COMPUTATIONAL POLITICS AND ECONOMY FOR THE ESTABLISHMENT OF AN INTEGRATED INTELLIGENT GOVERNMENT

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Abstract

This paper aims at covering the following issues: computational approach to social sciences, analysis & reasoning in politics/economy, and the role of electronic technology in governing. The major goal of the first part is to create a new way of thinking about politics and economy, viewing them from a different perspective, not only as humanity disciplines but also considering engineering and computational patterns in these sciences. Next, we focus on designing an Integrated Intelligent Government (IIG) by partitioning a government's structure into different intelligent agents which use diverse knowledge bases and inference methodologies. Finally, we illustrate the role of electronic technology in a novel governing framework from various angles and come up with new ideas in this regard to develop participation, democratization, etc by an International Electronic Government (IEG).

Keywords*: Computational Politics; Integrated Intelligent Government; International Electronic Government.*

1. Introduction

Scientists are trying to develop various methods in computational politics and economy to create an infrastructure for defining political/economic problems and therefore computational solutions for these issues. Due to the potential complexity of these problems for human beings, scientists would like to apply intelligent techniques to see if they can achieve better results in comparison to the human's decisions.

The first problem is the need for more discussions among engineers, scientists, politicians and economists for a common language and understanding. The second problem is that we do not have any unified intelligent system with a defined objective as a high level approach in computational politics. And the third problem is that considering the current applications of electronic technology such as e-forms, e-learning, e-commerce and etc, the other useful applications have not been extended in governmental domains. Hence, the purpose of this paper and our major motivations are to tackle these problems by proposing 1) a new approach in social sciences, 2) an innovation to construct an *Integrated Intelligent Government (IIG)* which refers to a system of intelligent software agents rather than a human government, and 3) novel applications of electronic technology such as *International Electronic Government (IEG)*, *Electronic Consulting System (ECS)* and *Fuzzy Electoral System (FES)* (as detailed in section 4.3). We analyze these ideas from different technical angles and then focus on the benefits of these novelties.

This paper is organized as follows. Section 2 reviews the existing literature on computational politics. Section 3 illustrates a comparison between engineering and social sciences. Section 4 presents a computational approach and demonstrates analysis & reasoning in politics and economy while proposing an Integrated Intelligent Government. The role of electronic technology in a new governing pattern is also described. Finally in section 5, some concluding remarks and a recommendation are provided.

2. Literature review

In this part, the history of computational politics is reviewed in order to form a clear vision of this area, and many interesting political projects with mathematical approaches are referred to.

According to [2], "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". Philip A. Schrodt [1] presents a set of formal approaches for studying the regularities of international political behavior based on studies of human cognition and organizational information processing. He analyzes political decision-making procedures by patterns, rule-based models, machine learning and sequence analysis techniques. Arian Shahdadi [3] concentrates on computational systems that understand decisions by analyzing human decision-making and how human beings are able to understand ideas in abstract realms such as politics. He presents a new representation, the Augmented Decision Rationale Language (ADRL), which focuses primarily on States, Actions and Goals as the basic units of decisions. J. C. Mallery [4] explores foreign-policy decision-making by means of Artificial Intelligent (AI) systems; he also reviews limitations and restrictions of the knowledge-based expert systems and explains a series of issues related to the evaluation of AI

models and the interpretation of their behavior. J. Furnkranz et al. [6] investigate the possible contributions of AI to the avoidance and termination of crises and wars. They apply machine learning techniques for discovering knowledge in international conflicts and conflict management databases. G. Duffy and S. A. Tucker [7] focus on the application of AI in political science; they explain many intelligent models such as "American decision-making during the Cuban missile crisis", "Military expenditures decision making", and etc. Edith and Lane A. Hemaspaandra [8] investigate computation-related results in the study of electoral systems in respect to determining the winner.

