Internship Position on Deep Learning Applied to Robotic Manipulation

@Imagine Team of LIRIS lab, École Centrale de Lyon

Robotic manipulation is a cornerstone of autonomous robotics, enabling robots to interact with the physical world effectively. From industrial automation to domestic assistance, the ability to perform complex manipulation tasks such as grasping, sorting, or assembly is essential. Traditional approaches rely on rule-based systems and hand-crafted heuristics, which often fail in unstructured or dynamic environments.

Deep learning has revolutionized robotic manipulation by providing the means to learn complex behaviors directly from data. Models trained with deep learning can process high-dimensional sensory inputs (e.g., images, tactile data) and generalize to unseen scenarios, making them more adaptable and robust than traditional methods.

Among various techniques, **behavior cloning (BC)** stands out as a promising framework for robotic manipulation. BC leverages supervised learning to mimic human demonstrations, providing an intuitive and efficient way to train robots without the need for complex reward engineering as in reinforcement learning. However, despite its potential, BC faces challenges such as data inefficiency, generalization, and error compounding.

The main goal of this internship is to **develop and benchmark different behavior cloning baselines** for robotic manipulation tasks, addressing the key challenges of the field.

Specific Objectives:

1. **Literature Review**: Explore state-of-the-art methods in behavior cloning, imitation learning, and their application to robotic manipulation.
2. **Data Collection**: Gather high-quality demonstrations for manipulation tasks using simulation at first, and then a physical robotic arm.
3. **Model Development**: Implement baseline BC models using deep learning frameworks such as PyTorch.
4. **Evaluation and Benchmarking**: Compare the performance of different baselines on multi-task manipulation settings, testing models in both simulated and real-world environments.
5. **Address Challenges**: Propose improvements to the current state-of-the-art techniques to address the limitations found during the experiments.

The project will be jointly supervised by Liming Chen (liming.chen@ec-lyon.fr), Emmanuel Dellandréa (emmanuel.dellandrea@ec-lyon.fr), and Bruno Machado (bruno.machado-carneiro@ec-lyon.fr). Interested students should drop an email with CV and transcript to the following address: bruno.machado-carneiro@ec-lyon.fr

Requirements:

1. Strong background in deep learning and machine learning
2. Strong programming skills in Python and previous experience with PyTorch or another deep learning library
3. Prior experience with robotics is a plus
4. Fluency in English

Internship duration: 6 months

Location: École Centrale de Lyon, France