Preface—From the modeling of social behavior to computational diplomacy

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Preface—From the modeling of social behavior to computational diplomacy

Computational sciences offer an unprecedented way to describe, analyze and understand a vast body of new problems and offers new scientific opportunities. Mathematics is often considered as the "grammar of sciences". Modern computational methods extend the scope of this claim by moving the frontiers from the natural sciences into the realm of the social sciences.

To better understand the world, however, one does not always have to solve equations. Models implementing rule-based behaviors, based on a succession of actions and reactions, are often closer to our intuitive perception of how the universe works than a complicated process of equations solving. Hence, the computational sciences bring a new language to characterize the world around us. They are based on what is often referred to as the "computational thinking" approach, which can be formulated as an attempt to represent phenomena as computational processes among the fundamental entities of a system. Numerical modeling and simulations are obvious examples of computational thinking, particularly well suited to study complex systems, which are quite common in nature.

Modern data science, machine learning and artificial intelligence offer further tools. Data can be used to infer rules, discover patterns and hidden regularities, which adds a lot to our understanding of processes that are not simply governed by the fundamental laws of physics. Therefore, computational science entails very promising methodology to complement the current approaches used in the social sciences.

Our goal is to build a new, open domain of research that we call "computational diplomacy", aimed to apply modern numerical tools and techniques to collect and organize data in the field of International Relations, and more specifically multilateral processes. The purpose of this is to extract knowledge from these data, and provide diplomats, negotiators and researchers with high quality information.

The link between science and diplomacy has gained importance within the past few years. Nowadays, "science diplomacy", "diplomacy for science", "science for diplomacy" and "science in diplomacy" are mentioned in many documents and media. Science diplomacy, or equivalently, science for diplomacy is the idea that science is a soft power that can create bridges between nations and governments, through scientific collaborations and common goals. An institution such as the CERN illustrates this approach.

In contrast, diplomacy for science goes the opposite way: it is the use of negotiations and diplomatic actions to support international collaborations, common infrastructures and joint research programs.

Finally, science in diplomacy is the use of scientific methods to support diplomacy and provide tools and information to help decision makers. Our computational diplomacy initiative is therefore aligned with the objectives of science in diplomacy. We feel that several computer scientists, physicists, mathematicians, researchers in the social sciences and international relations are now ready to address the challenge of using quantitative tools and approaches to better explore and reveal the mechanisms at work in the complex system around us.

For clarity, let us recall that international relations (IR), remain mostly defined as interstates relations, based on the assumption that States represent national interests (political, economic, social, cultural, . . .) beyond the national borders. States are understood as aggregating domestic/national interests and conveying them on the international stage. However, due to the increased complexity of international relations, a consequence both of the doubling of the number of States as component of the international community since 1945 as well as the multiplication of domains of cooperation, the processes governing IR have fundamentally changed and, therefore, the rules, too.

International relations used to focus mostly on issues of war and peace on the one hand and trade on the other. Nowadays, in addition to these traditional fields, it includes (and this is far from exhaustive), disarmament, ecological challenges, finance & banking supervision, health and diseases management, Human Rights protection and promotion, scientific cooperation, etc. In order to manage such complexity, bilateral relations may soon turn out to be impracticable. This is why multilateralism was set up in the end of the first half of the 20th century, and has prospered since. Multilateralism means for States, firstly to accept abiding by a common legal regime for all participants cooperating in a given field, and, secondly, to set-up institutions (International Organizations) for managing and developing the governance issues in this field. This evolution creates a new ecosystem for international relations, in which States' preferences are no longer expressed through a single representative (an Ambassador) to a single partner (another State), but through a myriad of delegates, experts, civil servants, advocates, statisticians, stakeholders, etc, participating in multilateral fora.

This multilateral ecosystem, which developed and bloomed since 1945, has been producing a lot of data. We hypothesize that, by collecting and organizing these existing datasets, computational diplomacy can significantly contribute to the identification of processes and patterns specific to this multilateral complex ecosystem, which will most likely lead to a reappraisal of our understanding of multilateral cooperative processes. However, many IR theories, based on which IR scholars and diplomats are still being trained, date back to pre-multilateralism epoch. This leads to inappropriate understanding of IR processes and inefficient collective behavior, barring humanity from the capacity to provide appropriate collective answers to global challenges.

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A blatant example of such dysfunction is the incapacity of the current organizational social system of a State-based international communities to efficiently tackle the pressing challenges of sustainability. We, therefore, hope that the data-driven approach of computational diplomacy will allow us to capture the genuine complexity of multilateral processes, and help us to overcome the inbuilt limitations of current IR theories that preclude the proper functioning of the multilateral system. A second objective, more prospective, is to analyze various possible scenarios, propose actions to leverage conflicts, and identify early warning signals.

