

# Domenico Salvagnin

Curriculum Vitae - July 2024



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## Contact information

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## Research Interest

Theory and algorithms for Linear and Mixed Integer Linear Programming, Constraint Programming. Hybrid methods for Optimization.

## Education and Qualifications

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| 2018-Today | Associate professor in Operations Research at the Department of Information Engineering, University of Padova.   |
| 2018       | National Academic Qualification as Full Professor.   |
| 2017       | National Academic Qualification as Associate Professor.  |
| 2011-2018  | Assistant professor at the Department of Information Engineering, University of Padova.  |
| 2009-2011  | Post-doc position at the Department of Pure and Applied Mathematics, University of Padova.   |
| 2009       | Ph.D. in Computational Mathematics (Operations Research) at the University of Padova. Thesis title: <i>Constraint Programming Techniques for Mixed Integer Linear Programs</i> . Defended on March 26th, 2009. |
| 2006       | Licensed Professional Engineer.  |
| 2005       | Master Degree (summa cum laude) in Computer Engineering at the University of Padova. Thesis title: <i>A dominance procedure for Integer Programming</i> .  |

## Publications

### – Papers

1. M. Fischetti and D. Salvagnin. Feasibility Pump 2.0. *Mathematical Programming Computation*, 1:201–222, 2009.
2. M. Fischetti, D. Salvagnin, and A. Zanette. Fast approaches to improve the robustness of a railway timetable. *Transportation Science*, 43:321–335, 2009.

3. M. Fischetti and D. Salvagnin. Pruning Moves. *INFORMS Journal on Computing*, 22:108–119, 2010.
4. M. Fischetti, D. Salvagnin, and A. Zanette. A note on the selection of Benders' cuts. *Mathematical Programming B*, 124:175–182, 2010.
5. M. Fischetti and D. Salvagnin. A Relax-and-Cut Framework for Gomory's Mixed-Integer Cuts. *Mathematical Programming Computation*, 3:79–102, 2011.
6. T. Koch, T. Achterberg, E. Andersen, O. Bastert, T. Berthold, R. E. Bixby, E. Danna, G. Gamrath, A. M. Gleixner, S. Heinz, A. Lodi, H. Mittelmann, T. Ralphs, D. Salvagnin, D. E. Steffy, and K. Wolter. MIPLIB 2010 - Mixed Integer Programming Library version 5. *Mathematical Programming Computation*, 3:103–163, 2011.
7. M. Fischetti, M. Monaci, and D. Salvagnin. Three ideas for the Quadratic Assignment Problem. *Operations Research*, 60:954–964, 2012.
8. J. Lang, M. S. Pini, F. Rossi, D. Salvagnin, K. B. Venable, and T. Walsh. Winner determination in voting trees with incomplete preferences and weighted votes. *Autonomous Agents and Multi-Agent Systems*, 25:130–157, 2012.
9. M. Fischetti and D. Salvagnin. Approximating the split closure. *INFORMS Journal on Computing*, 25:808–819, 2013.
10. Q. Louveaux, L. Poirrier, and D. Salvagnin. The strength of multi-row models. *Mathematical Programming Computation*, 7:113–148, 2015.
11. H. D. Mittelmann and D. Salvagnin. Exact and Heuristic Approaches for Directional Sensor Control. *IEEE Sensors Journal*, 15:6633–6639, 2015.
12. H. D. Mittelmann and D. Salvagnin. On Solving a Hard Quadratic 3-Dimensional Assignment Problem. *Mathematical Programming Computation*, 7:219–234, 2015.
13. P. Belotti, P. Bonami, M. Fischetti, A. Lodi, M. Monaci, A. Nogales-Gómez, and D. Salvagnin. On Handling Indicator Constraints in Mixed Integer Programming. *Computational Optimization and Applications*, 1–22, 2016.
14. M. Fischetti, A. Lodi, M. Monaci, D. Salvagnin, and A. Tramontani. Improving branch-and-cut performance by random sampling. *Mathematical Programming Computation*, 8:113–132, 2016.
15. M. Fischetti, M. Monaci, and D. Salvagnin. Mixed-Integer Linear Programming Heuristics for the PrePack Optimization Problem. *Discrete Optimization*, 22:195–205, 2016.
16. M. Fischetti, M. Leitner, I. Ljubic, M. Luipersbeck, M. Monaci, M. Resch, D. Salvagnin, and M. Sinnl. Thinning out Steiner trees: A node-based model for uniform edge costs. *Mathematical Programming Computation*, 9:203–229, 2017.
17. M. Fischetti, L. Liberti, D. Salvagnin, and T. Walsh. Orbital Shrinking: Theory and Applications. *Discrete Applied Mathematics*, 222:109–123, 2017.
18. T. Berthold, A. Lodi, and D. Salvagnin. Ten years of Feasibility Pump, and counting. *EURO Journal on Computational Optimization* 2018.
19. S. Brigadoi, D. Salvagnin, M. Fischetti, and R. J. Cooper. Array Designer: automated optimized array design for functional near-infrared spectroscopy. *Neurophotonics*, 5:5–19, 2018.
20. S. S. Dey, A. Iroume, M. Molinaro, and D. Salvagnin. Improving the Randomization Step in Feasibility Pump. *SIAM Journal on Optimization*, 28:355–378, 2018.
21. M. Fischetti, M. Monaci, and D. Salvagnin. Self-split parallelization for Mixed Integer Linear Programming. *Computers & Operations Research*, 93:101–112, 2018.