On the other side, some scientists are working on mathematical aspects of political events. Michael Alvarez et al. [10] are working on "Caltech/MIT Voting Technology Project". They evaluate the current state of reliability and uniformity of U.S. voting systems and establish uniform attributes and quantitative guidelines for performance and reliability of voting systems. T. R. Gurr, M. G. Marshall et al. [11] are handling The Integrated Network for Societal Conflict Research (INSCR) program, performing research on five major projects. One of them is "State Failure" which discusses the internal wars and failures of governance from 1955 to 2003. They have accumulated many interesting statistical information about all the countries around the world and defined a lot of essential parameters which can be beneficial for any political analysis. Gary King at Harvard University is also working on political methodology, scientific inference, statistical patterns and analysis in political events such as presidential election.

Having mentioned the prior art, it can be clearly seen that these political models have been developed independently without considering the internal relation among them. Therefore, a consistent approach of integrating these frameworks as a whole is required in order to reach more realistic outcomes. This brings about the need of an IIG as a new approach.

3. Engineering versus Social Sciences

An engineering approach refers to a system which applies mathematical methods such as statistics, probability theories, and numerical analysis. The essential concept in all engineering modeling patterns is dynamism. From the mathematical point of view, if a system in a specific time T_1 is in a certain state like S_1 and, after a period of time, in T_2, goes to the state S_2, it means the system is changing according to time and has dynamic behavior. We can model these engineering schemes by various approaches such as differential equations which can model and show instantaneous states of a particular system.

In a decision-making process by human beings, there is a kind of uncertainty, for instant; someone in a specific condition (X) makes one decision (Y_1), while in the same situation someone else, or the same person in another time, makes a different decision (Y_2):

X: *Critical Situation*
Y_1: *Attack against the Opposite Group*
Y_2: *Negotiation with the Opposite Group*

It is not just a matter of time; it is also due to the complexity of the reasoning process in the human's brain which makes it more ambiguous. So the automated decision-making process in the social disciplines like political science is dynamic from the logical point of view; different persons use diverse inference procedures. That is why we can not apply a pure mathematical model and need to create a pattern which is similar to the human brain behavior.

4. Existing Systems and Our Approach

In this section, differences between existing systems and our approaches are illustrated.

4.1. Computational Approach to Social Sciences

Currently, one of the most essential phases of engineering projects is to simulate problems in order to anticipate different possible states. In other words, scientists try to evaluate the result of their systems before applying them in the real world to optimize the engineering system functions and avoid any damages. The important point here is that they usually use statistical information and apply mathematical techniques to achieve this goal. For instance, you can consider computer networks with many servers and clients and a huge flow of data packets among them; simulation in this context is for better network performance.

On the other hand, politicians and economists use past experiences, history and plenty of general rules in social sciences to evaluate and analyze political and economic situations and make decision based on these observations. The significant point here is that, the main pattern of these analyses is totally different from country to country and person to person. There are lots of questions about the role of human's perception in this regard. P. H. Winston and M. A. Finlayson [2] believe our social emotions are a key factor in our ability to reason effectively under specific and vague situations such as political circumstances.

The major goal of this discussion is to create a new way of thinking about politics and economy, viewing them from a different perspective, not only as humanity disciplines but also considering engineering and computational patterns in these sciences. Generally, political events are unpredictable and sometimes chaotic; moreover in some situations we have to guess or make decision in anxiety and hesitation. Therefore, if we want to establish a technical framework we have to use computational models. They are based on the algorithmic procedures and use discrete time, which is more compatible with social sciences, as opposed to continuous time in engineering structures. Also, as a result of the significant deficiency in social sciences, cognitive science can play a positive role in better understanding of politics, economy,

sociology, etc. This science consists of an interdisciplinary study of the structures of human mind; these structures include our perceptual equipments, internal mental processes such as language, thinking, reasoning and problem solving and many other aspects of mind. To create such a framework, firstly we should formulate models that establish connections between individual perceptions and social events and then think about the mystery of the decision-making process in human mind.

