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## Personal data

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-  Full name (pronouns): Alessandro Lonardi (he/him)
-  Employment: PhD student at the Max Planck Institute for Intelligent Systems
-  Address: Room S2.018, Max-Planck-Ring 4, 72076, Tübingen, Germany
-  E-Mails: [alessandro.lonardi \[at\] tuebingen.mpg.de](mailto:alessandro.lonardi@tuebingen.mpg.de), [alessandro.lonardi.vr \[at\] gmail.com](mailto:alessandro.lonardi.vr@gmail.com)
-  Personal website: [aleable.github.io](http://aleable.github.io)

## Short bio

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I am a PhD student at the [Max Planck Institute for Intelligent Systems](#) (GER). Previously, I got my Master's degree in Mathematical Engineering at the [University of Padova](#) (IT), where I also obtained my Bachelor's degree in Physics. My PhD is supported by the [International Max Planck Research School for Intelligent Systems \(IMPRS-IS\)](#), which is part of the [Cyber Valley](#) initiative.

My research focuses on data-rich problems where inferential predictions and mechanistic models mutually inform each other to describe complex systems. To address these problems, I develop mathematical models rooted in statistical physics and scalable algorithms. My interests are mainly in, but not limited to, urban sciences, machine learning, social sciences, and biology, and they fall under the umbrella of AI for science.

## Research experience

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Sep 1, 2020 – expected: 2024

**PhD student** at the Max Planck Institute for Intelligent Systems: Physics for Inference and Optimization group, Tübingen, Germany

Mar 1, 2020 – Aug 31, 2020

**Research Intern** at the Max Planck Institute for Intelligent Systems: Physics for Inference and Optimization group, Tübingen, Germany

## Education

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Sep 1, 2020 – expected: 2024

**PhD** in Computer Science at the Max Planck Institute for Intelligent Systems, Tübingen, Germany

**Thesis:** Designing Networks with Adaptation Rules and Optimal Transport

**Supervisor:** Dr. Caterina De Bacco

**Program:** International Max Planck Research School for Intelligent Systems (IMPRS-IS)

Oct 1, 2018 – July 23, 2020

**Master's Degree** in Mathematical Engineering at the University of Padova, Italy (cum laude)

**Thesis:** Developing new methods for routing and optimal transport on networks

**Supervisor:** Prof. Mario Putti

**Co-supervisor:** Dr. Caterina De Bacco

**Curriculum:** Mathematical Modelling for Engineering and Science

Oct 1, 2015 – Sep 24, 2018

**Bachelor's Degree** in Physics at the University of Padova, Italy

**Thesis:** Dynamics and thermodynamics of the adiabatic piston (in Italian)

**Supervisor:** Prof. Giancarlo Benettin

## Additional work experience

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Oct, 2022 – Apr, 2023

## Head, co-founder at Commute, Germany

**Advancement:** Our startup was dedicated to providing data-driven solutions to policymakers to build transportation infrastructures for better livability in cities. It was admitted to the initial phase of the MAX!imize incubation program ([maximize-incubator.com](https://maximize-incubator.com)) for the Max Planck Society, supported by Max Planck Innovation GmbH

## Talks

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Each category is in reverse chronological order.

### Invited talks

- [IT1] Bilevel optimization for flow control in optimal transport networks  
[Alessandro Lonardi](#)  
[Research Seminar on Mathematical Optimization](#) (online, Saarland University, Germany, 2024) · [Slides](#)

### Contributed talks

- [CT3] Bilevel optimization for flow control in optimal transport networks  
[Alessandro Lonardi](#)  
[Netsci 2023](#) (Vienna, Austria, 2023) · [Abstract](#) · [Slides](#)
- [CT2] Infrastructure adaptation and emergence of loops in network routing with time-dependent loads  
[Alessandro Lonardi](#)  
[Netsci 2023 Satellite, Networks & cities](#) (Vienna, Austria, 2023) · [Abstract](#) · [Slides](#)
- [CT1] Optimal transport in networks for design and flux optimization  
[Alessandro Lonardi](#)  
[NetPLACE Seminars](#) (online, 2023) · [Slides](#) · [Video](#)

