Second Session EGT project: From Freedom to Coercion.

General remarks:

Deadline 18-08-2025 11:59 p.m.

- You must submit your assignment through GitHub classroom. You MUST connect to the link https://classroom.github.com/a/yAt73w7R and **push your assignment** to your provided repository **before the deadline**. Creating the repository might take some time! If it does not appear to work, refresh the page!
- Provide a single (self-contained) *.**PDF** file, named <Surname>_<Name>_<studentID>_<affiliation>.pdf. Your name and surname should start with a capital letter (e.g. Wim). If you have two surnames, please separate them with a '-' (e.g., de-Munter).
- Put your name and your affiliation (VUB/ULB) in the document.
- Don't send in photos of your results, scan them, if necessary, but always submit a PDF.
- Any doubts should be emailed to Marco Saponara <marco.saponara@ulb.be>.

Note 1: If these guidelines are not respected, your assignment will not be corrected, and your grade will be 0. Also, you will not be able to push any new changes to your private repository after the deadline.

Note 2: For this project we discourage the use of LLMs like ChatGPT. If you decide to use them, please disclose precisely in which scenarios (or which portions of code) you did use them. We will value whether your effort in this assignment was still significant. However, you may use any library you require (e.g., egttools, nashpy).

Note 3: This is an individual assignment, although we expect that there will be similar solutions, if we notice any deliberate plagiarism, all the students involved will receive a 0 for this assignment.

Description of the work

In this homework, the goal is to verify that you each are now able to reproduce a result discussed in a paper, which would indicate that you are ready to work on the group project for the exam. We have chosen the paper "Via Freedom to coercion: the emergence of costly punishment" written by Hauert et al. The paper and the supporting information, which provides more technical details on how the results are obtained, are provided in the homework folders on UV and Canvas.

Your objective is to make a Jupyter notebook that reproduces the Figures 2 and 3 in the main paper and Figure 1 and 2 in the supporting online material, providing also your explanation on what can be observed in each figure (in your own words). Add comments and explanations to your code in the notebook so it is easy to understand how you arrived at the results. The PDF is simply a saved version of the notebook.

The two figures from the main manuscript, show the reduced Markov chain with states corresponding to the strategies used, i.e. cooperation, defection, non-participant and/or punisher. The figures in the supporting online material show in function of increasing values of selection strength how the stationary distribution changes. You do not have to produce the numerical simulations shown in Figure 1 of the main paper and the dots in Figure 1 and 2 in the supporting online material.

Note that in the paper they use a different way to calculate the fitness and have thus a different parameter for selection strength. You can simply use the Pairwise comparison rule (as used in the "Avoiding or restricting defectors in public goods games_" notebook shown in the course.) The results should remain equivalent, with selection strength now given by different values of β as opposed to s. You may want to scale β logarithmically from a very small value (e.g. 0.00001) to maximum 10. As a matter of fact, you can use the "Avoiding or restricting defectors in public goods games_" notebook as a basis for making this project as many parts will be the same.

Deliverables

PDF of the notebook and the Jupyter notebook itself.