

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

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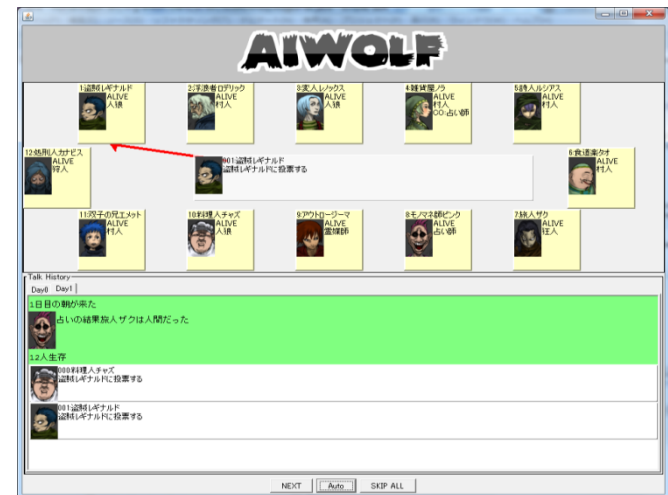
- Werewolf games
 - AI Wolf: an intelligent agent for werewolf
 - Rules of the game
 - Werewolf BBS
- Method
- Results
- Conclusion and Future Work

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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”

aiwolf

<http://www.amazon.co.jp/dp/4627853718>

<http://aiwolf.org/en/resource/>

Rules 1/4 ~ Teams ~

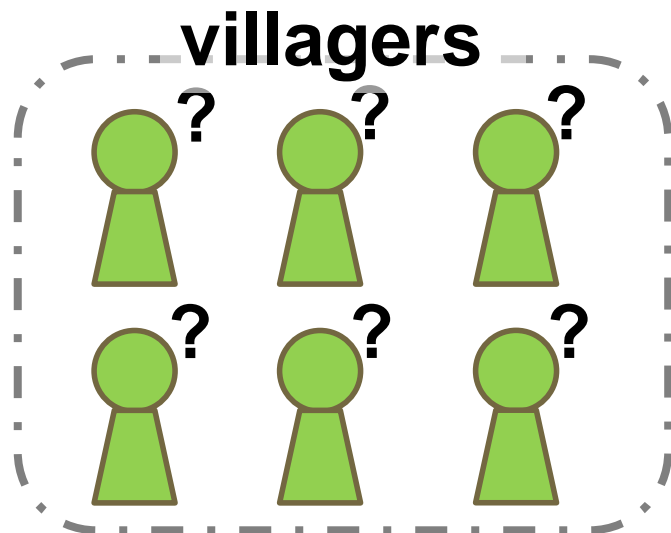
- Two teams, **werewolf** and **villager**.

