General Video Game playing AI: A Survey

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Overview

Introduction

Flagships
- Non-player game-playing
- Generality

Background
- General Video Game Playing AI
- Monte-Carlo Tree Search
- On-line Parameter Tuning

Competitions

Application
- AlphaGo
- StarCraft
- Atari Games

Introduction

Video games have long been popular benchmarks for artificial intelligence(AI). Many researches have been done in building a optimal video game playing AI in certain games. Such attempts comprises Chess, Go, Car Racing games, Ms.PacMan, Real-Time Strategy (RTS) games and Super Mario Bros, etc. While the general game playing aims at building an no-human-intervening game-playing agent that is able to playing multiple games refered as General Video Game Playing Artificial Intelligence (GVPAI).

Flagships of General Game-playing AI

- Non-player game-playing
- Generality

Non-player game-playing

Game-playing

How AI agent playing games is the core problem. This may involve modeling the way human playing games. Some characteristics such as short-term memory, reaction time and perceptual capabilities should be take into concern.

Non-human behavior

GVPAI should act like human rather than autonomous machine program, Many games have non-player characters (NPCs), and AI can help in making NPCs believable, human-like, social and expressive.

Generality

Heading

1. Game generality
2. Task generality
3. Player generality

Develop AI methods that work with not just one game, but with multiple game.
Develop methods that can do not only one task but several differnet related tasks.
Develop methods that can model, respond or reproduce the large variability among humans in design style, playing style, preferences and abilities.

Background

- General Video Game Playing AI
- Monte-Carlo Tree Search
- On-line Parameter Tuning

General Video Game Playing AI

Aiming at using it as a research and competition framework for studying General Video Game Playing (GVGP). It consists of 5 tracks. Games were defined in Video GAme Description Language (VGDL). It has the advantage of being more extensible, meaning that it is much easier to add new games and variations of those games.

Monte-Carlo Tree Search

It is a best-first search algorithm that incrementally builds a tree representation of the search space of a problem (e.g., a game) and estimates the values of states by performing simulations[1].

On-line Parameter Tuning

The parameters of an AI agent can be seen as a vector of integers and doubles. The tuning of parameters is therefore a problem of searching optimal numerical vector(s) in a given parameter search space.

Competitions

One of the main challenges of General Video Game Playing is to create a software framework that allows for games to be designed and representated and different game-playing agents tested via some form of long-running competition.

- Ms pac-man competition
- The 2k botprize
- The Physical Travelling Salesman Problem

Ms pac-man competition[2]

This competition is focused on the tasks of programming computer agents to play as either Ms. Pac-Man or as the ghosts.

