CRISTINA CORNELIO

+41 76 443 22 36 ☎

corneliocristina AT gmail.com ✉

cor AT zurich.ibm.com ✉

🔍 RESEARCH INTERESTS

My general research interests lie in the areas of Artificial intelligence and Cognitive Computing. In particular, I have worked on preference reasoning, graphical preference representation, preferences under uncertainty, preference aggregation in a multi agent context, voting rules, computational social choice, recommender systems, matching algorithms, logic of preferences and kidney exchange algorithms.

More recently I focused on the research topics of logic and reasoning, inference mechanisms, automated theorem proving, probabilistic logic, knowledge representation and extraction, natural language processing (NLP), neural-symbolic methods, neural embeddings for logic, combination of deep learning techniques with standard reasoning systems and reasoning for scientific discovery.

🎓 EDUCATION

PhD in Mathematics (Computer Science Area) | University of Padua, Italy

JANUARY 2013 – MARCH 2016

Supervisor: Francesca Rossi.

PhD Thesis: "Preference reasoning and aggregation over combinatorial domains in uncertain and multi-agent scenarios".

PhD Thesis reviewers: Barry O'Sullivan and Craig Boutilier.

Master's degree in mathematics | University of Padua, Italy

OCTOBER 2010 – OCTOBER 2012

Supervisors: Francesca Rossi and K. Brent Venable.

Master Thesis: "Dynamic and Probabilistic CP-nets".

Master Thesis reviewers: Toby Walsh.

Bachelor's Degree in mathematics | University of Udine, Italy

SEPTEMBER 2007 – OCTOBER 2010

Bachelor Thesis: "Local search cuts for the maximum satisfiability problem".

Supervisor: Franca Rinaldi.

💼 WORK EXPERIENCE

Research Scientist | IBM Research – Zurich Research Center (Rüschlikon)

JULY 2019 – PRESENT

Manager: Anika Schumann

Area: Reasoning, NLP and Knowledge Extraction

Research Staff Member | IBM Research – T.J. Watson Research Center
OCTOBER 2017 – JUNE 2019
Manager: Michael Witbrock / Achille Fokoue
Area: AI Foundations - Reasoning

Post-Doc | IBM – T.J.Watson Research Center
JULY 2016 – OCTOBER 2017
Manager: Michael Witbrock
Mentor: Vijay Saraswat

Post-Doc | University of Padua, Italy
JANUARY 2016 – JUNE 2016
Supervisor: Francesca Rossi

SKILLS

- PhD curriculum:
  - Programming Big Data in X10, Quantum Information, Statistical methods, Embedded Real-Time Systems, Preference reasoning in computational social choice, Decision making and social networks, Machine learning for structured domains by kernel methods, Networking Issues and Solutions in Online Games.
- Programming languages:
  - Good: Python, Prolog/Datalog.
  - Basic: Java, C++, C, Mathematica, html.

PUBLICATIONS

- Journal papers:
  - "Deceased-donor-initiated chains: first report of a successful deliberate case and its ethical implications", *L. Furian, C. Cornelio, C. Silvestre, F. Rossi, P. Rigotti, E. Cozzi, F. Neri and A. Nicolò*, Transplantation, 2019.
  - "Multi-agent soft constraint aggregation via sequential voting: theoretical and experimental results", *C. Cornelio, M.S. Pini, F. Rossi, K. B. Venable*, Journal of Autonomous Agents and Multi-Agent Systems (JAAMAS), 2019
  - "Potential gain of utilizing kidneys from deceased donors to initiate "Chain" Kidney Paired donations: quantification of benefit through a real-world retrospective analysis", C. *Cornelio, L. Furian, F. Neri, A. Nicolò, F. Rossi, P. Rigotti, C. Silvestre.*, Transpl Int, 2017

- Conference papers:
  - "Updates and Uncertainty in CP-net", *C. Cornelio, U. Grandi, J. Goldsmith, N. Mattei, F. Rossi and K.B. Venable*, Proceedings of the 26th Australasian Joint Conference on Artificial Intelligence, AUAI-13.