Werewolves : rich information minority

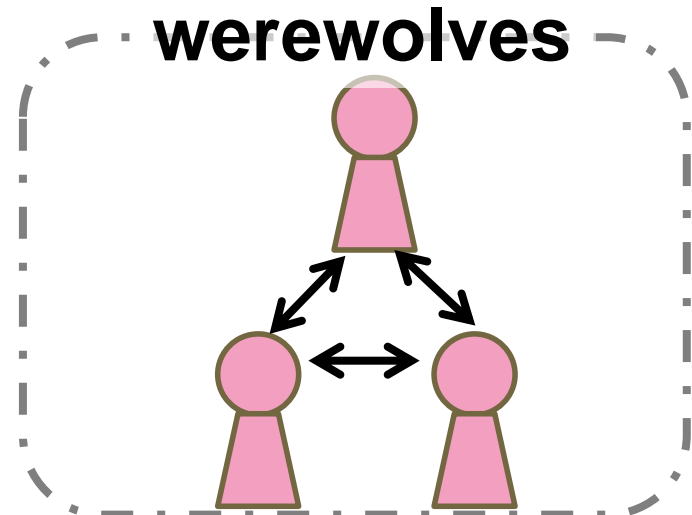
- recognize their teammates

Villagers : less information majority

- don't know other player at all



vs



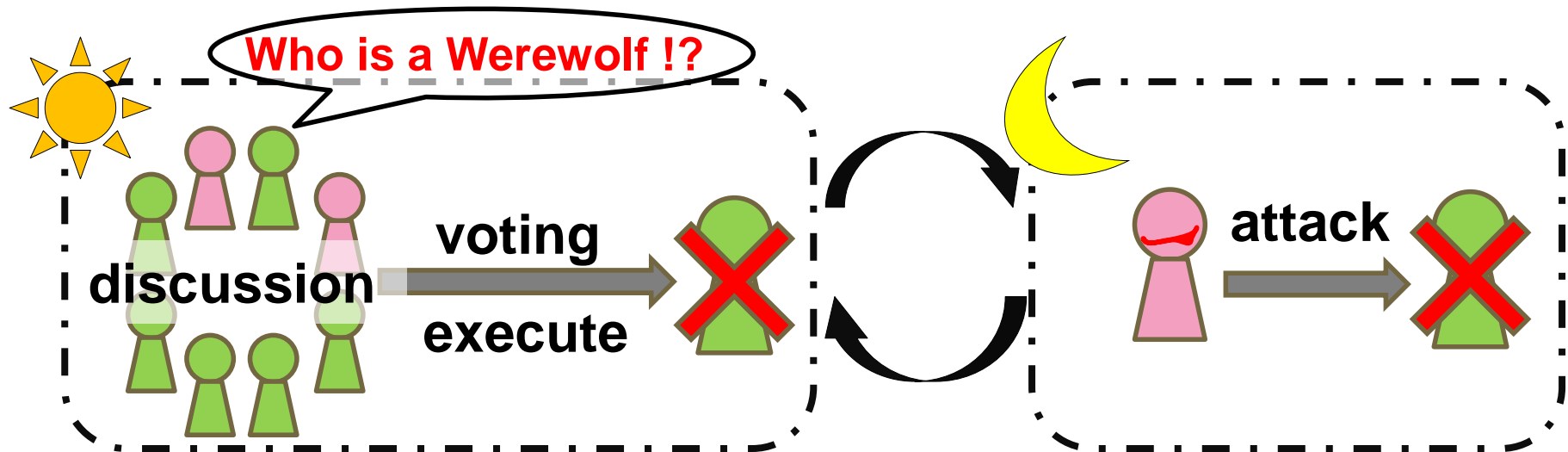
Rules 2/4 ~ Phases ~

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

Day : discussion for deciding a player to be executed

Night : attack of the player by a werewolf

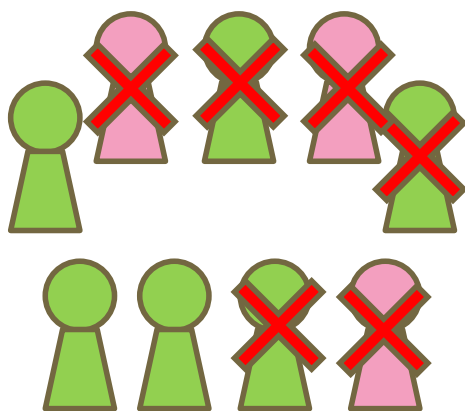
- Executed or attacked players get kicked out of the game.



