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PREFACE: KEY STRATEGIES TO ADDRESS ARGUMENT AND COMPUTATION

The problems lying at the intersection between argumentation theory and computer science constitute the subject of an intensive inquiry undertaken within the recent study of reasoning and argument. The label "Argument and Computation" characterizes the field of inquiry undertaken by the nascent research movement which has developed during the past decade.[1] The development of this movement may be illustrated by the growing activity of numerous research groups, the establishment of specialized journals, and the increasing number of monographs, conferences and workshops. Some logicians, argumentation theorists and computer scientists working in this area (see e.g. Walton & Godden, 2006; Reed & Grasso, 2007) highlight the fact that the inquiry into the overlap between argumentation theory and computer science is mutually beneficial for both disciplines:

- on the one hand, argumentation theory has brought valuable insights into the nature and structure of common sense reasoning; those insights turned out to be particularly important for building models of defeasible reasoning in Artificial Intelligence (see e.g. Rahwan & Simari, 2009);
- on the other hand, computer science, as applied to the study of argument, provided a wide range of software tools that are implemented in analyzing the structure of arguments; the key procedures which are particularly useful in accomplishing such tasks are recognizing typical argumentation schemes (see Walton, Reed & Macagno, 2008) and applying argument diagrams as tools of representing the structure of arguments (see e.g. Reed, Walton & Macagno, 2007).

[1] *Argument and Computation* is the name of the journal published by Taylor & Francis. The first issue appeared in 2010. For the motivation of the journal see (Grasso et al., 2010).

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The present editorial initiative is a step towards publishing the series of volumes of the journal *Studies in Logic, Grammar and Rhetoric* devoted to the major research areas in the current study of argumentation. The first volume of this kind appeared in 2009 under the title *Informal Logic and Argumentation Theory* (vol. 16(29)). It was aimed at sketching the map of major research initiatives and approaches to argument from the 1970s to this day. This journal issue intends to give a representative sample of crucial strategies of an inquiry into the intersection between argumentation theory and computer science. Among other tasks, it discusses the implementation of formal-logical tools in representing and analyzing the structure of arguments. Such tools constitute a keystone for building computational models of argument, which are indispensable in designing computer programs employed in argument diagramming and agent communication scenarios in Artificial Intelligence. The models of argument are also discussed in the broader context of applying argumentation theory and computer science in analyzing social discourse.

In order to realize the tasks of this special issue, as sketched above, the papers of the volume discuss:

- the state of the art of inquiry into the overlap between argumentation theory and computer science;
- the applications of the systems of logic in building tools for argument analysis and evaluation;
- the implementation of argumentation systems (such as Carneades) in the study of Artificial Intelligence;
- the implementation of some ontologies for argument (such as Argument Interchange Format) as instruments providing a universal language that allows unifying various approaches to argument;
- the tools (such as model checker Perseus) for measuring the quality of persuasion dialogs;
- deductive and defeasible inference rules;
- argument schemes and diagrams;
- Internet as an instrument of argument interchange.

The authors represent major research centres and communities focusing on the study of argument. Among the contributors there are the representatives of:

- the Centre for Research in Reasoning, Argumentation and Rhetoric (CRRAR), University of Windsor, Canada;
- the Amsterdam School of Pragma-Dialectics, Department of Speech Communication, Argumentation Theory and Philosophy, University of Amsterdam and the International Learned Institute for Argumentation Studies (ILIAS), Amsterdam;

- Argumentation Research Group (ARG), School of Computing, University of Dundee, Scotland;
- the research group Argumentation, Décison, Raisonnement, Incertitude et Apprentissage (ADRIA), Institut de Recherche en Informatique de Toulouse (IRIT), Toulouse, France;
- Labóratorio de Argumentaçao (Arg Lab), Institute for the Philosophy of Language (IFL), Universidade Nova de Lisboa, Portugal;
- the PERSEUS research group (Persuasiveness: Studies on the Effective Use of Arguments), University of Cardinal Stefan Wyszyński in Warsaw and Białystok University of Technology, Poland;
- Group of Logic, Language and Information (GLLI), Opole University, Poland;
- Institute of Computer Science, Warsaw University of Technology, Poland;
- Faculty of Law, University of Białystok, Poland;
- Chair of Logic, Informatics and Philosophy of Science, University of Białystok, Poland.

The papers of the volume point to two major problems:

1. what kinds of formal tools are applied in designing computational models of argument?
2. what kinds of tools of argumentation theory are employed in representing the structure of everyday arguments?

