From Policy Gradient to Actor-Critic methods

Introduction: the 4 routes to deep RL

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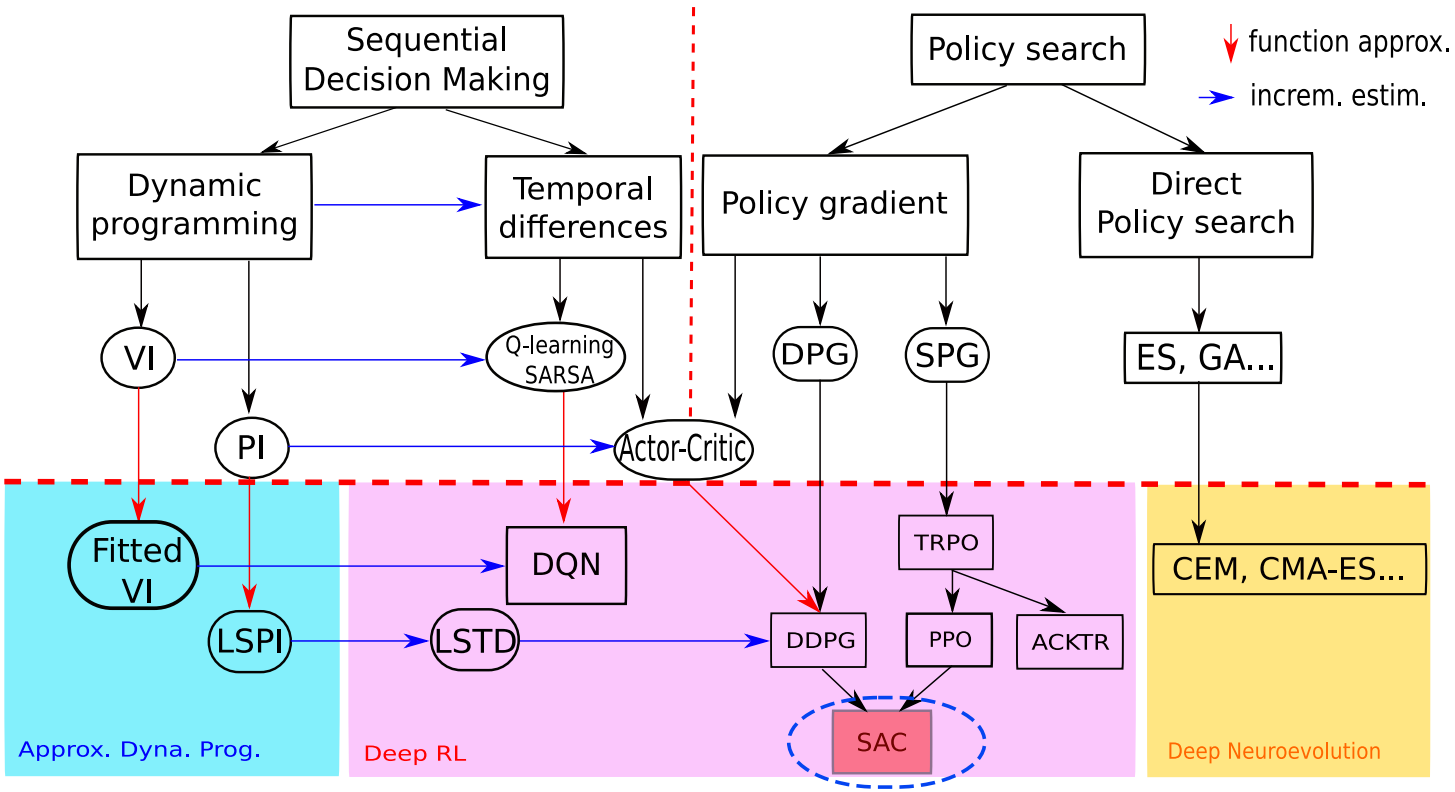
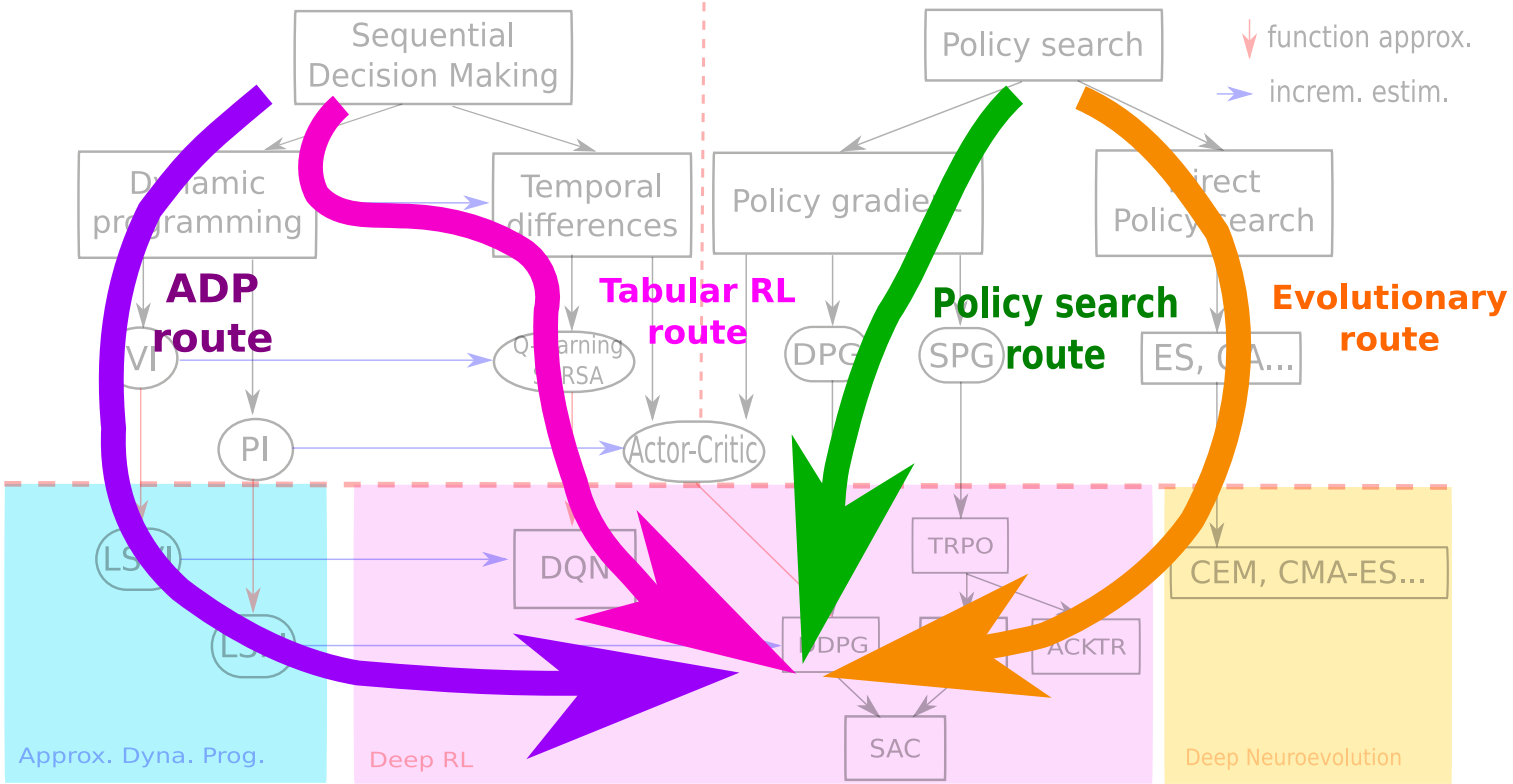
The Big Picture



