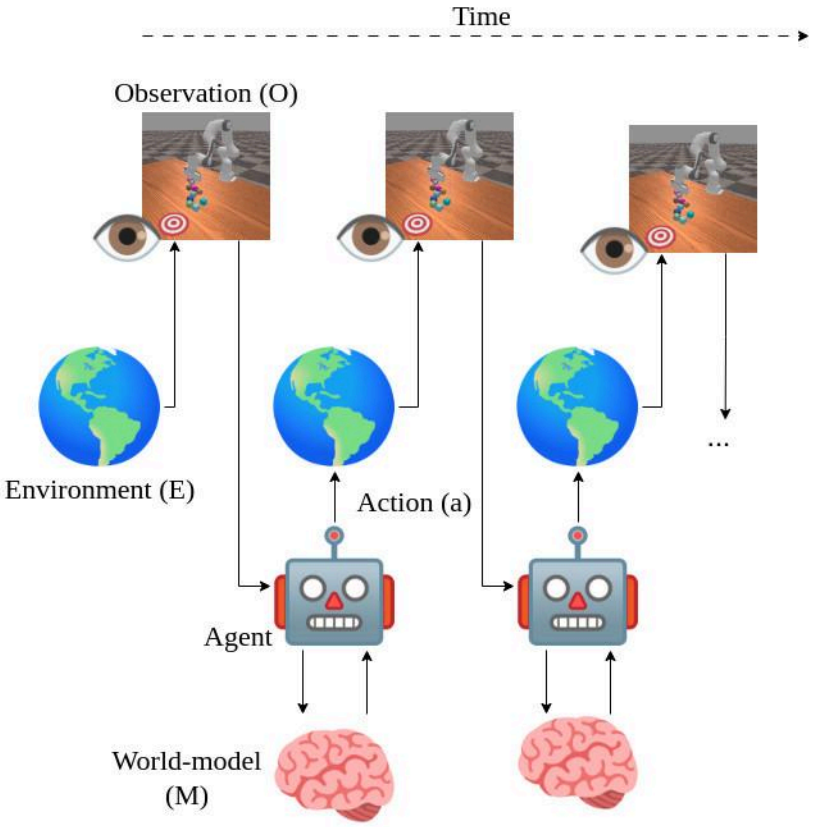
Internship Position on Object-Centric World-Model for Robotics

@Imagine Team of LIRIS lab, Ecole Centrale de Lyon



World models represent a significant milestone in the development of AI systems and permitted to achieve significant progress in the field of RL and robotics [1, 2, 3, 4]. These models incorporate perception, memory, and planning to encode and predict complex environmental dynamics. By simulating and understanding their surroundings, agents can improve data-efficiency by learning within their imagined representations of the environment.

However, current vision-based learning for robotic manipulation, especially World-Models, often relies on holistic visual scene representations, where the environment is depicted as a single vector. While this approach has proven effective in some cases, it is often inadequate for managing diverse objects and scenes in unconstrained environments. Better representations can improve generalization and data efficiency in robotic learning [5]. Inspired by human perception, **object-centric representations** have been developed to represent environments with multiple vectors, each corresponding to an object's properties [6].

This internship aims to advance the capabilities of world models by incorporating object-centric representations, with a focus on applications in robotic manipulation.

Key Objectives:

- **Setup**: Create multi-object robotic manipulation tasks within a simulation environment.
- **Development**: Design and train an object-centric world model tailored to these tasks.
- **Evaluation**: Benchmark the developed model against established baselines, such as Dreamer and TD-MPC.
- **Deployment**: Train and deploy the agent on a real-world robotic platform.

[1] D. Ha et al. "World Models" (2018) https://arxiv.org/pdf/1803.10122

[2] D. Hafner et al. "Mastering Diverse Domains through World Models" (2023) https://arxiv.org/abs/2301.04104

[3] N. Hansen et al. "TD-MPC2: Scalable, Robust World Models for continuous control" (2023) https://arxiv.org/abs/2310.16828

[4] P. Wu et al. "DayDreamer: World Models for physical robot learning" (2022) https://arxiv.org/abs/2206.14176

[5] O. Kroemer et al. "A review of robot learning for manipulation: Challenges, representations, and algorithms" (2019) https://arxiv.org/abs/1907.03146

[6] F. Locatello et al. "Object-centric learning with Slot Attention" (2020) https://arxiv.org/abs/2006.15055

The project will be co-supervised by Prof. Liming Chen (liming.chen@ec-lyon.fr), Prof. Emmanuel Dellandrea (emmanuel.dellandrea@ec-lyon.fr) and Alexandre Chapin (alexandre.chapin@ec-lyon.fr). Interested students should drop an email with CV and transcript to the following mail : alexandre.chapin@ec-lyon.fr

Requirements:

1. Strong background in computer vision
2. Strong programming skills in Python and experience with Pytorch
3. Prior experience with RL and robotics is preferred
4. Fluency in English

Project duration: 6 months

Location: Ecole Centrale de Lyon, France