22. G. Gamrath, T. Berthold, and D. Salvagnin. An exploratory computational analysis of dual degeneracy in mixed-integer programming. *EURO Journal on Computational Optimization*, 1–21, 2020.
23. A. Gleixner, G. Hendel, G. Gamrath, T. Achterberg, M. Bastubbe, T. Berthold, P. Christophel, K. Jarck, T. Koch, J. Linderoth, M. Lübbecke, H. D. Mittelmann, D. Ozyurt, T. Ralphs, D. Salvagnin, and Y. Shinano. MIPLIB 2017: Data-Driven Compilation of the 6th Mixed-Integer Programming Library. *Mathematical Programming Computation*, 13:443–490, 2021.
24. J. Pavan, D. Salvagnin, A. Facchinetti, G. Sparacino, and S. D. Favero. Incorporating Sparse and Quantized Carbohydrates Suggestions in Model Predictive Control for Artificial Pancreas in Type 1 Diabetes. *IEEE Transactions on Control Systems Technology*, 31:570–586, 2022.
25. G. Mexi, T. Berthold, and D. Salvagnin. Using Multiple Reference Vectors and Objective Scaling in the Feasibility Pump. *EURO Journal on Computational Optimization*, 11:1–18, 2023.
26. J. Pavan, G. Noaro, A. Facchinetti, D. Salvagnin, G. Sparacino, and S. D. Favero. A Strategy Based on Integer Programming for Determining the Optimal Dosing and Timing of Hypotreatments in Type 1 Diabetes Management. *Computer Methods and Programs in Biomedicine*, 250:1–11, 2024.

#### – Book chapters

1. M. Fischetti, A. Lodi, and D. Salvagnin. “Just MIP it!” In: *Matheuristics*. Ed. by V. Maniezzo, T. Stuetzle, and S. Voss. Vol. 10. Annals of Information Systems. Springer US, 2010, pp.39–70.

#### – Conference proceedings

1. M. Fischetti, D. Salvagnin, and A. Zanette. Fast Approaches to Robust Railway Timetabling. In: *ATMOS*. 2007, pp.142–157.
2. R. Brafman, F. Rossi, D. Salvagnin, K. B. Venable, and T. Walsh. Finding the Next Solution in Constraint- and Preference-based Knowledge Representation Formalisms. In: *Principles of Knowledge Representation and Reasoning*. 2010, pp.425–433.
3. M. Fischetti and D. Salvagnin. A Relax-and-Cut Framework for Gomory’s Mixed-Integer Cuts. In: *CPAIOR*. 2010, pp.123–135.
4. M. Fischetti and D. Salvagnin. An In-Out Approach to Disjunctive Optimization. In: *CPAIOR*. 2010, pp.136–140.
5. T. Berthold and D. Salvagnin. Cloud Branching. In: *CPAIOR*. 2013, pp.28–43.
6. D. Salvagnin. Orbital Shrinking: a new tool for hybrid MIP/CP methods. In: *CPAIOR*. 2013, pp.204–215.
7. M. Fischetti, M. Monaci, and D. Salvagnin. Self-splitting of workload in parallel computation. In: *CPAIOR*. 2014, pp.394–404.
8. D. Salvagnin. Detecting and exploiting permutation structures in MIPs. In: *CPAIOR*. 2014, pp.29–44.
9. G. Gamrath, A. Melchiori, T. Berthold, A. Gleixner, and D. Salvagnin. Branching on multi-aggregated variables. In: *CPAIOR*. 2015, pp.141–156.
10. D. Salvagnin. Detecting Semantic Groups in MIP models. In: *CPAIOR*. 2016, pp.329–341.
11. M. Fischetti and D. Salvagnin. Chasing First Queens by Integer Programming. In: *CPAIOR*. 2018, pp.232–244.