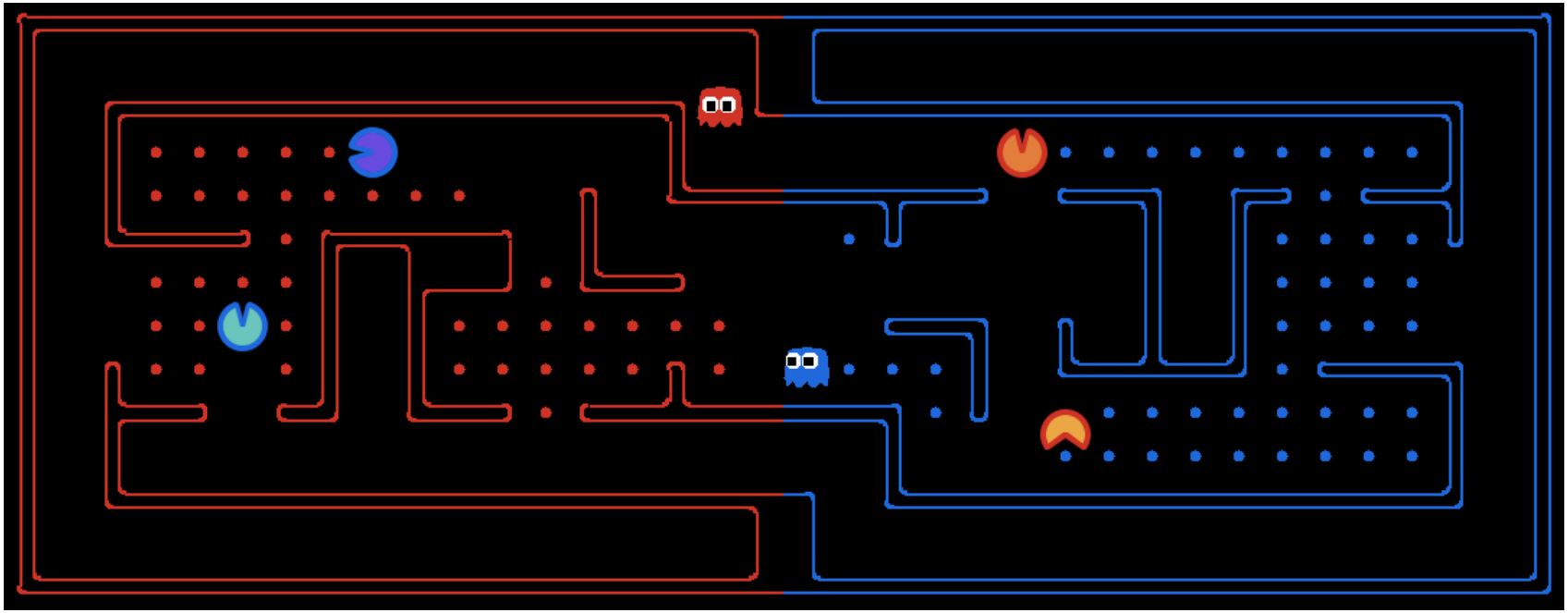

Figure: Pacman Capture the Flag

The 2k botprize[3]

In the contest, bots try to convince a panel of expert judges that they are actually human players.

Figure: BotPrize judging protocol

The physical travelling salesman problem competition[4]

It is a classic algorithmic problem in the field of computer science and operations research. It is focused on optimization.

