Michele Braccini's curriculum vitae

PERSONAL INFORMATION

Full name: *Michele Braccini*

Date of birth: *18 February 1991*

Nationality: *Italy*

Sex: *Male*

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ORCID:0000-0002-2335-2514

WORK EXPERIENCE

- ***Research fellow*** [2021 — 2022]
  @ European Centre for Living Technology ECLT, Università Ca' Foscari Venezia

  – Research theme title: *DC-ren - Drug combinations for rewriting trajectories of renal pathologies in type II diabetes*

  – Research description: My research involves the employment of Machine Learning methods and Multiple and Multivariate Regression models (Clustering algorithms, Random Forest, Neural Network, Support Vector Regression, Lasso, etc...) to model states characterising Diabetic Kidney Disease and to predict the prognosis of patients in the context of precision medicine. In addition, Reinforcement Learning approaches (Q-learning) have been put in place to optimise the sequence of available treatments.

- ***Research fellow*** [2020 — 2021]
  @ Department of Computer Science and Engineering, University of Bologna

  – Research theme title: *From cell differentiation to collective robotics: genetic regulatory network models as control software for robot swarms*

  – Research description: My research is focused on the study of cell differentiation mechanisms by means of formulation and refinement of computational models based on Boolean networks. Also, we make use of the developed models in robotics to design robots with the ability to specialise their behaviours in a way similar to that of cells that undergo differentiation. Moreover, we exploit robotics to study bio-inspired adaptive mechanism that contribute to the appearance of complex behaviour and therefore represent, in an evolutionary biology perspective, valid candidates for the emergence of novelty, diversity and fittest organisms along the evolutionary scale.

- ***Internship as computer programmer*** [February, 2013 — May, 2013]
  @ Ideato srl, Cesena (Italy)

  – Project: *Development of an Android application concerning the management of conferences.*

EDUCATION

- ***PhD in Computer Science and Engineering*** [April, 2020]
  Alma Mater Studiorum - Università di Bologna, Dipartimento di Informatica - Scienza e Ingegneria
  - Thesis Title: *Towards a Boolean network-based Computational Model for Cell Differentiation and its applications to Robotics*
  - Supervisor: *Andrea Roli*
  - Tutor: *Mirko Viroli*
  - Reviewers: *Stuart Kauffman* and *Timoteo Carletti*
  - Commission final evaluation: *Excellent*
- ***M.S. in Computer Engineering LM-32*** [2013 — 2016]
  Name of the course of study: *Ingegneria e Scienze Informatiche*
  Alma Mater Studiorum - Università di Bologna - School of Engineering and Architecture, Cesena (Italy)
  - Final degree mark: *110L/110 Magna Cum Laude*
  - Thesis Title: *Automatic design of boolean networks for modelling differentiation trees*
  - Supervisor: *Andrea Roli*
  - Thesis subject: *Intelligent Robotic Systems*
- ***B.S. in Information Engineering L-8*** [2010 — 2013]
  Name of the course of study: *Ingegneria Elettronica, Informatica e Telecomunicazioni*
  Alma Mater Studiorum - Università di Bologna - School of Engineering and Architecture, Cesena (Italy)
  - Final degree mark: *104/110*
  - Thesis Title: *Intelligenza artificiale: test di Turing e alcune questioni filosofiche*
  - Supervisor: *Andrea Roli*
  - Thesis subject: *Foundations of Informatics B*
- ***High School Diploma*** [2005 — 2010]
  ITIS (State Industrial and Technical Institute) Blaise Pascal, Cesena (Italy)
  - Final degree mark: *100/100*

AWARDS AND ACHIEVEMENTS

- ***Honorable mention - "Lions Award for Scientific Research and Technological Innovation 2020"*** [28 September, 2020]
  My PhD thesis, titled "Towards a network-based Boolean computational model for cell differentiation and its applications to robotics", was selected among the 6 finalists of the "Lions Award for Scientific Research and Technological Innovation 2020", named after Claudio Bonivento, and received an honorable mention.
- ***'Roberto Ruffilli' Award*** [January 2010]
  Issued by 'Camera di Commercio Forlì-Cesena' for having obtained the secondary school education diploma with a score of 100/100

LICENSES AND CERTIFICATIONS

- ***Matlab Fundamentals*** [20 May, 2020]
  Course Completion Certificate released by MathWorks Training Service

EXPERIENCE

- ***Visiting Researcher*** [June, 2018 — September, 2018]
  @ Institute for Systems Biology (ISB), Seattle (WA), United States Of America
  - Performed activity: *Simulation and analysis of discrete and continuous models of GRNs (Boolean network and ODE-based models) for studying cell differentiation process.*

