Existential Tablut

...

Lorenzo Mario Amorosa
Mattia Orlandi
Giacomo Pinardi
Giorgio Renzi

Table of Contents

0 Introduction

1 Initial Neural Networks

2 Neuroevolution

3 Baseline, Checker, final result

Introduction

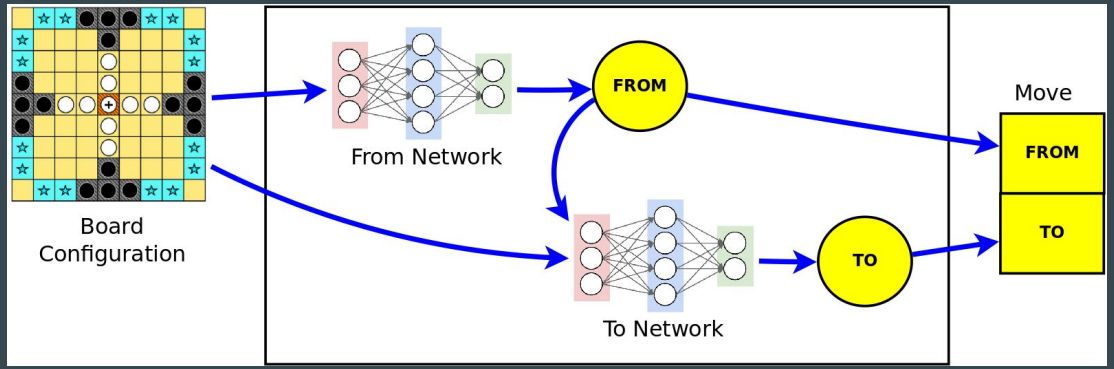
Introduction

- **Neuroevolution** algorithm
- Initial idea:
  - NNs trained to make **legal moves**
  - **Zero generation** based on those NNs
  - **Championship** to assign **fitness**
  - **Genetic algorithm** applied on networks' **weights**

Initial Neural Networks

Initial Neural Networks

- Represent the initial population of players
- Trained using 4M moves
- Every player composed by two neural networks



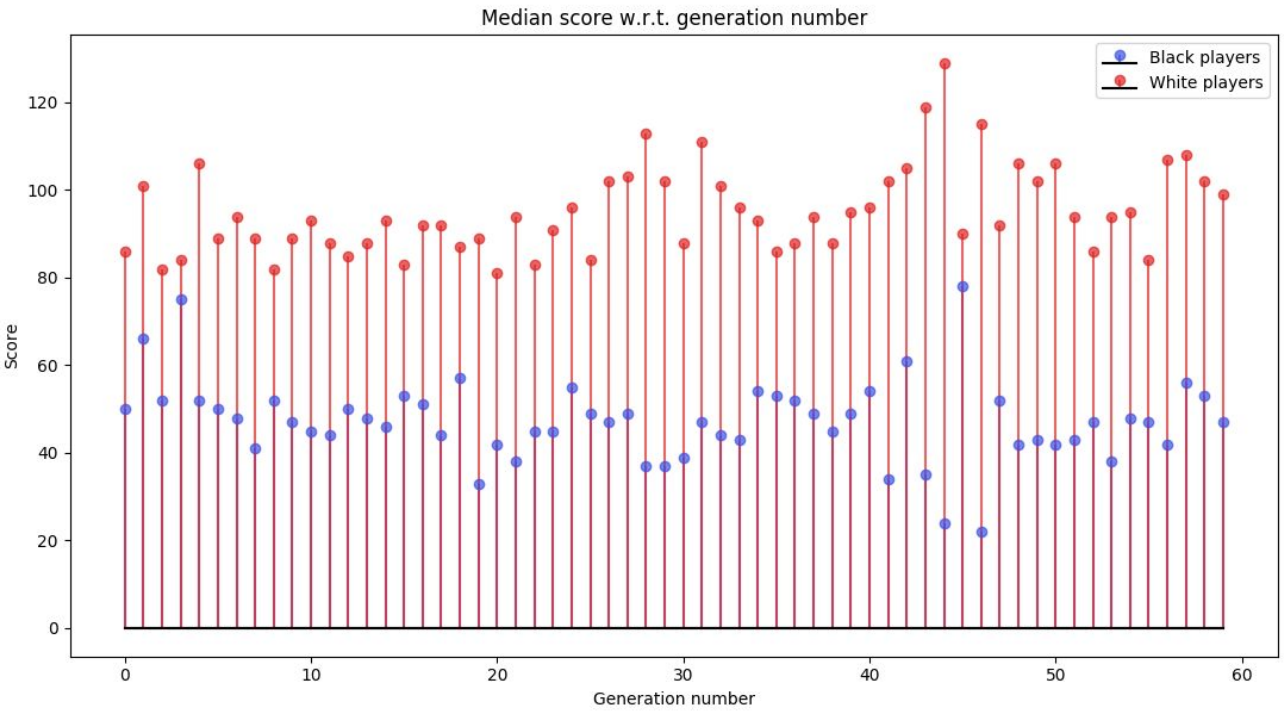
- **Purpose**: train players that don't break game rules
- **Result**: 99.5% legality for both players