- o "Reasoning with PCP-nets in a Multi-Agent Context", *C. Cornelio, U. Grandi, J. Goldsmith, N. Mattei, F. Rossi and K.B. Venable*, Proceedings of the International Conference on Autonomous Agents & Multiagent Systems 2015, AAMAS-15.
- o "Using deceased-donor kidneys to initiate chains of living donor kidney paired donations: algorithm and experimentation", *C. Cornelio, L. Furian, A. Nicolò and F. Rossi,* Proceedings of the AAAI/ACM Conference on Artificial Intelligence, Ethics and Society (AIES), 2019.
- o "A Deep Reinforcement Learning Approach to First-Order Logic Theorem Proving", *M. Crouse, I. Abdelaziz, B. Makni, S. Whitehead, C. Cornelio, P. Kapanipathi, K. Srinivas, V. Thost, M. Witbrock, A. Fokoue*, Proceedings of the Thirty-Fifth AAAI Conference on Artificial Intelligence, AAAI-21.

- Published research extended abstracts:
  - o "Dynamic and Probabilistic CP-nets", *C. Cornelio*, Proceedings of the Doctoral Program of International Conference on Principles and Practice of Constraint Programming 2013, CP-13.
  - o "Models for Conditional Preferences as extensions of CP-nets", *C. Cornelio,* Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (extended abstract), IJCAI-15.
  - o "Voting with Random Classifiers (VORACE)", *C. Cornelio, M. Donini, A. Loreggia, M.S. Pini, F. Rossi*, Proceedings of the International Conference on Autonomous Agents & Multiagent Systems 2020 (AAMAS-20).
  - o "Sequential voting in multi-agent soft constraint aggregation", *C. Cornelio, M.S. Pini, F. Rossi, K. B. Venable*, Proceedings of the International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS) 2020 - JAAMAS track.

- Patents:
  - o "Generative Reasoning for Symbolic Discovery", C. Cornelio, L. Horesh, V. Pestun, R. Yan, *patent application filed on: 10th Feb. 2020*
  - o "Symbolic Model Discovery based on a combination of Numerical Learning Methods and Reasoning", C Cornelio, L Horesh, A Fokoue-Nkoutche, Sanjeeb Dash, *patent application filed on: 21st Jul. 2020*
  - o "Problem manipulators for language-independent reasoning". C. Cornelio, A. Fokoue, A. Pareja, I. Abdelaziz, M. Witbrock, *patent application filed on: 29th Apr. 2020*
  - o "Experimental Design for Symbolic Model Discovery". L. Horesh, K. Clarkson, C. Cornelio, S. Magliacane, *patent application filed on: 21st Apr. 2020*
  - o "Capturing the global structure logical formulae with graph long short-term memory", M. Crouse, I. Abdelaziz, C. Cornelio, V. Thost, L. Wu, B. Makni, K. Srinivas, A. Fokoue, *patent application filed on: 14th Nov. 2019*
  - o "Automatic transformation of complex tables in documents into computer understandable structured format and managing dependencies", C. Cornelio, M. Canim, R. Musa, M. Rodriguez Muro, A. Iyengar, *patent application filed on: 18th Apr. 2019*

- o "Automatic transformation of complex tables in documents into computer understandable structured format with mapped dependencies and providing schema-less query support for searching table data", C. Cornelio, M. Canim, R. Musa, M. Rodriguez Muro, A. Iyengar, *patent application filed on: 18th Apr. 2019*
- o "Method for automatic transformation of complex tables in documents (PDF, Word) into computer understandable structured format and providing schemaless query support Data Extraction", C. Cornelio, M. Canim, R. Musa, M. Rodriguez Muro, A. Iyengar, *patent application filed on: 18th Apr. 2019*

- Workshop papers:
  - o "Dynamic Probabilistic CP-nets", *C. Cornelio, U. Grandi, J. Goldsmith, N. Mattei, F. Rossi and K.B. Venable*, Proceedings of the 7th Multidisciplinary Workshop on Advances in Preference Handling, MPREF-13.
  - o "Voting with CP-nets using a Probabilistic Preference Structure, *C. Cornelio, U. Grandi, J. Goldsmith, N. Mattei, F. Rossi and K.B. Venable*, 5th International Workshop on Computational Social Choice, ComSoC-14.
  - o "Logical conditional preference theories", *C. Cornelio, A. Loreggia, and V. Saraswat,* Proceedings of the MPREF workshop of the International Joint Conference on Artificial Intelligence 2015, IJCAI-15.
  - o "Expressing Probabilistic Graphical Models in RCC", *C. Cornelio and V. Saraswat*, Symbolic Inference and Optimization workshop of AAAI-17.
  - o "A Knowledge and Reasoning Toolkit for Cognitive Applications", *M. Canim, C. Cornelio, R. Farrell, A. Fokoue, K. Gao, J. Gunnels, A. Iyengar, R. Musa, M. Rodriguez-Muro, R. Uceda-Sosa*, HotWeb 2017.
  - o "Identifying the Discourse Function of News Article Paragraphs", *W.V.H. Yarlott, C. Cornelio, T.Gao, M.A. Finlayson*, Proceedings of COLING workshop: EventStory 2018.
  - o "Improving Graph Neural Network Representations of Logical Formulae with Subgraph Pooling", *M. Crouse, I. Abdelaziz, C. Cornelio, V. Thost, L. Wu, K. Forbus and A. Fokoue*, The Second International Workshop on Deep Learning on Graphs: Methods and Applications 2020 (DLG-KDD'20).