SCIENTIFIC PUBLICATIONS

- **Michele Braccini**, Andrea Roli, Edoardo Barbieri, and Stuart A. Kauffman. On the criticality of adaptive boolean network robots. *Entropy*, 24(10), 2022.
  *Paper selected as **"Feature Paper"** by Entropy, as it is considered advanced research with significant potential for high impact in the field.*
  *It was also selected as **title story** for Entropy in November 2022.*
- **Michele Braccini**, Andrea Roli, Marco Villani, and Roberto Serra. Dynamical properties and path dependence in a gene-network model of cell differentiation. *Soft Comput.*, 25(9):6775–6787, 2021.
- Sara Montagna, **Michele Braccini**, and Andrea Roli. The impact of self-loops on boolean networks attractor landscape and implications for cell differentiation modelling. *IEEE ACM Trans. Comput. Biol. Bioinform.*, 18(6):2702–2713, 2021.
- **Michele Braccini**, Andrea Roli, and Stuart A. Kauffman. Online adaptation in robots as biological development provides phenotypic plasticity. *CoRR*, abs/2006.02367, 2020.
- **Michele Braccini**, Andrea Roli, Marco Villani, Sara Montagna, and Roberto Serra. A simplified model of chromatin dynamics drives differentiation process in Boolean models of GRN. volume ALIFE 2019: The 2019 Conference on Artificial Life of *ALIFE 2021: The 2021 Conference on Artificial Life*, pages 211–217, 07 2019.
- **Michele Braccini**, Andrea Roli, Marco Villani, Sara Montagna, and Roberto Serra. The effects of a simplified model of chromatin dynamics on attractors robustness in random boolean networks with self-loops: An experimental study. In Franco Cicirelli, Antonio Guerrieri, Clara Pizzuti, Annalisa Socievole, Giandomenico Spezzano, and Andrea Vinci, editors, *Artificial Life and Evolutionary Computation - 14th Italian Workshop, WIVACE 2019, Rende, Italy, September 18-20, 2019, Revised Selected Papers*, volume 1200 of *Communications in Computer and Information Science*, pages 28–37. Springer, 2019.
- Andrea Roli and **Michele Braccini**. Attractor landscape: A bridge between robotics and synthetic biology. *Complex Syst.*, 27(3), 2018.
- **Michele Braccini**, Sara Montagna, and Andrea Roli. Self-loops favour diversification and asymmetric transitions between attractors in boolean network models. In Stefano Cagnoni, Monica Mordonini, Riccardo Pecori, Andrea Roli, and Marco Villani, editors, *Artificial Life and Evolutionary Computation - 13th Italian Workshop, WIVACE 2018, Parma, Italy, September 10-12, 2018,*

Revised Selected Papers, volume 900 of *Communications in Computer and Information Science*, pages 30–41. Springer, 2018.

- Sara Montagna, **Michele Braccini**, and Andrea Roli. The impact of self-loops in random boolean network dynamics: A simulation analysis. In Marcello Pelillo, Irene Poli, Andrea Roli, Roberto Serra, Debora Slanzi, and Marco Villani, editors, *Artificial Life and Evolutionary Computation - 12th Italian Workshop, WIVACE 2017, Venice, Italy, September 19-21, 2017, Revised Selected Papers*, volume 830 of *Communications in Computer and Information Science*, pages 104–115. Springer, 2017.
- **Michele Braccini**, Andrea Roli, Marco Villani, and Roberto Serra. A comparison between threshold ergodic sets and stochastic simulation of boolean networks for modelling cell differentiation. In Marcello Pelillo, Irene Poli, Andrea Roli, Roberto Serra, Debora Slanzi, and Marco Villani, editors, *Artificial Life and Evolutionary Computation - 12th Italian Workshop, WIVACE 2017, Venice, Italy, September 19-21, 2017, Revised Selected Papers*, volume 830 of *Communications in Computer and Information Science*, pages 116–128. Springer, 2017.
- **Michele Braccini**. Applications of biological cell models in robotics. *CoRR*, abs/1712.02303, 2017.
- **Michele Braccini**, Andrea Roli, Marco Villani, and Roberto Serra. Automatic design of boolean networks for cell differentiation. In Federico Rossi, Stefano Piotto, and Simona Concilio, editors, *Advances in Artificial Life, Evolutionary Computation, and Systems Chemistry - 11th Italian Workshop, WIVACE 2016, Fisciano, Italy, October 4-6, 2016, Revised Selected Papers*, volume 708 of *Communications in Computer and Information Science*, pages 91–102, 2016.

