Induction of Rule Ordering in Production-based Processing Models

Adrian Brasoveanu
University of Santa Cruz

Production-based cognitive models, such as ACT-R or Soar agents, have been a popular tool in cognitive science to model sequential decision processes. While the models have been useful in articulating assumptions and predictions of various theories, they unfortunately require a significant amount of hand coding, both with respect to what building blocks cognitive processes should consist of and with respect to how these building blocks are selected and ordered in a sequential decision process. Hand coding large, realistic models poses a challenge for modelers, and also makes it unclear whether the models can be learned and are thus cognitively plausible. The learnability issue is probably most starkly present in cognitive models of linguistic skills, since linguistic skills involve richly structured representations and highly complex rules. We investigate how Reinforcement Learning (RL) methods can be used to solve the production selection and production ordering problem in ACT-R. We focus on four algorithms from the Q learning family, tabular Q and three versions of Deep Q Networks (DQNs), as well as the ACT-R utility learning algorithm, which provides a baseline for the Q algorithms. We compare the performance of these five algorithms in a range of lexical decision (LD) tasks framed as sequential decision problems.