Rules 3/4 ~ Winning ~

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

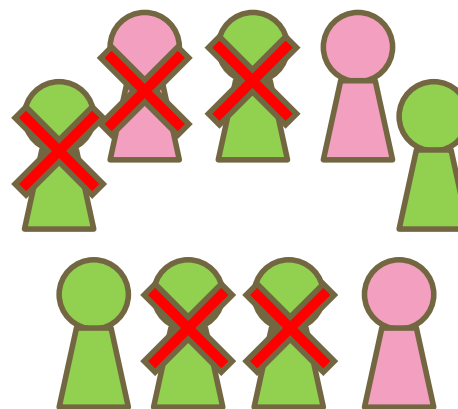
villagers win



villager : 3

werewolf : 0

werewolves win



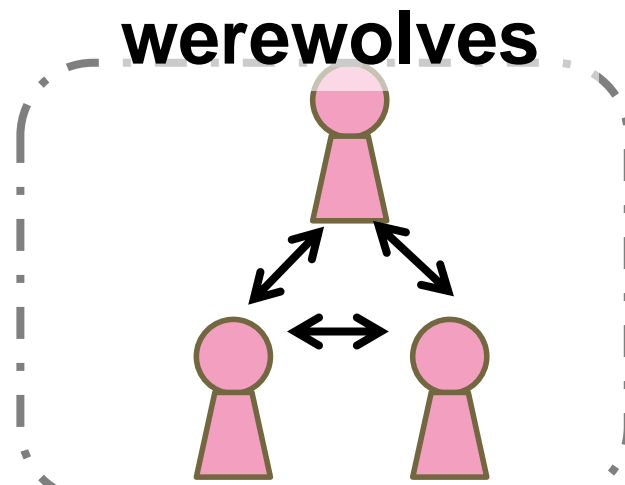
villager : 2

werewolf : 2

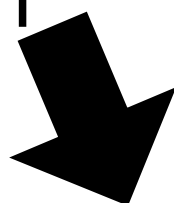
Rules 4/4 ~ Special ability ~



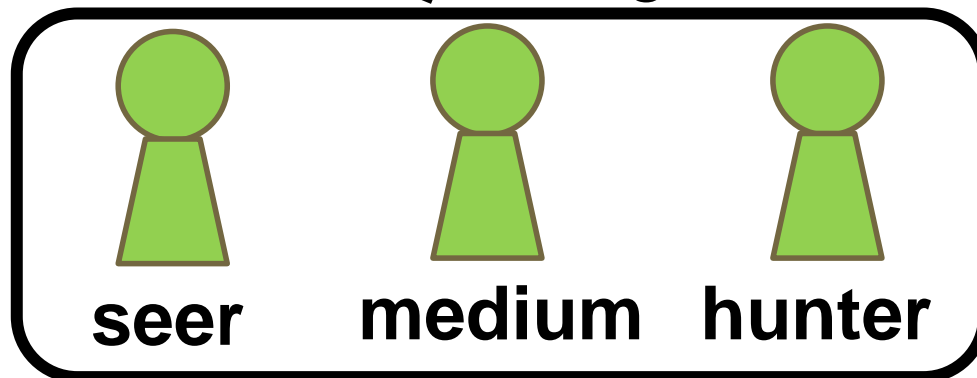
less information



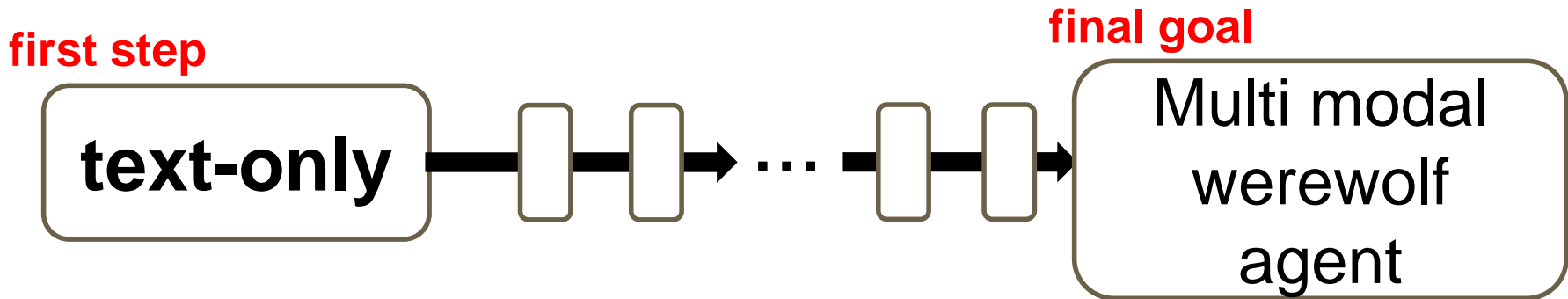
rich information



Villagers have special ability

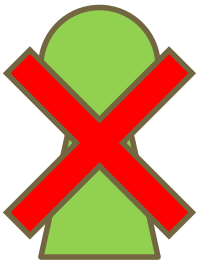


Purpose & Target

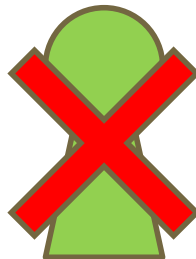


- Tried extract characteristics behavior of particular players.
- A target to executed players, attacked players, and players who receive a vote.

