

## Brief CV Professor Ann Nowé

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I'm co-director of the AI lab of the VUB and I currently hold a Francqui Professorship on Explainable Reinforcement Learning. I have published 260 in the past 10 years. All papers are peer-reviewed. In the past 10 years 37 papers have been published at top conferences (such as AAAI, IJCAI, AAMAS, ICML, ECML, ...) or first quartile journals (such as JMLR, IEEE transactions, JAAMAS, Bioinformatics). I also have 163 publications with co-authors from 51 other institutions, which illustrates my large international network. My Google scholar index is 37 (per 1/7/21).

Currently my main research interests are: Reinforcement Learning; Learning in Multi-agent Systems; Transparent and Explainable AI by exploiting the meta-information of the learning process; Human in the loop learning.

Under my supervision 25PhDs have been completed. My former PhD students have taken up academic positions at the University of Liverpool, the University of Delft, the University of Eindhoven, the University of Maastricht, and positions in companies such as Google Deepmind and PROWLER.io Cambridge, UK. I'm currently supervising 12 PhD students, of which 6 in co-supervision. My team also includes 6 postdocs.

My project portfolio contains fundamental as well as applied research projects from a variety of funding agencies FWO (national science foundation), IWT & VLAIO for collaboration with other research groups in Flanders (SBO projects) and more applied research in Flanders, Innoviris for research in Brussels (both fundamental as well as applied) and EU.I was involved in the creation of 1 spin-off.

I'm a former board member of both BNVKI and EURAI, respectively BeNeLux and European associations for Artificial Intelligence, and a current board member of IFAAMAS (Int. Conf. on Autonomous Agents and Multiagent Systems). I was PC chair of AAMAS'21 joint with Ulle Endris.

## PROFESSION EXPERIENCE & EDUCATION

- 2012-present: Full professor, 90% Faculty of Sciences and Bioengineering Science & 10% Faculty of Engineering Vrije Universiteit Brussel, Belgium.
- 2004-2011: Associate professor, 90% Faculty of Sciences and Bioengineering Sciences, 10% Faculty of Engineering, Vrije Universiteit Brussel, Belgium.
- 1999-2004: Assistant professor, 90% Faculty of Sciences and Bioengineering Sciences, 10% Faculty of Engineering, Vrije Universiteit Brussel, Belgium.
- 1997-1999: Postdoctoral researcher funded by the National Science Foundation FWO-Vlaanderen. Faculty of Engineering, Vrije Universiteit Brussel, Belgium.
- 1994-1997: Postdoctoral researcher funded by the Vrije Universiteit Brussel. Faculty of Engineering, Vrije Universiteit Brussel, Belgium.
- 1988-1994: Teaching assistant, Faculty of Engineering, Vrije Universiteit Brussel, Belgium.
- 1992-1994: Visiting Researcher, Aeronautical Department, Queen Mary and Westfield College University London, UK, Scholarship for the British Council.
- 1994: PhD in Sciences Title of thesis: Synthesis of "safe" fuzzy controllers based on reinforcement Learning. Faculty of Sciences, Vrije Universiteit Brussel, Belgium in Collaboration with Queen Mary and Westfield College University London, UK.
- 1987: Master in Mathematics, Minor in Computer Science, Faculty of Sciences, Universiteit Gent, Belgium.

## Selected publications

(for a full publication list, see <https://researchportal.vub.be/en/persons/ann-nowe/publications/> or <https://scholar.google.be/citations?user=LH5QKbgAAAAJ&hl=nl>)

- Y. Coppens, D. Steckelmacher, C. M. Jonker & A. Nowé. (2021) Synthesising Reinforcement Learning Policies through Set-Valued Inductive Rule Learning. To appear in: Post-proceedings of the 1st TAILOR Workshop. Springer, Berlin, 2021. 163-179
- Rădulescu, R., Verstraeten, T., Zhang, Y. et al. (2021) Opponent learning awareness and modelling in multi-objective normal form games. Neural Comput & Applications

