Democracy in Open Agent Systems

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1. INTRODUCTION

Open agent systems are multi-agent systems which any software agent may join. Entry may require compliance with particular stated conventions, such as use of an agent communication language and interaction protocol, or the making of a financial deposit. However, subject only to such conventions, any software agent may join. Because such agents may represent different human principals and typically will have been constructed by different software design teams, they may, in general, have conflicting goals, interests, beliefs and values. In these circumstances, which agent's goals or beliefs prevail in the interaction will depend on the nature of the social and political relationships between the participants. In situations where the agents adhere to some hierarchical relationship inside the agent system, that agent or agents at the top of the hierarchy may have final decision-making authority. For example, in an auction interaction, the auctioneer may have the explicit power to determine the final allocation of the scarce resources being sought by the bidders. Power such as this may not reside in particular agents, but accrue to certain roles within the agent system, as in electronic institutions.

However, if human interaction is any guide, in many open environments there will either be no such hierarchy, or what hierarchies there are may be contested by some participants. Indeed, this is already true of existing agent societies on the Internet. What structures are appropriate for agent societies in these circumstances? The absence of hierarchy means that the relationship between the participants is closer to one of equality; this in turn suggests that some form of democracy is appropriate when we consider the structure of these agent systems. Within the discipline of political philosophy, human democracy is a notion much debated, and there are several alternative normative theories of democracy. A designer of an open agent system intending to permit democratic participation by the agents in the system therefore has a choice of theories of democracy to encode in the system. In this work, we explore these alternatives from political theory, in order to identify what structures they provide for, and what constraints they place on, designers of multi-agent systems. We present the three primary normative theories of democracy developed by political philosophers, and then discuss their implications for the design of open agent systems. It happens that one theory, the Deliberative Model of democracy, stresses the joint and discursive nature of decision-making in a democracy, with participants exchanging arguments for and against various policy proposals, and forming preferences on the basis of these exchanges. The structure that this model provides to the agent system designer creates the means necessary to develop a strong form of social semantics, thereby increasing the extent to which a mentalistic semantics of an agent communications languages can be verified.

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2. THREE MODELS OF DEMOCRACY

Political philosophers have articulated several normative models of democracy. In their most abstract form, these models all view a polity as comprising just two entities: *Society* and *the State*. Society is the collection of individuals, organizations and companies in a polity, together with the panoply of relationships between them, while the State is the apparatus of public-sector administration. The key question for political theory is then: *What should be the process of formation of political will?* or *How should Society program the State?*

Supporters of democracy, beginning with the French Enlightenment philosopher, Jean-Jacques Rousseau [7], believe that these questions should be answered with the use of democratic procedures, such as elections based on universal adult suffrage. But if such procedures are used, what is the nature of the relationship between citizens and their elected representatives? Rousseau had assumed that the people have a "general will" which their elected representatives should seek to implement, but this is at best a high-level approximation to the multifarous cacophony which is modern democracy.

The first modern political theory of democracy which sought to answer this question was proposed in 1942 by Austrian-American economist Joseph Schumpeter [8]. Schumpeter's theory, possibly in reaction to the mass populism of Nazism and Communism and to his own failed political career, was disdainful of ordinary people and their views. Consequently, Schumpeter proposed that elected officials should act as a technocratic elite, making decisions on behalf of the general public and in accordance with what the elite believes are the public's best interests. Apart from voting, the people are entirely passive in Schumpeter's model of democracy, which has rightly acquired the label *elitist* [3, p. x]. We call this the *Wise Elite Model* of democracy.

In contrast to Schumpeter's inherently non-democratic view of democracy, Anthony Downs in 1957 proposed an economic-theoretic model of political will-formation in a democracy in which citizens were more than simply passive objects [5]. This model has since been called a *rational-choice* or *liberal* model [6], and it views democracy as akin to the operation of an economic market. Downs proposed a theory of democracy where political parties and interest groups act as entrepreneurs, offering alternative "products" in the form of bundles of state-instructions (or equivalently, ideologies, which are philosophies of bundle-formation), to voters who then "purchase" their preferred bundle when they vote. That bundle with the greatest "market-share" — in the form of a majority of the popular votes — becomes the set of instructions used to program the State.

Downs explicitly assumed that voter-consumers in a free and democratic society make their political choices on the basis of their perceived self-interest, and act according to the now-standard definition of rational economic behavior, e.g., [1]. In other words, voters are assumed to always vote so as to maximize their perceived utility they expect from the outcome of the election. In addition to consuming bundles of state-instructions, citizens also consume information about policies, ideologies, political parties, and candidates to the extent necessary to make their voting decisions. And, as for any other good, such consumption may be subject to time-, resource-, or processing-constraints, and cost-benefit trade-offs.

The rational-choice model affords citizens a greater role than does the elitist model, namely that of consumers of relevant political information and of recipients of the effects of policies enacted by their representatives. But citizens, in the rational-choice model of democracy, are not regarded as *producers* of political information or public policies. This viewpoint ultimately stems, we believe, from Downs' adoption of Kenneth Arrow's operational definition of economic rationality [1], which assumes that a decision-maker's preferences and utilities are given and precede the task of selection of a decision-option. In many, if not all, public policy determinations, however, the preferences and utilities of voters may only be formed in the very process of decision-making, as participants learn about feasible decision-options and about the effects of various decision-options on one another and on others not involved in the decision process.

In contrast, the *deliberative democracy* model of political will-formation emphasizes the manner in which beliefs and preferences of participants are formed or change through the very process of interacting together [2, 4]. In this model, citizens do not merely interact to exchange their preferences at election time, and to consume political information, as is the case with the rational-choice model. Rather, they are also producers of political information and policies, as they participate in political processes and debate, identify and publicize issues of personal or social concern, exchange arguments for and against various policy options, and generally seek to influence the outcomes of political decision processes. Seeking to influence and persuade other participants means that they must themselves be open to persuasion, and thus undergo what has been called *self-transformation*.

These three models of political will-formation in a democracy can be seen as offering alternative roles to the citizens who comprise the Society. In the Wise Elite model, the people are seen as completely passive, except when choosing the Elite. In the Rational-Choice model, the people are viewed as consumers of policies, ideologies and information. In the Deliberative model, the people are viewed as both consumers and producers of policies, ideologies and political information.

3. CONCLUSION

We have explored these alternative normative models of democracy for their relevance to the design of open agent systems. In particular, we have considered their implications for the design of agent communications languages, for interaction protocols, and for any mechanisms for the resolution of conflicts. The different models place very differing requirements on the design of these aspects of an agent system, and thus allow for different ways of structuring open agent societies. Following this, we have also discussed the notion of rationality in deliberative models of democracy, which we argue could provide a form of semantic verifiability of the communications language used by agents in an interaction. This form of verifiability, *contestability*, is stronger than Singh's social semantics [9], because an agent's utterances may not only be checked for consistency over the course of a dialogue, but also questioned and contested by other agents. As a consequence, insincere utterances become harder to sustain.

We believe the primary value of this work is to raise awareness among designers of open agent systems of the availability of alternative conceptualizations of the notion of democracy, and the possibilities they provide for organizing open societies. Without such awareness, system designers are likely to encode one or other model implicitly, and thus may subsequently limit the functionality of the agent system. A second value of this work is our notion of contestability, which provides a form of semantic verifiability for agent communications languages stronger than previous forms.

The full paper is available from the web-site of the first author: `www.csc.liv.ac.uk/~peter/pubs.html`

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