Ball Kicking for Reinforcement Learning on Poppy Humanoid

Initial Presentation of Applied Reinforcement Learning

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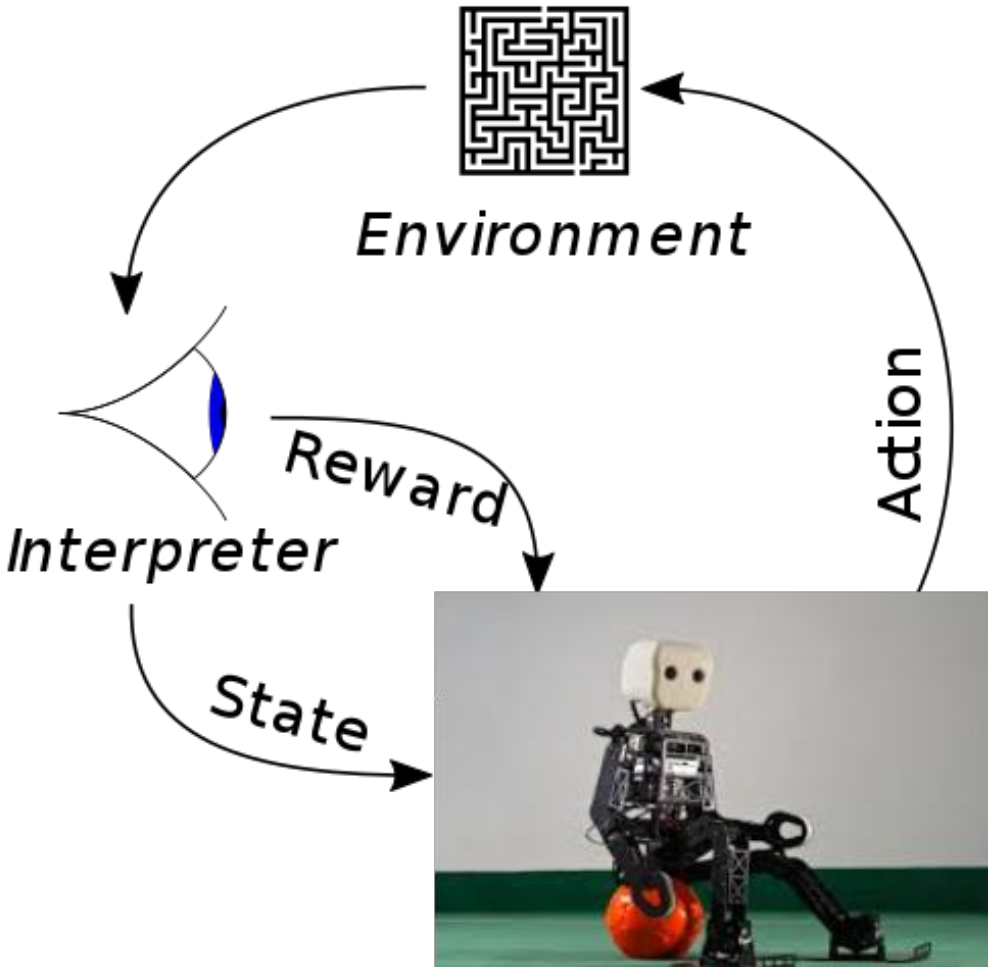
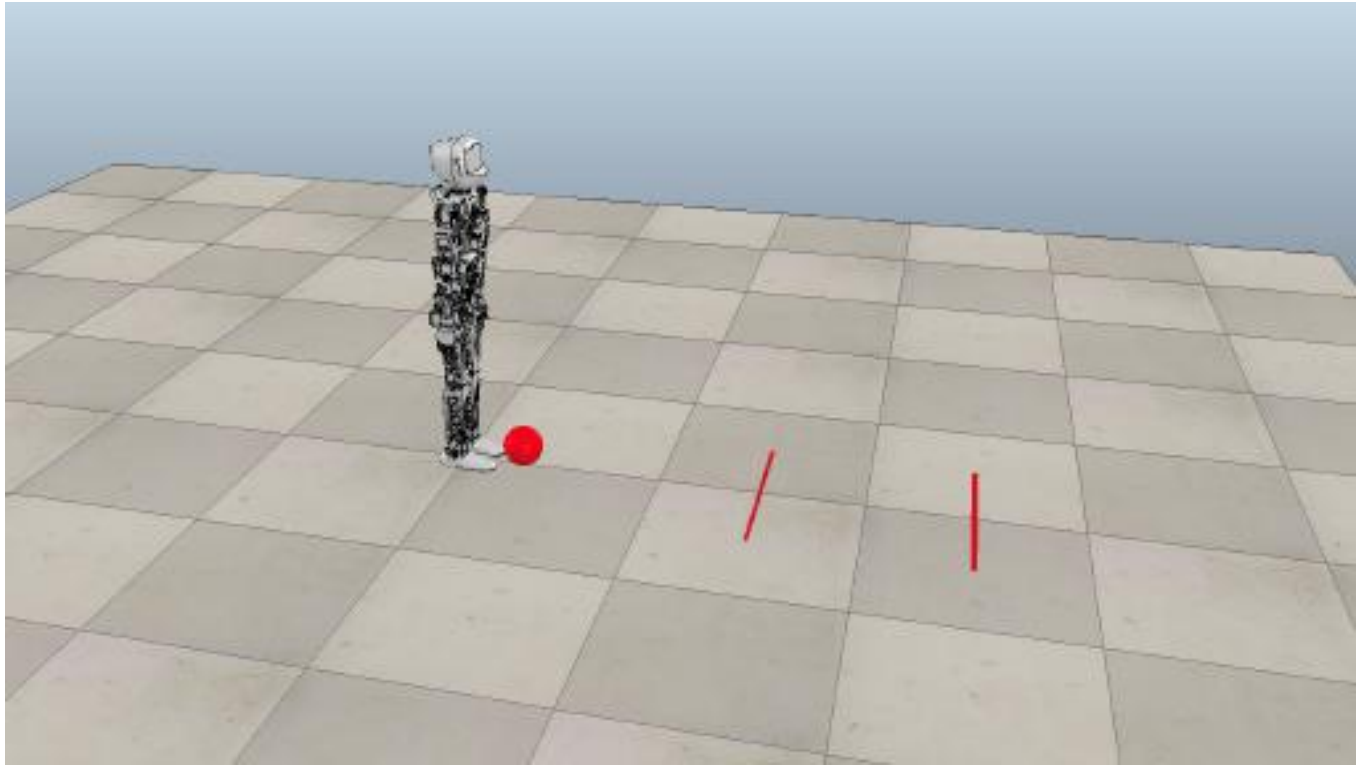
Motivation

