



Northeastern University
Network Science Institute

Call for Applicants – Pymdp Fellowships

September 23, 2022

We are pleased to announce a new fellowship opportunity for early career researchers in the Active Inference community: the Pymdp Fellowship. The goal of the fellowship is to expand the use and development of the `pymdp` software package [1], by awarding researchers \$3,200 USD to cover up to two months of part-time work to support their effort to advance ongoing `pymdp` projects and develop new ones.

Description: In this first round of fellowships, we are working with researchers at Northeastern University, who will sponsor between 2-4 Pymdp Fellows to join ongoing projects that could benefit from being re-formulated using active inference models. Each fellow would join as a collaborator on one of several relatively well-developed projects, and their role will be to use `pymdp` to analyze or develop an active inference model suited to the particular topic and, in doing so, adapt the original work to more closely conform to the active inference / Free Energy Principle (FEP) formalism [1,2]. Brief descriptions of the different projects can be found below.

Expectations: These fellowships are targeted towards researchers who already have experience simulating agents equipped with partially-observed Markov Decision Processes (POMDP) generative models, as well as deep familiarity with the mathematical foundations of active inference and the FEP. Special consideration will be given to 1) researchers with a publication record in this space, or 2) researchers with experience using the `pymdp` package for studying active inference in Python. Fellows are expected to write code and documentation and, if interested, contribute to writing a Methods section of a paper. We acknowledge that not everyone who applies for this position will have goals of publications or academia, and we welcome applicants who see this as an interesting opportunity to be financially compensated while also contributing to ongoing scientific research. If you have any questions about the fellowship, please email Brennan Klein.

Application deadline: October 14, 2022.

Award: \$3,200 USD per fellow.

Location: Remote.

To apply: Please send a brief cover letter, CV, and the names of two references to Brennan Klein (b.klein@northeastern.edu) with the subject line “[Pymdp Fellowship] Application: YourName”.

Brennan Klein, PhD
Complexity & Society Lab
Network Science Institute
Northeastern University
b.klein@northeastern.edu

Professor Christoph Riedl, PhD
Collaborative Social Systems Lab
Network Science Institute
Northeastern University
c.riedl@northeastern.edu

Current Fellowship Projects

Project #1: Bayesian Theory of Mind and Active Inference

This project is based on recent work by Westby & Riedl, (2022) [3] which develops a multi-agent system that collectively models a team’s mental states from the team’s observed communication. Using empirical data from a large group experiment, the work shows that successful teams share more useful information and incorporate available information more fully into their decisions. The extent to which agents are routinely able to share useful and relevant information characterizes their theory of mind ability.

Supervisor: Christoph Riedl; **Collaborator:** Brennan Klein.

Project #2: Active Inference and Search on Rugged Landscapes

This project involves one of multiple efforts underway to use active inference to study human search behavior in classic “exploration-exploitation” tasks. This involves agents making sequential decisions in order to maximize their final payout when exploring a rugged landscape. Possible settings for this line of questions include multi-armed bandit experiments as well as more spatially correlated search tasks such as Wildcat Wells [4].

Supervisors/collaborators: Brennan Klein, Conor Heins, Christoph Riedl.

Project #3: Networked Active Inference

This project is a more general effort to make `pymdp` more suited to studying networked, multi-agent systems. This can be in the context of studying team dynamics, collective decision making, multi-agent game theory, etc.; we are looking to build out for useful ways to connect `pymdp` to Python’s `networkx` package.

Supervisors/collaborators: Brennan Klein, Conor Heins.

Project #4: Propose your own project or develop `pymdp` further

We will consider fellowships for individuals who bring their own ideas to the table, but due to the short nature of the fellowship, we prefer to fund projects that already developed conceptually. Question to consider: can I complete this in two months (without spending *all* of my time on it)?

References:

1. Heins et al., (2022). `pymdp`: A Python library for active inference in discrete state spaces. *Journal of Open Source Software*, 7(73), 4098, doi: 10.21105/joss.04098.
2. Parr, Pezzulo, & Friston. *Active Inference: The Free Energy Principle in Mind, Brain, and Behavior*. MIT Press, 2022.
3. Westby & Riedl (2022). Collective Intelligence in Human-AI Teams: A Bayesian Theory of Mind Approach. <https://arxiv.org/abs/2208.11660>.
4. Mason & Watts. (2012). Collaborative learning in networks. *Proceedings of the National Academy of Sciences*, 109(3), 764-769, doi: 10.1073/pnas.1110069108.