

Active Learning for Multi-agent Cooperation and Competition

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Machine learning techniques are widely researched and many have been applied to real-world problems. One influential factor in their success or failure is the availability and the suitability of training data. In some cases, the training data set is given or fixed, and how to use these data is part of the particular learning technique. In many other cases, gathering training data itself is an essential part of the learning task. For example, we argue that in the domain of the RoboCup Soccer 2D Simulator (RCS2DS) [1] agents representing individual players need to design their own drills to collect the training data for learning various low-level and high-level soccer skills. We define this kind of learning process as “active learning.” Active learning includes the design of automatic means to gather training data according to the purposes of the learning task.

We propose a proof of concept system for cooperative, multi-agent active learning in adversarial environments using the RCS2DS environment as our test-bed. Human active learning typically involves experiences of doing, of observing and of dialogue with self and others [2]. We provide agents with prior domain knowledge about the environment and built-in mechanisms to maintain (create, update and remove) that knowledge. According to the prior domain knowledge and the current learning task (e.g., a shooting practice of 2 attackers against 1 defender), each agent identifies its own objectives (or ones shared with teammates), designs its own or shared plans, executes them while obtaining feedback from the environment. Feedback includes that given explicitly by other agents, if any. The agent then summarizes the feedback and the learning task into knowledge and merges it into its domain knowledge. We believe that active learning can significantly reduce the learning time while maintaining (or exceeding) a given level of task performance.

References

- [1] Mao Chen, Ehsan Foughi, etc. “Users Manual RoboCup Soccer Server for Soccer Server Version 7.07 and later”, The RoboCup Federation, Jan. 2003.
- [2] L. Dee Fink, “Active Learning”. Retrieved April 6, 2006 from <http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/active.htm>