SHARPIE: A Modular Framework for Reinforcement Learning and Human-AI Interaction Experiments

Hüseyin Aydin[1*], Kevin Godin-Dubois[2*], Libio Goncalvez Braz[1*], Floris den Hengst[2*],
Kim Baraka[2], Mustafa Mert Çelikok[3], Andreas Sauter[2], Shihan Wang[1], Frans A. Oliehoek[3]

[1]Utrecht University, [2]Vrije Universiteit Amsterdam, [3]TU Delft
*Equal Contribution

h.aydin@uu.nl, k.j.m.godin-dubois@vu.nl, l.b.goncalvesbraz@uu.nl, f.den.hengst@vu.nl, k.baraka@vu.nl, m.m.celikok@tudelft.nl, a.sauter@vu.nl, s.wang2@uu.nl, f.a.oliehoek@tudelft.nl
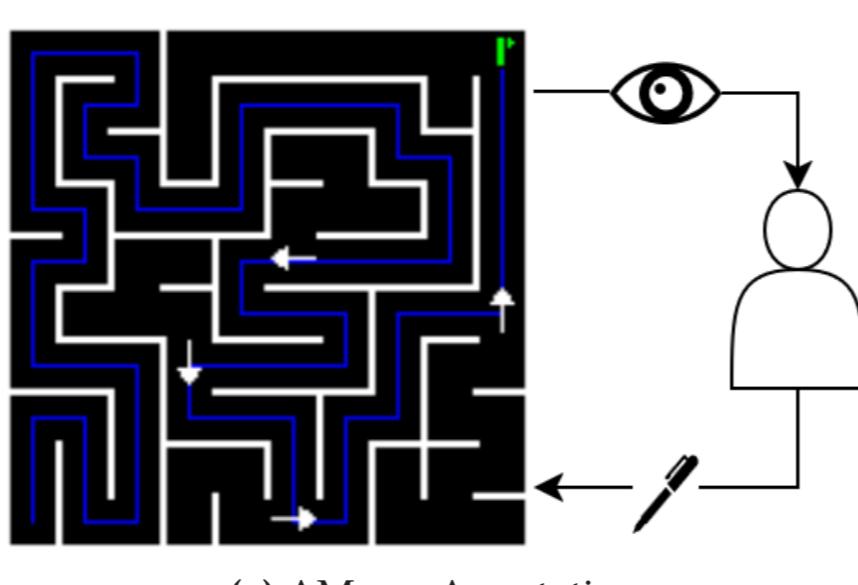
Introduction