Hence, due to the limitations of brain functions such as short memory, speed of computation and detail forgetfulness, design of a computational intelligent analyzer by means of a behavioral model of the brain could overcome these limitations to assist human decisions. On the other hand, a good understanding of human brain perception, analysis and decision-making in social events would result in a better comprehension of the essence of politics itself which may lead to an international consensus and a common understanding. To conclude, we believe creating a joint research area among computer & cognitive scientists, engineers, politicians and economists would improve decision-making in social sciences.

4.2. Analysis & Reasoning in Politics/Economy

Typically, statistical information is useful in economic analysis, e.g. economists use computer simulations to explore the consequences of monetary policy and commodity pricing. But in politics we can not judge based on the general statistical results due to the ambiguity of the context. As we mentioned before, scientists apply computational approaches in political modeling such as the *"Bridge Project"* at MIT as an intelligence-processing and policy-analyst tool which allows, near-natural language, access to analysis of outcomes of complex sequences of political and policy actions [2]. From the technical point of view the following questions come to mind:

- How can we model the behavior of the brain in a political context with similar consequences to the human's decision?
- How can we improve our mistakes in the political decision-making process by designing intelligent systems?
- How can we apply an intricate reasoning to get more accurate decisions owing to power of computers? Etc…

In the next sections, we focus on some of these issues.

4.2.1 A simple prototype for political reasoning. First of all, we consider a hybrid technology to establish a decision-making scheme for an *Intelligent Department, such as foreign ministry, in the government* and then we explain our approach regarding the integration of the different government sections. This system consists of various computational structures such as an intelligent perception component, logical reasoning engine and machine learning methods used for knowledge reinforcement. You can see part of this configuration in Fig. 1 in which after perceiving a problem, we look for the solution in the Knowledge Base (KB) by a reasoning process and then use feedbacks to strengthen and modify our existing awareness.

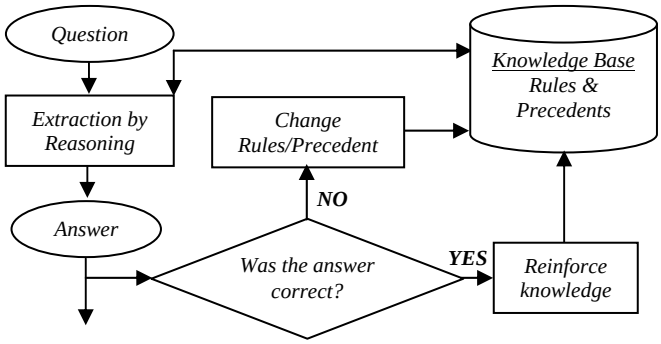

Figure 1. A simple reasoning prototype

One of the essential arguments in a reasoning process is the methodologies which are *"induction"* and *"deduction"*. The former is usually described as moving from the specific to the general, while the latter begins with the general and ends with the specific. Arguments based on experience or observation are best expressed inductively, while arguments based on laws, rules, or other widely accepted principles are best expressed deductively, so we should apply these techniques according to the properties of the problem. Here we would like provide you an example [1] of Rule-based model which is based on deduction reasoning by the procedural knowledge as apposed to the declarative one:

***IF** (X is an ally of Y) **AND** (Y is attacked by Z)*
***THEN** (X will attack Z) **OR** (X mediate for peace)*
"Ally" and *"Attack"* are general concepts

To accumulate such information, we have two approaches: *"Event-Oriented"* which describes sequence of events that occur in that specific situation like crisis and *"Case-Oriented"* which expresses a concept such as conflicts as a whole [9].

