Challenging Human Supremacy: Evaluating Monte Carlo Tree Search and Deep Learning for the Trick Taking Card Game Jass

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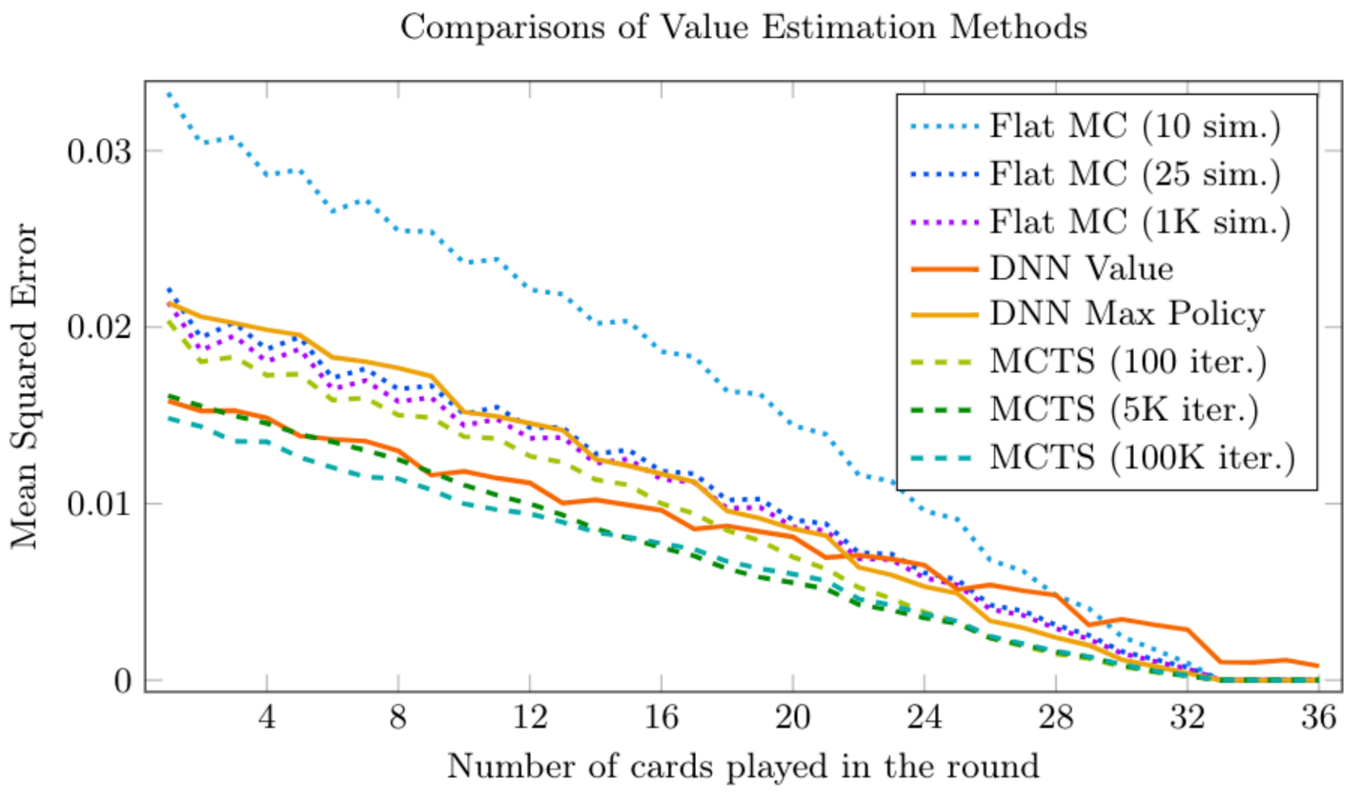
Key Contributions

Analysis of most promising state-of-the-art methods for AI in card games (Determinized and Information Set Monte Carlo Tree Search, Deep Neural Network and Rule-Based)