CONFERENCES PARTICIPATION

- ***WIVACE 2022*** [14 September, 2022 — 16 September, 2022]
  Workshop on Artificial Life and Evolutionary Computation, Gaeta (Italy)
- ***ALIFE 2019*** [29 July, 2019 — 2, August 2019]
  "The 2019 Conference on Artificial Life", Newcastle (United Kingdom)
- ***WIVACE 2019*** [18 September, 2019 — 20 September, 2019]
  Workshop on Artificial Life and Evolutionary Computation, Rende (Cosenza) (Italy)
- ***WIVACE 2018*** [10 September, 2018 — 12 September, 2018]
  Workshop on Artificial Life and Evolutionary Computation, Parma (Italy)
- ***WIVACE 2017*** [19 September, 2017 — 21 September, 2017]
  Workshop on Artificial Life and Evolutionary Computation, Venezia (Italy)
- ***WIVACE 2016*** [4 October, 2016 — 7 October, 2016]
  Workshop on Artificial Life and Evolutionary Computation, Salerno (Italy)

ATTENDED PHD COURSES

- ***Bertinoro International Spring School 2017*** [2017]
  School for PhD students in Computer Science, Bertinoro, Italy
  `www.cs.unibo.it/projects/biss2017/`
  - *Approximation algorithms* - Prof. Fabrizio Grandoni, Scuola Universitaria Professionale della Svizzera Italiana.

  - *Kleene algebra with tests and applications to network programming* - Prof. Alexandra Silva, University College London
  - *Probabilistic graphical models in intelligent systems* - Prof. Luigi Portinale, Università del Piemonte Orientale "Amedeo Avogadro"
- *Approximate solution of optimization problems* - Prof. Silvano Martello, Operations Research, University of Bologna, Italy.
- *Models and algorithms for matching and assignment problems* - Prof. Silvano Martello, Operations Research, University of Bologna, Italy.
- *Developing, maintaining and sharing software tools for research* - Prof. Danilo Pianini, University of Bologna, Italy.
- *Introduction to complex systems science* - Prof. Andrea Roli, DISI University of Bologna, Italy.
- *Spatial multiagent systems and aggregate computing: new directions for spatial computing* - Prof. Andrea Omicini and Prof. Mirko Viroli, DISI University of Bologna, Italy.

TUTORING ACTIVITY

- ***Laboratory of Biomedical Computer Engineering*** [2020]
  Bachelor in Biomedical Engineering, University of Bologna, hours: 40
- ***Foundations of Informatics A*** [2020]
  Bachelor in Electronics Engineering for Energy and Information, University of Bologna, hours: 20
- ***Foundations of Informatics A*** [2019]
  Bachelor in Electronics Engineering for Energy and Information and Bachelor in Biomedical Engineering, University of Bologna, hours: 50
- ***Foundations of Informatics A*** [2018]
  Bachelor in Electronics Engineering for Energy and Information and Bachelor in Biomedical Engineering, University of Bologna, hours: 60
- ***Foundations of Informatics A*** [2017]
  Bachelor in Electronics Engineering for Energy and Information and Bachelor in Biomedical Engineering, University of Bologna, hours: 60
- ***Foundations of Informatics A*** [2016]
  Bachelor in Electronics Engineering for Energy and Information and Bachelor in Biomedical Engineering, University of Bologna, hours: 75

ACADEMIC SERVICE

- *SCIENTIFIC REPORTS (NATURE)* [29 September 2022]
  - *Reviewer*
- *FRONTIERS IN MOLECULAR BIOSCIENCES* [15 November 2021]
  - *Reviewer*
    (`https://www.frontiersin.org/articles/10.3389/fmolb.2021.754444`)

- *WIVACE 2021* [15 September 2021 — 17 September 2021]
  XV International Workshop on Artificial Life and Evolutionary Computation, Winterthur, (Switzerland)
  - *Program Committee (PC) member*
  - *Subreviewer*
- *LOD 2021* [4 October 2021 — 8 October, 2021]
  The Seventh International Conference on Machine Learning, Optimization, and Data Science - An Interdisciplinary Conference: Machine Learning, Optimization, Big Data & Artificial Intelligence without Borders, Grasmere, (UK)
  - *Program Committee (PC) member*
  - *Reviewer*
- *ALIFE 2021* [19 July, 2021 — 23 July, 2021]
  The 2021 Conference on Artificial Life (Prague, Czech Republic)
  - *Subreviewer*
- *AAMAS 2020* [9 May, 2020 — 13 May, 2020]
  19th International Conference on Autonomous Agents and Multi-Agent Systems, Auckland (New Zealand)
  - *Reviewer*
- *LOD 2020* [19 July 2020 — 23 July, 2020]
  The Sixth International Conference on Machine Learning, Optimization, and Data Science, Certosa di Pontignano, Siena (Italy)
  - *Program Committee (PC) member*
  - *Reviewer*
- *WIVACE 2019* [18 September, 2019 — 20 September, 2019]
  Workshop on Artificial Life and Evolutionary Computation, Rende (Cosenza) (Italy)
  - *Program Committee (PC) member*
- *WIVACE 2018* [10 September, 2018 — 12 September, 2018]
  Workshop on Artificial Life and Evolutionary Computation, Parma (Italy)
  - *Program Committee (PC) member*
  - *Reviewer*
- *WIVACE 2017* [19 September, 2017 — 21 September, 2017]
  - *Program Committee (PC) member*
  - *Subreviewer*