## Teaching experience

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Oct 21, 2021 – Feb 11, 2022

**Teaching assistant** of Advanced Probabilistic Machine Learning and Applications, University of Tübingen, Tübingen, Germany  
**Lecturer:** Dr. Caterina De Bacco

Apr 19, 2021 – July 31, 2021

**Teaching assistant** of Advanced Probabilistic Machine Learning and Applications, University of Tübingen, Tübingen, Germany  
**Lecturer:** Dr. Caterina De Bacco

## Academic service

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Peer-review: [Journal of Physics Communications](#) 3, [Physica Scripta](#) 2

## Languages

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English (proficient user) – IELTS score: 8/9 | Cambridge ESOL: CAE | CEFR: C1

Italian (native)

German (independent user) – CEFR: B1 (formal training in progress)

Spanish (basic user) – CEFR: ~A1/A2 (personal interest)

## IT skills

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Advanced level: Python (libraries for scientific computing, data science, ML, data visualization), Linux: Debian-based distributions, macOS,  $\text{\LaTeX}$ , code parallelization on computing infrastructures, git

Basic level: C++, Mathematica, Linux: Arch-based distributions, MATLAB, HTML, CSS, Suites for scientific presentations

## Extracurricular activities

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July 30-31, 2022 Volunteer for TRenD in Africa Python Workshop 2022, online ([trendinafrica.org](https://trendinafrica.org))

2016 – 2017 Volunteer for Pint of Science Italia, Padua, Italy ([pintofscience.it](https://pintofscience.it))

## Publications

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Each category is in reverse chronological order. Asterisks denote equal contribution.

### Journal Papers

- [JP7] Message-Passing on Hypergraphs: Detectability, Phase Transitions, and Higher-Order Information  
Nicolò Ruggeri\*, [Alessandro Lonardi](#)\*, Caterina De Bacco  
Journal of Statistical Physics: Theory and Experiment · [arXiv](#) · [GitHub](#) · [CO<sub>2</sub> compensation](#)
- [JP6] Bilevel Optimization for Traffic Mitigation in Optimal Transport Networks  
[Alessandro Lonardi](#), Caterina De Bacco  
[Physical Review Letters 131, 267401 \(2023\)](#) · [arXiv](#) · [GitHub](#)
- [JP5] Immiscible Color Flows in Optimal Transport Networks for Image Classification  
[Alessandro Lonardi](#)\*, Diego Baptista\*, Caterina De Bacco  
[Frontiers in Physics 11:1089114 \(2023\)](#) · [arXiv](#) · [GitHub](#) · [Poster](#) · [CO<sub>2</sub> compensation](#)
- [JP4] Infrastructure adaptation and emergence of loops in network routing with time-dependent loads  
[Alessandro Lonardi](#), Enrico Facca, Mario Putti, Caterina De Bacco  
[Physical Review E 107, 024302 \(2023\)](#) · [arXiv](#) · [GitHub](#)
- [JP3] Multicommodity routing optimization for engineering networks  
[Alessandro Lonardi](#), Mario Putti, Caterina De Bacco  
[Scientific Reports 12, 7474 \(2022\)](#) · [arXiv](#) · [GitHub](#)
- [JP2] Optimal Transport in Multilayer Networks for Traffic Flow Optimization  
Abdullahi Adinoyi Ibrahim, [Alessandro Lonardi](#), Caterina De Bacco  
[Algorithms, 14\(7\), 189 \(2021\)](#) · [arXiv](#) · [GitHub](#)
- [JP1] Designing optimal networks for multicommodity transport problem  
[Alessandro Lonardi](#), Enrico Facca, Mario Putti, Caterina De Bacco  
[Physical Review Research 3, 043010 \(2021\)](#) · [arXiv](#) · [GitHub](#)

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