

Learning dynamics

INFO-F-409

Organisation

The project will allow students to experiment with the principles of learning discussed during the course.

The project will be performed in **groups of 4 students**.

We provide here a number of proposals but students are also allowed to suggest their own proposal, which will be evaluated by the academic staff.

Each group will send an email to Prof. Tom Lenaerts containing a ranking of 3 projects according to their preferences (**by December 7, 2017 no later than 1PM**). A project will be assigned which will take into account these preferences.

Requirements and Evaluation

The project will be presented during the exams. Students will be graded on the quality of their project, their article, the presentation, their reviews and their participation during the exam seminar.

Students will write down their work in an **article format** (, for which the LaTeX style is provided on the website. (see formatting)

An essential constraint is that the article should contain sufficient information to reproduce the results. So be as clear and specific as possible when you describe the model and its parameters. Also provide a clear and logical interpretation of your results.

There are **additional points to be gained for originality, creativity and scientific relevance**. We hence encourage each group to go beyond the specific information provided for each topic and **demonstrate their interest in this course**.

The article should consist of **at least 5 pages** (see formatting) and will be handed in at least two weeks before the exam (see dates below).

Upon receiving the article it will be distributed to another group who will have to review the article. Reviewing entails that one writes a document discussing the following issues (2-3 pages):

1) Does the introduction explain clearly the content of the paper

- 2) whether there is sufficient background information to understand the relevance of the work
- 3) whether the methods are clearly explained (can the results be reproduced?)
- 4) whether the results answer the questions asked in the paper.
- 5) whether all questions are answered
- 6) whether the conclusion is sufficient
- 7) and whether the overall style is ok and
- 8) whether you believe things are missing in the discussion.
- 9) etc.

We also expect that you add to this review:

- 1) 3 positive points concerning the work, clearly specifying why you think they are well-done or interesting
- 2) 3 negative points, which may include missing/unclear explanations or suggestions for improvement
- 3) at least 3 clear and relevant questions on the content or the methods used which can be asked (next to other questions).

The review has to be mailed no later than the 16th of January 2017 to tlenaert@ulb.ac.be

The working language is **English**. Make sure that spelling and grammar mistakes are minimal.

Formatting

Structure of the article: (Introduction, Methods, results, discussion, references)

1. In the **introduction** a clear specification of the problem is provided, including related work. Look for additional but relevant references which you can cite in this part.
2. In the **Methods** section you specify how the model is constructed
3. In the **Results** section you provide a descriptions of the simulations you have done and their results. Also include the information concerning the parameter settings.
4. In the **Discussion** section you provide a summary and an explanation of your work.
5. A good scientific article has a **bibliography**
- 6.

The following article provides an example of how an article should be structured :
[example.pdf](#)

We will use the Alife XII formatting template for each article. Below you can find a pdf explaining the formatting instructions. Next you find a zip-file containing an example (and style files) to write your article in LaTeX. For those who prefer we also added the style file for word. Please make use of the bibliographic tools of Word when you use this document. The final manuscript should be provided in PDF and send to tlenaert@ulb.ac.be. Ignore the submission explanation in the formatting instructions.

[formatting_instructions.pdf](#)

Important dates

For this project, there are two steps: a preparation and the actual exam. During the exam, the work is presented and evaluated by your fellow students and the academic staff.

Choice : **December 7, 2017 1PM** (email to tlenaert@ulb.ac.be)

Article submission : **January 8, 2018** (email to tlenaert@ulb.ac.be)

Review submission: **January 15, 2018** (email to tlenaert@ulb.ac.be)

Date exam : **January 19, 2017**, room t.b.a. (exam schedule will be announced after submission).

Project proposals

The first set of proposals asks you to read an article, write a software that reproduces the results discussed in the paper. **Additional credits can be gained for extending the work** discussed in those papers in a new and innovative manner. Describe in the manuscript the context (**search for additional articles**), the methodology YOU used to arrive at the results and extensions and YOUR OWN explanation of the results you observe and how they relate to the results in those articles. Propose also possible extensions to the work you produced in the Discussion section.