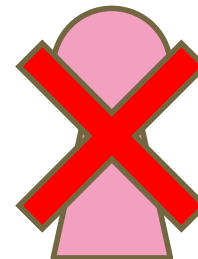
executed



attacked



receive a vote



Werewolf BBS

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

The screenshot shows the Werewolf BBS website. At the top, there's a header with the title "人狼BBS" and a background image of a village at night. Below the header, there's a login form with fields for "user_id" (containing "emaaan") and "password" (containing "*****"), and a "login" button. Below the login form, there's a message "G001 疑心暗鬼の村 (3/13 01:15 に更新) rss" and a navigation menu with links for "プロローグ", "1日目", "2日目", "3日目", "エピローグ", and "終了". Below the navigation menu, there's a "mode" dropdown set to "人狼 完全". The main content area contains a large text box with the following text: "さあ、自らの姿を鏡に映してみよう。そこに映るのはただの村人が、それとも血に飢えた人狼か。例え人狼でも、多人数で立ち向かえば怖くはない。問題は、だれが人狼なのかという事だ。占い師の能力を持つ人間ならば、それを見破れるだろう。" Below this text box, there's another text box with the text: "どうやらこの中には、村人が7名、人狼が2名、占い師が1名、霊能者が1名、狂人が1名、狩人が1名いるようだ。" Below the text boxes, there's a list of messages. The first message is from user "181. 楽天家 ゲルト" at 01:15, with a yellow character icon and the text "ふぁーあ……ねむいな……寝てていい？". The second message is from user "182. 神父 ジムゾン" at 01:15, with a blue character icon and the text "諸君、私は共有者もしくはハムスター人間もしくは6国お初のおのぼりさんである。……おお神よ、私を許し給え。". The third message is from user "183. 行商人 アルビン" at 01:23, with a blue character icon and the text "神父さんに対抗するに必要さもあるびんです。私はハムが共有者か善良".

Log of Werewolf BBS

545. 村長 ヴァルター 00:48

判定文容易しなかったー！
 えっと、ゲルト神日く、カタリナはメラより年上で、20代後半くらいで考えてるらしいよ！結構切実な年代だね！
 【老は人間】

546. 宿屋の女主人 レジーナ 00:48

占い結果
 【娘は人間だったわ。】

547. 司書 クララ 00:48

【モーリッツは人狼】

モーリッツは人狼！人狼でしたよー！
 モーリッツは人狼！
 大事な事なので2回言いました。

548. 司書 クララ 00:50

結局外してるんじゃないかと不安でしたが人狼でしたwwwwww
 これレジーナさんの方が狼なんですか？
 ▼老●宿セツ

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

Walter says that
Moritz is villager.

Regina says that
 Pamela is villager.

contradict !!

Clara says that
Moritz is werewolf.

Clara estimates that
 Regina is werewolf.

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Facts

- **comingout** : 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

```
Pred( Game:Day, N, Player, Args... ) :-  
    prev_days( N ), PDay is Day - N,  
    Pred( Game:PDay, Player, Args...).
```

```
prev_days(N):- member(N, [0,1, 2, 3])
```

for example

```
comingout( Game:Day, N, Player, Role ) :-  
    prev_days( N ), PDay is Day - N,  
    comingout( Game:PDay, Player, Role ).
```

Data Set

Winner	number of game	average number of days	average number of utterances
villager	3	7	1166.6
werewolf	3	8	1234.0

Table1. details of data set

target	positive example	negative example	total
executed	39	528	= 567
attacked	27	505	= 532
vote	89	478	= 567