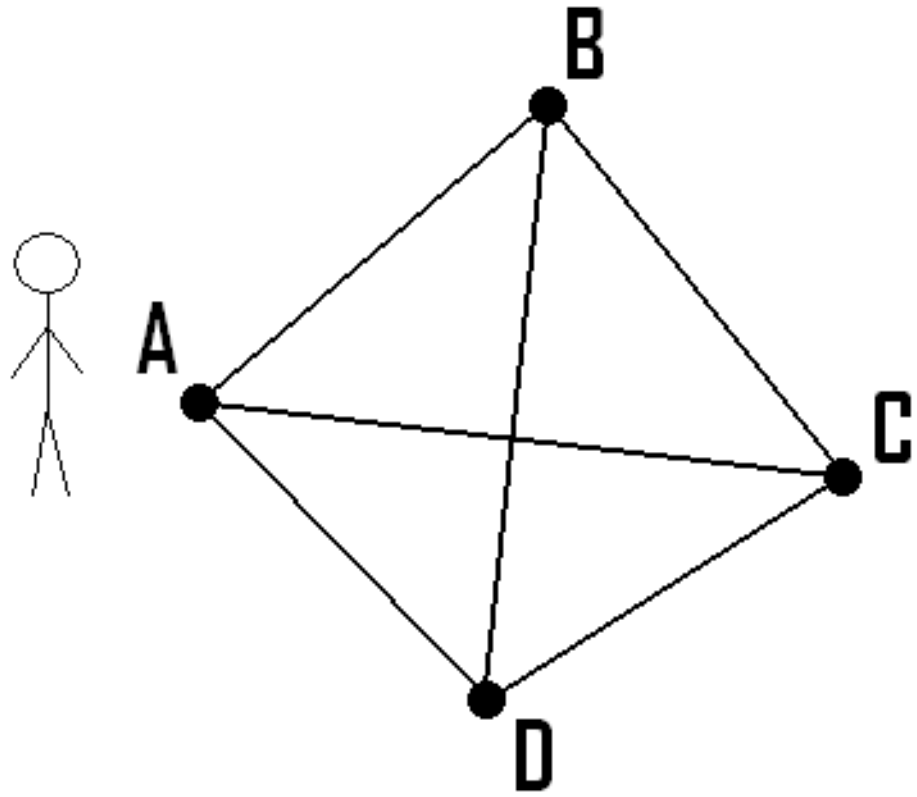

Figure: A salesman wants to visit all cities,A, B, C and D. What is the best way to do this

Applications

AlphaGo - Neural Network and Tree Search

Sliver et.al. [5] introduce a new approach to computer Go that uses ‘value networks’ to evaluate board positions and ‘policy networks’ to select moves.

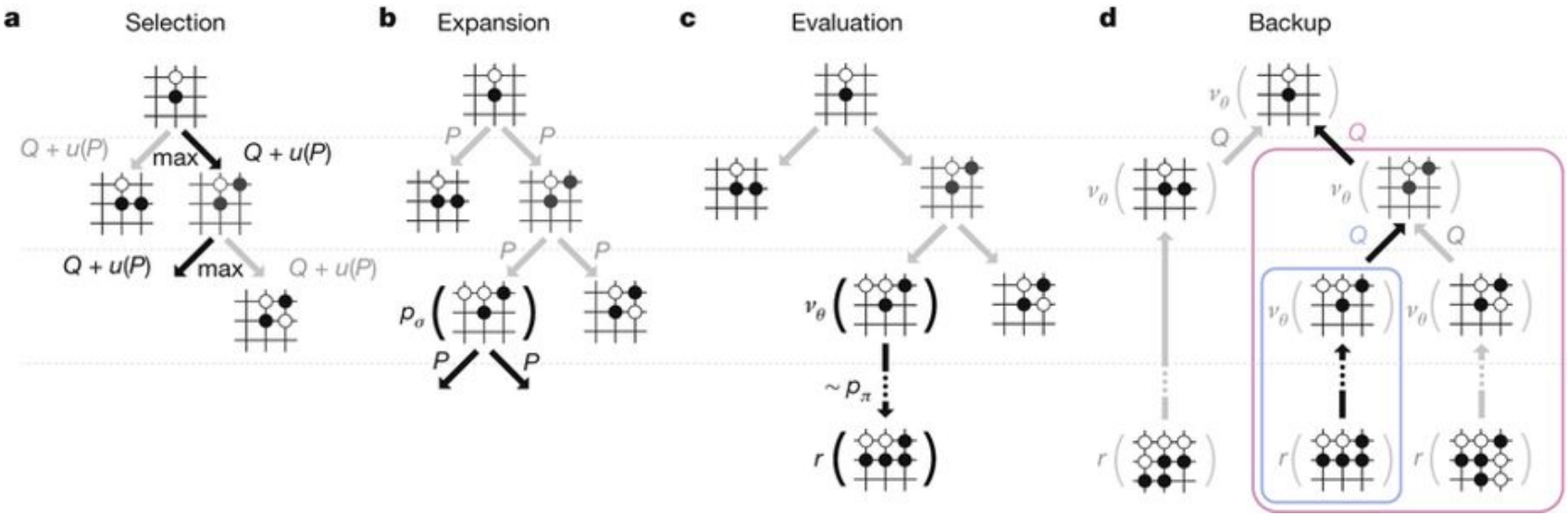

Figure: Monte Carlo tree search in AlphaGo

Reinforcement Learning Applied to StarCraft

Wender and Watson did some research [6] 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.

