

Title: Autonomous Machine Learning

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Abstract:

Autonomous machine learning has become a top priority in science and engineering of learning. In July 2007, NSF had a workshop on the “*Future Challenges for the Science and Engineering of Learning*.” Here is the summary of the “*Open Questions in Both Biological and Machine Learning*” from the workshop

(<http://www.cnl.salk.edu/Media/NSFWorkshopReport.v4.pdf>).

“Biological learners have the ability to learn autonomously, in an ever changing and uncertain world. This property includes the ability to generate their own supervision, select the most informative training samples, produce their own loss function, and evaluate their own performance. More importantly, it appears that biological learners can effectively produce appropriate internal representations for composable percepts -- a kind of organizational scaffold - - as part of the learning process. By contrast, virtually all current approaches to machine learning typically require a human supervisor to design the learning architecture, select the training examples, design the form of the representation of the training examples, choose the learning algorithm, set the learning parameters, decide when to stop learning, and choose the way in which the performance of the learning algorithm is evaluated. This strong dependence on human supervision is greatly retarding the development and ubiquitous deployment autonomous artificial learning systems. Although we are beginning to understand some of the learning systems used by brains, many aspects of autonomous learning have not yet been identified.”

This dismal NSF characterization of the state of our learning systems opens the door to creating **a new generation of learning algorithms**. And IJCNN and sister conferences could become the focal point for research collaboration on this new breed of learning algorithms.

The objective of this tutorial is to present some new ideas regarding brain-like learning, ideas that can lead to the development of autonomous learning methods. Autonomous learning is extremely important for robotics. For autonomous robots that can learn on their own like humans, we have to have tweak-free learning algorithms that can **design and train** computational structures (e.g. neural networks) on their own without any kind of human intervention.

Structure of the tutorial:

- Provide an overview of a broad set of principles for designing and constructing autonomous learning algorithms. Present some new ideas about brain-like learning that differ from current connectionist approaches.
- Discuss one particular autonomous learning algorithm for pattern classification problems. Give a demonstration of this autonomous learning algorithm. Summarize its basic features and design principles.
- As noted in the NSF report, autonomous learning is the technology we need and it is important that we get organized and focus on this new breed of learning algorithms. So there will be some open discussion on this issue. We would take this opportunity to **form a research group for collaboration on autonomous learning systems**.