- Abels A., Lenaerts T., Trianni V., Nowé A. (2020) Collective Decision-Making as a Contextual Multi-armed Bandit Problem. In: Nguyen N.T., Hoang B.H., Huynh C.P., Hwang D., Trawiński B., Vossen G. (eds), Computational Collective Intelligence. ICCCI 2020. Lecture Notes in Computer Science, vol 12496. Springer.
- Y. Zhang, R. Rădulescu, P. Mannion, D. M. Roijers, A. Nowé (2020) Opponent modelling for reinforcement learning in multi-objective normal form games. Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems, AAMAS 2020, 2080-2082.
- Coppens, Y., Efthymiadis, K., Lenaerts, T., & Nowé, A. (2019). *Distilling Deep Reinforcement Learning Policies in Soft Decision Trees*. IJCAI 2019.
- Abels, A., Roijers, D. M., Lenaerts, T., Nowe, A., & Steckelmacher, D. (2019). Dynamic weights in multi-objective deep reinforcement learning. In K. Chaudhuri, & R. Salakhutdinov (Eds.), *Proceedings of the 36th International Conference on Machine Learning, ICML 2019*, 13-22.
- D. Steckelmacher, D. M. Roijers, A. Harutyunyan, P. Vrancx, H. Plisnier, A. Nowé. (2018) Reinforcement learning in POMDPs with memoryless options and option-observation initiation sets. Thirty-Second Conference on Artificial Intelligence. AAAI 2018.
- De Clercq S, Schockaert S, Nowé A, et al. (2018) Modelling incomplete information in Boolean games using possibilistic logic. International Journal of Approximate Reasoning, 93: 1-23.
- Sofie De Clercq, Kim Bauters, Steven Schockaert, Mihail Mihaylow, Ann Nowé. (2017) Exact and heuristic methods for solving Boolean games, Journal of Autonomous Agents and Multi-Agent Systems, 31(1): 66-106.
- Grau, I., Sengupta, D., Lorenzo, M. M. G., & Nowé, A. (2018). Interpretable self-labeling semi-supervised classifier. In D. W. Aha, T. Darrell, P. Doherty, & D. Magazzeni (Eds.), Proceedings of the 2nd Workshop on Explainable Artificial Intelligence: 27th International Joint Conference on Artificial Intelligence and the 23rd European Conference on Artificial Intelligence (pp. 52-57).
- A. Harutyunyan, P. Vrancx, P.-L. Bacon, D. Precup and A. Nowé. (2018) Learning with options that terminate off-policy, Thirty-Second AAAI Conference on Artificial Intelligence. AAAI'18.
- Pieter Libin, Ewout Vanden Eynden, Francesca Incardona, Ann Nowé, Antonia Bezenchek, (2017) EucoHIV Study Group. PhyloGeoTool: interactively exploring large phylogenies in an epidemiological context. Bioinformatics, 2017, 33(24): 3993-3995.
- Radulescu R., Vrancx P., Nowe A. (2017) Analysing congestion problems in multi-agent reinforcement learning. Proceedings of the 16th Conference on Autonomous Agents and Multiagent Systems. (AAMAS'17). IFAAMAS, 2017: 1705-1707.
- T. Brys, A. Harutyunyan, H. B. Suay, S. Chernova, M. E. Taylor, and A. Nowé. (2015). Reinforcement learning from demonstration through shaping. In Proceedings of the 24th International Conference on Artificial Intelligence, IJCAI'15, AAAI Press, 3352–3358.
- K. Van Moffaert; A. Nowé. (2014) Multi-Objective Reinforcement Learning using Sets of Pareto Dominating Policies. JMLR, Journal of Machine Learning Research, Vol. 15, 2014, p. 3483- 3512.
- Lazar, Vasile Cosmin; Meganck, Stijn; Taminau, Jonatan; Steenhoff, David; Coletta, Alain; Molter, Colin; Weiss-Solis, David Y.; Duqué, Robin; Bersini, Hugues; Nowe, Ann. (2013) GENESHIFT: a non-parametric approach for integrating microarray gene expression data, based on the inner product as a distance measure between the distributions of genes. / In: IEEE/ACM Transactions on Computational Biology and Bioinformatics, Vol. 10, No. 2, 2013, p. 383-392.
- A. Nowé, P. Vrancx Y.-M. De Hauwere (2012) Game Theory and Multi-agent Reinforcement Learning. In: Wiering M., van Otterlo M. (eds) Reinforcement Learning. Adaptation, Learning, and Optimization, vol 12. Springer, Berlin, Heidelberg
- C. Lazar et al., "A Survey on Filter Techniques for Feature Selection in Gene Expression Microarray Analysis," in IEEE/ACM Transactions on Computational Biology and Bioinformatics, vol. 9, no. 4, pp. 1106-1119, July-Aug. 2012, doi: 10.1109/TCBB.2012.33.
- Lazar, C., Meganck, S., Taminau, J., Steenhoff, D., Coletta, A., Molter, C., Solís, D.W., Duque, R., Bersini, H., & Nowé, A. (2013). *Batch effect removal methods for microarray gene expression data integration: a survey*. *Briefings in bioinformatics*, 14 4, 469-90 .

