A bounds-driven analysis of “Skull and Roses” cards game

A. Gragera and J. Baffier and V. Suppakitpaisarn
alonso@iis.u-tokyo.ac.jp, jf.baffier@iis.u-tokyo.ac.jp, vorapong@nii.ac.jp

About the Game

Skull & Roses is a card game based on bluff and composed of a large number of short mini-games. It was created by Hervé Marly, illustrated by Rose Kipik, and edited by lui-même in 2010. The game received the international prize of as d’or, jeu de l’année, Cannes 2011.

Relevant properties

- Four parameters: $P$ players, $S$ cards of skull, $R$ cards of rose, $W$ number of wins required, (with $3 \leq P \leq 12$ players, $S = 1$ skull, $R = 3$ roses and $W = 2$ wins – in the Skull & Roses RED).
- Compared to Go and Shogi, this game learning curve is much shorter.
- It was created by Hervé Marly, illustrated by Rose Kipik, and edited by lui-même in 2010.
- It was awarded the international prize of as d’or, jeu de l’année, Cannes 2011.
- Hard game with partial information.
- Compared to Go and Shogi, this game learning curve is much shorter.
- Four parameters:
  - $P$ players
  - $S$ cards of skull
  - $R$ cards of rose
  - $W$ number of wins required

Different stages

A game is composed of rounds, each of them is divided into three stages. A player wins if he has W wins and is disqualified if he has no card left.

State space analysis

Our results are obtained by studying separately the different stages.

- Round Variables: $P(S + 1)(R + 1)(W + 1)^P$
- Placement Variables: $(R + S)(S + R)P$
- Betting Variables: $P(R + S)^2$
- Revelation Variables: $(R + 2) + (R + 1)^P - 1$

Combining them to form the global upper-bound, we get:

$$\text{State Space Size} \leq P(S + 1)^2(R + 1)(W + 1)\left(\frac{S + R}{S}\right)^P.$$

Upper-bounds

The results on the search tree size came in a similar way than for the state space size.

Comparison with other games

- Formalization of the rules and first analysis of Skull & Roses.
- Upper-bounds for the space-time size and the search tree size.
- Simulation to compute the average branching factor and game length.

Contribution

- Develop a Monte-Carlo based AI.
- Specific cases where some variables are set to be fixed. Specifically, we are improving our search tree size upper bound for the case when $S = 1, R = 3, W = 2$ as in Skull & Roses RED.
- Look for further evidences that developing a competitive AI strategy for Skull & Roses is difficult.

Different stages

A game is composed of rounds, each of them is divided into three stages. A player wins if he has W wins and is disqualified if he has no card left.

Placement: Players will consecutively play a card till one of them bet a number of card k between 1 and c, the number of cards played. Bet cannot occur before everyone play at least one card. Someone who cannot play a card has to bet.

Bet: Current player can either bet strictly more than k or pass. It goes on till everyone pass or c is reached. A player that have passed cannot bet anymore.

Revelation: The player who previously won the challenge will try to reveal the number of cards he bet on. If he revealed a skull the round stops and he loose one of his cards. Otherwise he wins a point. He first needs to reveal all of his cards. Then, he reveals one of the top card of the other players deck and repeat it as necessary.

The skull and the three roses cards from the “Skull & Roses” card game designed by Hervé Marly and illustrated by Rose Kipik.

References