Criticality: a Monte-Carlo Heuristic for Go Programs

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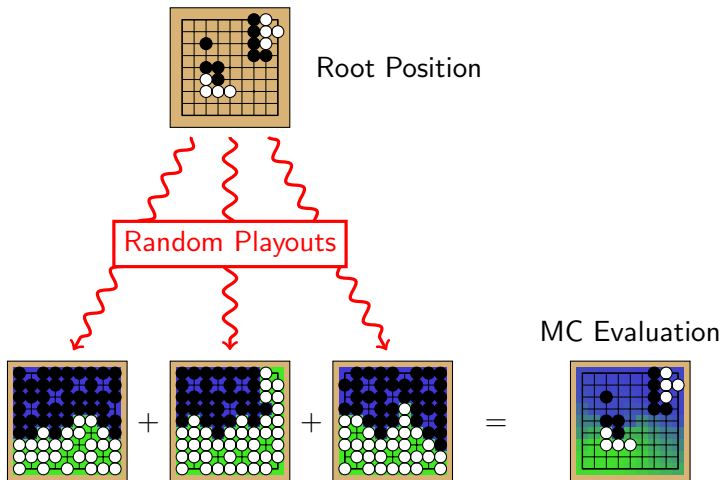
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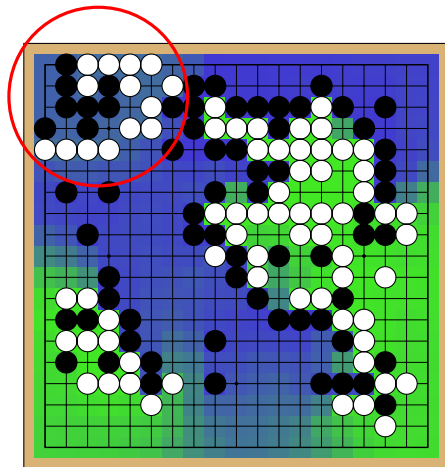University of Electro-Communications, Tokyo, Japan

Talk Outline

1 Introduction

2 Criticality Heuristic

3 Experiments with Crazy Stone

4 Conclusion

Introduction: Principle of Monte-Carlo Evaluation

Root Position

Random Playouts

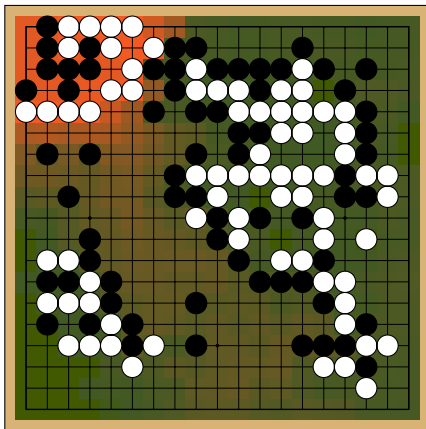MC Evaluation

$+$ $+$ $=$

Introduction: the Semeai Problem

○ Human
● Crazy Stone

■ Black territory
■ White territory

○ Evaluation error:
  White is alive

Criticality: Graphical Representation

Intuitively: How important is it to own this point in order to win the game?

Useful information for pruning the search tree.

Criticality: Mathematical Definition

Criticality at point x

$$c(x) = \frac{v(x)}{N} - \left(\frac{w(x)}{N} \times \frac{W}{N} + \frac{b(x)}{N} \times \frac{B}{N} \right)$$

Notations

- N: number of playouts;
- W/B: playouts won by White/Black;
- $w(x)/b(x)$: playouts where x is owned by White/Black;
- $v(x)$: playouts where x is owned by playout winner.

A similar idea was independently proposed by Seth Pellegrino, Andrew Hubbard, Peter Drake, and Yung-Pin Chen,

in *Localizing Search in Monte-Carlo Go Using Statistical Covariance* (in preparation).

Criticality as a Pattern Feature

Gamma-value of criticality

- Used for progressive widening and progressive bias
- Details in *Computing Elo Ratings of Move Patterns in the Game of Go*, Coulom (2007)
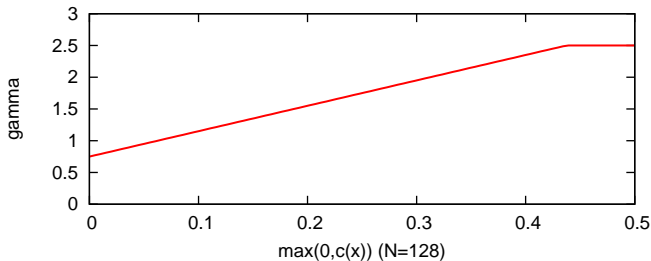
Influence on Program Strength

	against GNU Go L10	against CS0
CS0: reference	49.3%	(50.0%)
CS0+Owner	58.5%	60.0%
CS0+Criticality	53.8%	60.0%
CS0+Owner+Criticality	60.5%	66.0%

19×19, 600 games, 5k playouts per move, 95% confidence interval $= \pm 2\%$.

(note: old results obtained in July 2008. FIT'2008 version scores 72.2% against GNU Go 3.7.12 Level 10, after minor improvements and parameter tuning)

Conclusion

Summary of Criticality

- MC pattern feature, like point owner
- Improves playing strength of Crazy Stone

Future Work

- The semeai problem still has to be solved.
- Criticality of first play: alternative to AMAF?