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CSE 415: Introduction to AI

Project Report

Feature-Based Reinforcement Learning for the Rubik Cube Puzzle

In this problem, we construct the problem formulation for the Rubik’s Cube puzzle and apply feature-based reinforcement learning in order to solve it. We formulated the problem with the following constraints: we will be solving a 2x2x2 Rubik’s cube and we will only be allowing 180 degree moves. Instead of exploring all the states like we would do in traditional Q-Learning, we used features to group states as we explore them.

The technique we used is called SARSA. This is an abbreviation for “State–action–reward–state–action”. This is an algorithm for learning Markov decision process policy. We update the policy at each iteration using the information contained in the abbreviation: The current state, the action the agent chooses, the reward the agent gets for choosing that action, the state we get to by performing the action, and lastly the action the agent would choose from its new state. In addition to the SARSA technique we selected two features to use to represent our states. We initially decided the goal state should not require a color to be on a specific side and one could reach the goal state with all colors on a side, regardless of which side that was. That lead us to our first feature: the number of unique colors on each side. The higher the number the “worse” the state. We then realized that we also needed information on the intermediary states and decided to use adjacent pairs as our second feature. This counted the number of adjacent pairs of each color on a face. The higher the value, the “better” the state.