General Game AI Based On Machine Learning

maywzh

CCNU-UOW JI

maywzh@gmail.com

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Overview

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Introduction

Tradationally, Game artificial intelligence (AI) refers to pre-defined automation programs generating adaptive or certain behaviors in fixed pattern for Non-player characters (NPCs) to simulate the reality in a real world.[1]
Recently, the merge between academia and industry introduce machine learning algorithms and methods to video game AI development.[2] This trend enhanced the AI capability to a large extent and can be positive for creating comparative adaptive and intelligent Game AI agents including NPC, intelligent machine players or even powerful General Video Game Playing AI (GVGAI), etc.

Game AI Aims

- play certain or uncertain games as a player
- without any human intervention
- learn automatically to get better performance

Flagships[2]

Player Experience Modeling[3]

Player experience modeling (PEM) is the study and use of AI techniques for the construction of computational models of experience of players.

Procedural Content Generation[4]

Generate playable, smooth, superior environment or game objects for game.

Massive-Scale Game Data Mining[5, 6]

Data mining for player data to track these things:how. why , what do players play? To offer data analysis for game playing.

NPC AI[7, 8, 9]

Enhance the NPC capabilities and apply difficulty scaling techniques to this to improve the playing experience.

Game AI Learning problems

Learning for Game AI[10]

1. Learning to play the game
2. Learning about players
3. Behavior capture of players
4. Model selection and stability
5. Optimizing for adaptivity
6. Model interpretation
7. Performance

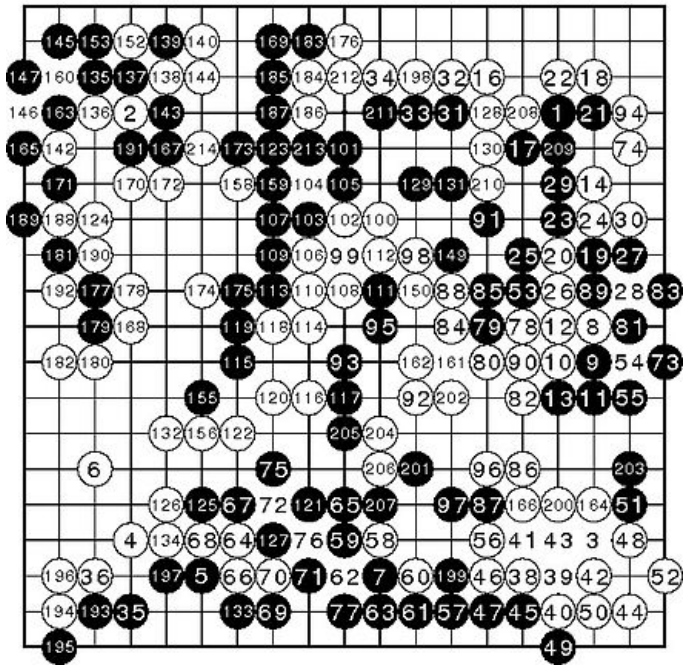

Figure: AlphaGo vs Fan Hui, Game 5

AlphaGo - Neural Network and Tree Search

Sliver et.al. [11] introduce a new approach to computer Go that uses 'value networks' to evaluate board positions and 'policy networks' to select moves.