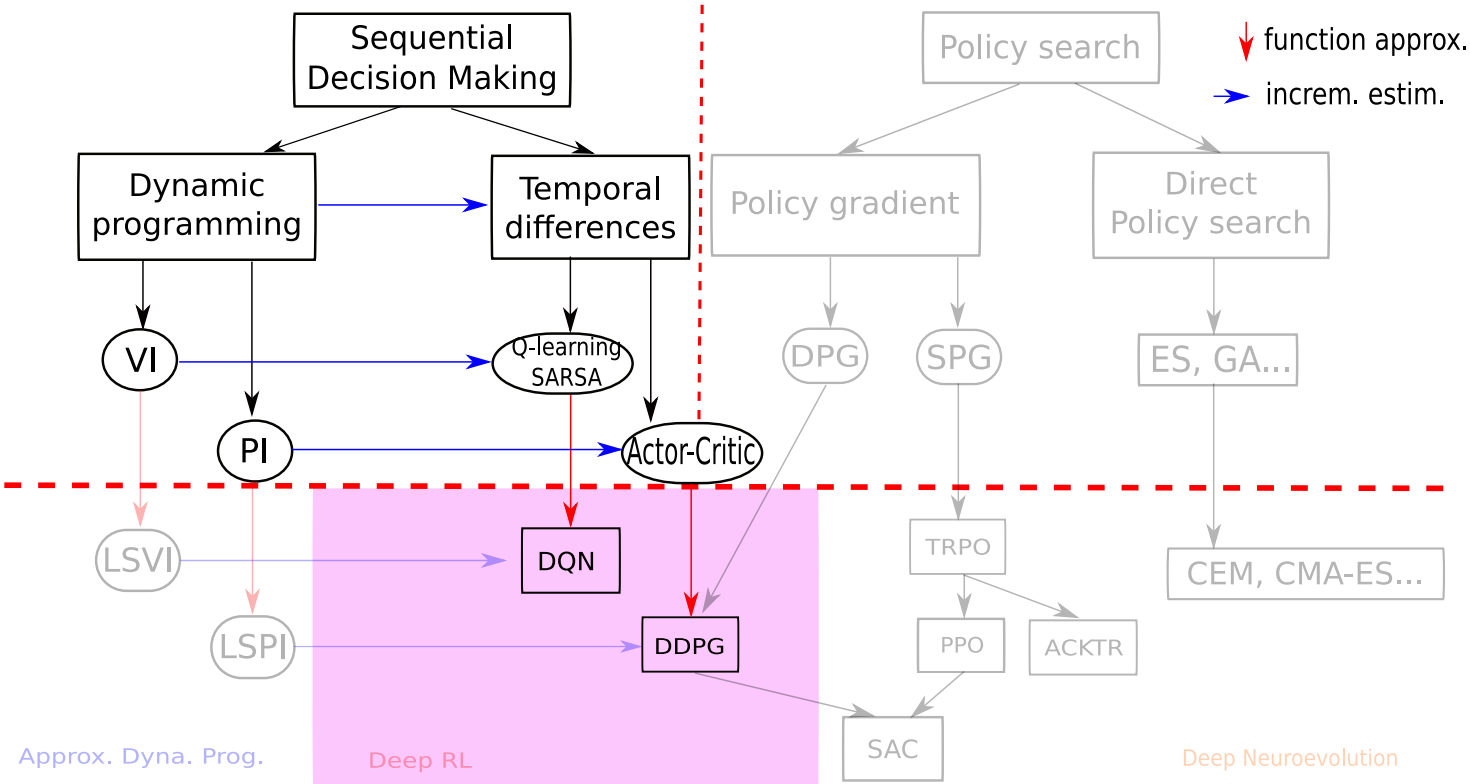
- A very partial view of the whole RL literature