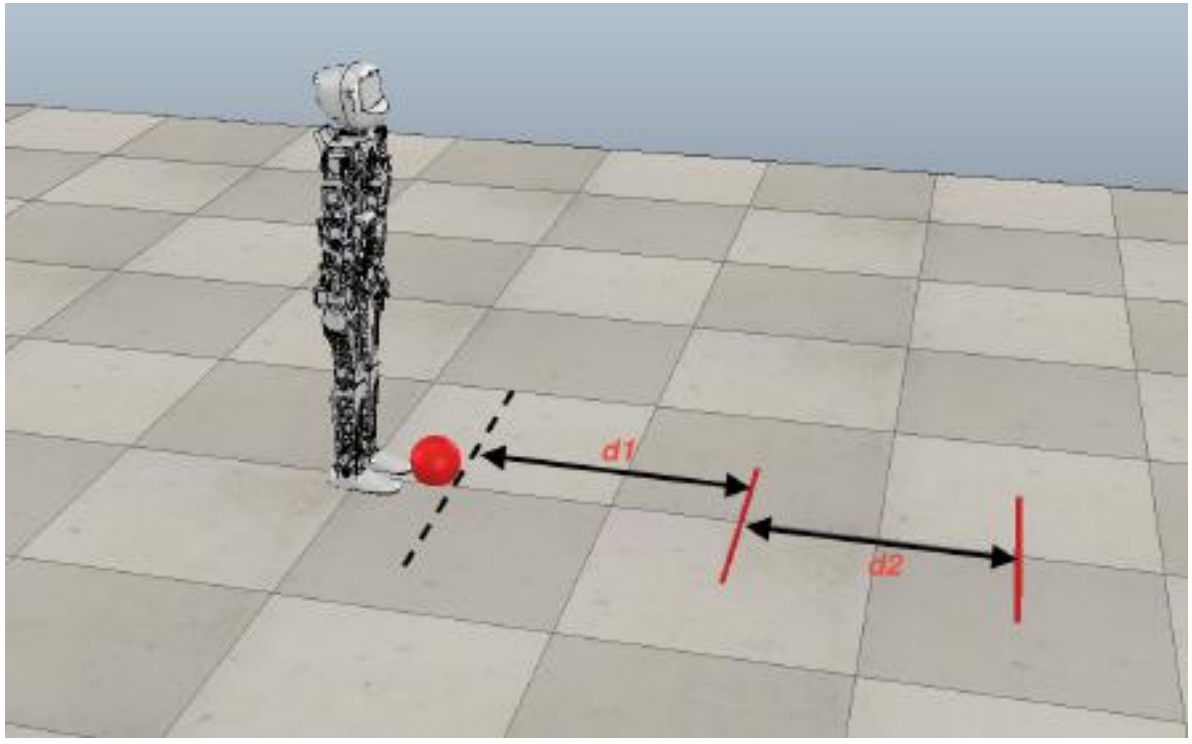


Problem Description



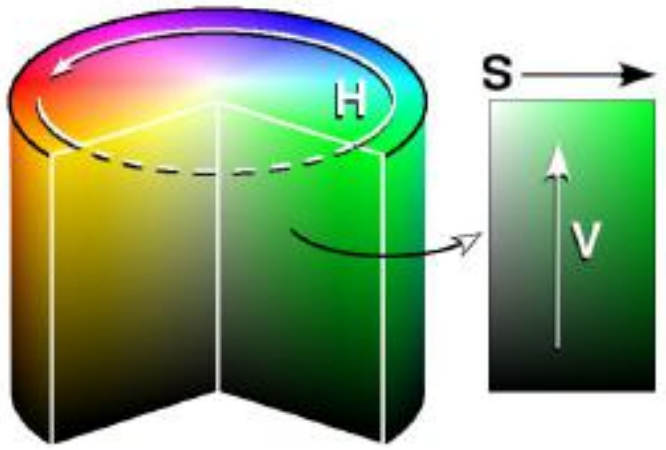
The goal is to train a poppy humanoid that sits on a chair to kick the ball into the target region.

States



- Ball and lines detection using real-time images
- States are constructed by Pixel distance d_1 and d_2 in form(d_1,d_2)
- Goal state is kicking the ball into the region between two red lines

Image processing and Object detection



- H – Hue(Dominant Wavelength)
- S – Saturation (Purity / shades of the color)
- V – Value(Intensity)

After get the pixels of red in the HSV color space, use Hough Transform to detect lines and circle(ball).

Action

- Motor angle in knee starting from an initial value θ_0
- Angular velocity control, e.g. a 2-dimensional vector of goal position and time duration: $[\theta_t, t]^T$
