Final Report

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Abstract

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1. Introduction

Def. A finite Markov Decision Process (MDP) is a five-tuple (S, A, P, R, γ) where[1][2]

1. S is the finite state space,
2. $A(s)$ is the finite action space for state $s \in S$,
3. $P : S \times A \times S$ is the transition probability function,
4. $R : S \times A \times S$ is the reward function, and
5. $\gamma \in [0, 1]$ is the discount factor.

$P(s' \mid s, a)$ is the probability that the next state is $s' \in S$ given that the current state is $s \in S$ and the action taken is $a \in A(s)$. $R(s', a, s)$ is the reward received when the current state is $s' \in S$, the action taken was $a \in A(s)$, and the previous state was $s \in S$.

Def. A policy π is a function $\pi : A \times S \to [0, 1]$ where $\pi(a \mid s)$ is the probability that an agent in state $s \in S$ takes action $a \in A(s)$. This is a probability distribution, so

$$\sum_{a \in A(s)} \pi(a \mid s) = 1$$

for all $s \in S$.

Def. The discounted return G_t at time t is the sum of all future rewards, discounted by the factor γ. That is,

$$G_t = \sum_{k=1}^{\infty} \gamma^k R_{t+k}$$

where R_{t+k} is the reward received at time $t + k$.

Def. The state-value function $V_\pi(s)$ is the expected return when starting in state s and following policy π:

2. Markov Decision Process

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3. Reinforcement Learning

4. Simulation Study

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5. Discussion

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6. Conclusion

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References

[1] P. Brothers, Risk: The Classic World Domination Game (1993). URL `https://www.hasbro.com/common/instruct/risk.pdf`
[2] M. L. Puterman, Markov decision processes: discrete stochastic dynamic programming, John Wiley & Sons, 2014.