

1. Applying Importance Sampling to MCTS for Mahjong

Accession number: 20250617834229

Authors: Tang, Shih-Chieh (2); Chen, Jr-Chang (1); Wu, I-Chen (2, 3)

Author affiliation: (1) National Taipei University, Department of Computer Science and Information Engineering, New Taipei City; 23741, Taiwan; (2) National Yang Ming Chiao Tung University, Department of Computer Science, Hsinchu; 30050, Taiwan; (3) Research Center for Information Technology Innovation, Academia Sinica, Taipei; 11529, Taiwan

Corresponding author: Chen, Jr-Chang

Source title: IEEE Transactions on Games

Abbreviated source title: IEEE Trans. Games

Issue date: 2025

Publication year: 2025

Language: English

ISSN: 24751502

E-ISSN: 24751510

Document type: Article in Press

Publisher: Institute of Electrical and Electronics Engineers Inc.

Abstract: Mahjong is a four-player, stochastic, imperfect-information game. In this paper, we utilize importance sampling within Monte Carlo Tree Search (abbr. MCTS) to enhance the playing strength of our Mahjong program, MeowCaTS.

First, we propose a tree structure called the merging solitary-tile model, which facilitates the application of importance sampling. This model also reduces the branching factor of the search tree. Second, we apply importance sampling to MCTS and introduce the calculation of importance weights during the backpropagation stage. Finally, we design a multi-depth transposition table to accumulate simulation results of similar positions in MCTS, further enhancing the strength of MeowCaTS. In the experiments, the performance of the proposed methods was analyzed, and the results showed a significant improvement. Notably, MeowCaTS won the first place in Computer Olympiad 2023. © 2018 IEEE.

Number of references: 32

Main heading: Stochastic systems

Controlled terms: Intelligent systems - Stochastic models - Trees (mathematics)

Uncontrolled terms: Branching factors - Imperfect information games - Mahjong - Monte carlo tree search - Search trees - Stochastics - Tile models - Transposition table - Tree structures - Tree-search

Classification code: 1101 Artificial Intelligence - 1201.8 Discrete Mathematics and Combinatorics, Includes Graph Theory, Set Theory - 1202.1 Probability Theory

DOI: [10.1109/TG.2025.3535740](https://doi.org/10.1109/TG.2025.3535740)

Compendex references: YES

Database: Compendex

Data Provider: Engineering Village

Compilation and indexing terms, Copyright 2025 Elsevier Inc.