- Reinforcement Learning;
  - refers a family of algorithms where the agent learns by trial-and-error to maximize its long time reward (Sutton and Barto 1998).
  - has been widely used in various problems, many of which involves human (Den Hengst et al. 2020).
  - applications range from delegation (Natarajan et al. 2010) to communication (Zhao et al. 2021) and sparse teaching (Knox and Stone 2009; Christiano et al. 2017).
- Existing studies for Human-RL agent interactions are limited to a specific type of interaction.
- Popular RL libraries such as *Gymnasium* (Brockman 2016; Towers et al. 2024), *PettingZoo* (Terry et al. 2021), *JaxMARL* (Rutherford et al. 2024) are not capable of handling diverse and dynamic interactions as emphasized by Akata et al. 2020.
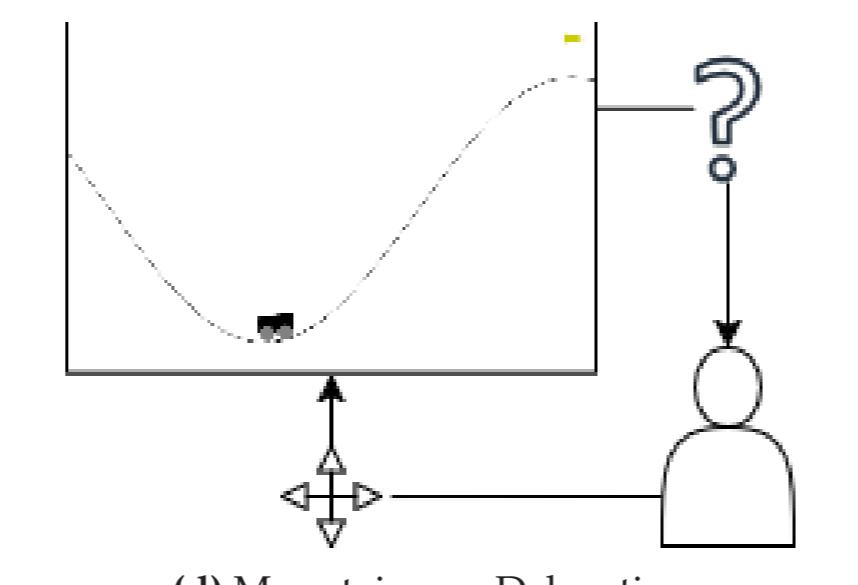
To address this gap, we propose SHARPIE:
  Shared
  Human-
  AI
  Reinforcement-Learning
  Platform for
  Interactive
  Experiments
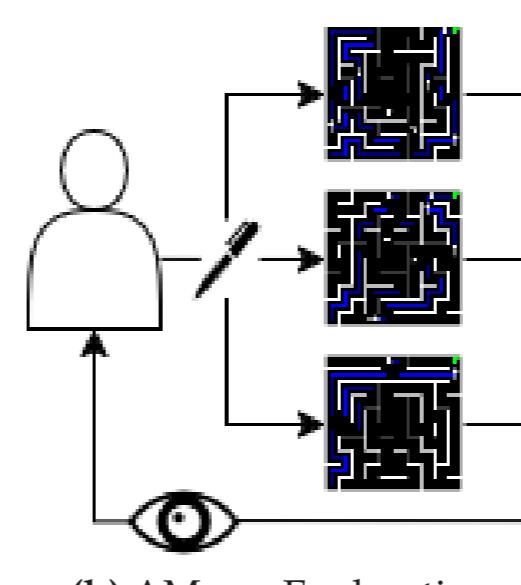
Motivating Use Cases

Figure 1: Practical examples of target use cases that illustrate the wide range of problems that SHARPIE is designed to deal with. Please check the paper for details and more use cases.
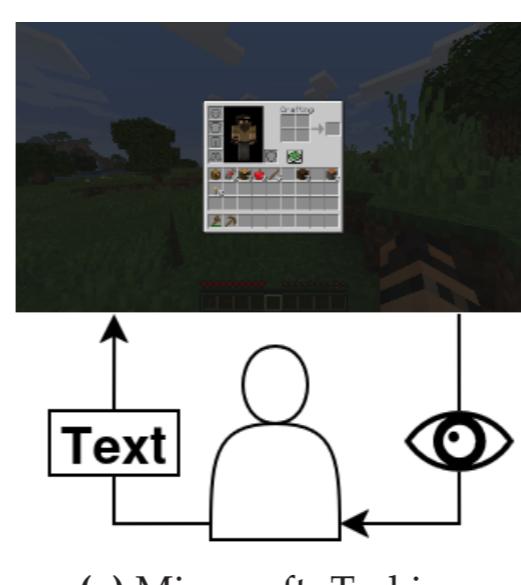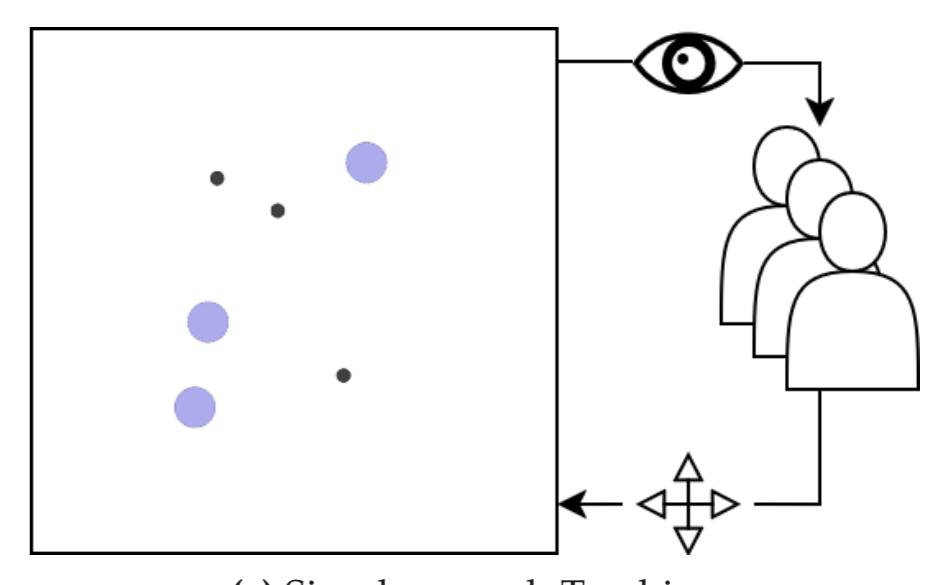
(a) AMaze: Annotation
(b) AMaze: Exploration
(c) Simple spread: Teaching
(d) Mountain car: Delegation
(e) Minecraft: Tasking
(f) Simple Tag: Collaboration

