Cover Letter - Akilan Ramakrishnan

My MSc thesis is in the intersection of Game Theory and Multi Agent Reinforcement Learning. I am using this framework to explore the emergence of cooperation in collective risk scenarios, such as catastrophic climate change. Specifically, I'm looking at the role of information: how social and environmental cues modulate cooperative behavior. A short overview of some preliminary results are here, in this work-in-progress paper

I went through some of the publications from your group and found them closely aligned with my interests and background. I found the CANDy framework presented in the *Imitation-based cooperation in dynamic social networks* paper insightful in how it clearly delineates the roles of initial conditions, timescale ratios, and update strategies in shaping outcomes. A potential research idea for the PhD could be to introduce "manager" a higher-level RL agent that learns to modify the network structure to maximize overall cooperation, to gain insights from a mechanism design perspective on fostering cooperative behavior. I also enjoyed reading the paper on *Extensive Form games with limited foresight.* Along similar lines, an interesting project would be to simulate how (i) asymmetry in search horizons between players and (ii) systematic misperception of the opponent's foresight—over- or underestimation affects outcomes in a stylized game. The *Unlearning loyalty* paper was intriguing as it showed how persistent partner choice hinders achieving higher levels of cooperation.

I am enthusiastic about pursuing a PhD focused on cooperation in dynamic networks, but am equally open to exploring other research directions you might suggest.

My current project has provided me with a strong foundation in game theory, social dilemmas, multi-agent systems, reinforcement learning, and dynamical systems. Previously, I worked in theoretical evolutionary biology with Prof. Hanna Kokko (University of Mainz, Germany), which has strengthened my skills in modelling and simulating complex systems. I am currently preparing a manuscript based on that work. As part of my undergraduate coursework I've taken a range of mathematics and data science courses, giving me a solid grasp of deep neural networks, machine learning, bayesian statistics and dynamical systems. Together, these experiences have given me the analytical and computational tools to derive insights in multi-agent systems

I will complete my Master's by the end of this year and am open to starting a PhD anytime from January 2026 onwards

I look forward to the opportunity to contribute to your research group and develop these ideas under your guidance