Table2. Positive and Negative examples

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Result

target	number of rules
executed	28
attacked	23
vote	53

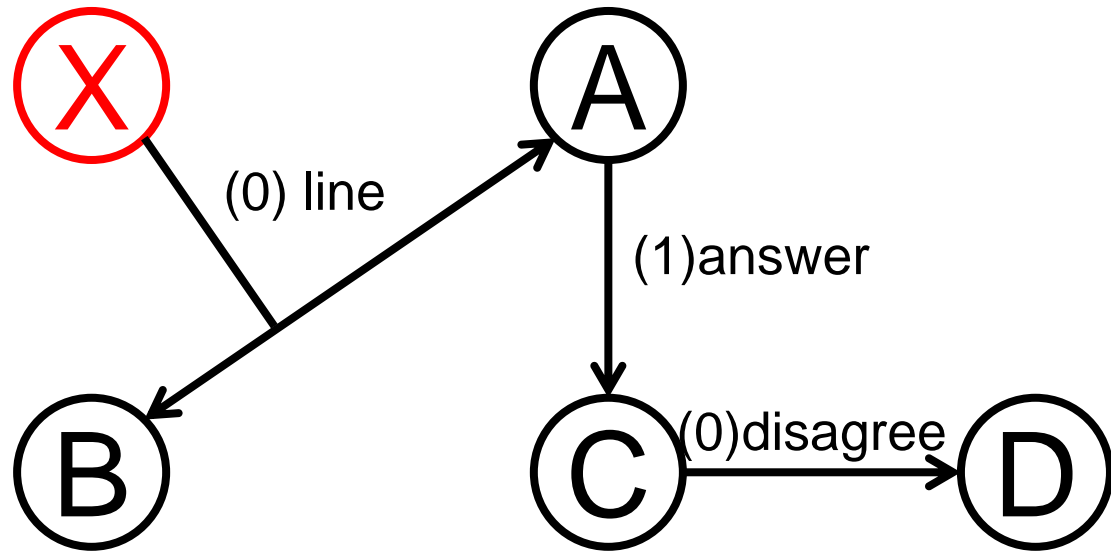
Table3. number of rules

By Aleph

(<http://www.cs.ox.ac.uk/activities/machinelearning/Aleph/aleph>)

Result 1 a rule of executed players

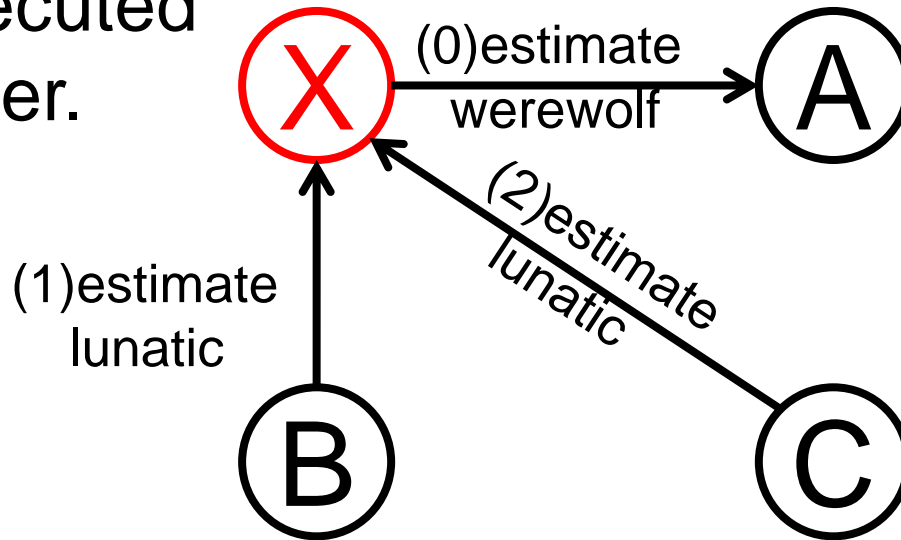
X is executed player.



```
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

➤ **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.)