The four routes



- Four different ways to come to Deep RL

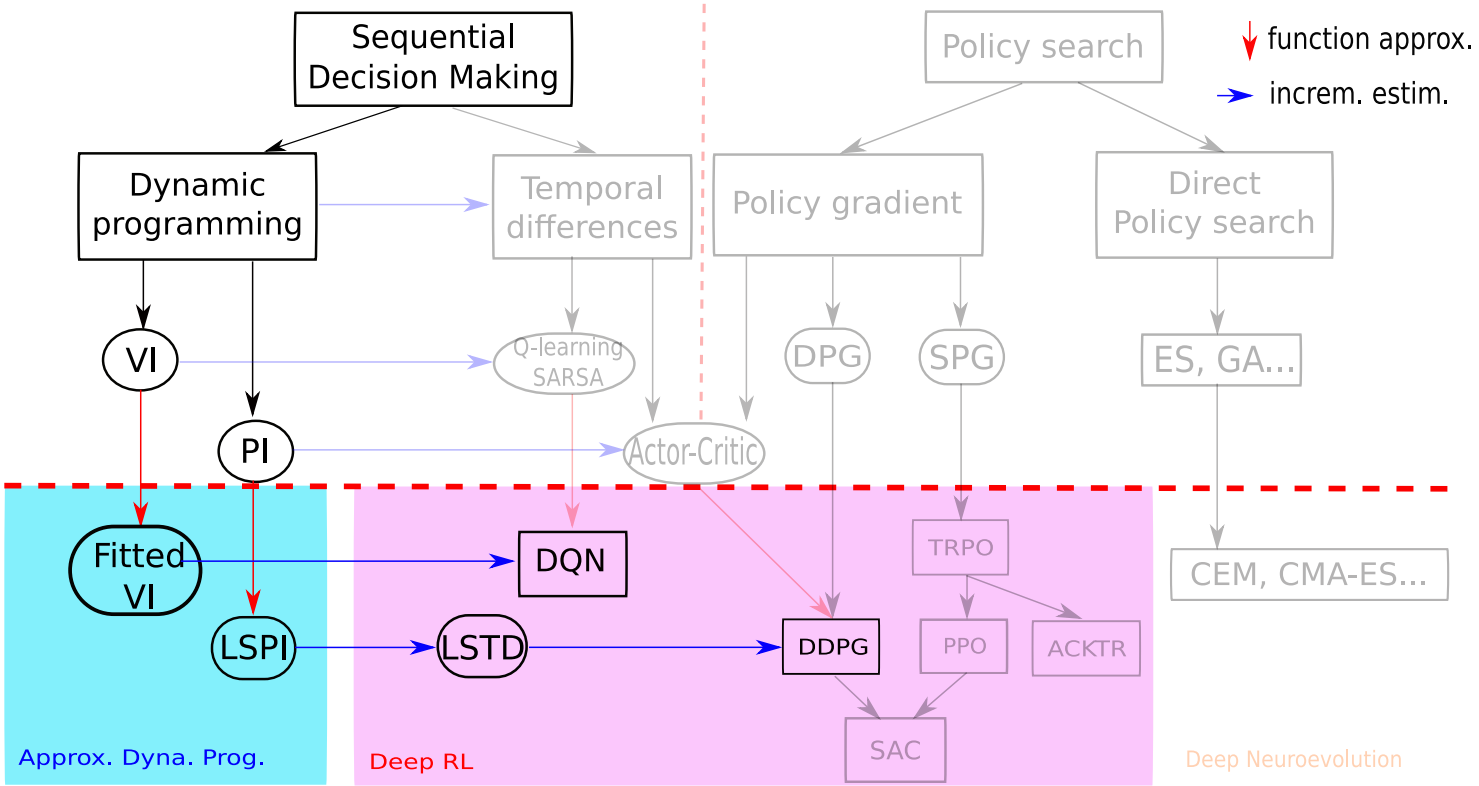
The Tabular RL route



- The favorite route of beginners
- Start from Sutton&Barto, present Q-learning, SARSA and Actor-Critic
- Add function approximation with NNs, go to DQN, then DDPG

Sutton, R. S. & Barto, A. G. (1998) *Reinforcement Learning: An Introduction*. MIT Press.

