

Learning with Dirichlet Priors for Affordance Aware Planning

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Abstract

Planning algorithms for non-deterministic domains are often intractable in large state spaces due to the well-known “curse of dimensionality.” In previous work, we introduced a novel, state- and reward- general approach to limiting the branching factor in large domains by reasoning about the domain in terms of *affordances* [1]. Our affordance formalism can be coupled with a variety of planning frameworks to create “affordance aware planning,” allowing an agent to efficiently search the state-space by focusing on relevant action possibilities.

$$\Delta_i = \langle p, g \rangle \mapsto \lambda$$

$$A = \{a_1, a_2, \dots, a_n, o_1, o_2, \dots, o_m\}$$

Previously, we provided planners with affordances, leading to massive speed ups in planning compared to algorithms without affordances. To avoid hand crafting knowledge we propose learning affordances through scaffolding [2]. We randomly generate many simplified state spaces that are representative of more complicated environments the agent will plan over.

We propose forming policies over each of the simplified state spaces and using these policies to learn a Dirichlet-Multinomial distribution over each affordance’s action set. In addition, we propose sampling optimal trajectories from the trained policies to form a Dirichlet distribution over the number of useful actions for each affordance. During evaluation, for each state the agent visits we sample from the latter distribution to infer how many useful action possibilities will be available to it. This process maximizes the probability of an affordance focusing the agent on the most relevant actions.

We are still collecting experimental data on hard-coded vs learned affordances. We believe that the learned affordances will perform slightly worse than hand crafted affordances, and substantially better than planners without affordances.

References

- [1] JJ Gibson. The concept of affordances. *Perceiving, acting, and knowing*, pages 67–82, 1977.
- [2] David Wood, Jerome S Bruner, and Gail Ross. The role of tutoring in problem solving*. *Journal of child psychology and psychiatry*, 17(2):89–100, 1976.