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Diplomacy game: the test bed

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A rich shared-application domain is helping to further current research on negotiation and trust.

Multiagent-systems studies (involving bunches of computer programs) have lately been enjoying a renewed surge of interest. Current lines of investigation emphasize cognitively oriented models of trust and reputation,[1] and argumentation techniques to improve negotiating strategies.[2] Progress in theoretical models has enabled software agents to behave more like humans. Agents are learning how to interact, argue and negotiate, as well as whom to trust and why. By the same token, practical application of the models has been slower to take shape. Because researchers lack shared domains for comparing even simulated environments, the ones they design tend to be artificial. As a result, most experiments suffer from a chronic insufficiency of both data and computational resources for model validation. Environments are urgently needed that are rich enough to test simulations without having to oversimplify them. In particular, software agents must be able to interact not just with humans but also with other software agents. We argue that the popular strategy board game Diplomacy provides just such a test bed.

In Diplomacy, players negotiate with the aim of conquering Europe.[3] The game is situated on the Continent at the beginning of the 20th century, shortly before World War I. Each player is in charge of the armed forces of a major European power and must decide which movements the various units should execute. The game ends when someone has an army powerful enough to control half of the European 'provinces'. This is achieved by defeating other players' units, conquering their provinces and controlling the supply centres that allow armies to build new units.

One of the most interesting features of Diplomacy is the absence of random movements: there are no cards or dice. Also, this is not a turn-taking game. That is, all players move their units simultaneously: there is no advantage in a player being the first or last to move. Moreover, all units are equally strong. Consequently, when one attacks another, the winner of the battle is decided by taking into account only the number of units helping one another. This feature is what makes Diplomacy so compelling for our purposes. Accordingly, the most relevant skills for a player are negotiating ability, intuition (knowing whom to trust) and powers of persuasion.

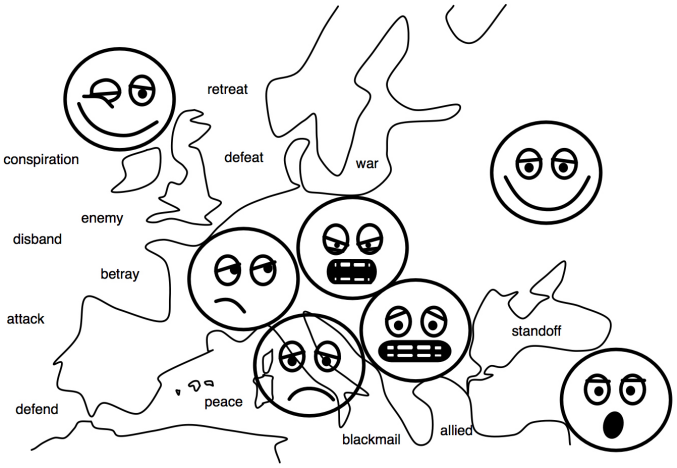

Figure 1. *Diplomacy.*

The game is not hard. Indeed, the individual plays are quite simple. What is difficult is to resolve the conflicts that crop up owing to the simultaneous public announcement of the movements. Expert players, or masters, usually perform this task. In our experiments, however, software programs replace the masters. From a player's point of view, the most important aspect of the game is the negotiation process: deciding allies, selecting whom to ask for help, arguing with other players to get information about their objectives or to find out what they know, and so on.

Diplomacy is often played on the Internet. Interestingly, playing online makes it easier to secretly meet with other players to negotiate and keep conspiracies under wraps. Large communities of players organize both in situ and online games. Sometimes two conferees have no common natural language. In that case, they use 'translator sheets' to support communication. This is another beneficial aspect as it restricts the language that humans use and allows software agents to easily step in by just knowing the code. In other words, there is no need to deal with natural language. The stage is thus set to use Diplomacy as a test bed that combines humans and agents.

The idea of creating a Diplomacy software player was first suggested by Sarit Kraus 20 years ago.[5] We think it is time to

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continue her work. Computer and network technologies have evolved so much in the interim that many people now accept entertainment online from their homes as a matter of course. In fact, a community called Diplomacy Artificial Intelligence Development Centre (DAIDE) makes it possible to share a common infrastructure for developing software players and comparing their performance.[4] To date, such efforts have focused mainly on the strategy and tactics of the no-press variant of the game (i.e., without negotiation). The work that the members of DAIDE have done is relevant, however, and should be completed by adding negotiation capabilities. At present, our own research focuses on creating the test bed itself, making the best use of existing resources insofar as possible. We modify only what we think will not work optimally, for example, the communication language used in the negotiation process.

In conclusion, Diplomacy is an ideal environment for testing trust and negotiation models because players must constantly confer, sign agreements and decide whether to honour them. There is also a large group of human players ready to go head to head with software agents and accustomed to both playing online and dealing in a restricted language. Finally, the game has no random elements that could decrease the relevance of the experimental results. We are already working along these lines in the COST (European Cooperation in Science and Technology) Agreement Technologies project.[6,7] Our immediate next steps are to define a new model that will enable an agent to play the full version of Diplomacy, including negotiation. We believe that ultimately the model will also have widespread application in the real world.

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