

Identifying strategies in agent-based simulations

Internship. This M1/M2 research internship will take place under the supervision of Peter Fratrič and Nils Holzenberger, in the DIG team, at Télécom Paris, 19 place Marguerite Perey, 91120 Palaiseau. The intended duration is 6 months, with a start date between March and May 2024. The internship will take place in the context of a project conducted in collaboration with David Restrepo Amariles at HEC Paris.

Context. Taxpayers occasionally find clever ways to combine existing policies to achieve unexpected tax discounts. These combinations are often referred to as *tax loopholes*, and come up often enough in tax courts, likely causing a significant tax deficit to governments.¹ While policy-makers can use available historic data to guide their policy choices, unexpected reactions of entities to new policies can hardly be foreseen. We aim to discover tax loopholes by simulating a legal and economic environment and letting agents interact with the environment and possibly one another, guided by reward maximization. This exploration leads to the discovery of new schemes of behavior, including previously unknown tax loopholes. This tool for agent-based simulation — *Code ReCivil* — relies on *agent-based simulation environments, formalized legal rules, reward-oriented exploration and knowledge extraction*.²

Goals. To find tax loopholes, *Code ReCivil* must identify strategies used by agents.³ It must turn sequences of events captured by event logs into schemes that humans can make sense of. This requires formalizing a trajectory into a knowledge graph. This internship aims at comparing different forms of clustering sequences or trajectories, to support the discovery of fraud schemes. You will have the opportunity to work with experts in law, finance and economy from HEC and Télécom Paris.

Responsibilities. As an intern, you will become familiar with research relevant to agent-based modeling and formal frameworks for the law. You will identify relevant clustering methods for *Code ReCivil*, and compare them using a set of use cases. This will involve tools from information extraction and rule mining. You will also contribute to the codebase of *Code ReCivil*.

Abilities. We are looking for an excellent student currently in a Master's program, with experience programming in Python and applying tools from machine learning. Experience with Prolog or other formal language, with expert systems and symbolic AI would be a plus.

Contact. Please send your CV and cover letter to nils.holzenberger@telecom-paris.fr

¹Andrew Blair-Stanek, Nils Holzenberger, and Benjamin Van Durme. "Shelter Check: Proactively Finding Tax Minimization Strategies via AI." in: *Tax Notes Federal*, Dec 12 (2022).

²Peter Fratric et al. "Do agents dream of abiding by the rules?: Learning norms via behavioral exploration and sparse human supervision." In: *ICAIL 2023*.

³Ibid.