Initiated by the former Swiss president and minister of Foreign Affairs, Ms Micheline Calmy-Rey, the University of Geneva and the ETH Zürich have created a joint research entity, the Science in Diplomacy Laboratory (SiDLab). This serves to develop this research field, in an international and multilateralism perspective, with the hope to favor scientific exchange across different nations and bring to the world a new corpus of knowledge in connection with the diplomatic process. Therefore, computational diplomacy is also expected to play a positive role in the scope of science for diplomacy. So far, the SiDLab has been very welcome by many colleagues in science, and also by several Swiss ambassadors, who judged that the proposed approach is actionable and well aligned with the needs of practitioners.

The location of the SiDLab in Geneva, close to many international organizations and NGOs, is an important asset for the project. It happens that Geneva is one of the main hubs of multilateralism, with 43 International Organizations and some 750 international NGOs operating there on a daily basis. Large States' representation in Geneva may have up to 28,000 staff. This establishes a unique ecosystem, coined as "International Geneva".

This Special Issue on Computational Diplomacy is a first step to initiate building this new field. We have identified a few colleagues that have already produced research work aligned with our objectives: namely, to demonstrate how the scientific progresses in complex systems, statistical physics, graph theory, automatic language processing, time series analysis, multi-agent modeling, high performance computing, etc, provide a powerful methodology to study the ecosystem, in which diplomacy often needs to be deployed.

More precisely, this Special Issue showcases eight contributions, representing an attempt to catalyze the emerging field of scientific diplomacy. They can be divided into two broad categories.

The first three contributions identify some challenges raised by computational diplomacy. Cederman and Girardin [1] offer an overview of the type of problems and possible computational approaches related to several aspects of computational diplomacy. Their application is largely focused on conflict research. In addition to agent-based modeling, spatial computations are proposed for validation with empirical data.

Then, Helbing et al. [2] discuss the recent and dramatic evolution of technological tools and data. Their paper explores how digital tools and data can be used to improve democracy, civic engagement and decision making, and how the diplomatic world is likely to change in response to these new opportunities.

Furthermore, rigorous methodology to observe a system is a central step in building a new research field such as computational diplomacy. In his contribution [3], Cafiero, therefore, proposes a set of tools to respond to several envisioned challenges that computational diplomacy is expected to face: data collection, responsiveness in crisis situation, the management of sensitive diplomatic information, and creation of FAIR data repositories, complying with the FAIR principles (findability, accessibility, interoperability, and reuse).

The remaining five contributions offer to tackle some of these challenges through different angles and present various research agendas. Galam [4], for example, proposes a physics-inspired model of the dynamics and stability of the alliances between countries. Assuming a simple type of interactions between nations, based on history and interest, he elaborates what factors may lead to conflicts and how a super-alliance can help restoring stability.

Thomas Chadefaux [5] derives early warning signals for emerging conflicts from the analysis of various sources of data, such as financial information and diplomatic cables. Recurring motifs can be identified and help monitoring the evolution and the causes of diplomatic disagreements.

Understanding crises such as massive migration or the COVID pandemics are key to finding solutions at the national and international levels. Again, computer simulations offer powerful methodologies if carefully crafted. Along these lines, Groen [6] proposes a generic approach to develop such simulations, with a focus on the quantification of reliability and uncertainty.

A complexity perspective on governance and multilateralism is then discussed by Wernli [7]. It shows how a governance system can be modeled in terms of multi-layered networks and computer-assisted methodology. Furthermore, a new perspective of global multilateralism is offered.

Social interactions and collective group opinions are, of course, an important element that drives international relations. They are considered in Holyst's article [8], through a complex networks and simulation approach. Discontinuous transitions, also referred to as tipping points or catastrophes, are shown to be triggered by a combination of stochastic and deterministic interactions in a social system, and can lead to unexpected and surprising behaviors.

As always, there are certainly additional researchers, whose work could have been covered by this Special Issue. Nevertheless, we believe that this first collection of papers demonstrates several of the promises of computational diplomacy. We also hope that it will stimulate the creation of a wider community that will concentrate its effort on developing this new and interdisciplinary field further.

The editors are grateful to the authors who contributed to this first Special Issue in Computational Diplomacy, a corner stone of a new academic field, with obvious significance for our entire society. We also want to extend our gratitude to the reviewers who helped improving this set of articles, and to the foundation that made this project possible. Finally, we thank as well the editorial board of the Journal of Computational Sciences for its enthusiastic support throughout this endeavor.

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