

## Lecture 2: Markov Decision Processes

## └ Markov Reward Processes

## └ Bellman Equation

## Solving the Bellman Equation

- The Bellman equation is a linear equation
- It can be solved directly:

$$\begin{aligned}v &= \mathcal{R} + \gamma \mathcal{P}v \\(I - \gamma \mathcal{P})v &= \mathcal{R} \\v &= (I - \gamma \mathcal{P})^{-1} \mathcal{R}\end{aligned}$$

- Computational complexity is  $O(n^3)$  for  $n$  states
- Direct solution only possible for small MRPs
- There are many iterative methods for large MRPs, e.g.
  - Dynamic programming
  - Monte-Carlo evaluation
  - Temporal-Difference learning