DRL Homework 01

Group 27

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pa em roc	ame of chess as an MDP $MDP(S, A, p(S_{t+1} S_t, A_t), r(S_t, A_t))$ $Pieces := \{p \mid \text{p is one of the possible chess pieces}\}$ $S := \{x \in (Pieces \cup \{empty\})^{8 \times 8} \text{x is one of the possible chess combination of pieces}$ $S_0 := (rook, knight, bishop, queen, king, bishop, knight, rook, knight, bishop, queen, king, bishop, knight, rook, knight, pawn, paw$	
,	$p: S \times S \times A \to \mathbb{R}; (S_{t+1}, S_t, A_t) \mapsto \begin{cases} 1 & \text{if } S_{t+1} \text{ is optimal as det. by a Minimax impl} \\ 0 & \text{else} \end{cases}$ $\pi: A \times S \to \mathbb{R}; (A_t, S_t) \mapsto \frac{\sum_{S_{t+1}} [p(S_{t+1} S_t, A_t)(r(S_{t+1}, A_t) + \gamma V_{\pi}(S_{t+1}))]}{\sum_{a \in A} \sum_{S_{t+1}} [p(S_{t+1} S_t, a)(r(S_{t+1}, a) + \gamma V_{\pi}(S_{t+1}))]}$	

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2 Task 2

Lunar Lander as an MDP

 $MDP(S, A, p(S_{t+1}|S_t, A_t), r(S_t, A_t))$

Possible states are the positions of the lander

(x,y):(x,y) are the coordinates of lander

 $(\vec{x}, \vec{y}) : (\vec{x}, \vec{y})$ are linear velocities in x and y of lander}

 $\alpha:\alpha$ is angle of lander

 $\vec{\alpha} : \vec{\alpha}$ is angular velocity of lander

(ll, lr): (ll, lr) booleans for each leg if it touches the ground

 $S \doteq \{s \in (x, y, \vec{x}, \vec{y}, \alpha, \vec{\alpha}, ll, lr) | \text{ s is one possible state of the lander} \}$

 $A \doteq \{a \in (no, left, main, right) | \text{ a is one of 4 possible actions (no action, fire left, fire middle, fire right)}\}$

 $p(S_{t+1}|S_t,A_t)$ is determined by physics

 $r(s, a) = r(s_{t+1}, a_{t+1}) + optional.Rewards$

optional.Rewards = Reward for moving from the top of the screen to the landing pad and coming to rest is about 100-140 points.

If the lander moves away from the landing pad, it loses reward.

If the lander crashes, it receives an additional -100 points.

If it comes to rest, it receives an additional +100 points.

Each leg with ground contact is +10 points.

Firing the main engine is -0.3 points each frame.

Firing the side engine is -0.03 points each frame. Solved is 200 points.

3 Task 3

The environment dynamics is defined as

$$p(s', r|s, a) \doteq \Pr\{S_t = s', R_t = r|S_{t-1} = s, A_{t-1} = a\}$$

for all s', $s \in \mathcal{S}$, $r \in \mathcal{R}$, and $a \in \mathcal{A}$ (Sutton and Barto 2018, p. 48). The Markov property defines that the state and reward values depend only on the immediately preceding state and action rather than the entire history. The information required to determine what the next state and reward will be when the agent takes an action should be contained within the current state.

In real-world problems, it is rare that we have complete knowledge of the environment dynamics, i.e. an all-encompassing model of the environment is normally not readily available, but rather, we may have a limited dataset of observations made in the environment, or we may collect observations in order to obtain such a dataset.

In a real-world scenario the dynamics may also not be completely known, e.g. in the scenario of a self-driving car, not all behavior of real-world drivers can be predicted with a mathematical model.

References

Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). The MIT Press. http://incompleteideas.net/book/the-book-2nd.html