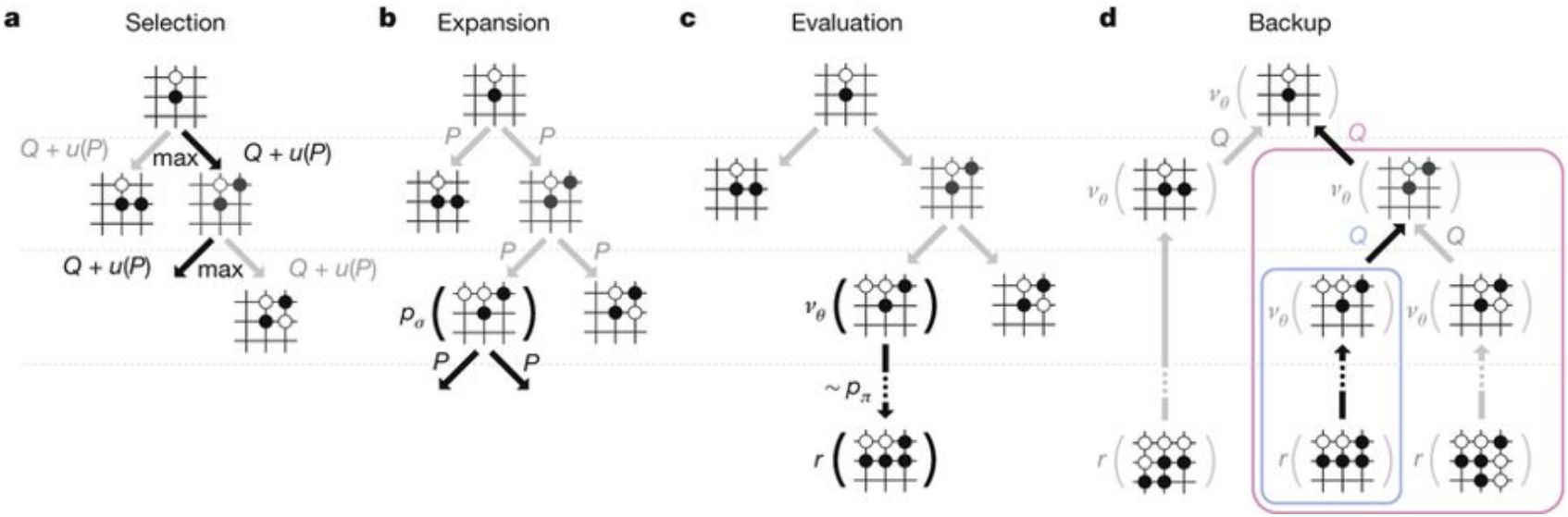

Figure: Monte Carlo tree search in AlphaGo

Reinforcement Learning Applied to StarCraft

Wender and Watson did some research [12] on applying reinforcement learning (RL) to tiny scale combat in StarCraft, aiming to design an agent performing unsupervised learning in complex environment. The result showed the viability of RL algorithms in SC.

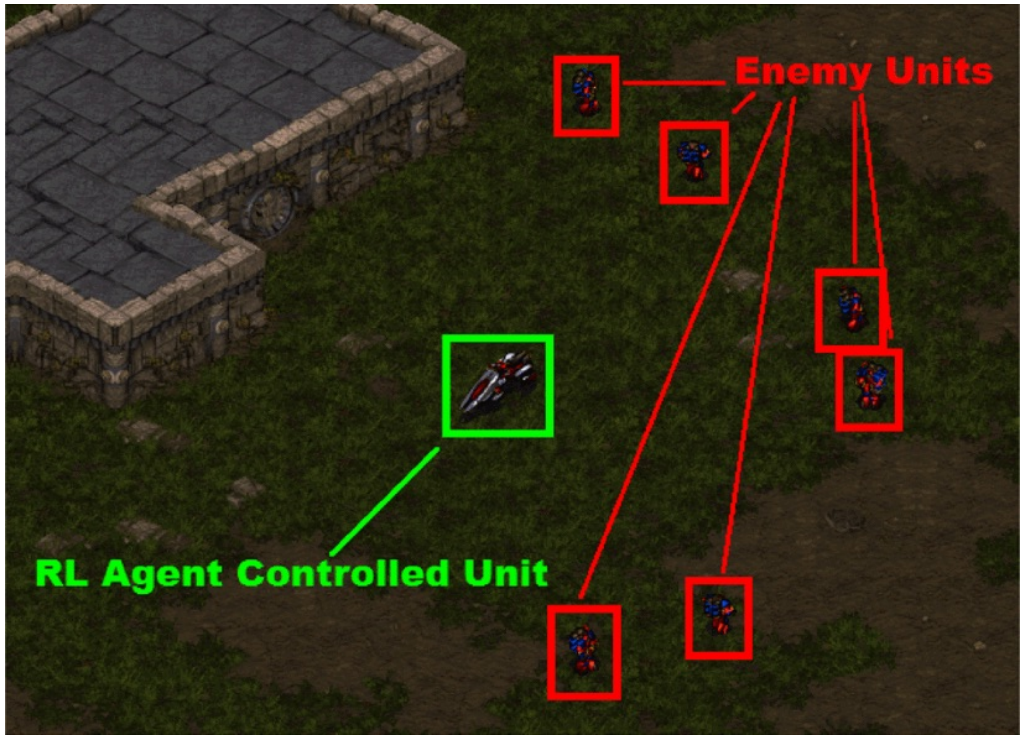

Figure: Initial unit positioning for the experimental evaluation

Deep Reinforcement Learning Applied to Atari Games

Mnih et.al [13] applied convolutional neural network trained with a variant of Q-learning to seven Atari 2600 games from the Arcade Learning Environment. The AI reached the expert level of human-like player.

Figure: Screen shots from five Atari 2600 Games: (Left-to-right) Pong, Breakout, Space Invaders, Seaquest, Beam Rider

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