Aldebaran AI Lab
Internship open positions
ailab-team@aldebaran.com

The AI Lab:

The Artificial Intelligence group (AI-Lab) is an independent research unit inside Aldebaran Robotics which focuses on developmental robotics. It is a fundamental research group with long term goals in the continuity of academic research labs. Its goal is to make progress in the understanding and modeling of the mechanisms of development and learning in embodied intelligent robots. In this context, multiple topics are proposed for mid to longterm internships. We aim to offer a stimulating environment, working on hightech humanoid robotic platforms. The following internship proposals are broad so that they can be discussed and oriented more towards research or engineering, depending on the candidate.

1. Evolutionary learning applied to deep learning architectures in a computer cluster

Deep learning is a recent trend in machine learning. The computing speed of new CPUs and GPUs allows the use of large-scale architectures for unsupervised learning. Multiple approaches exist to design the layers of such architectures (e.g. RBMs, convolutional networks...). At the AI-Lab we have implemented such architectures for visual processing, in order to build hierarchies of representations. These architectures are usually of fixed dimension: the amount of layers and their size is fixed beforehand by the researcher using heuristics. The intern will participate in the implementation of evolutionary learning based strategies to evolve the deep learning architecture on demand.

2. Self-organizing layer of Deep Learning

Still on the Deep Learning topic, we are interested in the training of a single layer of the Deep Learning hierarchy. Usually, the learning involves the setting of many parameters that allow the layer to converge to a stable representation. However, we would like to minimize the amount of parameters to set by allowing the learning algorithm to adapt those parameters depending on the data. In order to do so, the algorithms should optimize multiple concurrent criteria that guarantee the sparsity and relevance of the representation. The intern will focus on self-adaptation and regulation mechanisms that will allow the learning algorithm to converge to a stable solution depending on the input it gets. This work will be using an online, incremental, and unsupervised learning approach, tested on real images captured with Aldebaran Robots.

3. Parallel implementation of SLAM algorithm applied to object recognition through saccadic visual exploration

In the framework of sensorimotor perception, our team aims at redefining the concept of object as a stable network of sensory and motor experiences. Applied to human vision, this network can be acquired through a saccadic exploration of moving objects. In order to cope with noise and uncertainty during data acquisition, a SLAM-like algorithm can be implemented to build a probabilistic model of an object's sensorimotor network. The intern will participate both in the parallel implementation and optimization of this algorithm and in the improvement of the sensorimotor encoding of the concept of object.

4. Learning to see - how to have a naive agent master its uninterpreted foveal vision?

Human vision is strongly conditioned by the foveal organization of the light-sensitive cells on the retina. Although fairly unnoticed in our everyday experience, the decreasing cell density when moving away from the retina's center leads to a very poor resolution in our peripheral field of view. To compensate for such a limitation, humans develop a saccading strategy to explore visual scenes and capture accurate information about different parts of the environment. Considering that the agent wants to look accurately at interesting features in the environment, it first needs to know where to saccade; in other words, it needs to know which low resolution feature in the peripheral vision corresponds to a desired high-resolution feature in the fovea. Such a knowledge is not a priori accessible to a naive agent with uninterpreted sensory input but can be learned through an active (saccades) exploration of the world. The intern will participate in the design and implementation of an algorithm able to learn the relations between sensory features captured in the periphery and the corresponding foveal feature obtained after saccading.

5. Learning hierarchical movement representations

Complex movements are compositional: A small part of a movement (for example opening the right hand) could be part of many different skills (grasping an object, shaking someone's hand, pushing a door open, etc.). When learning complex movements on a robot, it is therefore important to find a way to reuse these parts of movements, so that the robot does not have to rediscover them for each new movement that it learns. The intern will participate in the design and implementation of an algorithm to learn hierarchical movement representations, based on the recently proposed framework of dynamic movement primitives.

6. Learning to interact by learning to predict others

How can a robot learn to interact with others? Infants learn very early on in life that they can influence their social environment (in particular their parents) through their own actions. For example, extending the arm towards a toy that is out of reach may lead a caregiver of the infant to move the toy closer. Thus, the infant discovers that she/he can not only manipulate the physical world (move objects, grasp toys, ...), but that she/he can also "control" the "social world" (parents, peers, ...). In this internship, we will develop an agent (a simplistic virtual "robot") that learns to predict the behavior of other agents. The "world" in which the agents live is a Tetris-like grid world with simple physics, where agents can grasp and move around blocks (the world simulator has already been implemented, but can easily be extended and modified). Using such a simplistic scenario allows to study fundamental basics of social interaction: It can be investigated if, and how, agents can develop a simple form of social interaction. This is a first step towards robots that can autonomously learn to interact, just the way that infants do.

Details

Topics can be adapted depending on the academic level and duration of the internship.
Location: Paris, in Aldebaran HQ, 43 rue du Colonel Pierre Avia, 75015 Paris
Profile: Engineering Diploma / Master of Science / Master of Research
Language: English is mandatory
Programming language: C/C++ or Python.
Please send applications to ailab-team@aldebaran.com with the following elements:

- Resume
- Short paragraph about your expectations for this internship
- A brief summary of your relevant experience