THESIS (CO)SUPERVISION

- ***Master Thesis.*** *(co-supervisor)* [Academic year 2021 — 2022]
  Student: **Paolo Baldini**.
  Thesis title: *Online adaptation of robots controlled by nanowire networks*, University of Bologna
  Keywords: adaptation,endogenic memory,nanowire network,network plasticity,neuromorphic computation,phenotypic plasticity,reservoir computing
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2020 — 2021]
  Student: **Andrea Petreti**.
  Thesis title: *Evoluzione artificiale di comportamenti collettivi in gruppi di robot controllati da reti booleane*, University of Bologna
  Keywords: progettazione automatica, boolean network, misure di complessità, swarm robotics, algoritmi genetici, teoria dell'informazione, evoluzione artificiale, sistemi intelligenti robotici
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2020 — 2021]
  Student: **Matteo Magnini**.
  Thesis title: *An information theory analysis of critical Boolean networks as control software for robots*, University of Bologna
  Keywords: Boolean network, robot, information theory, obstacle avoidance, path following, phototaxis, phenotypic plasticity, automatic design
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2020 — 2021]
  Student: **Edoardo Barbieri**.
  Thesis title: *Adattamento online di robot controllati da reti booleane*, University of Bologna
  Keywords: adattamento, robotica, simulazione, rete booleana, entropia
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2019 — 2020]
  Student: **Alessandro Gnucci**.
  Thesis title: *Online adaptation in Boolean network robots*, University of Bologna
  Keywords: Boolean network, online adaptation, robot, obstacle avoidance, prey chasing, phenotypic plasticity
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2019 — 2020]
  Student: **Luca Polverelli**.
  Thesis title: *Sintesi e comparazione di funzioni obiettivo per l'evoluzione online di sciami di robot controllati da reti booleane*, University of Bologna
  Keywords: Progettazione automatica, evoluzione online, funzione obiettivo, sciame di robot, rete booleana
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2019 — 2020]
  Student: **Giulia Lucchi**.
  Thesis title: *Meccanismi evolutivi per la progettazione automatica online di reti booleane per sciami di robot*, University of Bologna
  Keywords: Progettazione automatica, meccanismi evolutivi, evoluzione online, sciami di robot, reti booleane
- ***Master Thesis.*** *(co-supervisor)* [Academic year 2018 — 2019]
  Student: **Alessandro Cevoli**.
  Thesis title: *Engineering behavioural differentiation in robots controlled by Boolean networks*, University of Bologna
  Keywords: Automatic design, behavioural differentiation, boolean networks, robotic agents, stochastic descent search

PROJECTS

- ***Development of the R package "diffeRenTES: Computation of TES-Based Cell Differentiation Trees"*** [2022]
  - Released on CRAN repository at `https://CRAN.R-project.org/package=diffeRenTES`
  - GitHub link `https://github.com/mbraccini/diffeRenTES`
  - DESCRIPTION: The package computes the ATM (Attractor Transition Matrix) structure and the tree-like structure describing the cell differentiation process (based on the Threshold Ergodic Set concept introduced in "A Dynamical Model of Genetic Networks for Cell Differentiation" Villani M, Barbieri A, Serra R (2011) PLOS ONE 6(3): e17703.), starting from the Boolean networks with synchronous updating scheme of the 'BoolNet' R package.
- A Java software for simulating Boolean networks [Ongoing Development]

MAIN SKILLS

Generic skills:

- Complex systems analysis;
- Simulation and analysis of Boolean networks;
- Biological cell differentiation;
- Swarm robotics;
- Problem solving;
- Machine Learning techniques;
- Data analysis;
- Software design;
- Evolutionary computation;
- Metaheuristic algorithms;
- Aptitude for teamwork and collaboration;
- Keen interest in scientific research dealing with human complex diseases.

Computer Programming & Software Design skills:

- Java, C, R, Python, MATLAB, UNIX shell scripting;
- Object Oriented programming;
- Concurrent programming;
- Functional programming;
- Distributed Version Control Systems (Git);
- Continuous Integration (Travis CI, GitHub Actions);
- Virtual environments (Conda).

HOBBIES AND INTERESTS Photography, football and music.

Updated on: November 10, 2022

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Place	Date	Signature