- ArXiv papers:
  - o "A Deep Reinforcement Learning Based Approach to Learning Transferable Proof Guidance Strategies", M. Crouse, S. Whitehead, I. Abdelaziz, B. Makni, C. Cornelio, P. Kapanipathi, E. Pell, K. Srinivas, V. Thost, M. Witbrock, A. Fokoue, *2019*, arXiv:1911.02065
  - o "RuDaS: Synthetic Datasets for Rule Learning and Evaluation Tools", C. Cornelio, V. Thost, *2019*, arXiv:1909.07095
  - o "Schemaless Queries over Document Tables with Dependencies", M. Canim, C. Cornelio, A. Iyengar, R. Musa, M. Rodrigez Muro, *2019*, arXiv:1911.09356

- o "Improving Graph Neural Network Representations of Logical Formulae with Subgraph Pooling", M. Crouse, I. Abdelaziz, C. Cornelio, V. Thost, L. Wu, K. Forbus, A. Fokoue, *2019*, arXiv:1911.06904
- o "Voting with Random Classifiers (VORACE)", C. Cornelio, M. Donini, A. Loreggia, M.S. Pini, F. Rossi, *2019*, arXiv:1909.08996
- o "Logical conditional preference theories", C. Cornelio, A. Loreggia, V. Saraswat*, 2015*, arXiv:1504.06374.

👤 TALKS

- **Conference talks:**
  - o "Sequential voting in multi-agent soft constraint aggregation", International Conference on Autonomous Agents and Multi-Agent Systems, 2020.
  - o "Reasoning with PCP-net in a Multi-Agent Context", International Conference on Autonomous Agents and Multi-Agents Systems 2015, AAMAS-15, Istanbul, Turkey.
  - o "Using deceased-donor kidneys to initiate chains of living donor kidney paired donations: algorithm and experimentation", AAAI/ACM Conference on Artificial Intelligence, Ethics and Society (AIES), 2019. Honolulu, Hawaii, USA
- **Workshop talks:**
  - o "Logical conditional preference theories", MPREF, workshop of the International Joint Conference on Artificial Intelligence 2015, IJCAI-15, Buenos Aires, Argentina.
  - o "Expressing Probabilistic Graphical Models in RCC", C. Cornelio and V. Saraswat, Symbolic Inference and Optimization workshop of AAAI-17
- **Poster presentations:**
  - o "Dynamic and Probabilistic CP-nets", International Conference on Principles and Practice of Constraint Programming 2013, CP-13, Uppsala, Sweden.
  - o "Models for Conditional Preferences as extensions of CP-nets", International Joint Conference on Artificial Intelligence 2015, IJCAI-15, Buenos Aires, Argentina.
  - o "Expressing Probabilistic Graphical Models in RCC", C. Cornelio and V. Saraswat, Symbolic Inference and Optimization workshop of AAAI-17
  - o "Using deceased-donor kidneys to initiate chains of living donor kidney paired donations: algorithm and experimentation", C. Cornelio, L. Furian, A. Nicolò, F. Rossi, Proceedings of the AAAI/ACM Conference on Artificial Intelligence, Ethics and Society, 2019. Honolulu, Hawaii, USA
- **Doctoral consortium talks:**
  - o "Dynamic and Probabilistic CP-nets", Doctoral Consortium of the International Conference on Principles and Practice of Constraint Programming 2013, CP-13, Uppsala, Sweden.
  - o "Models for Conditional Preferences as extensions of CP-nets", Doctoral Consortium of the International Joint Conference on Artificial Intelligence 2015, IJCAI-15, Buenos Aires, Argentina.