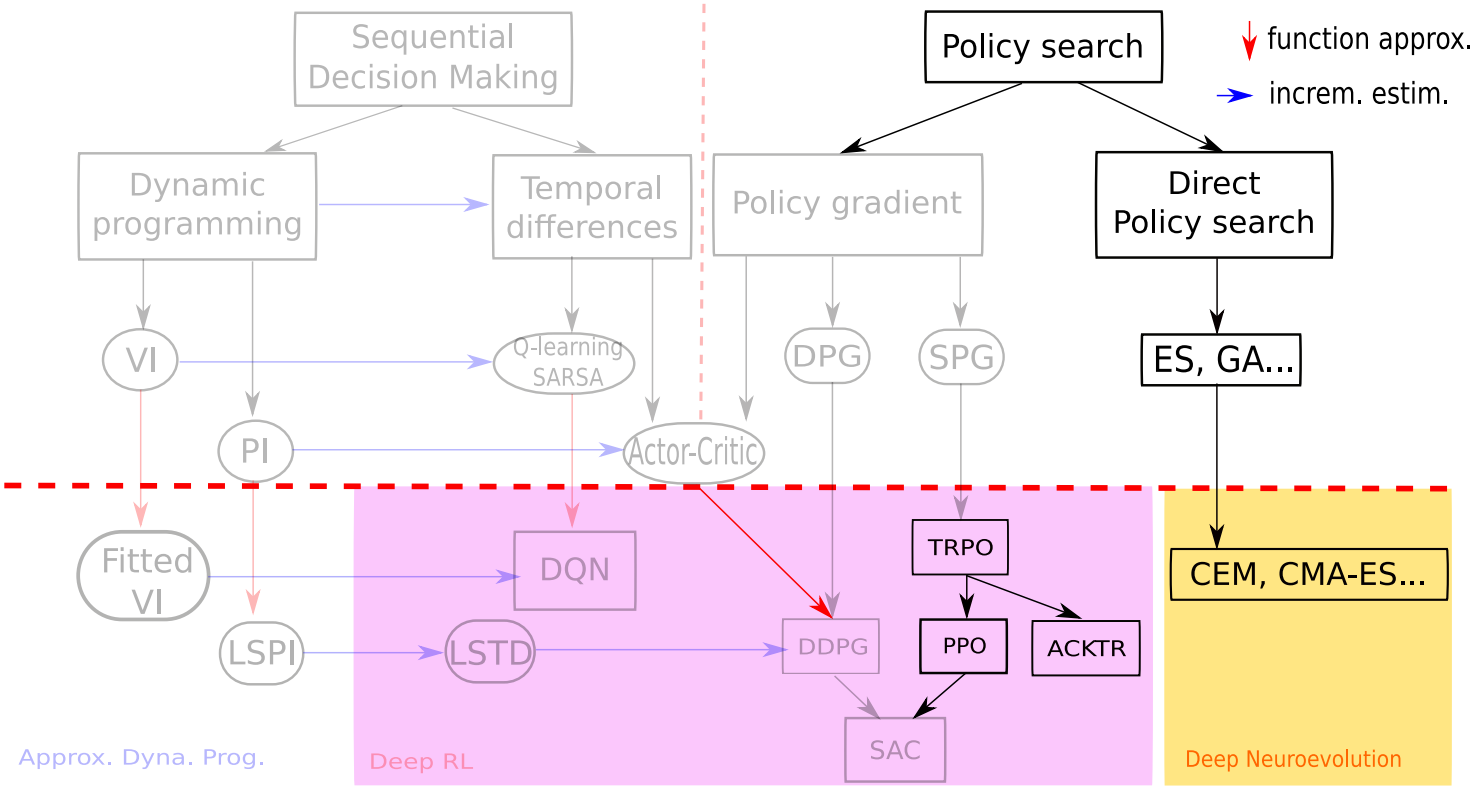
The Approximate Dynamic Programming route