4.2.2 Integrated Intelligent Government. We believe there is a considerable gap between the results of the existing political decision-making analyzers and the expected outcomes. There are many reasons like complexity of reasoning procedures, uncertainty of the context, limitation of technology and so on, but researchers have solved lots of these problems during last decade such as computer processor speed while there are still numerous open problems like reasoning in complex context and perfect natural language understanding. Therefore, we would like to decrease this gap from another technical angle which is related to the isolation of issues such as foreign policy, international conflicts, crises and wars, military expenditures, electoral systems in these decision-making frames. In reality all of these matters have strong connection and inevitable impact on each other; we can not generate any comprehensive and consistent knowledge base or reasoning system by this separation while at the same time we should be careful about the relation among them. This is one of the major deficiencies in these systems. On the other hand, human brain

perceives these concepts all together and forms inference based on a unified approach.

For example, an international crisis such as Iran's nuclear program may lead to a long term negotiation or military attack which somehow depends on electoral results: who or which political party is in power? As a consequence, it may also cause fluctuation on the oil price or affect military expenditures and other economic parameters all around the world. On the other side it may form different coalitions, which have effects on the foreign policy of countries. In this example, you can see a lot of complications and dependencies which are results of the human's brain perception, analysis and decision; it demonstrates that we require an appropriate model. Cederman [5] believes behavioral aspects of social systems are the most active research area in agent-based modeling.

To tackle this problem, we would like to propose a more compatible pattern which is a multi-agent representation. If we partition the government's structure into distributed and concurrent intelligent agents, we can then form an *Integrated Intelligent Governing System.* In fact, a multi-agent system is a network of agents that interact to solve problems which are beyond the individual capacities or knowledge of each component while it enhances overall system performance. Multiple agents could speed up a system's operation by a parallel computation; moreover, we can apply intentional notions by assigning attitudes, such as *believe, would like and hope* which is practical for predicting or modeling human ambiguous behaviors. To create such a system, we have to construct various knowledge bases for reasoning process; we can use existing information or statistical data storage and formulate rules by consulting professional politicians and economists while embedding learning features into the framework.

Our proposed prototype is an artificial world populated by agents who are representatives of various ministries such as *Defense, Foreign Affairs, Commerce,* and so forth. They can analyze various political or economy problems in an integrated social network by a global view through autonomous reactions, cooperation, coordination and negotiations similar to human beings. This can be seen as a recovered rational model (Fig. 2) in compare to the existing systems. Human beings can also interact with the decision-making process of the multi-agent framework (IIG) to enhance the performance of the system through an electronic consulting scheme.

One of the key problems here is how to tackle a potential inconsistency among these agents. For instance assume, *Defense Ministry Agent* decides to attack while *Commerce and Foreign Ministries* reject this decision because of the oil price, economy and foreign policy reasons, but they can negotiate a trade-off based on the enormous data analysis and reasoning from a high level vision. It is more similar to the reality which can be a reason for overall achievement of this intelligent schema because in the real world we also have such conflicts among people.

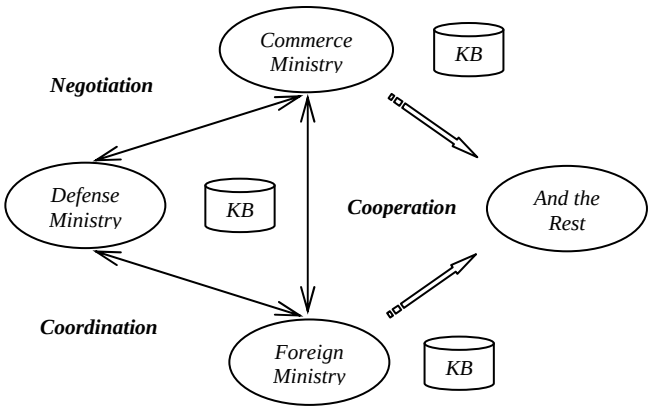

Figure 2. Integrated Intelligent Government

4.3. E-Technology in a New Governing Pattern

At the present time, there are various research projects in electronic technology domain such as e-government, e-learning, and e-banking. Researchers are trying to provide the best electronic services for clients by means of Internet such as online taxation, loan applications and legal actions in different government departments. They are expanding e-services in all aspects of a citizen's ordinary life and also improving the quality aspects by deploying new technologies such as intelligent interactions, semantic web and security.