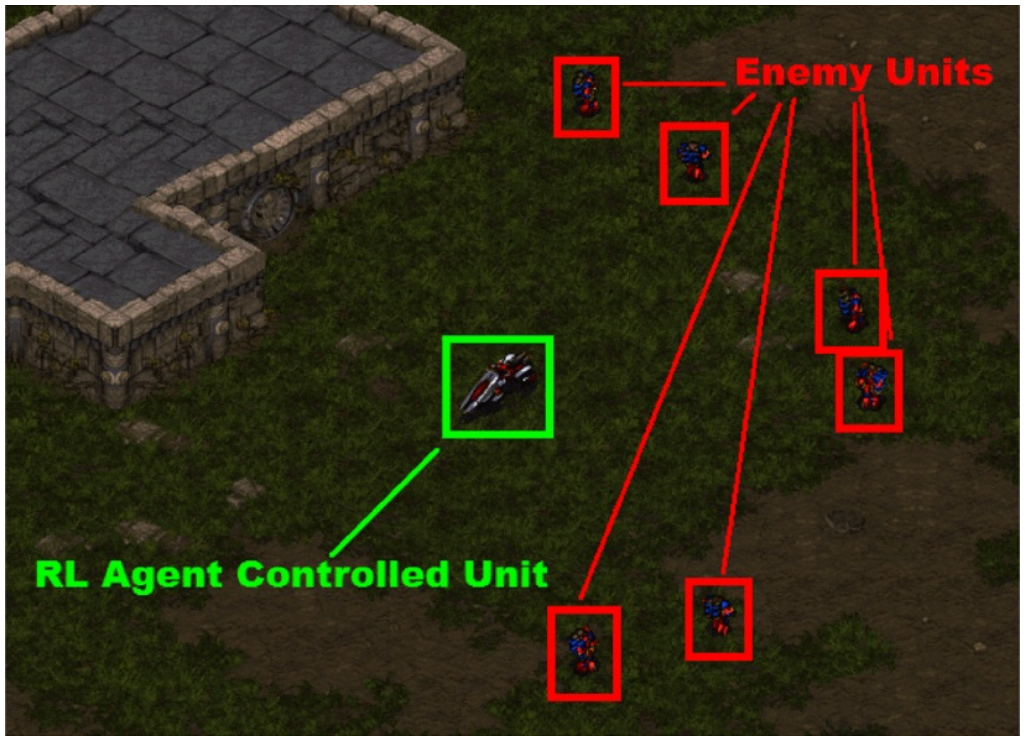

Figure: Initial unit positioning for the experimental evaluation

Deep Reinforcement Learning Applied to Atari Games

Mnih et.al [7] 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.

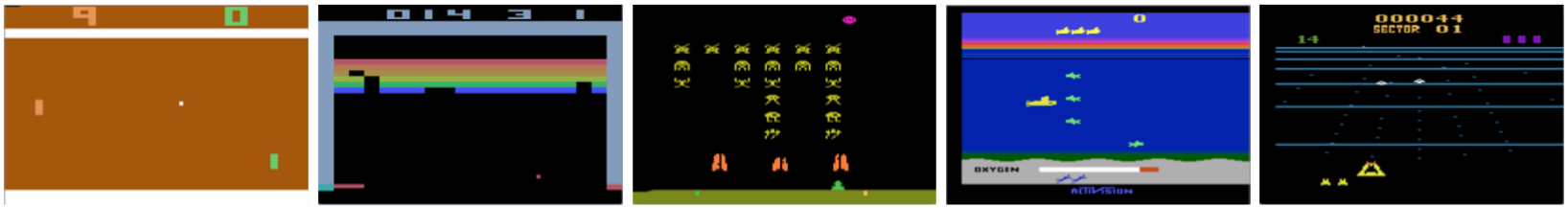

Figure: Screen shots from five Atari 2600 Games: (Left-to-right) Pong, Breakout, Space Invaders, Seaquest, Beam Rider

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The End