

Agent Communication

José M Vidal

Department of Computer Science and Engineering University of South Carolina

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Abstract

We present the basics of agent communication [Vlassis, 2003, Chapter 6], [Gmytrasiewicz and Durfee., 2001].



Language Layers

- **Network** level: TCP
- **Language** level: RDF, OWL
- **Application** level: what to say, who to say it to, and when.
MAS problem.



Communicative Acts

- **Informing** about the current state.
- **Querying** aspects of the hidden state.
- **Committing** to a particular action.
- **Prohibiting** an action.
- **Directing** an agent to do an action.
- FIPA ACL implement these. No other standard has arisen.



Value Of Communication

- *Communication is a way of reducing uncertainty.*
- It's value depends on the expected utility gain.

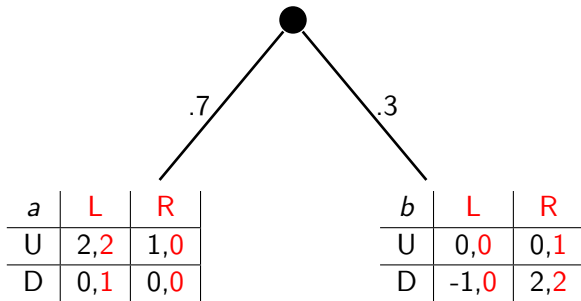


Value Of Communication

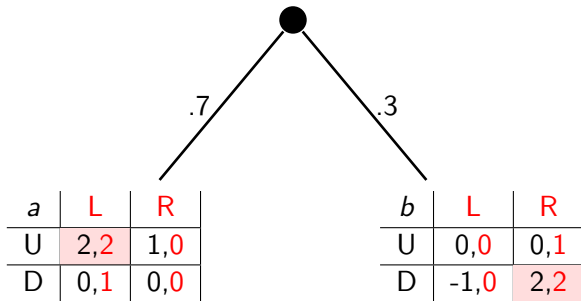
- *Communication is a way of reducing uncertainty.*
- It's value depends on the expected utility gain.
- You should say that which maximizes your expected utility.
- Calculate this using probabilities and game matrices.