12. D. Salvagnin. Symmetry Breaking Inequalities from the Schreier-Sims table. In: *CPAIOR*. 2018, pp.521–529.
13. F. Pommerening, G. Röger, M. Helmert, H. Cambazard, L.-M. Rousseau, and D. Salvagnin. Lagrangian Decomposition for Optimal Cost Partitioning. In: *ICAPS*. 2019, pp.338–347.
14. D. Salvagnin. Some experiments with submodular function maximization via integer programming. In: *CPAIOR*. 2019, pp.488–501.
15. P. Bonami, D. Salvagnin, and A. Tramontani. Implementing Automatic Benders Decomposition in a Modern MIP Solver. In: *IPCO 2020 Proceedings*. Ed. by Springer. 2020, pp.78–90.
16. T. Berthold, G. Hendel, and D. Salvagnin. Transferring Information across Restarts in MIP. In: *CPAIOR*. 2022, pp.24–33.

### – Reports

1. D. Salvagnin, R. Roberti, and M. Fischetti. *A fix-propagate-repair heuristic for Mixed Integer Programming*. Tech. rep. DEI, 2022.
2. F. Cavaliere, M. Fischetti, R. Roberti, and D. Salvagnin. *Models and Algorithms for the Time Window Assignment Traveling Salesperson Problem with Stochastic Travel Times*. Tech. rep. DEI, 2024.
3. M. Fischetti, R. Roberti, and D. Salvagnin. *An Improved Compact Formulation for the Assortment Optimization Problem with Small Consideration Sets*. Tech. rep. DEI, 2024.

### – PhD thesis

1. D. Salvagnin. “Constraint Programming Techniques for Mixed Integer Linear Programs”. PhD thesis. University of Padova, 2009.

### Prizes

1. Winner of the 11th DIMACS Implementation Challenge for the best computer codes for Steiner Tree problems (codes *mozartballs*, *mozartduet* and *staynerd* jointly developed with Matteo Fischetti, Markus Leitner, Ivana Ljubic, Martin Luipersbeck, Michele Monaci, Max Reschand Markus Sinnl), 2014.
2. Computational Optimization and Applications 2016 Best Paper Award for the paper “On handling indicator constraints in mixed integer programming”, together with Pietro Belotti, Pierre Bonami, Matteo Fischetti, Andrea Lodi, Michele Monaci and Amaya Nogales-Gómez.
3. CPAIOR 2019 Distinguished Paper Award for the paper “Some experiments with submodular function maximization via integer programming”.
4. ICAPS 2019 Best Paper Award for the paper “Lagrangian Decomposition for Optimal Cost Partitioning”, together with Florian Pommerening, Gabriele Röger, Malte Helmert, Hadrien Cambazard and Louis-Martin Rousseau.
5. Finalist of the MIP 2022 Computational Competition “A fix-propagate-repair heuristic for Mixed Integer Programming”, together with Matteo Fischetti and Roberto Roberti.

### Plenary and semi-plenary lectures

*Feasibility Pump 2.0*

13th Combinatorial Optimization Workshop, Aussois, France, January 2009

*Three ideas for the Quadratic Assignment Problem*

MIP Workshop, Waterloo, Canada, June 2011

*Hunting for split cuts*

16th Combinatorial Optimization Workshop, Aussois, France, January 2012

*On Solving a Hard Quadratic 3-Dimensional Assignment Problem*

18th Combinatorial Optimization Workshop, Aussois, France, January 2014

*Detecting and exploiting permutation structures in MIPs*

MIP Workshop, Columbus, USA, July 2014

*Some experiments with Benders CGLPs*

22nd Combinatorial Optimization Workshop, Aussois, France, January 2018

*Benchmarking in MIP*Dagstuhl Seminar 18071 *Planning and Operations Research*, Dagstuhl, Germany, February 2018*Global Structures in MIP*Dagstuhl Seminar 18071 *Planning and Operations Research*, Dagstuhl, Germany, February 2018*Some experiments with submodular function maximization via integer programming*

23rd Combinatorial Optimization Workshop, Aussois, France, January 2019

*A fix-propagate-repair heuristic for Mixed Integer Programming*

MIP Workshop Computational Competition, Rutgers, USA, July 2022

*Computational Research 101*

IPCO Summer School, Madison, USA, June 2023

**Teaching**

Courses (University of Padova):

- 2008/2009    lecturer in *Mathematical programming to support management decisions*, Mathematics.  
               lecturer in *Operations Research I*, Information Engineering.  
               teaching seminar *Implementation Techniques for LP and MIP solvers*.  
               teaching seminar *Asset Allocation with Excel and VBA*.
- 2009/2010    lecturer in *Operations Research*, Computer Science.  
               lecturer in *Operations Research I*, Information Engineering.  
               lecturer in *Optimization*, Mathematics.  
               teaching seminar *Optimization in the economic domain with GAMS*.
- 2010/2011    lecturer in *Operations Research*, Computer Science.  
               lecturer in *Methods and mathematical models for combinatorial optimization*, Computer Science.  
               professor in *Operations Research*, Mathematics.
- 2011-2014    professor in *Models and software for discrete optimization*, Computer Engineering.
- 2017-Today    professor in *Models and software for discrete optimization*, Computer Engineering.
- 2019/2020    professor in *Algorithms for Engineering*, Computer Engineering.