The following papers, are proposed:

A.Moerland, J. Broekens, and C. Jonker, "Fear and hope emerge from anticipation in model-based reinforcement learning," IJCAI Int. Jt. Conf. Artif. Intell., vol. 2016–Janua, pp. 848–854, 2016.

A.N. Foerster, R. Y. Chen, M. Al-Shedivat, S. Whiteson, P. Abbeel, and I. Mordatch, "Learning with Opponent-Learning Awareness," arXiv preprint arXiv:1709.04326 (2017).

A.Hintze and R. Hertwig, "The Evolution of Generosity in the Ultimatum Game," Sci. Rep., vol. 6, no. 1, p. 34102, 2016.

A.Jagau and M. Van Veelen, "A general evolutionary framework for the role of intuition and deliberation in cooperation," Nat. Publ. Gr., vol. 1, no. August, pp. 1–6, 2017.

F. P. Santos, J. M. Pacheco, A. Paiva, F. C. Santos, M. Rutter, and A. Fabrega, "Structural power and the evolution of collective fairness in social networks," PLoS One, vol. 12, no. 4, p. e0175687, 2017.

Gómez-Gardenes, Jesús, M. Campillo, L. M. Floría, and Yamir Moreno. "Dynamical organization of cooperation in complex topologies." Physical Review Letters 98, no. 10 (2007): 108103.

McAvoy, Alex, Nicolas Fraiman, Christoph Hauert, John Wakeley, and Martin A. Nowak. "Public goods games in populations with fluctuating size." arXiv preprint arXiv:1709.03630 (2017).

Poncela, Julia, Jesús Gómez-Gardenes, Luis M. Floría, Angel Sánchez, and Yamir Moreno. "Complex cooperative networks from evolutionary preferential attachment." *PLoS one* 3, no. 6 (2008): e2449.

Wu, Bin, Philipp M. Altrock, Long Wang, and Arne Traulsen. "Universality of weak selection." *Physical Review E* 82, no. 4 (2010): 046106.

Garant, D., da Silva, B. C., Lesser, V., & Zhang, C. (2015). Accelerating multi-agent reinforcement learning with dynamic co-learning. Technical report. (<https://web.cs.umass.edu/publication/docs/2015/UM-CS-2015-004.pdf>)

Rădulescu, R., Vrancx, P., & Nowé, A. (2017). Analysing Congestion Problems in Multi-agent Reinforcement Learning. In *Adaptive Learning Agents (ALA) Workshop at AAMAS 2017*. (http://ala2017.it.nuigalway.ie/papers/ALA2017_Radulescu.pdf)

Kok, J. R., & Vlassis, N. (2004, July). Sparse cooperative Q-learning. In *Proceedings of the twenty-first international conference on Machine learning*. ACM. (<http://www.machinelearning.org/proceedings/icml2004/papers/267.pdf>)

Devlin, S., Yliniemi, L., Kudenko, D., & Tumer, K. (2014). Potential-based difference rewards for multiagent reinforcement learning. In *Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems* (pp. 165-172). International Foundation for Autonomous Agents and Multiagent Systems. (<https://pdfs.semanticscholar.org/1df7/5b42b3c5c9a0f2d238a0ca8bbdb1121fc0ba.pdf>)

Das, S., Kamenica, E., & Mirka, R. Reducing Congestion Through Information Design. (<http://faculty.chicagobooth.edu/emir.kamenica/documents/reducing-congestion-information.pdf>)

Brys, T., De Hauwere, Y. M., Nowé, A., & Vrancx, P. (2011). Local coordination in online distributed constraint optimization problems. In *European Workshop on Multi-Agent Systems* (pp. 31-47). Springer, Berlin, Heidelberg. (<https://pdfs.semanticscholar.org/6017/81cb6618568f0d386377652d03aeb14264ee.pdf>)

Bowling, M., & Veloso, M. (2001). Rational and convergent learning in stochastic games. In *International joint conference on artificial intelligence* (Vol. 17, No. 1, pp. 1021-1026). (<http://www.cs.cmu.edu/~mmv/papers/01ijcai-mike.pdf>)

These articles can be found through [google scholar](#), if not contact either Prof. T. Lenaerts or Prof. A. Nowé