

## One-step Actor–Critic (episodic), for estimating $\pi_{\theta} \approx \pi_*$

Input: a differentiable policy parameterization  $\pi(a|s, \theta)$

Input: a differentiable state-value function parameterization  $\hat{v}(s, \mathbf{w})$

Parameters: step sizes  $\alpha^{\theta} > 0$ ,  $\alpha^{\mathbf{w}} > 0$

Initialize policy parameter  $\theta \in \mathbb{R}^{d'}$  and state-value weights  $\mathbf{w} \in \mathbb{R}^d$  (e.g., to  $\mathbf{0}$ )

Loop forever (for each episode):

    Initialize  $S$  (first state of episode)

    Loop while  $S$  is not terminal (for each time step):

$A \sim \pi(\cdot|S, \theta)$

        Take action  $A$ , observe  $S', R$

$\delta \leftarrow R + \gamma \hat{v}(S', \mathbf{w}) - \hat{v}(S, \mathbf{w})$       (if  $S'$  is terminal, then  $\hat{v}(S', \mathbf{w}) \doteq 0$ )

$\mathbf{w} \leftarrow \mathbf{w} + \alpha^{\mathbf{w}} \delta \nabla \hat{v}(S, \mathbf{w})$

$\theta \leftarrow \theta + \alpha^{\theta} \delta \nabla \ln \pi(A|S, \theta)$

$S \leftarrow S'$