We would like to create a new insight in statecraft by presenting innovative applications of the electronic technology for extension of liberty and a fair contribution pattern. We intend to change the main structure of the governing system and organize a novel scheme for ruling in the international or national arena and present a new opportunity for the public to experience a real democratic global structure. The question is how we can decrease the role of the president, government administration and political parties by computer technology and create more opportunities for the society and intellectuals to play a direct role in significant international or national decisions and crises. Our major goal is to enrich both our previous approach regarding IIG and also the role of United Nations (UN) as an international organization. In the next sections new applications of e-technology are presented.

4.3.1 International Electronic Government. Today, most of the people in the world have access to computers and the World Wide Web; furthermore, this opportunity is expanding quickly all around the world by new low-priced technologies. Perhaps in the future, through an international resolution we would be able to construct identification profiles for the entire citizens all around the world in UN without harming security or privacy aspects. Our major goal is to develop direct participation, awareness, decentralization of the national governments and convergence among humans to have a peaceful world. Our proposed solution is the foundation of an *International Electronic Government (IEG).* The functionality of IEG is to provide the opportunity for the public to state their

beliefs, participate in international crisis decision-making, ratify international legislations, etc. By this direct contribution, the behavior of the national governments for a superior responsibility can also be monitored in respect to transparency, accountability, human rights and democracy. One main feature of IEG would be an Electronic Consulting System (ECS). This system can receive and process citizens' opinions; it facilitates the globalization process which is meaningless without the involvement of all human beings.

By such an approach we can enhance the role of public while declining the role of statesmen. As a result, we can fashion a multi-polar world and substitute other solutions in preference to war for democracy development. From the other perspective, by an ECS we can supplement the performance of IIG through a Human-Computer Interaction (HCI) scheme.

4.3.2 Fuzzy Electoral System. Our final discussion in this part is how to assign an actual role to each social group based on their values for a real meritocracy regime by using electronic technology. There are various social classes in the society with diverse views, abilities, and educational levels which have different effects on our social lives, but there is no fair polling pattern to develop public participation, democratization, etc.

Our solution is to classify our criteria into different categories and then experience a new *Fuzzy Electoral System (FES)* which assigns a specific weight to the vote of each person according to his/her education, experiences, skills, achievements, job ranking, etc. The context of voting must be applied here as well, whether it is related to educational matters, women's issues or other themes. This is opposed to the traditional approach (Boolean Logic) in which the value of each person's vote is zero or one.

Consequently, we can build a high-quality platform for a fair polling system. Possibly, someone criticizes this idea as a discriminative approach but even uneducated people would like to have a better life from different aspects such as financial situation, democracy, etc. On the other side, mostly in the developing countries political parties try to brainwash the society to get power, this can be prevented by giving more authority to the genius and intellectual persons through FES.

5. Conclusions and Recommendations

Our major intention for this proposal was to construct the main infrastructure of an IIG and investigate some prospective researches in e-technology. We believe there is noteworthy research potential in the computational social sciences; the problem is that most of the people who have been involved in these research projects are political experts rather than engineers or computer scientists. So, we still need more convergence among different research groups and deep technical evaluations of the IIG. We also think electronic technology can affect the international policy and there are lots of other valuable applications in this area which are unknown. For our future work, we aim to extend our research into more technical aspects and implementations.

As a final conclusion, we believe there is a lack of a unified university major which can cover all the concepts stated in our paper, therefore we recommend the foundation of a new discipline: *Government Engineering* which can be extracted from different scientific fields such as, Computer & Cognitive Science, Industrial Engineering, Political Science, Economy and Management to support the public, statesmen as well as global development all around the world. Our main reason for this recommendation is the fact that most developed countries support undeveloped ones financially, while what they most need is the art of statecraft.

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