- The favorite route of mathematicians
- I never travelled this route

Warren B. Powell. *Approximate Dynamic Programming: Solving the curses of dimensionality*, volume 703. John Wiley & Sons, 2007

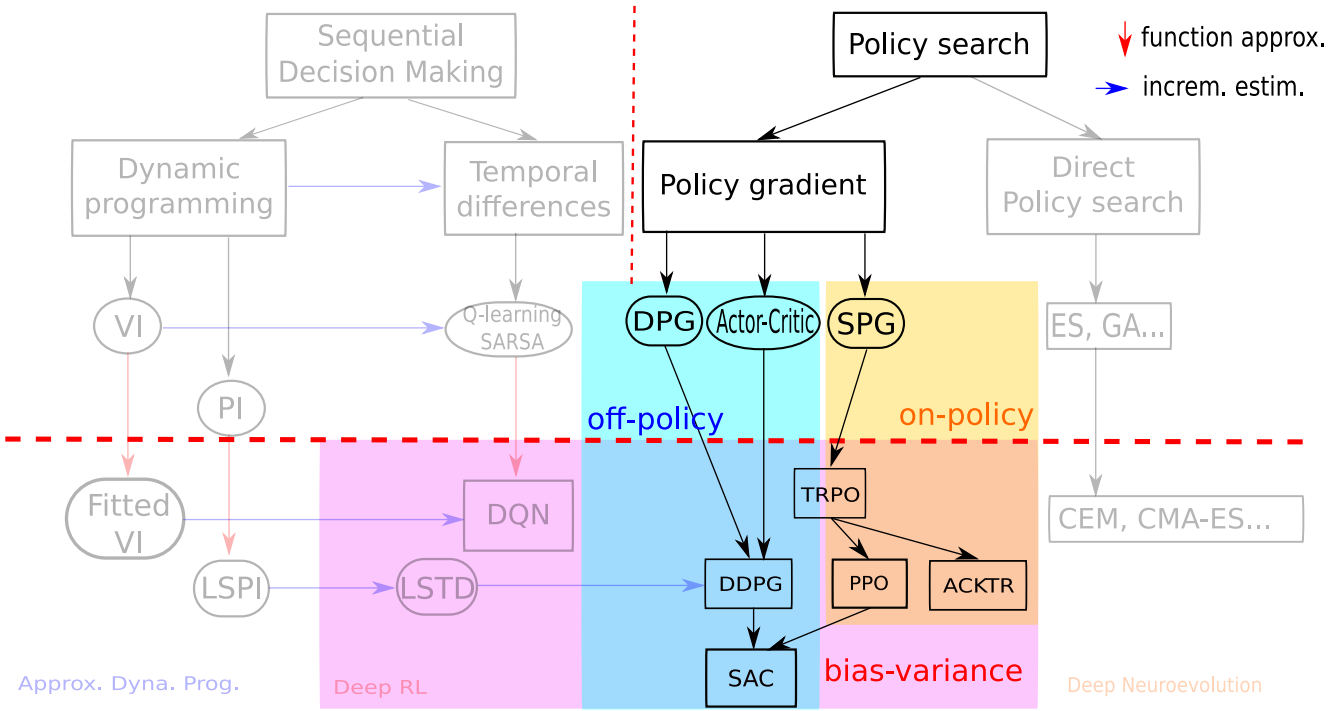
The Evolutionary route



- The favorite route of non-RL people
- Much more efficient than RL people think

Tim Salimans, Jonathan Ho, Xi Chen, and Ilya Sutskever. Evolution strategies as a scalable alternative to reinforcement learning.
arXiv preprint arXiv:1703.03864, 2017

