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8-16-1996

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VOTE: Decision Simulation

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Introduction

Decision making is the unifying theme of professional business education. Other disciplines, such as accounting, finance, economics, statistics, operations research, marketing, and organizational behavior provide methods and paradigms for analyzing and improving a manager's decisions.

Decision making is a complex cognitive process. An agent must recognize when a decision needs to be made, what options are available, who is affected by the options, what are the consequences of the choices, what option is preferable, and how to justify and implement the decision.

Using a variety of artificial intelligence techniques, we are developing decision simulation programs that make explicit the underlying process of decision making. The VOTE program demonstrated the computational feasibility of this approach in the domain of Congressional roll call voting. (Slade 1992; Slade 1994) In extending VOTE to business domains, we have introduced several additional features, including the qualitative interpretation of quantitative data. (Slade, Fish et al. 1995; Slade and Madhavan 1995).

As is the tradition in artificial intelligence, our programs are written in LISP. The original VOTE program was written in the T (Scheme) dialect of LISP. (Slade 1987) We have subsequently moved to the more accessible Common LISP dialect. (Slade 1996) We have made our programs available to the research community through Internet ftp. However, we recognize that the LISP code acts as a barrier to entry for many researchers.

In order to provide researchers greater access to our programs, we are developing a Web site which permits users to run the LISP code with a regular Web browser. No knowledge of LISP is required. The site has the following URL: http://www.stern.nyu.edu/~sslade/vote/ which contains an interactive version of this paper. Underlined text in this paper denotes a hypertext link in the HTML file.

In the remainder of this paper, we discuss the following topics. First, we describe the underlying decision model for our research. Second, we discuss the VOTE program. Third, we describe the Web site and future directions.

Qualitative Decision Making

We view decision making as a qualitative process. There are many quantitative decision analysis techniques which are widely used, however, we submit that those techniques involve implicit qualitative processes. In applying quantitative methods, the decision maker must both formulate the problem and interpret the results, which require qualitative reasoning.

Our model of decision making comprises the following elements.

- **Goals.** Agents have a large number of goals which vary in importance. Due to resource limitations, the agent is not able to achieve all her goals. In general, the agent will try to achieve the more important goals. Decision making requires an understanding of the relative importance of different goals. In business domains, goals may include increasing market share or decreasing overhead.
- **Relationships.** Agents are not alone in the world. Agents have relationships with other agents. The other agents have their own goal agendas. Through relationships, agents adopt each other's goals, so that decisions can incorporate the adopted goals. Just as goals vary in importance, so do relationships. Goals are adopted at a level proportional to the importance of the relationship. This means that an agent is more likely to help a friend than a stranger. In business domains, a manager's relationships include customers, employees, and competitors (for whom there may be a negative relationship).
- **Choices.** In evaluating a decision, an agent must understand the consequences of the options, that is, how each option will affect the agent's goals or preferences. Moreover, the agent should remember past choices as a guide for predicting future outcomes. Using case-based reasoning (Slade 1991), we can incorporate past decisions in the decision making process. In business domains, choices might include technology investment decisions, such as purchasing a computer or outsourcing.
- **Explanations.** In many situations, the decision making process does not end when the agent arrives at a choice. The agent must also explain or justify the choice, particularly if the decision has adverse consequences for other agents. The explanation is typically not an ex post construction, but a mediating factor in the decision process. In business domains, agents need to be able to justify their decisions to the many parties involved.
- **Agents.** Our model is not a prescriptive model of some hypothetical rational agent. Rather, it is a descriptive model of subjective decision making. Different agents have different goals, relationships, choices, and explanations. These differences will result in different outcomes for the same decision. Our model does not suppose that most real decisions have a rational or optimal result. Our model is realistic. (Slade 1995) Moreover, as agents adopt goals through relationships, an agent may have conflicting goals. That is, an agent may have the equivalent of P and NOT-P. This state would cripple a logical system, but it is natural in a psychological system. A similar contrast is also found between monotonic and non-monotonic deductive systems.

These elements are integrated in the decision process.

The VOTE Program

The qualitative decision making model is instantiated in the VOTE program which simulates Congressional roll call voting for members of the U.S. House of Representatives.

- **Goals.** In the political domain, goals are issues, such as gun control or balancing the budget. A position or stance on an issue includes a side (pro or con) and a level of importance (A, B, or C, where A is high and C is low). The importance levels are qualitative, not quantitative. This is consistent with utility theory which requires only ordinal values. A given issue also includes justification stances for and against the issue, as well as a normative stance for the issue. The Web site allows the user to examine all the issues. The program generates a natural language interpretation of the knowledge representation for the goals. Click here to access the issue database.
- **Relationships.** Members of Congress have relationships with constituency groups, such as organized labor or the National Rifle Association. Each of these groups has an issue agenda which members adopt through relationships. The Web site permits the user to examine the constituency groups and their relationships with members of Congress. Click here to access the group database.

- **Choices.** A member votes on a bill. The program represents bills in terms of the consequences of voting for or against the bill. The consequences are represented in terms of issue stances, that is, a consequence will be pro or con a given issue at some level of importance. The Web site lets the user examine the bill database. Click here to access the bill database.
- **Explanations.** It is not enough to make a decision. A member of Congress must produce an explanation. VOTE has more than a dozen decision strategies that get tested during the decision making process. Each strategy has an associated explanation. The first strategy to succeed gets used. The Web site lets the user examine the strategies. Click here to access the strategy database.
- **Agents.** The agents are the members of Congress. Each member has an issue agenda (or credo), a voting record, and a set of constituent relationships. VOTE infers additional goals through the voting record and constituent relationships. The Web site provides support for viewing all the members. Click here to access the member database.
- **Decisions.** Most importantly, a given member can vote on a given bill. The Web site provides a convenient mechanism for the user to specify a member and a bill, and then run the simulation. Click here to run a simulated roll-call vote.

As stated above, the program (in T and Common LISP) is available through the Internet. The Web site provides convenient access for researchers who wish to download the code.

The VOTE Web Site and Future Directions

We have long been interested in using the Internet for distributing software. As the Web came into prominence, we considered porting VOTE to a normal Web CGI programming language, such as perl, C, or C++. However, VOTE comprises over 10,000 lines of code and over 9,000 lines of data. We are not trying to minimize our productive lifespan.

Researchers at the MIT Artificial Intelligence Lab have developed a LISP-based http server, and made it available to the research community. In the (unsuccessful) process of porting that body of LISP code to our local dialect, we discovered that we could write a simple CGI stub script in C-shell which would then spawn a LISP process. The LISP image (which is nearly 10 MB) already has the VOTE code and data loaded. We use regular HTML forms to solicit parameter choices from the user, and then pipe those into the LISP process using appropriate LISP expressions.

We have modified the LISP code to incorporate HTML tags in the output to improve the form.

Future work includes the following:

- provide a means for users to add new issues, bills, groups, and members. The user could then systematically explore different decision scenarios, varying the goals, levels of importance, and relationships.
- create new decision domains, such as technology investment or PC purchase decisions.

Free Software

The VOTE program, in Common LISP and T, are available via anonymous ftp from is.stern.nyu.edu in /pub/vote or as the URL file://is.stern.nyu.edu/pub/vote/ using a Web browser.

- The README file
- Common LISP source code (a compressed tar file)
- T (Scheme) source code (a compressed tar file)

References

Additional citations as well as on-line versions of selected papers are available at:

http://www.stern.nyu.edu/~sslade/papers/

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