SHARPIE

- is a **Python-based web framework** that is under active development following the conventional *Gymnasium API* shared many existing RL platforms.
- aims to provide a **versatile wrapper** around popular RL environments, algorithms, and methodologies (see Figure 2).
- is not tightly integrated with any one particular environment or library, but rather aims to be **compatible with many**.
- has a **customizable and easily deployable UI** which is primarily web-based and multi-modal to **allow communication between agents** (again, RL or human).
- supports RL agents that may be able to request **action delegation**, explicitly or as prompted by their learning algorithm, to further increase the range of interaction scenarios.
- provides **various complementary utilities** to further smoothen out the experimental processes: (a)synchronous evaluations of an agent, scheduling and management on long-term data storage, logging facilities etc.
- is designed with **utilities to deploy** to a cloud server, a private machine, or a local host.
- provides an **abstraction between the machines that the researchers** and participants are using and where the experiment is actually running.
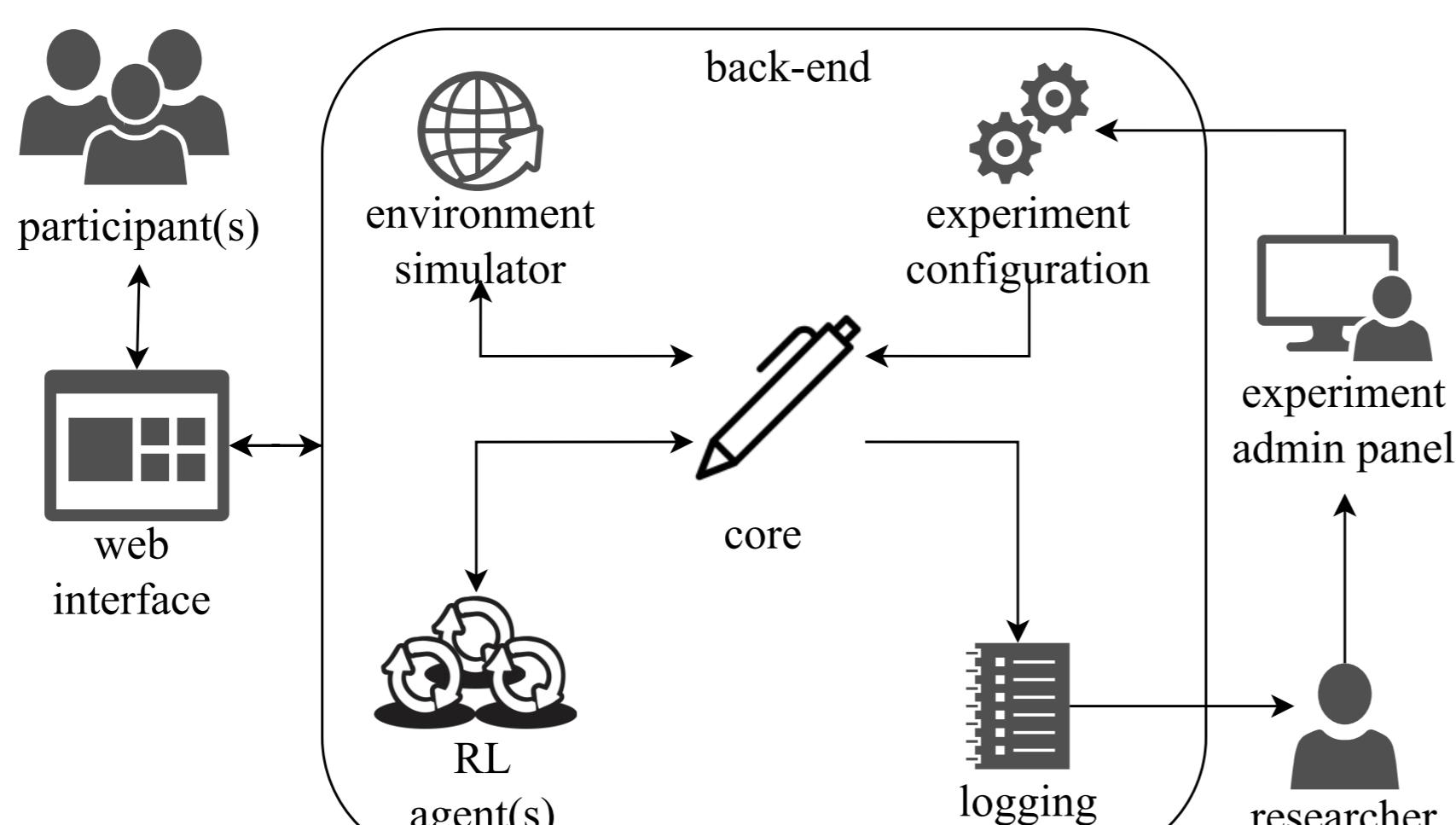

Figure 2: High-level SHARPIE architecture.

Access to Video

To watch the video presentation of the framework:

`https://archive.org/embed/sharpie_demo_1_noaudio_captions`
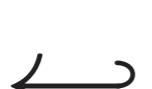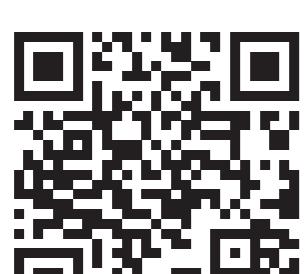
Discussion & Future Work

- SHARPIE integrates with existing environments and algorithms provide **utilities to ease experimentation** involving both human and artificial agents.
- SHARPIE may contribute to laying **the foundations for a standard** for the interaction between human and artificial agents.
- **The modularity of SHARPIE** allows for numerous directions of improvement:
  - providing an increasing number of ready-made, supported plugins to handle a large part of the existing work on environments, libraries, and deployment options.
  - widening the scope of possible human-agent interactions by incorporating additional modalities such as audio or video.
  - hosted version of SHARPIE that can be used for outreach, education and user literacy purposes.

Access to Paper

To read our paper on the `arXiv`:

`http://arxiv.org/abs/2501.19245`

Access to Code

To access the source code in `GitHub`:

`https://github.com/libgoncalv/SHARPIE`

Acknowledgement

CAIHu
AAAI 2025

Hybrid Intelligence

NWO