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Knowledge, Skill, and Behavior Transfer in Autonomous Robots

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Abstract: The workshop on Knowledge, Skill, and Behavior Transfer in Autonomous Robots took place in Austin, Texas on January 25, 2015, as part of AAAI-15 conference. The aim of the workshop was to investigate methods for obtaining more general, versatile and capable robots through knowledge transfer in a broad sense, such as between similar problems, similar robots, or humans and robots.

Autonomous robots have achieved high levels of performance and reliability at specific tasks. However, for them to be practical and effective at everyday tasks in our homes and offices, they must be able to learn to perform different tasks over time, demonstrating versatility. Learning each task in isolation is an expensive process, requiring large amounts of both time and data. In robotics, this expensive learning process also has secondary costs, such as energy usage and joint fatigue. Recent developments in transfer and multi-task learning provides a potential solution to this problem, enabling robots to minimize the time and cost of learning new tasks by building upon knowledge learned from other tasks. This ability is essential to enable the development of versatile autonomous robots that are expected to perform a wide variety of tasks and rapidly learn new abilities.

Various aspects of this problem have been addressed by research across several different communities, including machine learning, knowledge representation, optimal control, and robotics. This workshop brought together researchers from these different communities toward the goal of enabling autonomous robots to support a wide variety of tasks, rapidly and robustly learn new abilities, adapt quickly to changing contexts, and collaborate effectively with other robots and humans to achieve a common goal.

One of the main themes of the workshop was transfer learning in a reinforcement learning setting. Automatic hierarchical decomposition of tasks and policies was explored, together with abstract representations that can capture the similarities between tasks. Matthew Taylor (Washington State University) gave an invited talk on different aspect of transfer learning, and in particular between different agents that can communicate only through advice.

Another theme was knowledge transfer between humans and robots. Robots can positively affect human behavior, especially with children, that can learn from the interaction with robots differently from what they do with humans. Furthermore, robots can exploit interaction in order to change their own behavior, and to acquire knowledge about objects and categories of interest, in particular when encompassing different sensory modalities.

Attendants also discussed environments and benchmarks for knowledge transfer in robotics. Maria Gini (University of Minnesota), in her invited talk, presented different complex scenarios for multi-robot systems, including the RoboCup rescue simulator.

The workshop participants discussed with interest the diversity of the methods in this emerging area, and the difficulties that still arise in their application to physical robots. The challenge of knowledge transfer can take different shapes in the different fields related to artificial intelligence and robotics. Participants agreed that future workshops on this topic will help identify connections across such fields, in order to overcome the difficult problem of overly specialized robots, unable to generalized to similar contexts and exhibit versatile behaviors.

Matteo Leonetti served as chair of the workshop, with the collaboration of Eric Eaton and Pooyan Fazli as co-chairs.

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