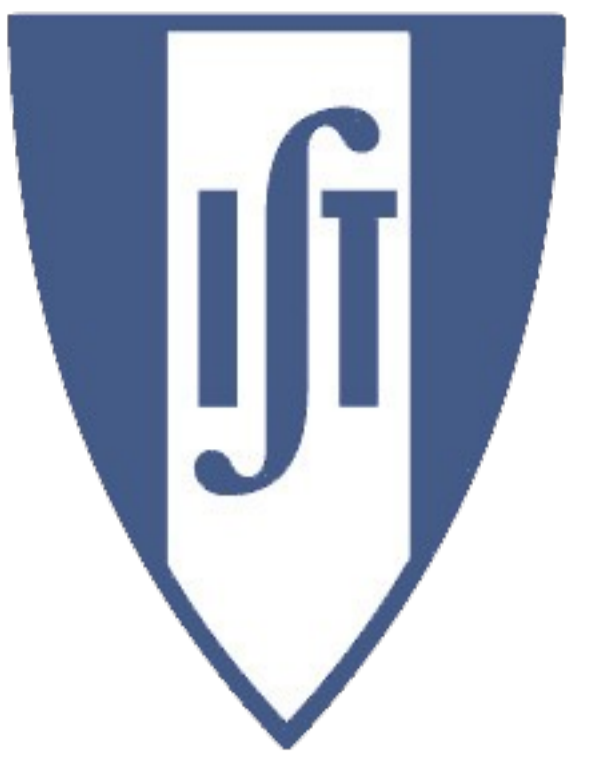
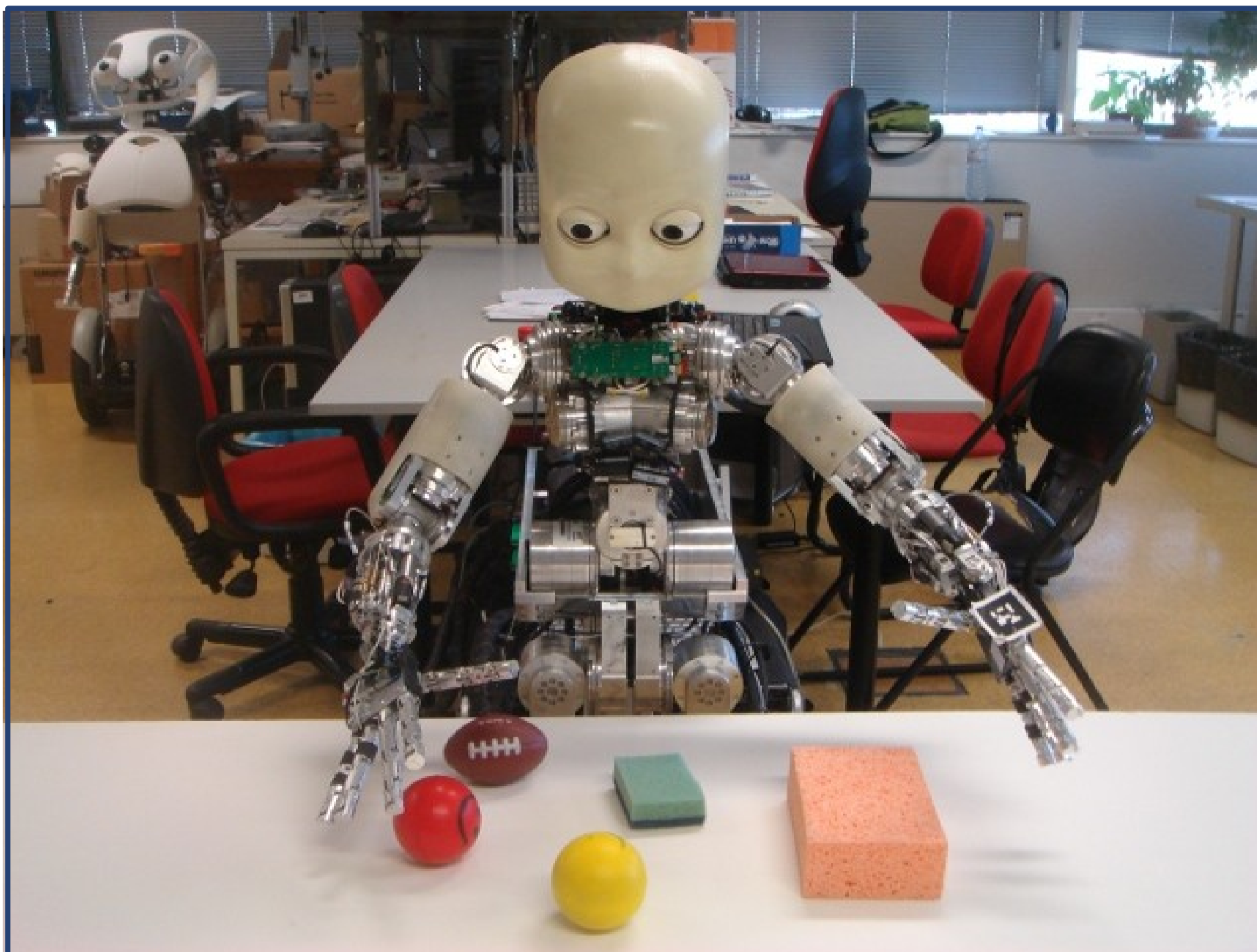




# Towards Fully Automated Learning of Grasping Affordances



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## Introduction

In this work we address how a robot can learn to grasp objects from experience with a focus on *open-ended learning*. We aim at a system that gets along without a person assisting in interacting with the objects during its whole lifespan. The implementation was done based on the humanoid robotic platform *iCub*. In particular we dealt with:

- policies for the selection of promising training data
- automated labeling of training samples and
- on-line learning

The presented system will serve as the basis for the evaluation of our research on *cognitive learning*.

## System Overview

The figure on top shows the setup consisting out of the *iCub* and a simple table with objects on it. The robot is supposed to perceive an object on the table, grasp and lift it and put it back (drop it) afterwards. In this way we are able to restart a grasping experiment on the same object but every time with a different orientation and viewing angle.

As illustrated in the figure on the right, the setup divides into two disjoint modes of operation:

- the automated collection of training data for bootstrapping the system and
- the application.

In a first stage (bootstrapping) we do not factor in learning or prediction of grasping points at all. We rather make the robot explore the scene by grasping multiple times at various positions on the table. Hereto, we aim at strategically selecting points that are the most expressive ones.

For the application setup we use the previously collected data to predict good grasping points. For this we build upon the work presented in [1]. The figure on the bottom shows the predicted probability map for an upside down Martini glass. The brighter an area is in the right image, the higher is the probability for a successful grasp. Furthermore we attempt to perform this analysis in an on-line manner. Instead of assuming a fixed database of labeled data we are able to extend this database over time and update the prediction accordingly.

[1] Luis Montesano and Manuel Lopes. *Learning grasping affordances from local visual descriptors*. In IEEE 8<sup>th</sup> International Conference on Development and Learning, pages 1–6, June 2009.

