Behavior analysis of executed and attacked players in Werewolf game by ILP

Nihon University

Ema Nishizaki  Tomonobu Ozaki
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  - AI Wolf: an intelligent agent for werewolf
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What’s Werewolf game

- One of the multi player party games.
- Such as “Mafia game”.
- A human player lie and persuade him/her in Werewolf game.
- To realize AI for playing the game several research have been reported recently in Japan.

“artificial intelligence in Werewolf”
http://www.amazon.co.jp/dp/4627853718

aiwolf
Rules 1/4 ~ Teams ~

- Two teams, **werewolf** and **villager**.

  **Werewolves**: rich information minority
  - recognize their teammates

  **Villagers**: less information majority
  - don’t know other player at all

![Diagram showing villagers and werewolves]
Rules 2/4  ~ Phases ~

Iterates two phases, **day** and **night**.

- **Day**: discussion for deciding a player to be executed
- **Night**: attack of the player by a werewolf

- Executed or attacked players get kicked out of the game.

Who is a Werewolf !?
Rules 3/4  ~ Winning ~

- **Villagers** : Execute all werewolves.
- **Werewolves** : Make the survival number of villagers be the same as that of werewolves.

**villagers win**

- villager : 3
- werewolf : 0

**werewolves win**

- villager : 2
- werewolf : 2
Rules 4/4 ~ Special ability ~

- Villagers
  - seer
  - medium
  - hunter
  - disadvantage
  - less information

- Werewolves
  - rich information

Villagers have special ability
Tried extract characteristics behavior of particular players.

A target to executed players, attacked players, and players who receive a vote.

- executed
- attacked
- receive a vote
Werewolf BBS

- Online community website
- Text only
- No voice, no video message

http://www.wolfg.x0.com/index.rb
Walter says that Moritz is villager.

Regina says that Pamela is villager.

Clara says that Moritz is werewolf.

Clara estimates that Regina is werewolf.

Three seers
real seer : 1 player
fake seer : 2 players

contradict !!
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Facts

- **coming out**: a coming-out of the role
- **estimate**: an estimate of other player’s role
- **divined**: a report of the divination
- **inquested**: a report of the inquest
- **guarded**: a report of the guard
- **question**: a player’s question to other player’s
- **answer**: an answer of question by a player’s
- **agree**: a player’s agreement to other player’s
- **disagree**: a player’s disagreement to other player’s
- **line**: an estimation of that two player’s belong to the same team
- **unline**: an estimation of that two player’s belong to different team
- **disrelation**: a backstabbing within werewolf teams
Rules

\[ \text{Pred}( \text{Game:Day, N, Player, Args} \cdots ) :\]
\[ \text{prev\_days( N ), PDay is Day - N,} \]
\[ \text{Pred}( \text{Game:PDay, Player, Args} \cdots ). \]

\[ \text{prev\_days(N)} :\]
\[ \text{member(N, [0,1, 2, 3])} \]

For example

\[ \text{comingout( Game:Day, N, Player, Role) :}\]
\[ \text{prev\_days( N ), PDay is Day - N,} \]
\[ \text{comingout( Game:PDay, Player, Role ).} \]
Data Set

<table>
<thead>
<tr>
<th>Winner</th>
<th>number of game</th>
<th>average number of days</th>
<th>average number of utterances</th>
</tr>
</thead>
<tbody>
<tr>
<td>villager</td>
<td>3</td>
<td>7</td>
<td>1166.6</td>
</tr>
<tr>
<td>werewolf</td>
<td>3</td>
<td>8</td>
<td>1234.0</td>
</tr>
</tbody>
</table>

**Table1.** details of data set

<table>
<thead>
<tr>
<th>target</th>
<th>positive example</th>
<th>negative example</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>executed</td>
<td>39</td>
<td>528</td>
<td>567</td>
</tr>
<tr>
<td>attacked</td>
<td>27</td>
<td>505</td>
<td>532</td>
</tr>
<tr>
<td>vote</td>
<td>89</td>
<td>478</td>
<td>567</td>
</tr>
</tbody>
</table>

**Table2.** Positive and Negative examples
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### Result

<table>
<thead>
<tr>
<th>target</th>
<th>number of rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>executed</td>
<td>28</td>
</tr>
<tr>
<td>attacked</td>
<td>23</td>
</tr>
<tr>
<td>vote</td>
<td>53</td>
</tr>
</tbody>
</table>

*Table 3. number of rules*

By Aleph

([http://www.cs.ox.ac.uk/activities/machinelearning/Aleph/aleph](http://www.cs.ox.ac.uk/activities/machinelearning/Aleph/aleph))
Result 1  a rule of executed players

X is executed player.

executed( Game:Day, X ) :-
    line( Game:Day, 0, X, A, B ),
    disagree( Game:Day, 0, C, D ),
    answer( Game:Day, 1, A, C ).
Result 2  a rule of executed players

X is executed player.

executed( Game:Day, X ) :-
estimate( Game:Day, 2, C, X, lunatic ),
estimate( Game:Day, 1, B, X, lunatic ),
estimate( Game:Day, 0, X, A, werewolf ).
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Conclusion

- Analysis log of Werewolf BBS.
- Apply inductive logic programming to three classification problems. (past behaviors of plural players)

Future Work

- Incorporate certain predicates representing each player’s view and intention. (Each player has different information.)
- Employ answer set programming. (Suitable for agent modeling) (Because more advanced framework is expected for AI.)