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- 2020-Today professor in *Convex Optimization*, Control Systems Engineering.
- 2020-Today professor in *Heuristics for Mathematical Optimization*, Information Engineering Ph.D.

## Service

### Student supervision and activities

Supervision of 25 bachelor theses and 14 master theses since 2012.

PhD dissertation committee member for the following candidates:

- Laurent Poirrier, University of Liège, 2012
- Gerald Gamrath, TU Berlin, 2020
- Gregor Hendel, TU Berlin, 2021
- Jakob Witzig, TU Berlin, 2021

Co-organizer in the years 2020-2021 of the competitive programming activity *The Coding DEI*, at the Department of Information Engineering, University of Padova.

### University

- 2017-Today Member of the *Commissione Ricerca*, Department of Information Engineering, University of Padova.
- 2020-Today Member of the PhD School Board, Department of Information Engineering, University of Padova.
- 2022 Committee member for the Italian Information Engineering state exam.

### Scientific Community

- 2006-Today Reviewer for *Mathematical Programming*, *Mathematical Programming Computation*, *INFORMS Journal on Computing*, *Annals of Operations Research*, *Computational Optimization and Applications*, *Computers & Operations Research*, *Annals of Mathematics and Artificial Intelligence*, *4OR*.
- 2011-Today Technical editor for *Mathematical Programming Computation*.
- 2015 Program Committee member for CPAIOR-2014.
- 2015 Program Committee member for MIP2015.
- 2016 Senior Program Committee member for IJCAI-16.
- 2017 Program Chair and Conference Chair for CPAIOR-2017.
- 2017 Program Committee member for CPAIOR-2018.
- 2018 Program Committee member for AAI-2019.
- 2018 Program Committee member for CPAIOR-2019.
- 2019 Program Committee member for CPAIOR-2020 and CP-2020.

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2020	Program Committee member for CPAIOR-2021.
2021	Program Committee member for CPAIOR-2022 and CP-2022.
2022	Program Committee member for IPCO-2022 and CPAIOR-2023.
2023	Program Committee member for CPAIOR-2024.
2024	Senior Program Committee member for CP-2024.
2024	Chair of the MIP Workshop 2024 Computational Competition.

### Professional Experiences

2006-2008	Participation to the <i>ARRIVAL (Algorithms for Robust and online Railway optimization: Improving the Validity and reliability of Large scale systems)</i> European project.
2007-2009	Participation to the <i>Models and algorithms for robust network optimization</i> PRIN project, MiUR.
2009	Research grant on <i>Implementation and evaluation of new Benders decomposition techniques for Stochastic Programming</i> , University of Padova.
2009-2011	Participation to the <i>Progetto di Eccellenza 2008-2009: Integer Programming and Combinatorial Optimization</i> project of the Fondazione Cassa di Risparmio di Padova e Rovigo.
2011-2013	Participation to the <i>Computational Integer Programming</i> project of the University of Padova.
2011-2013	Participation to the <i>Nonlinear aspects in primal MILP heuristics, and in robustness</i> PRIN project, MiUR.
2013	Collaboration with ALSTOM on train timetabling problems.
2014	Collaboration with Inthebra on car sharing problems.
2014	Scientific consultant for IBM ILOG CPLEX.
2015-2017	Lead development scientist for IBM ILOG CPLEX.
2017-2019	Scientific consultant for IBM ILOG CPLEX.
2019-2021	Scientific consultant for FICO XPRESS.
2022-2023	Principal Investigator for Department Project <i>MIP<sup>2</sup>: Mixed Integer Programming and (AI) Planning</i> , 13k€.
2021-Today	Principal Investigator for Department Consultancy Project with FICO <i>Development of the Xpress Solvers</i> , 84k€/year.

### Languages

Italian (native), English (fluent).

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**Skills**

Advanced knowledge of the C/C++ programming language and Unix/Linux/Mac OS X. Expert on advanced usage of MIP solvers and CP solvers.

Good knowledge of the Python programming language, of algebraic modeling languages, of collaborative tools (Git) and of Web development technologies.

**Spare Time**

ACM Member since 2004.

Software development, trekking, digital photography, fine woodworking.

Domenico Salvagnin