Neuroevolution

Neuroevolution

- **Initial NNs** + **Mutation** → **Zero generation**
- After championship, NNs gain points for victories and draws which are **normalized** into a [0, 1] range → **fitness**
- **Best individuals** are **cloned** into next generation
- **Selection proportional** to **fitness**
- **Crossover** between selected individuals
- **Mutation** on crossover results
- Mutated individuals inserted into next generation
- **Problems**:
  - genetic operators **compromised legality** of moves → necessity of a **checker**
  - NNs learned to **play less bad** than their opponents → necessity of a **baseline**

Networks vs Networks



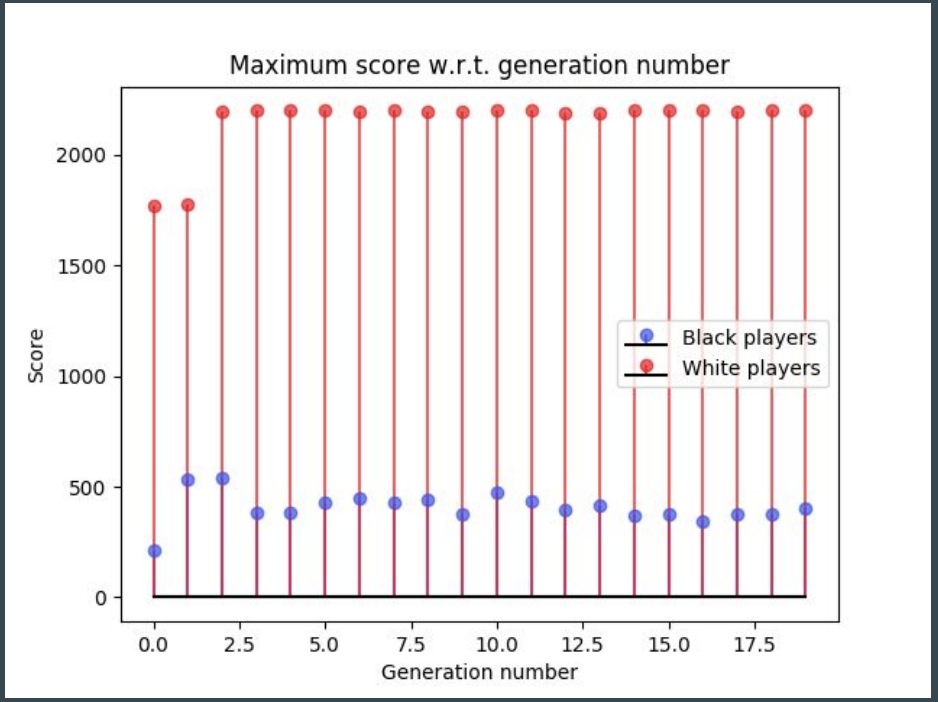
Baseline, Checker, final result

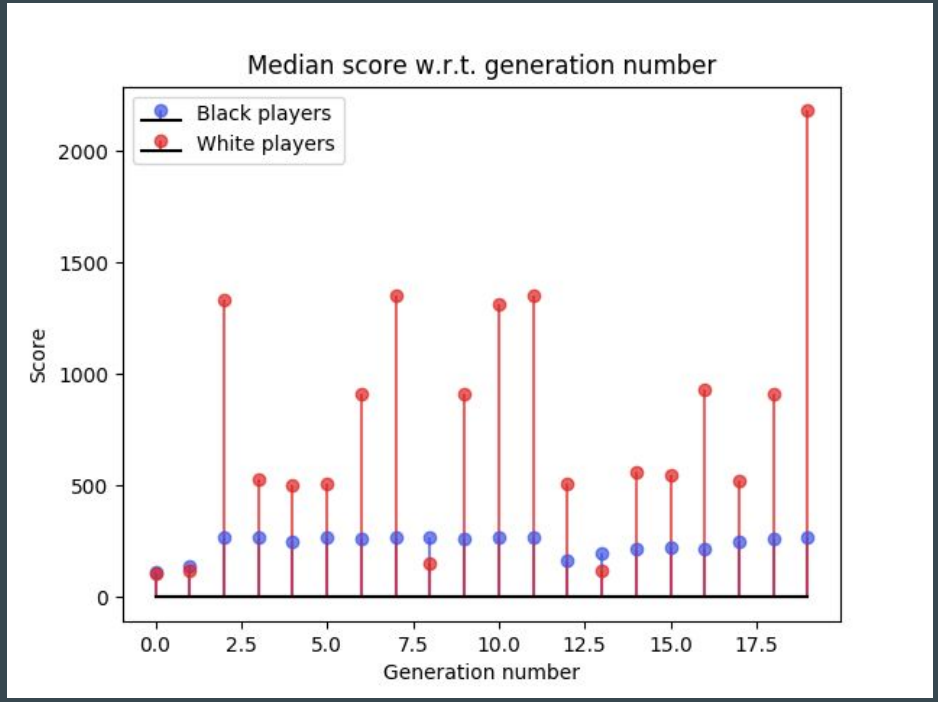