- Constraints on values and sensitivity need to be studied
- After test on real robot, action space and how to do discretization will be determined

Reward

- Most critical part of a reinforcement learning scenario
- Assign ’-10’ when the episode terminates outside the desired region; assign ’+10’ otherwise
- Both values will be tuned in practice to find out the best choice

Algorithm

TD Learning in Q function

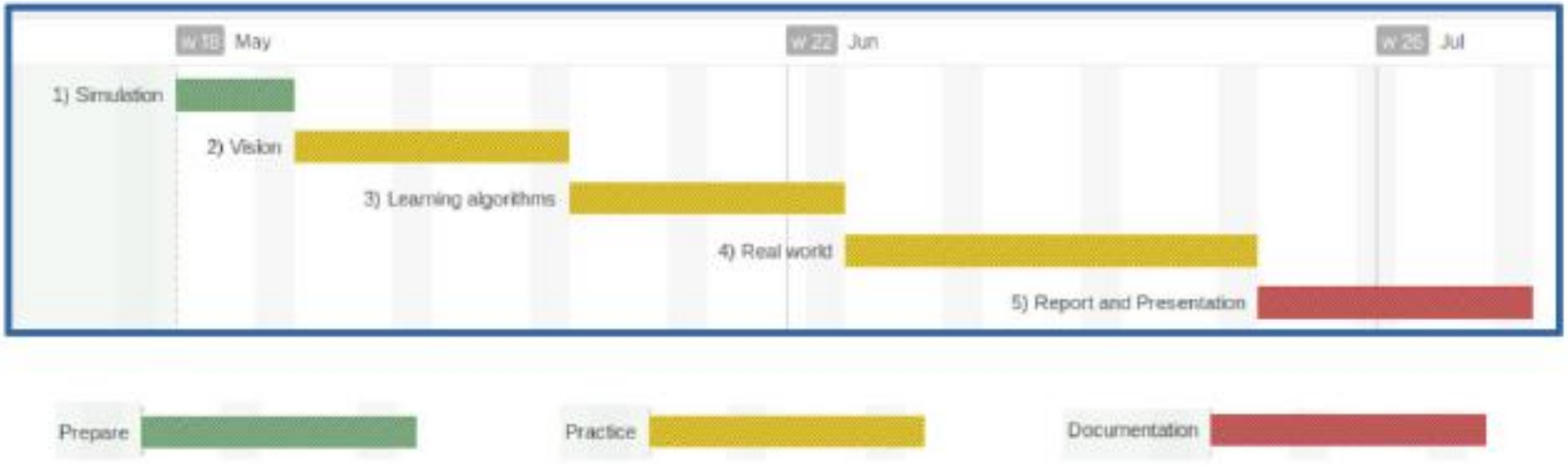
SARSA

$$Q(s,a) \leftarrow Q(s,a) + \alpha(r(s,a,s') + \gamma Q(s', \pi(s')) - Q(s,a))$$

Q-Learning

$$Q(s,a) \leftarrow Q(s,a) + \alpha(r(s,a,s') + \gamma \min_{a' \in A(s')} Q(s',a') - Q(s,a))$$

Time Plan


w 18
May
w 22
Jun
w 26
Jul
1) Simulation
2) Vision
3) Learning algorithms
4) Real world
5) Report and Presentation
Prepare
Practice
Documentation