Project proposal: Comparative exploration of Abalone game-playing agents

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Abstract. Games provide the perfect environment for artificial agents to navigate in. Especially for the

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1 Introduction

Abalone is a fairly new game, that was devised in 1987 by Michel Lalet and Laurent Lévi [1]. It is a two-player game consisting of a hexagonal board with 61 fields and 14 marbles for black and white respectively. This gives the game a complexity, that makes it very interesting for the design of a game-playing agent. Even for modern computers it is not possible to expand of all possible moves. Hence, more sophisticated approaches for navigating the state space and evaluating good paths are needed. On the other hand, the game does not have piece specific rules or large distance moves which reduces the need for a very domain specific knowledge about the game like chess.

1.1 Rules

The goal of the game is to push six of the opponent's marbles off the playing field.

1.2 Complexity

State space complexity

$$\sum_{k=8}^{14} \sum_{m=9}^{14} \frac{61!}{k!(61-k)!} \times \frac{(61-k)!}{m!((61-k)-m)!}$$

Game tree complexity

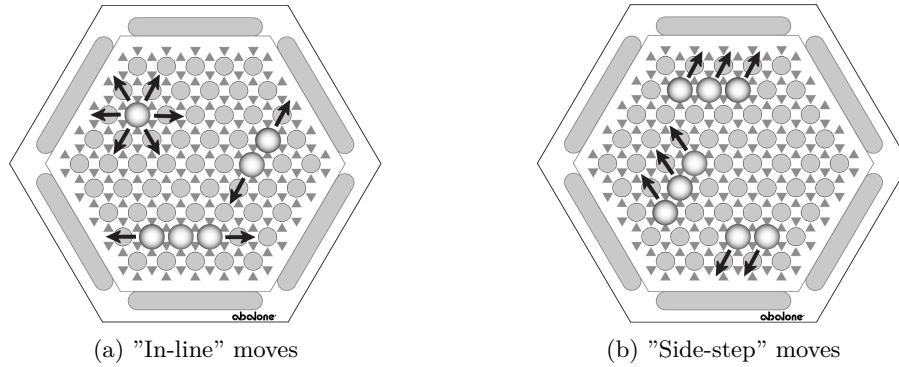*Comparative complexity*

Existing approaches

(a) "In-line" moves   (b) "Side-step" moves

Fig. 1: Basic moves [3]

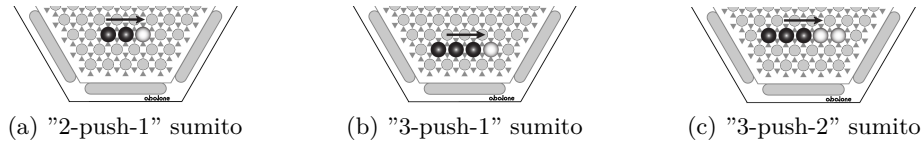(a) "2-push-1" sumito   (b) "3-push-1" sumito   (c) "3-push-2" sumito

Fig. 2: Sumito positions allow pushing the opponent's marbles [3]

2 Project details

2.1 Agent design

Based on the PEAS framework we can analyze the task environment for the agent. [2, p.107]

Performance measure Win/loss, number of moves, time to deliberate
Environment Digital playing board
Actuators Move marbles, display text to CLI
Sensors Position of marbles

2.2 Algorithm comparision

Alpha-beta pruning

Monte Carlo Tree Search

2.3

3 Conclusion

References

1. Abalone (board game). Wikipedia (Dec 2020)

2. Russell, S., Norvig, P.: Artificial Intelligence: A Modern Approach. Pearson Education, Inc, fourth edn. (2021)
3. S.A., A.: Abalone rulebook. https://cdn.1j1ju.com/medias/c2/b0/3a-abalone-rulebook.pdf