The Policy Search route



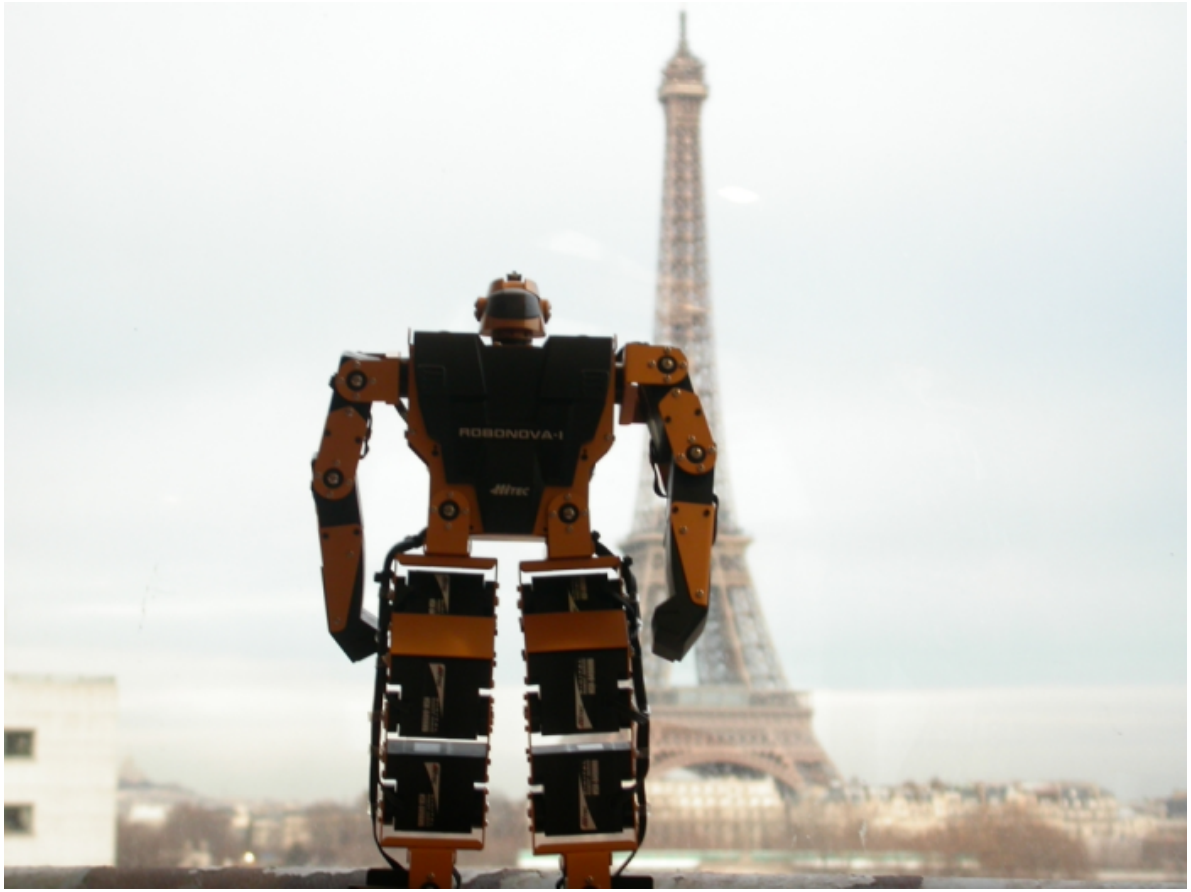
- The favorite route of roboticists
- The one I'm travelling in these lessons
- Central question: difference between PG with baseline and Actor-Critic

Marc P. Deisenroth, Gerhard Neumann, Jan Peters, et al. A survey on policy search for robotics. *Foundations and Trends® in Robotics*, 2(1–2):1–142, 2013

Outline

1. (8') The policy search problem
2. (20') Policy Gradient derivation (3 parts)
3. (10') From policy gradient with baseline to actor-critic
4. (7'30") Bias-variance trade-off
5. (15') On-policy vs off-policy
6. (12') TRPO, ACKTR
7. (9') PPO
8. (17'30") DDPG, TD3
9. (15'30") SAC
10. (4'30") RWR
11. (4'30") Wrap-up

Any question?



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