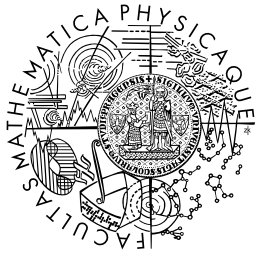

FACULTY
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BACHELOR THESIS

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Board game with artificial intelligence

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Study programme: Computer Science
Study branch: IOI

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Most of all I want to thank my supervisor for his help and advice, he was always there for me whenever I needed his opinion. I also thank all of my family and friends for being there for me along the way, my journey has been long and I could not have done it without them.

Title: Board game with artificial intelligence

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Abstract: Multiplayer board games with imperfect information present a difficult challenge for many common game-playing algorithms. Studying their behavior in such games can be difficult, because existing implementations of such games have poor support for artificial intelligence. This thesis aims to implement an imperfect information multiplayer board game in a way that provides a framework for developing and testing artificial intelligences for board games with the aforementioned qualities. Furthermore, this thesis explores the implementation of several algorithms for the game. This aims to showcase the artificial intelligence framework, as well as to analyze the performance of existing algorithms when applied to a board game with elements such as hidden information and multiple players.

Keywords: board game, artificial intelligence

Contents

Introduction

Foreword

In game theory, perfect information two-player games are often studied, and numerous algorithms have been designed with the purpose of playing them. This includes games like Chess and Go, which have had large breakthroughs in recent years [1]. However, real world situations do not always have perfect information, or only two parties involved. We could for example imagine multiple countries, which have only approximate information about the armies of their opponents. In this scenario, it could be useful to have tools to simulate potential enemy troop movements or placements.

Even though algorithms which are able to model imperfect information and multiple players are often useful, they are not studied nearly as often. Designing such an algorithm is not easy, and there are many pitfalls which make conventional game theory algorithms much less effecive at solving imperfect information and multi-player problems. This thesis therefore aims to analyze the problems of implementing such algorithms, and to implement some of them in pursuit of that goal.

Naturally, some frameworks do already exist for the implementation of such games. However, at the time of writing, some of them only have AI support as an experimental and sparsely documented feature [2], and others only focus on specific fields of AI [3]. This work aims to provide a kind of ”plug-and-play” experience, where AI developers have minimal barriers between cloning a git repository and having a working AI.

Goals

The main goal of this thesis is to create a multi-player board game with imperfect information states. This game will be designed with AI (Artificial Intelligence) in mind, and it will provide a reasonable interface for the implementation of AI players.

Another goal is the implementation of several AI players for said game. This will allow us to not only explore potential problems with implementing AIs for games of this kind. We will also verify that the API (Aplication Programming Interface) provided by the game is sufficient for implementation of such AI players, and that the API is reasonably easy to use.

1. Related Work

1.1 Games and Frameworks

1.2 Algorithms

1.2.1 Minimax

1.2.2 Monte Carlo Methods

2. Game Design

3. Framework

3.1 Design

3.2 Interface

4. Used Algorithms

4.1 Random Decisions

4.2 Heuristics

4.3 MaxN

4.4 Information Set Monte Carlo Tree Search

5. Experiment Description

5.1 Title of the first subchapter of the second chapter

5.2 Title of the second subchapter of the second chapter

Conclusion

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[3] Openai gym. `https://gym.openai.com`. Accessed: 2020-05-31.

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A.1.1 Installation

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A.2 Developer Documentation

A.2.1 Prerequisites

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A.2.3 Game Engine

A.2.4 Artificial Intelligence

A.2.5 User Interface