

Chapter 10:

Dimensions of Reinforcement Learning

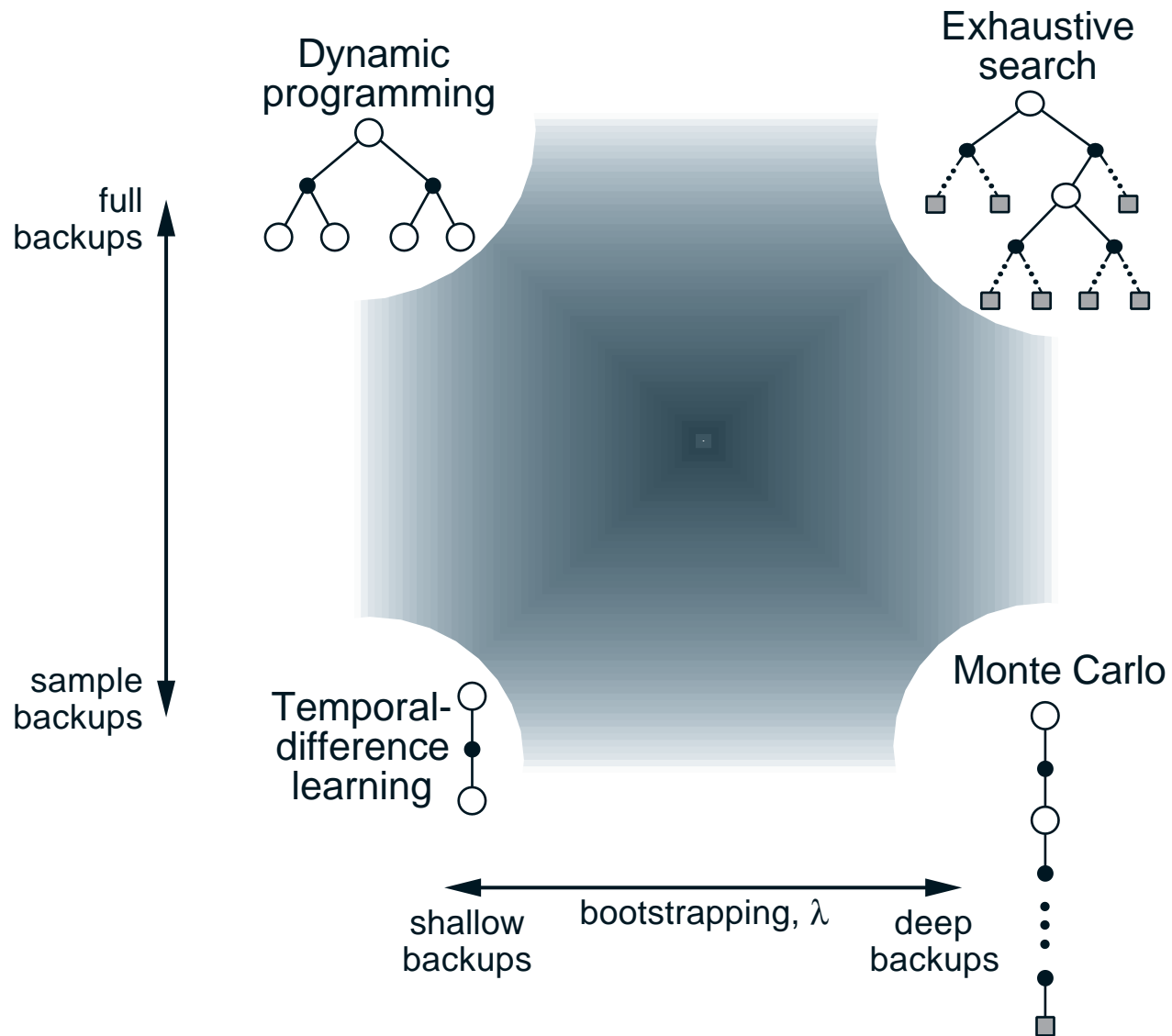
Objectives of this chapter:

- ☐ Review the treatment of RL taken in this course
- ☐ What have left out?
- ☐ What are the hot research areas?

Three Common Ideas

- ❑ Estimation of **value functions**
- ❑ **Backing up values** along real or simulated trajectories
- ❑ **Generalized Policy Iteration**: maintain an approximate optimal value function and approximate optimal policy, use each to improve the other

Backup Dimensions



Other Dimensions

❑ Function approximation

- tables
- aggregation
- other linear methods
- many nonlinear methods

❑ On-policy/Off-policy

- On-policy: learn the value function of the policy being followed
- Off-policy: try learn the value function for the best policy, irrespective of what policy is being followed

Still More Dimensions

- ❑ Definition of return: episodic, continuing, discounted, etc.
- ❑ Action values vs. state values vs. afterstate values
- ❑ Action selection/exploration: ϵ -greed, softmax, more sophisticated methods
- ❑ Synchronous vs. asynchronous
- ❑ Replacing vs. accumulating traces
- ❑ Real vs. simulated experience
- ❑ Location of backups (search control)
- ❑ Timing of backups: part of selecting actions or only afterward?
- ❑ Memory for backups: how long should backed up values be retained?

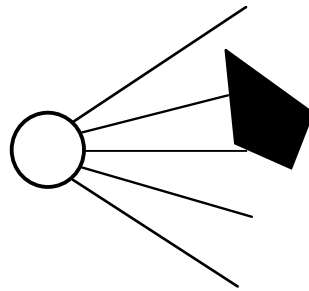
Frontier Dimensions

- ❑ Prove convergence for bootstrapping control methods.
- ❑ Trajectory sampling
- ❑ Non-Markov case:
 - Partially Observable MDPs (POMDPs)
 - Bayesian approach: belief states
 - construct state from sequence of observations
 - Try to do the best you can with non-Markov states
- ❑ Modularity and hierarchies
 - Learning and planning at several different levels
 - Theory of options

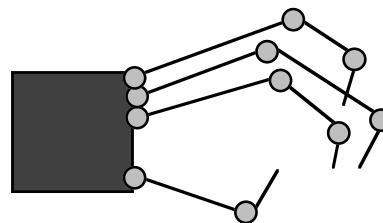
More Frontier Dimensions

□ Using more structure

- factored state spaces: dynamic Bayes nets



- factored action spaces



Still More Frontier Dimensions

- ❑ Incorporating prior knowledge
 - advice and hints
 - trainers and teachers
 - shaping
 - Lyapunov functions
 - etc.