Abstract

Machine Learning and Game Playing are two very hot topics. In this project we apply machine learning techniques to the board game Blockus. We pick Backpropagation Algorithm as our learning algorithm and apply it to a Neural Network with 7 layers. The project is implemented in python. We trained the Neural Network with over 1000 games. Significant improvement could be seen.

Introduction

Nowadays, Machine Learning becomes more and more popular. After the success of AlphaGo, the field catches the attentions all over the world. In 1959, Arthur Samuel defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed.[]. Developing traditional AI application without using machine learning strategy is the process that transfers human knowledge to formal computer algorithm and implements it in programming languages. This approach gives the computer the knowledge needed to complete the tasks rather than the abilities to learn the knowledge. Game play is one of the applications of Machine Learning.

Traditional AI approach without machine learning solves the Game Play problem typically in the following steps.

1. Given the current game state s0, calculate possible next game states S\_next = {si|s0-->s,through move mi}

2. Evaluate all game states in S\_next with the Evaluation Function f. Find the best next game state s\_best where f(s\_best) = max{f(s) s belongs to S\_next} and corresponding move m\_best.

3. Apply the move m\_best.

Obviously the key element in Game Play AI application is the Evaluation Function. Designing Evaluation Function is the process to transfer human knowledge or heuristics into a formula that gives a meaningful Evaluation Score to help with decision making.

The problem with the traditional AI

1.The Evaluation Function is hard to design. There are too many factors needed to be considered in order to give a meaningful score.

2. Typically the Evaluation Function only considers the current game state without looking at the future, which makes the Evaluation Score no so meaningful. Min-Max search[] was introduced to solve the problem. But as the number of game states grows exponentially, this approach becomes not practical.

Machine Learning overcomes the problem by giving computer the abilities to learning how to evaluate the game states. We use Artificial Neural Network as the model of Machine Learning. A game state is converted to a input vector which gets plugged into the Neural Network. The output of the Network is the Evaluation Score of the game state. We use back-propagation algorithm as our learning algorithm. In the next section, we will talk about our approach in details.