- <u>Invited talks:</u>
  - "**Affable Knowledge Elicitation**", Rensselaer Polytechnic Institute (RPI), Troy (NY), USA, October 2017.
  - "**Potential gain of utilizing kidneys from deceased donors to initiate "Chain" Kidney Paired donations: quantification of benefit through a real-world retrospective analysis",** Workshop on Matching Theory and Applications, University of Padua, Padua, Italy, December 2017.
- <u>Other talks:</u>
  - "**Probabilistic and Dynamic CP-Nets**", (PRANA Seminar Series), University of Padua, Padua, Italy.
  - "**Reasoning with PCP-net in a Multi-Agent Context: Optimality and Dominance**", (Insight Seminar Series), Insight Centre for Data Analytics, Cork, Ireland.
  - "**Preferences in AI**", (Doctoral Seminar Series), University of Padua, Padua, Italy.

ATTENDED CONFERENCES

- 2013: International Conference on Principles and Practice of Constraint Programming 2013, CP-13, Uppsala, Sweden.
- 2013: AI*IA, Turin, Italy. Workshop on Iterative Voting and Voting Games, Padua, Italy.
- 2014: Workshop on Iterative Voting and Voting Games, Padua, Italy.
- 2015: International Conference on Autonomous Agents and Multi-Agents Systems 2015, AAMAS-15, Istanbul, Turkey.
- 2015: International Joint Conference on Artificial Intelligence 2015, IJCAI-15, Buenos Aires, Argentina.
- 2016: International Conference on Logic Programming, ICLP-16, New York, USA.
- 2017: AAAI-17, San Francisco, USA.
- 2019: AAAI-19, Honolulu, Hawaii, USA
- 2019: AIES-19, Honolulu, Hawaii, USA
- 2019: Dagstuhl seminar: "Application-Oriented Computational Social Choice"
- 2020: AAMAS-20 (Online conference)

AWARDS

- Special mention for "Premio per NeoLaureati" (Italian national award for recent graduates) AI*IA-2013, Italian Association of Artificial Intelligence.
- Paper "Updates and Uncertainty in CP-nets": nomination for the best paper at the 26th Australasian Joint Conference on Artificial Intelligence.
- "Patent issuance award": IBM patent & invention program (on Acclaim), 2020.
- "Plateau": IBM patent & invention program (on Acclaim), 2020.

PROFESSIONAL ACTIVITIES AND ACHIEVEMENTS

- 2013-2014: Project "Incorporating patients' preferences in kidney transplant decision protocols": From January 2018 the system is piloted in Padova (involving NITp - Nord Italia Transplant program) and it started recently to be adopted nationally. It received national media and press attentions.
- 2013-2014: PhD representative for the Department of Mathematics of the University of Padua (Computer Science Area).
- 2014: Co-Organization of "Workshop on Iterative Voting and Voting Games" and realization of the corresponding web site.
- 2014 SEPTEMBER-DECEMBER:
  - Internship at "Insight Centre for Data Analytics" (Cork, Ireland) under the supervision of Nic Wilson and Barry O'Sullivan.
  - Co-Internship at *Avego*: optimization of the car-sharing algorithms for the application "CARMA".
- 2014: Co-supervision of a Computer Science Master thesis: "A Personalized Recommender System for the Financial Domain".
- 2015: IJCAI-15 Student Volunteer Program in Buenos Aires, Argentina.
- 2015: Post-Doc representative for the Department of Mathematics of the University of Padua.
- Supervision of summer interns/externs at IBM Research: 2017-2018-2019-2020
- 2019: Co-author of the proposal "Accelerated Scientific Discovery via Globally Optimal Symbolic Regression", accepted by DARPA for the call AIRA (Artificial Intelligence Research Associate)
- 2019-2021: participation in the DARPA project AIRA
- **REVIEWING FOR CONFERENCES:**
  - European Conference of Artificial Intelligence (**ECAI**): 2014, 2015, 2016.
  - International Conference on Algorithmic Decision Theory (**ADT**): 2017.
  - International Joint Conference on Artificial Intelligence (**IJCAI**): 2015, 2016, 2017,2018, 2020, 2021.
  - Conference on Artificial Intelligence, Ethics and Society (**AIES**): 2018, 2019, 2020.
  - International Conference on Autonomous Agents and Multi-agent Systems (**AAMAS**): 2018, 2019.
  - International Conference on Artificial Intelligence (**AAAI**): 2018, 2019, 2020, 2021.
  - International Conference on Artificial Intelligence (**AAAI**)-**Demo** track: 2020, 2021.
  - Neural Information Processing Systems (**NeurIPS**) − 2020.