Computational Politics

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Motivation: Computational Politics is the study of political and social phenomena by computational means. Through models of human reasoning processes in conjunction with databases of historical knowledge cast in computationally-compatible representations, we hope to produce viable models of social perception, social reasoning, and social dynamics.

The motivation for this work is twofold: first, political scientists and government analysts, on whom society depends for advice regarding some its most critical matters, need new tools to address the dangers of the twenty-first century. The information that characterizes social and political systems has become so complex that few individuals know everything required to make sound decisions or recommendations. Furthermore, their analyses are rarely quantitative or reproducible. We envision that a computational approach to assisting analysts will allow them to make more responsible and enlightened decisions in the pursuit of policy and national security goals.

Second, we believe that to understand how cognition is grounded in experience, we need to carefully account for the social environment in which people are embedded. In recent years a substantial body of evidence has accumulated which suggests socially-oriented cognitive functions have a significant impact on perception and reasoning. For example, it has been hypothesized [1] that social emotions are a major factor in our ability to reason effectively in under-specified and vague situations. In a similar vein, economists have been increasingly adding 'irrational' cognitive mechanisms to their standard rational-actor models so as to explain social actions in the economic sphere. With these precedents in mind we hope to construct models that establish connections between individual perceptions and social events, thereby gaining a better window into human cognition in general.

Approach: Analogical reasoning [2, 7] forms the core of our approach to these problems. Analogy, as opposed to deduction or induction, is almost certainly the primary mode of creative social reasoning, since it can be brought to bear on problems that are seemingly under-constrained and under-specified. Our research draws upon the significant recent progress that has been made in constructing cognitively plausible representations [4, 6], representations that allow substantial advances in structure-matching, the technique that lies at the heart of analogical reasoning. The Genesis Group at MIT CSAIL, of which we are a part, has developed a prototype system, called the Bridge Project, which integrates these representations and provides a variety of tools, such as an English-language parser, representation-manipulation modules, and specialized GUIs, that facilitate the study of analogical reasoning from this representation-rich viewpoint.

The focus of our research in Computational Politics has been adapting the Bridge Project's infrastructure to analogical problems in the social science domain. This has required an expansion of the vocabulary and expressive power of the Bridge project's semantics and syntax that takes us well past toy problems to real-world issues that analysts struggle with on daily basis. These problems deal with a range of conceptual structures from the socially minute and concrete—why an individual might shoot a gun, or how an individual might cast a vote—to the socially global and abstract—why one nation might attack another, or why the world economy might affect political outcomes, and thus span a range which will allow us to fully test our analogical architecture.

Progress: So far we have made substantial progress toward medium-term goals. Our current organizing goal is that of a *blunder stopper*, an intelligence-processing and policy-analyst tool which would allow near-natural language access to analysis of outcomes of complex sequences of political and policy actions. In pursuit of this goal, we have first significantly expanded our representational vocabulary [5] that allows us to express complex relations of social events. Second, in preparation for work on political precedent finding and precedent matching, we have considerably increased the size and complexity of the precedents that the Bridge system can absorb and store. The following illustrates the sort of political scenario we have so far been able to read and richly represent:

The UnitedStates is a nation; Iraq is a nation; Kuwait is a nation; Iraq wanted Iraq to control Kuwait's oil; Iraq invaded Kuwait because Iraq wanted Iraq to control Kuwait's oil; Iraq was stronger than Kuwait; Iraq defeated Kuwait because Iraq invaded Kuwait and Iraq was stronger than Kuwait; Iraq controlled Kuwait because Iraq defeated Kuwait. The UnitedStates didNotWant Iraq to control Kuwait; The UnitedStates invaded Iraq because the UnitedStates didNotWant Iraq to control Kuwait and Iraq controlled Kuwait; The UnitedStates was stronger

than Iraq; The UnitedStates defeated Iraq because the UnitedStates invaded Iraq and the UnitedStates was stronger than Iraq; The UnitedStates controlled Iraq because the UnitedStates defeated Iraq; The UnitedStates forced Iraq to leave from Kuwait because the UnitedStates controlled Iraq.

This scenario, read by our system, and presented in a graphical form that highlights, in this example, causal connections, appears as follows:

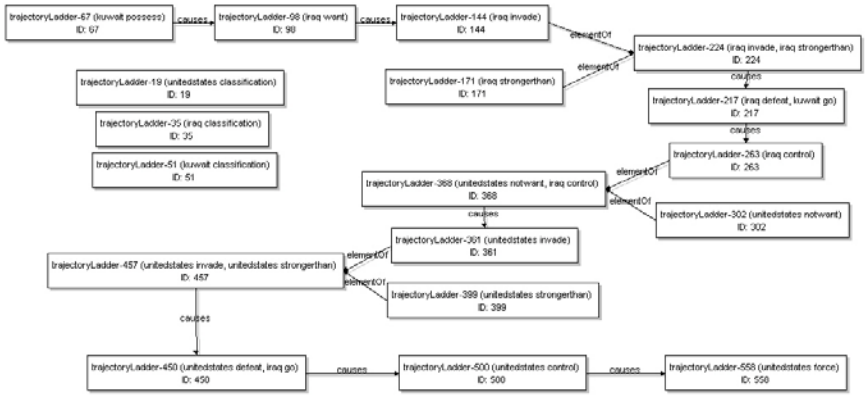

Figure 1: Sample Representation of the Persian Gulf War as Parsed by the Bridge Project

We have also so far built simple, but inspiring, modules for finding precedents and completing patterns, which are the two *sine qua non* in analogical reasoning. Our strategy in building these early modules has been to follow especially the findings of Gentner [3], who argues that we retrieve with properties and exploit with structure. This means that when faced with analyzing a new situation, precedent candidates are retrieved in which the agents have similar types. Then, once we have the candidates, we make use of them by a structure mapping mechanism that maps the way the agents previously have been tied together onto the current situation.

Our precedent finder and pattern completer, just now emerging in early form, differ from the products of previous work in that our modules exploit representations that are grounded in our understanding of human thinking, especially representations of class, trajectory, and change.

Future Work: We plan to increase the size of our database of political scenarios by an order of magnitude. Major effort will be expended on our analogical retrieval and adaptation algorithms toward our mid-range goal of building a viable blunder stopping application. In concert with these more complex algorithms will come more complex graphical displays. Furthermore, significant work needs to be done in conjunction with the Bridge project to develop extensions to our representational suite to give a satisfactory representation of time, hypotheticals, and emotion.

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