#### MEMBERSHIPS OF SCIENTIFIC SOCIETIES

- PC Chair (with Ulle Endris) AAMAS 2021.
- 2003- present: Senior Steering Committee Members of the yearly workshop on Adaptive Learning Agents (ALA), co-located with AAMAS
- 2018-present: Board Member of The International Foundation for Autonomous Agents and Multiagent Systems (IFAAMAS)
- 2011-2016: Board Member of EURAI (formerly named ECCAI the European Coordinating Committee for Artificial Intelligence)
- 2010-2015: IEEE Computational Intelligence Society (CIS), Technical Committee on Adaptive Dynamic Programming and Reinforcement Learning (ADPRL TC)

- 2008-2015: Board member BNVKI, BeNeLux association for AI. The last 4 years (second term), chairman of the association.
- Regular reviewer for funding agencies (NWO, EPSRC, ERC), and Journals such as JAAMAS, JAIR, IEEE, KER, and international conferences including: ICML, AAAI, ECML, AAMAS, GECCO.
- Editor: Journal of Artificial Intelligence, Knowledge Engineering Review, Frontiers.

#### INTERNATIONAL LECTURING AND INVITED TALKS

- Invited talk "Aspects of transparency in Reinforcement Learning" at Plate Forme Intelligence Artificielle (Evènement affilié à PFIA 2021) 28 Juin- 2 Juillet 2021.
- Invited talk "How Reinforcement Learning and Formal Verification might meet", FMAI 2019, Second International Workshop of Formal Methods and AI in Rennes.
- Invited talk "Multi-agent systems from theory to practice" at DAI 2019 : First International Conference on Distributed Artificial Intelligence
- Tutorial "Multi-agent reinforcement learning" at the Lorentz Center Workshop "Dynamics of MultiAgent Systems" 2018.
- ACAI summer school (EurAI) on Reinforcement Learning, co-organiser with Karl Tuyls University of Liverpool and Robert Babuska, TUDelft. Nieuwpoort, Belgium, 7-14 October'17.
- Tutorial "Reinforcement Learning in Single and Multi-Agent Settings" at the international conference on Autonomous Agents and Multiagent Systems, AAMAS, May 2016.
- Invited tutorial on Reinforcement. Learning at SUM, The International Conference on Scalable Uncertainty Management, September 2016.
- Invited talk "Multi-Criteria Reinforcement Learning" at the 26th Workshop on Computational Intelligence on 24th November 2016, Dortmund.
- Invited talk "Smart systems opportunities in an Internet of Things (IoT) age" at the Bavarian Academy of Sciences and Humanities, 27th June 2016, Munchen
- Tutorial "Multi-agent reinforcement learning" at the international conference on Autonomous Agents and Multiagent Systems, AAMAS, May 2012 and 2014.

