <i>Delft University of Technology, Delft, NL. Co-supervision with M.Sc. A. Dushatskiy and Prof. dr. P.A.N. Bosman of Master Thesis by L. Everse “Neuro-GOMEA – Using Modern Evolutionary Algorithms to Train Neural Networks”</i>
2021	<b>Co-supervisor of Master Thesis</b> <i>Chalmers University of Technology, Gothenburg, SE. Co-supervision with Prof. dr. M. Wahde of Master Thesis by H. Zheng “Transparent intention recognition for an intelligent information system with a web-based interface”</i>
SEPTEMBER–OCTOBER 2020	<b>Teaching Assistant</b> <i>Chalmers University of Technology, Gothenburg, SE. One-on-one student assistance and correction of practicals for the course “Stochastic Optimization Algorithms”</i>
MAY 2020	<b>Guest Lecturer</b> <i>Delft University of Technology, Delft, NL. Guest lecturer on Genetic Programming, incl. design and correction of a related assignment, for the course “Evolutionary Algorithms”</i>
2019–2020	<b>Co-supervisor of Master Thesis</b> <i>Delft University of Technology, Delft, NL. Co-supervision with M.Sc. A. Dushatskiy and Prof. dr. P.A.N. Bosman of Master Thesis by T. den Ottelander “Do More Elaborate Search Strategies Lead to Better Neural Architecture Search Performance?”</i>
APRIL–JULY 2019	<b>Teaching Assistant</b> <i>Delft University of Technology, Delft, NL. Assistance for exercise hours, design and correction of (part of) practicals and exam questions, and guest lecturer on Genetic Programming, for the course “Evolutionary Algorithms”</i>
2018	<b>Co-supervisor of Master Thesis</b> <i>University of Utrecht, Utrecht, NL. Co-supervision with Dr. D. Thierens of Master Thesis by S. de Vries, titled “Sensitivity Analysis Based Feature-Guided Evolution for Symbolic Regression”</i>
FEBRUARY–JUNE 2017	<b>Co-supervisor of Bachelor Seminar Course</b> <i>Delft University of Technology, Delft, NL. Co-supervision with Prof. dr. P.A.N. Bosman of Bachelor Seminar Course on Genetic Programming</i>

## INDUSTRY EXPERIENCE

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AUG ‘12 – SEP ‘13	<b>Front-end &amp; Back-end Web Developer (Part-time)</b> <i>Promoscience, Area Science Park, Padriciano, IT</i>
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## OTHER EXPERIENCE

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- ‘21 – Now    **Co-organizer of JoLEA**  
*Centrum Wiskunde & Informatica*, Amsterdam, NL. I co-organize the Joint Lectures on Evolutionary Algorithms (JoLEA) <https://jolea.project.cwi.nl>.
- ‘17    **Electronic Media Chair for GECCO 2017**  
*Centrum Wiskunde & Informatica*, Amsterdam, NL. I worked on back-end, front-end, and maintenance of the website and social pages of GECCO. A noteworthy contribution is the proposal of a new style that would fit and modernize the website of the conference (shapely theme). From 2017 onward, GECCO's website has a new face.
- ‘17    **Member of PhD Activity Committee**  
*Centrum Wiskunde & Informatica*, Amsterdam, NL. I organized and help organizing recreational events and activities.
- ‘14 – ‘15    **Volunteer for ASSociazione TRIestina Ospedaliera (ASTRO)**  
*Burlo Garofalo pediatric hospital*, Trieste, IT. I was keeping company and entertaining hospitalized children.
- ‘12 – ‘14    **Member of Electrical Engineering Students' European assoCiation (EESTEC)**  
*University of Trieste*, Trieste, IT. I helped with the organization of recreational international summer schools and was first responsible for the organization of some events, among which a seminar on job opportunities after the studies (What's Next, speakers eng. Erni Durdevic, eng. Giorgio Faustini, prof. Eric Medvet), and a seminar on Machine Learning (speaker dr. Andrea de Lorenzo).