Baseline, Checker, final result

- **Checker**
  - **discard illegal moves** suggested by the NNs → **learning of best legal moves only** ✔️
  - significant complexity reduction ✔️
- **Baseline:**
  - **Min-Max** algorithm with max depth = 1: good heuristic and fast enough ✔️
  - **Stronger** and more **stable opponent** → more effective learning ✔️
  - **Overfitting** (i.e. greedy openings of black baseline) ❌
  - **Asymmetry** (black tougher task) → **different training time** ❌

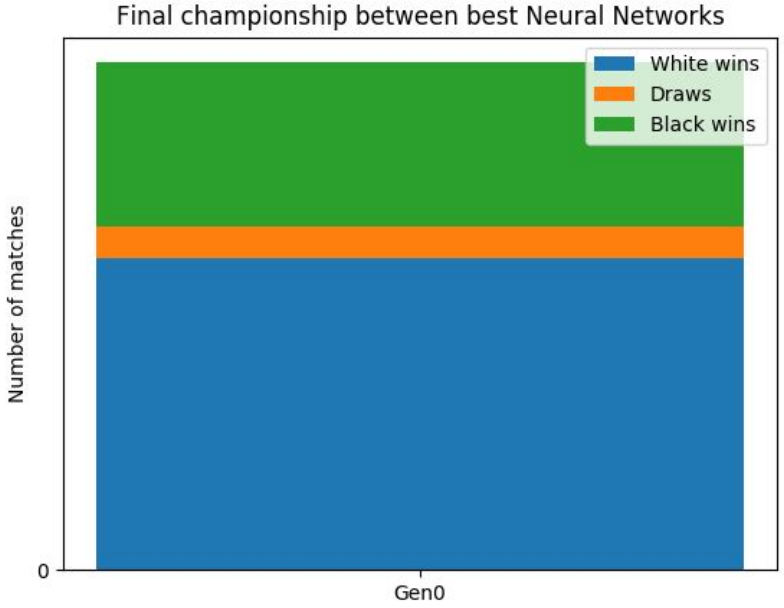
In the end: **final championship** between **NNs** capable of **beating the baseline**
Election of the best ones

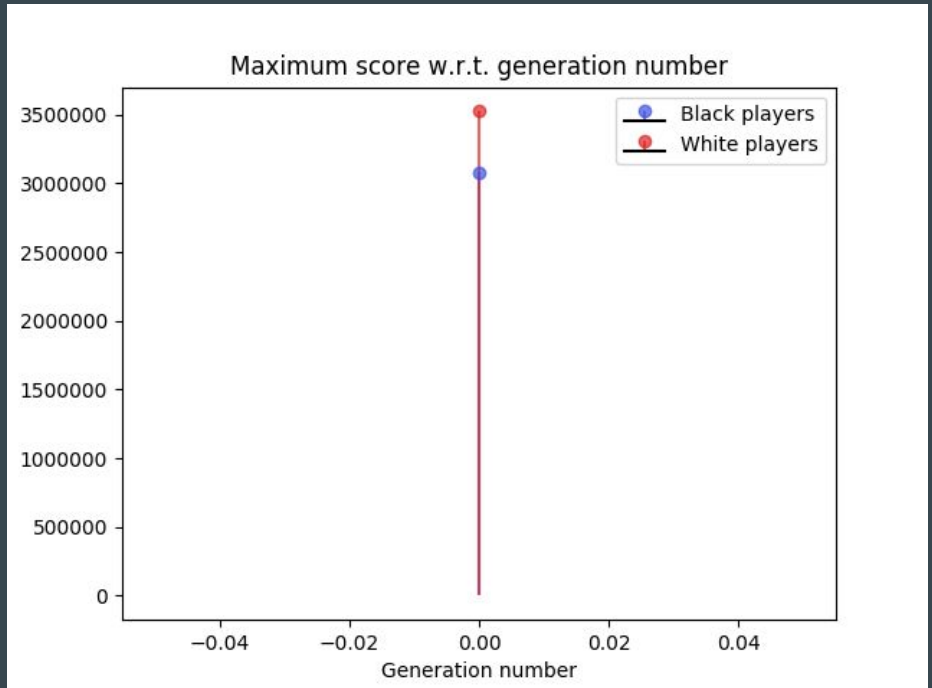
Networks vs Baseline





Final Championship





Thank you!