Composing Entropic Policies using Divergence Correction

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Compositional Policies

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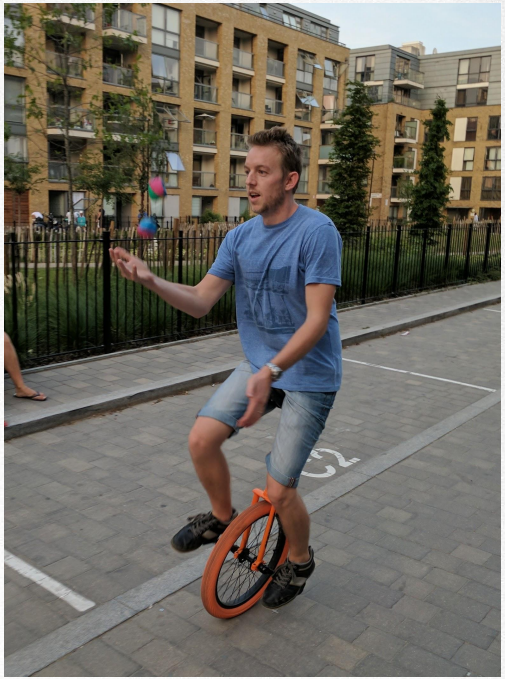

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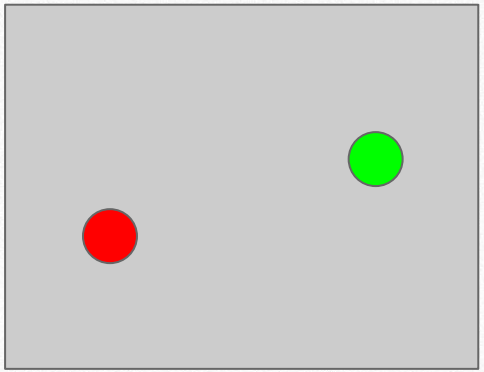
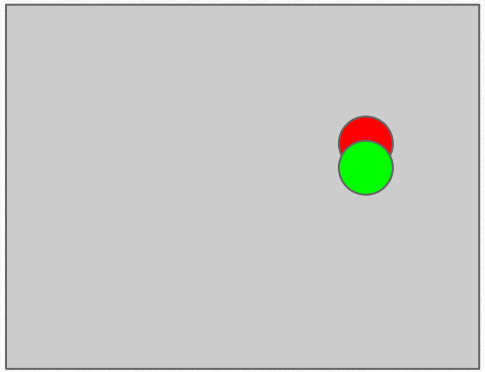
Problem

Training tasks: r_1, r_2

Transfer task: $r_b = r_1 + r_2$

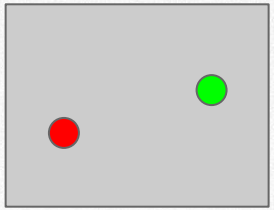




Prior Work

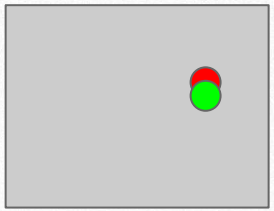
Generalized Policy Improvement (Barreto et al., 2017)

$$\{\pi_1, \pi_2, \ldots\} \qquad Q_b^{GPI}(s,a) = \max_i Q_b^{\pi_i}(s,a)$$



Compositional Optimism (Haarnoja et al., 2018) with Maximum Entropy RL

$$Q_b^{CO}(s,a) = Q^{\pi_1}(s,a) + Q^{\pi_2}(s,a)$$



Maximum Entropy Generalized Policy Improvement

1. **Successor Features**

$$\phi = (r_1, r_2) \qquad \psi^{\pi}(s,a) = \mathop{\mathbb{E}}_{\pi}\left[\sum_i \phi_i\right]$$

$$Q_b^{\pi}(s,a) = \psi^{\pi}(s,a) \cdot (b, 1-b)$$

2. **Generalized Policy Improvement**

$$Q_b^{GPI}(s,a) = \max_i Q_b^{\pi_i}(s,a)$$

$$\pi(a|s) \propto \exp(Q_b^{GPI}(s,a))$$

Divergence Correction

- Track the discounted, expected Rényi divergence between policies.

$$Q_b^{DC}(s,a) = Q^{\pi_1}(s,a) + Q^{\pi_2}(s,a) - C(s,a)$$

- This information allows to recover the optimal compositional policy.

$$Q_b^{DC} = Q_b^*$$

Results