

# team “takeda” Agent Discription

## 1<sup>st</sup> international aiwolf contest

### 1. Agent Overview

Our Agent consists of two main parts, Role Estimation part and Decision Making part. In Role Estimation part, the agent calculates the probability distribution of each players’ role by Bayesian inference. In Decision Making part, the agent decides how to act (what to talk, who to vote, who to attack and so on) by a simple rule-based algorithm.

### 2. Role Estimation

First, we define some random variables.

$R_i$  is the role of the  $i$ th agent.

$A$  is the assignment of roles;  $A = \{R_1, R_2, \dots, R_N\}$

$I$  is the information that is given to the agent.

By Bayes' theorem,

$$P(A|I) \propto P(A)P(I|A)$$

since  $P(A)$  is uniform,

$$P(A|I) \propto P(I|A)$$

This means that the probability of a certain role assignment is proportional to its likelihood.

What we want is the probability distribution of each player’s role, which is  $P(R_i|I)$ . We can calculate this value by

$$P(R_i|I) = \sum_{A \ni R_i} P(A|I)$$

This concludes that what we need is to calculate likelihoods.

To calculate likelihoods, we assume

$$P(I|A) = \prod_i P(I|R_i) \prod_{i,j} P(I|R_i, R_j)$$

This means that we don’t care relationship among  $\geq 3$  players

Next, we extract some <State, Action> pairs from Disclosed Information  $I$

$$P(I|A) = \prod_{(R_i, R_j, action, state) \in I} P(action|R_i, R_j, state)$$

Here, we assume that actions are independent to each other.

To calculate the likelihoods of these actions, we use frequency counting model.

We define  $Freq[R_i][R_j][state][action]$  as the frequency that  $i$ th agent do action  $action$

to  $j$ th agent when  $i$ th agent is role  $R_i$  and  $j$ th agent is role  $R_j$  and the game state is  $state$ .

Likelihood of the action is calculated as

$$P(action|R_i, R_j, state) = \frac{Freq[R_i][R_j][state][action]}{\sum_{action} Freq[R_i][R_j][state][action]}$$

### 3. Decision Making

Now our agent can estimate other agents' role. Next, our agent decide what to talk, who to vote, who to attack and so on.

#### 5-player game

- Villager:** Declare votes to the most suspicious player, vote to the same player.
- Seer:** Basically same as villager. If the divination result is white (not werewolf), report black result for the other suspicious player.
- Possessed:** Pretend to be a seer. Report black result to the least suspicious agent. When the remaining player is less than 3, reveal the true role (Power play).
- Werewolf:** Pretend to be a seer or a villager for 50% chance each. Attack the agent who is the least likely to be a possessed.

#### 15-player game

- Villager:** Declare votes to a player who gets a majority of votes. If no one gets a majority, declare votes to the most suspicious player. Vote to the same player.
- Seer:** Basically same as villager. Unlike the 5-player game, always report true divination results.
- Bodyguard:** Basically same as villager. Guard a player who is most likely to be a villager side player.
- Medium:** Basically same as villager. Report the identification result at the first turn of each day.
- Possessed:** Same algorithm as possessed in 5-player game.
- Werewolf:** Pretend to be a villager.