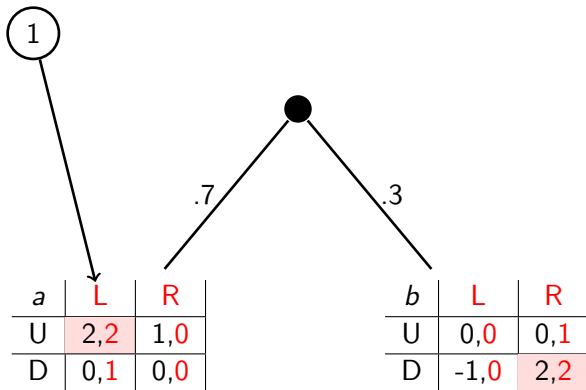
Game Example



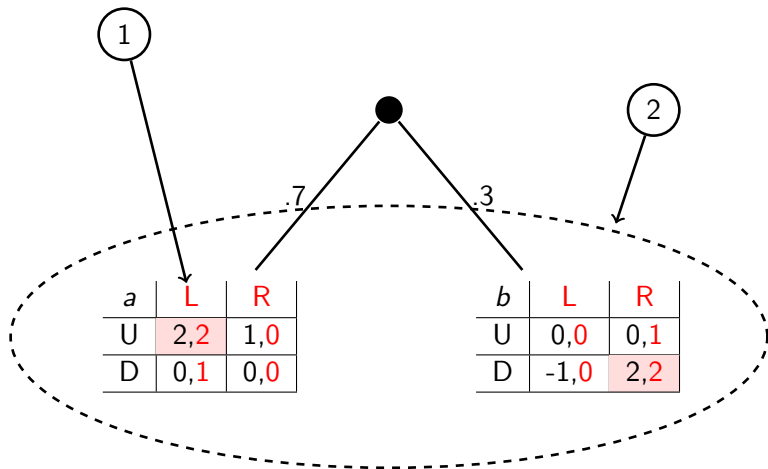
Game Example



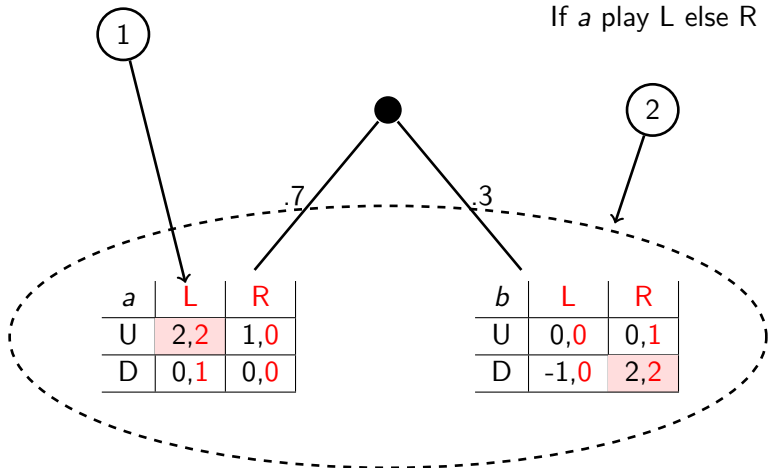
Game Example



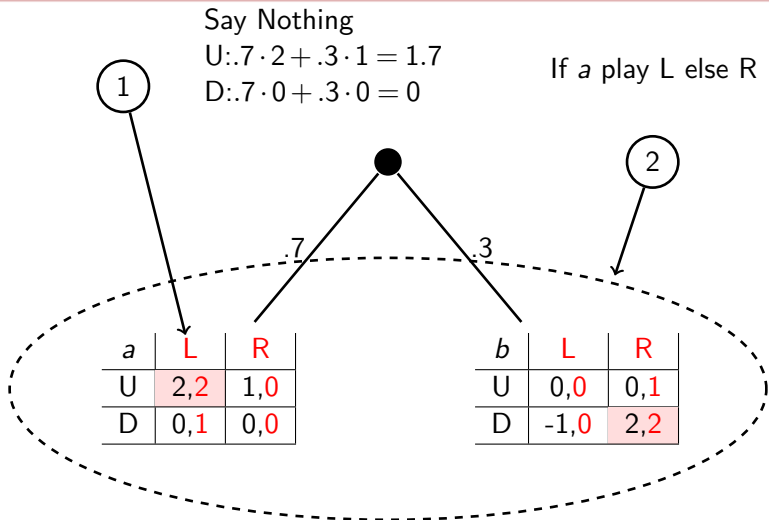
Game Example



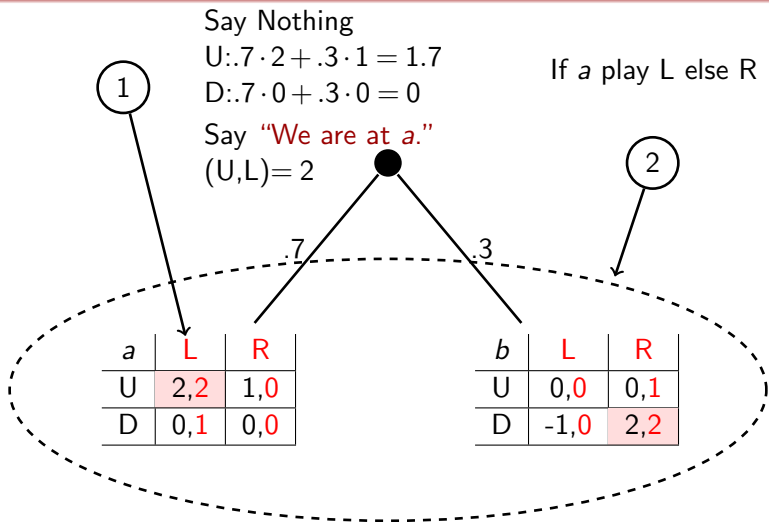
Game Example



Game Example



Game Example



Recursive Modeling Method

	L	R
U	2,2	1,0
D	0,1	2,0

|

	U	D
L	1,0	1,1
R	1,0	1,2

|

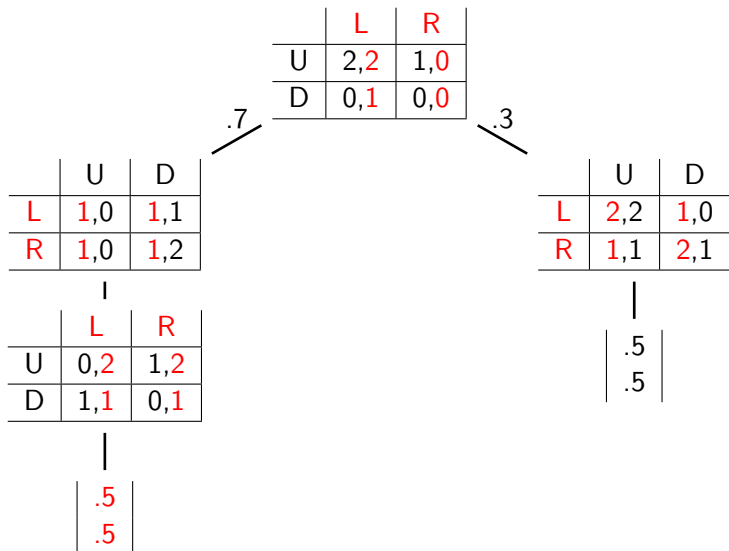
	L	R
U	0,2	1,2
D	1,1	0,1

|

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Recursive Modeling Method



Social Conventions

For each agent i in parallel

 If $i \neq 1$ then

 Wait until all actions $(a_1^*, \dots, a_{i-1}^*)$ are received

 Compute an equilibrium that contains $(a_1^*, \dots, a_{i-1}^*)$

 Choose action a_i^* from equilibrium

 Broadcast a_i^* to all agents $i+1, \dots, n$.



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- Forces sequential execution.
- Agents must do a lot of redundant work.
- First agent (mostly) gets to choose the equilibrium it likes best.



Role Assignment

```
For each agent  $i$  in parallel
   $I = \{\}$ 
  For each role  $j = 1, \dots, n$ 
    Compute the potential  $r_{ij}$  of agent  $i$  for role  $j$ .
    Broadcast  $r_{ij}$  to all agents.
  End For
  Wait until all  $r_{i'j}$ , for  $j = 1, \dots, n$  are received.
  For each role  $j = 1, \dots, n$ 
    Assign role  $j$  to agent  $i^* = \arg \max_{i' \in I} r_{i'j}$ .
    Add  $i^*$  to  $I$ .
  End For
```



Role Assignment

- Each agent computes its potentials for each role.
- Some agents might not have a role (if there are more agents than roles).
- It is easy to lie.
- Not guaranteed to find the set of roles that maximizes the sum of potentials.



Conclusion

- Determining what an agent should say requires us to know
 - ① the agent's current belief about the world,
 - ② the agent's current belief about what the others believe,
 - ③ and so on.
- Coordination protocols are often designed to make it easy for the agent to decide when to say something and what.





Gmytrasiewicz, P. J. and Durfee., E. H. (2001).
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