#### AWARDS:

- 2015: Best paper award at the Adaptive Learning Agents workshop at the International AAMAS conference.
- 2015: Best demo award at AAMAS 2015 Smart grid demo (EU FP7 project SCANERGY).
- 2015: Visiting Fellowship from the University of Liverpool from 30/06/15 till 09/07/15.
- 2016: IBM award of scientific excellence, 3rd prize, Small grid demo platform for renewable energy exchange.
- 2017: Best Demo award at BNAIC'17. Hierarchical Reinforcement Learning for a Robotic Partially Observable Task.
- 2017: Best paper award at the Hierarchical KL workshop at NIPS.
- 2018: Best student paper award at ICTAI 2018. Deep learning for 3D point segmentation
- 2019: Best demo at BNAIC'19 A Motorized Wheelchair that Learns to Make its Way through a Crowd
- 2020: Best paper award at the 12th International Conference, ICCCI 2020, Advances in Computational Collective Intelligence. How Expert Confidence Can Improve Collective Decision-Making in Contextual Multi-Armed Bandit Problems.

#### SELECTION of RESEARCH PROJECTS

**A full project portfolio from:**

<https://cris.vub.be/en/projects/search.html?search=nowe&uri=&journalName=&organisationName=&organisationName=&type=+&projectDateStart=+&projectDateEnd=+&period=+> <sup>1</sup>

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<sup>1</sup> Administrative Promotor means main PI

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- H2020: TAILOR : Foundations of Trustworthy AI- Integrating Reasoning, Learning and Optimization,,VUB budget 107.000.
  - 2016.07-2023.06 :IRP IMAGica: an Integrative personalised Medical Approach for Genetic diseases, Inherited Cardiac Arrhythmias as a model, IRP. Coordinator Nowé, A., promotoren : Sonia Van Dooren, Frederik Hes, Carlo de Asmundis, Johan Bilsen (Promoter), Anna Jansen, Budget: 183.333.
  - 2021.01-2025.12: iBof: DESCARTES - infectious DisEaSe eEconomics and Ai with guaRanTEEs, Budget (coordinator) Budget 540.000 EUR
  - 2020.01-2024.12: FWO SBO , Robustify: Condition monitoring robust against machine variations and dynamic environments. Joint with J.Helsen, W.Desmet, K.Grillias. Total Budget: 1.977.204 EUR.
  - 2019.6- : EWI: Flemish AI Plan, challenge leader Multi-agent Systems. Total Budget VUB: 1.050.000 EUR/year.
  - 2019.01-2022.12: FWO G062819N: Interpretable Reinforcement Learning. Budget: 240.000 EUR.
  - 2017.01-2021.12 FWO WOG- Guiding networked societies, linking data science and modelling. Budget 62.500 EUR. (coordinator)
  - 2017.01-2020.12: EU521: ODYCCEUS. Jointly with K. Beuls. Budget: 982.500 EUR.
  - 2016.07-2021.06 :IRP: IMAGica: an Integrative personalised Medical Approach for Genetic diseases, Inherited Cardiac Arrhythmias as a model, IRP. Coordinator Nowé, A., co-promotors: Bonduelle, M., Deschepper, R. & Brugada, P, Budget: 183.333.
  - 2015.01-2018.12: IWTSB02: SMILE-IT: Stable Multi-agent Learning for Networks. Budget: 603.530 EUR. (coordinator)
  - 2015.09-2018.08: BRGIMP4: SECLOUD, Innoviris BRIDGE 2014. Budget: 314.800 EUR.
  - 2014.01-2017.12: FWOAL726: Multi-criteria Reinforcement Learning. Budget: 260.000 EUR. (coordinator)
  - 2013.01-2016.01: IWT588: An Integrated Methodology to Bring Intelligent Robotic Assistive Devices to User. Budget: 240.000 EUR.
  - 2014.01 – 2023.12: EU FEDER, BRIGHTanalysis ICITY-RDI.BRU, co-promotor. Tom Lenaerts (ULB), Partners: Prof. Maryse Bonduelle, Prof. Sonia Van Dooren, Center for Medical Genetics, VUB UZ Brussel., Prof. Mark Abramowicz, Center for Human Genetics, ULB Erasme, Prof. Catheline. Budget: 233.388.
  - 2013.2-2016.01: EU FP7-PEOPLE-2012-IAPP, EU429: Scanergy, Modular system for energy trading between prosumers. Budget 405.496