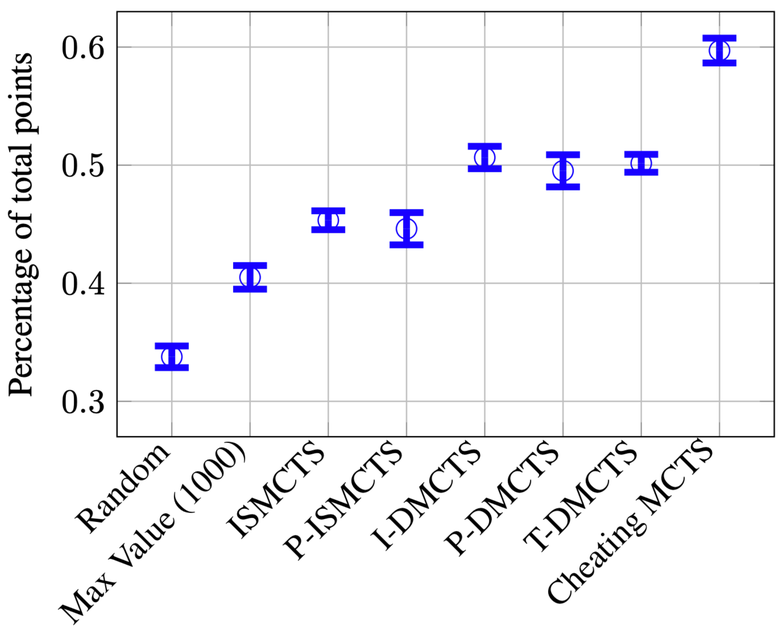
Public open-source software infrastructure and API: bots against bots (jass-server.abiz.ch) and bots against human via a GUI (jassteppich.abiz.ch)

Value Estimation

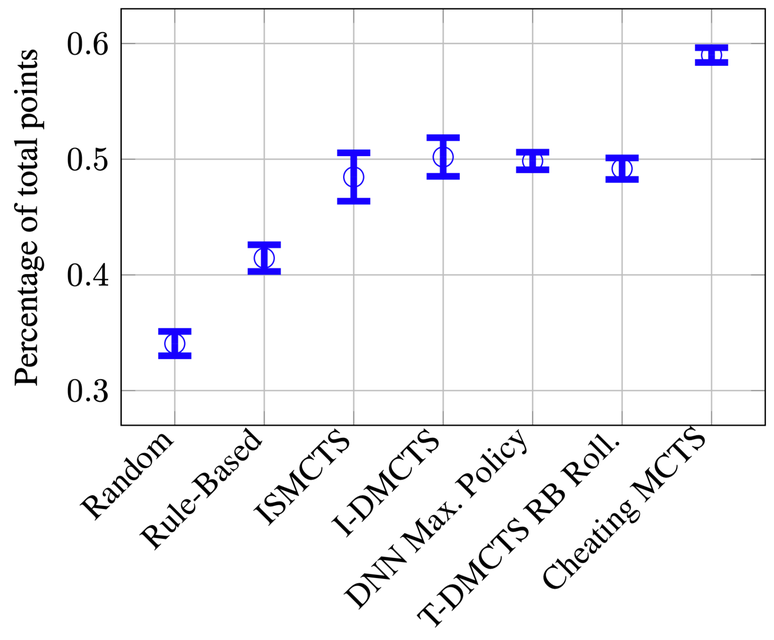
MSE of estimated value from algorithm and actual outcome at end of round. 4.8M card plays in total
→ ~133K card plays per number of cards played. Each data point is mean of MSEs of these 133K card plays.



Card Play



(a) Against DNN Max. Policy



(b) Against T-DMCTS

Conclusions

Comparison of most widely used methods for trick taking card games at example of Jass

Ranked Rule-Based trump selection almost as good as DNN

Clearly outperformed Random and Rule-Based Baseline

ISMCTS beaten

DMCTS on par with DNN

Why It Is So Hard?

Imperfect information

Two competing teams of two cooperating players

Approximately 1.16e28 states after cards have been dealt

Why Should One Care?

Many real world situations with imperfect information

Cooperation still unsolved

Very popular Swiss card game

Similar to Bridge, Spades or Skat

Trump Selection

Percentage of total points of different trump selection methods against DNN

Bot	Result (%)
Random	34.19±2.02
Simple Rule-Based	47.69±0.82
Ranked Rule-Based	49.26±1.11
MCTS	48.23±1.98

Jass – The Game