

Rule-Based Go Players

Michael Wollowski

This presentation focuses on the work of David Fotland.

It is based on his article “Knowledge Representation in The Many Faces of Go.”

<https://smart-games.com/knowpap.txt>

1

Introduction

- The Many Faces of Go is one of the strongest Go programs.
- It won the United States Computer Go competitions in 1988, 1991, and 1992.
- It is based on traditional AI techniques, such as:
 - alpha-beta search,
 - rule-based expert systems, and
 - pattern matching.
- The code is about 30K lines of ‘C’
- In addition, there is a pattern database and a joseki database.
- It was written by one person, part time, over a 10-year period.

2

5 major areas of Go Knowledge

1. Low level go knowledge built into the evaluation.
 - This is knowledge used to determine connectivity, eyes, potential eyes, and territory, as well as the move generators and move sorters used by the tactician.
 - It is hard coded in 'C' 'if' statements.
2. Dynamic knowledge stored about the state of the current position.
 - This data is stored in a global database
 - It is built up in successive passes, from low levels to high levels of abstraction.

3

Go Knowledge

3. A rule-based expert system.
 - It has about 200 rules.
 - They are used to suggest plausible moves for full board evaluation.
4. A Joseki database.
 - Contains standard corner patterns,
 - Contains over 36,000 moves,
 - Includes all moves from most of the joseki books published by Ishi Press.
5. A pattern database.
 - Contains 8x8 patterns,
 - Each with a move tree attached,
 - Currently over 700 patterns and over 4,000 moves.

4

Connections

- Each connection data structure records all connectivity between a pair of strings.

```

string s1, s2;           // two string numbers
int num_d1;              // number of distance one connections
int num_d2;              // number of distance 2 connections
int num_d3;              // number of distance 3 connections
list_t| d1points;        // list of distance one connection points
list_t d2points;         // list of distance 2 connection points
list_t d3points;         // list of distance 3 connections
int type;                // type of connection:
int strength;            // strength of the connection

```

5

Rule Based System For Move Suggestion

- Fuseki
 - Playing in empty corner
 - Shimari and kakari
 - Joseki moves
- Big moves on edge
 - Towards enemy
 - Invasions
 - Between friendly stones
- Playing in the center (reducing moves and junction lines)

6

Rule Based System For Move Suggestion

- Playing safe when ahead
 - Respond when enemy adds stone to dead group
 - Add extra stone to kill big group that is probably dead
- Squirming around when behind
 - Make a bogus invasion
 - Try to make a hopeless group live
- Save threatened string
- Capture threatened string

7

Rule Based System For Move Suggestion

- Pattern matching
 - patterns for cutting and connecting
 - patterns for surrounding and avoiding getting surrounded
 - patterns for invasion and defending against invasion
 - endgame patterns
 - killing/saving groups patterns
 - Shape moves
- Saving a weak group
 - making eyes
 - running
 - fighting semeais

8

Rule Based System For Move Suggestion

- Killing a weak group
 - surrounding
 - taking eyes
- Cutting and connecting
- Contact fights
 - Blocking
 - extending for liberties
 - hane
- Ko threats
 - make a big atari
- Filling dame