The overview of the research field lying at the intersection between argumentation theory and computer science is presented in the paper authored by Chris Reed and Marcin Koszowy. The paper discusses the origins of the research movement, main research centers, nascent communities, monographs, articles, dedicated journals, research grants, and the possible directions of the further development of the community. The article highlights the relationship between the efforts towards building computational models of argument and the logical studies carried out in the tradition of the Lvov-Warsaw School (LWS) – the Polish philosophical movement which flourished between 1918 and 1939. Some similarities between the two traditions are exemplified by the case of Mizar – the natural deduction system of Multi-Sorted predicate logic with Equality (MSE) which simulates the language of proofs in a simplified and standardized form, adjusted to computer processing.

The paper authored by Floris Bex and Chris Reed constitutes a systematic account of the applications of the Argument Interchange Format (AIF) – a common ontology for argument – in representing various structures of arguments. One of the goals of this research is to include within

the computational model of argument not only deductive inference schemes, but also the defeasible ones. This part of the work is of crucial importance in modeling natural language arguments, in which defeasible inferences are performed. The paper discusses the applicability of argumentation scheme theory as a tool which allows taxonomizing and classifying typical patterns of reasoning. Some analyses are based upon Henry Prakken's observation that some argumentation schemes are in fact generalized inference rules (see Prakken 2010). As given examples show, the AIF is an efficient tool for representing schemes of: (a) inference (such as Defeasible Modus Ponens or Witness Testimony), (b) conflict, and (c) preference.

In the next article which is also devoted to taxonomizing arguments, Kazimierz Trzęsicki puts forward a classification of arguments upon which the method for designing argument diagrams is built. The development of Information and Communication Technologies and their implementation in Artificial Intelligence is considered as a stimulus for applying some formal tools in the study of arguments expressed in natural language. The proposed account of argument as a pair of nonempty sets of propositions embraces the intuitive notion of argument involved in natural language discourse. This approach to argument constitutes a point of departure for proposing the classification of arguments. Propositions are characterized by their relation to a system of knowledge. The types of relations between the sets and the type of propositions being the members of the sets constitute a basis for classifying arguments. Three main relations are discussed: direction of argumentation, direction of entailment, and direction of justification. Classification of arguments constitutes the groundwork for representing a variety of natural language arguments by means of argumentation diagrams. The introduced method of argument diagramming is an efficient tool in grasping various kinds of inferences, e.g. deductive, inductive, and analogical.

Another set of instruments for representing arguments are formal models of persuasive communication. The following two articles are dedicated to the applicability of formal tools in analyzing and evaluating persuasion dialogs. Leila Amgoud and Florence Dupin de Saint Cyr examine the quality of dialogs, the goal of which is persuading agents to change their minds on a given state of affairs. Three types (*families*) of criteria for evaluating persuasion dialogs are proposed: (1) measures of the quality of arguments, (2) measures concerning the components of agent's behavior (such as *coherence*, *aggressiveness* and the *novelty* of arguments), (3) measures of the quality of the dialog; the discussed criteria of evaluating a dialog's quality are *relevance* and *usefulness* of dialog moves. For each type of a persuasion dialog, the *ideal dialog* is computed. The ideal dialog is conceived as a con-

cise sub-dialog. The quality of a given persuasion dialog is the higher the closer it is to its ideal sub-dialog.

The article authored by Katarzyna Budzyńska and Magdalena Kacprzak is another attempt at modeling persuasion dialogs formally. Persuasion dialog – a typical kind of inter-agent persuasive communication – starts with a conflict of opinion. The goal of resolving the conflict of opinion is to cause the change of agents' beliefs or commitments. The model checking technique is applied to examine the main properties of inter-agent persuasive communication. A Logic of Actions and Graded Beliefs $\mathcal{AG}_n$ is discussed as a basis upon which the model checker Perseus was designed. The authors examine the applications of Perseus in the semantic verification of $\mathcal{AG}_n$ formulas. Two kinds of procedures are performed by the system: (a) the system checks if a given $\mathcal{AG}_n$ formula is true in a given model (the standard model checking method); (b) the system searches for answer to a question concerning a given property of persuasion in a multi-agent system (the parametric verification method).

The next two contributions to the volume are devoted to the applicability of the Carneades Argumentation System in argument analysis. Carneades is an Open Source argumentation software application and library, which is employed, amongst other tasks, in argument construction with OWL ontologies and defeasible rules, calculating the acceptability of conclusions, argument mapping and visualization, goal selection, and argument interchange in XML using the Legal Knowledge Interchange Format (LKIF) (see e.g. Gordon & Ballnat, 2010). In his paper, