Evolving to Generalize

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Abstract

The phenomenon of learning generalization - where an organism repeats behavior learned in response to one stimulus when presented with a perceptually similar stimulus - has been well documented in a variety of animals.

I argue that evolutionary game theory can help explain the prevalence of this type of learning behavior by showing how and when generalization can outperform other strategies in situations where there are payoff similarities between states.

J́ager (2007) introduced Sim-Max games, a variation of the standard Lewis signaling game where the state space is endowed with a metric that captures a similarity relation over states of the world. This added structure is manifested in payoffs that reward behavior in both the ideal state for that behavior as well as similar states. A modication of this game can be used as a good model to explore the success of learning generalization in single organism situations.

I show that in these games learning generalization can sometimes outperform simple reinforcement learning. However, it does not do so in all cases. My results highlight an interesting tension. The strategies developed by generalizing learners are necessarily imprecise, and thus perform less well than ideal strategies in these games. However, learning generalization allows

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actors to develop a fairly successful strategy very quickly. I show that generalization can be expected to evolve in cases where organisms need to learn how to act in many different states over a short time scale.

References

Jager, Gerhard (2007). "The evolution of convex categories." Linguistics and Philosophy, 30, 551-564.