Preface

Robot learning is a broad and interdisciplinary area. This holds with regard to the basic interests and the scientific background of the researchers involved, as well as with regard to the techniques and approaches used. The interests that motivate the researchers in this field range from fundamental research issues, such as how to constructively understand intelligence, to purely application oriented work, such as the exploitation of learning techniques for industrial robotics. Given this broad scope of interests, it is not surprising that, although AI and robotics are usually the core of the robot learning field, disciplines like cognitive science, mathematics, social sciences, neuroscience, biology, and electrical engineering have also begun to play a role in it. In this way, its interdisciplinary character is more than a mere fashion, and leads to a productive exchange of ideas.

One of the aims of EWLR-6 was to foster this exchange of ideas and to further boost contacts between the different scientific areas involved in learning robots. EWLR is, traditionally, a "*European* Workshop on Learning Robots". Nevertheless, the organizers of EWLR-6 decided to open up the workshop to non-European research as well, and included in the program committee well-known non-European researchers. This strategy proved to be successful since there was a strong participation in the workshop from researchers outside Europe, especially from Japan, which provided new ideas and lead to new contacts.

EWLR-6 was held in conjunction with ECAL'97, the "European Conference on Artificial Life". EWLR-6 was an independent event, but it took place at the same site, as a two-day workshop starting immediately after the main conference. This allowed an interaction between Robot Learning and Artificial Life, bringing out some of the common methodological approaches between the two fields, mainly the investigation of fundamental research issues through constructive approaches. Of course, Alife is only one of the directions which EWLR intends to investigate and provide with a forum. There are many more approaches in the field of learning robots, and the range of papers included here in the proceedings of EWLR-6 reflects this broad range of views.

The proceedings start with a chapter related to an invited talk, where Luc Steels presents a view of learning robots in the context of research on the evolution of language. The related chapter by Belpaeme, Steels, and Van Looveren describes the learning of visual categories by a real robot, thus presenting a possible way to bridge the gap between dynamic, real-world sensing and the symbolic level of language acquisition.

The following three chapters of the book deal with reinforcement learning. Murao and Kitamura in their chapter describe an efficient method of constructing the state space by segmenting a sub-region of the sensor space or recombining existing states, starting from a single state covering the entire sensor space.

This method allows the Q-learning algorithm to accomplish their task in continuous sensor space. Kalmar, Szepesvari, and Lorinez in their chapter propose using high-level modules in order to transform the task into a completely observable one, and compare their method with several other RL variants on a real-robot task. Finally, Faihe and Müller introduce a methodology for designing reinforcement-based control architectures.

Uchibe, Asada, and Hosoda also deal with the state-space construction issue with an emphasis on a vision-based approach in a multi-agent environment, and apply their method to soccer playing robots. Of course, other agents in the environment do not always simply add an extra level of complexity, but can also be utilized to help a robot to learn how to achieve new tasks. The next two chapters deal with how to achieve that through imitation. Billard and Hayes propose using imitation to teach a vocabulary to a learner robot who is following the teacher robot, using a recurrent associative memory as the underlying architecture, while Grossmann and Poli present an approach that combines learning by imitation with reinforcement learning and incremental hierarchical development.

Robots, in order to be useful, need not only to be able to learn but also to be self-sufficient, and Birk in his chapter deals with the interplay between learning and self-sufficiency. They also need the ability to learn their environment. Vogt attempts to ground an adaptive language that can be used to describe objects in the robot's environment, while Chagas and Hallam use case-based reasoning to capture regularities in its environment and reinforcement learning to gradually improve the acquired knowledge and the robot's performance in a navigation task.

Finally, the interplay between evolutionary methods and learning are the subject of the two last papers. Lee, Hallam, and Lund, in their chapter, describe how complex robot behaviors can be learned using an evolutionary approach coupled with task decomposition, while Keymeulen et al. attempt a similar goal but at a completely different level, by evolving hardware at the gate level. These last two papers are also a good example of what can be achieved by the interaction between the fields of Artificial Life and Robotics.

Andreas Birk and John Demiris
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Program Committee

– Minoru Asada	(Osaka University, Japan)
– Luc Berthouze	(Electrotechnical Laboratory, Japan)
– Hendrik Van Brussel	(Katholieke Univ Leuven, Belgium)
– Thomas Christaller	(GMD FIT, Germany)
– Edwin DeJong	(Vrije Univ Brussel, Belgium)
– Rüdiger Dillmann	(Univ of Karlsruhe, Germany)
– Marco Dorigo	(Univ Libre de Bruxelles, Belgium)
– Attilo Giordana	(Univ of Turin, Italy)
– John Hallam	(Univ of Edinburgh, Scotland, UK)
– Gillian Hayes	(Univ of Edinburgh, Scotland, UK)
– Yasuo Kuniyoshi	(ETL, Japan / MIT, USA)
– Ramon Lopez de Mantaras	(IIIA, Barcelona, Spain)
– Rolf Pfeifer	(Univ of Zurich, Switzerland)
– Fabio Roli	(Univ of Cagliari, Italy)
– Jun Tani	(Sony CS Laboratory, Japan)
– Sebastian Thrun	(Carnegie Mellon Univ, USA)
– Walter Van de Velde	(Vrije Univ Brussel, Belgium)
– Jeremy Wyatt	(Univ of Birmingham, UK)