Control With Gradient TD Methods + The Nonlinear Case

COMP 767

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Overview

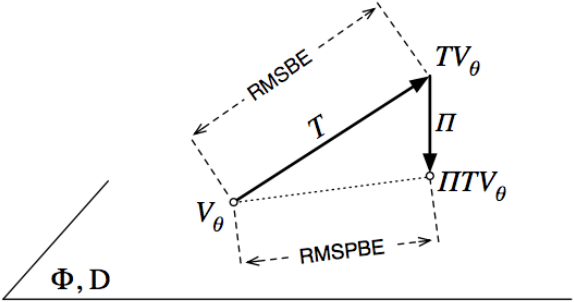
Gradient TD

Control With Gradient TD Methods

This slide is just to add slides.

The part we've covered:

- This Picture:



-

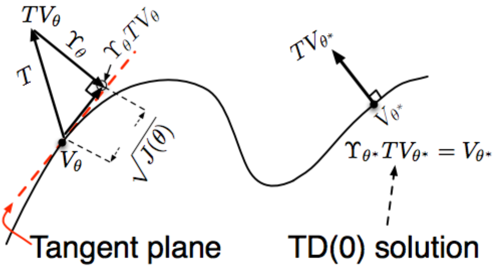
$$MSPBE = ||(\Pi_\theta TV_\theta - V_\theta)||_D^2$$

$$-1/2\nabla MSPBE = -\mathbb{E}[\delta\phi] - \gamma\mathbb{E}[\phi'\phi^\top]w$$

$$w = \mathbb{E}[\phi\phi^\top]^{-1}\mathbb{E}[\delta\phi]$$

The part we haven't:

- This Picture:



- MSPBE now projects onto the tangent space of the nonlinear function which we assume to be smooth enough to be locally linear.

$$MSPBE = ||\Pi_\theta(TV_\theta - V_\theta)||_D^2$$

$$-1/2\nabla MSPBE = -\mathbb{E}[\delta\phi] - \gamma\mathbb{E}[\phi'\phi^\top]w + h(\theta, w)$$

$$w = \mathbb{E}[\phi\phi^\top]^{-1}\mathbb{E}[\delta\phi]$$

The part we haven't:

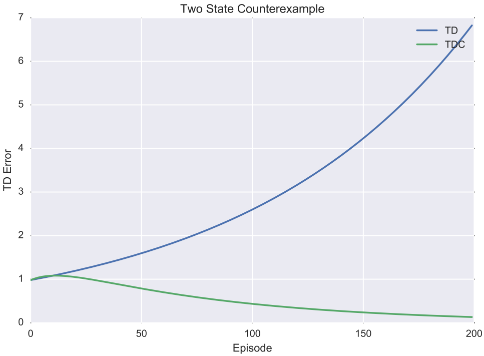
- Update rules are much the same but now there are second order terms.

$$\theta_{k+1} = \Gamma\left[\theta_k + \alpha_k\{\delta_k\phi_k - \gamma\phi'_k(\phi_k^\top w_k) - h_k\}\right]$$

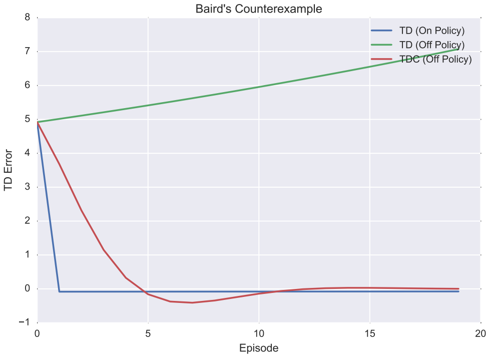
$$h_k = \delta_k - (\phi_k^\top w_k)\delta^2 V_\theta(s_k) w_k$$

- note that now $\phi_k = \nabla V_\theta(s_k)$
- Also, Lee and Anderson, 2014 do this + control with small neural nets

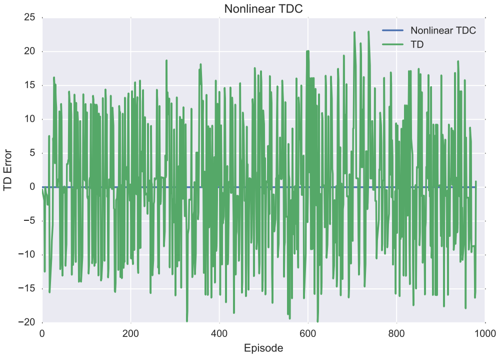
Quick Results



Quick Results



Quick Results



Control With Gradient TD Methods

$\theta \sim$ random

$s \sim$ inital state **while** *not terminal* **do**

  Choose a from ϵ-Greedy on $Q_\theta(s, a)$

  Observe (s', r)

  Choose $a' = max_i(Q_\theta(s', i))$

  update Q_θ according to TDC(θ,s,a,r,s', a')

  $s = s'$

end

Algorithm 1: Greedy-QC

Simply Plug TDC or GTD2 into SARSA or Q-learning!

This is in the original feature space!

Simply Plug TDC or GTD2 into SARSA or Q-learning!

This is in the original feature space!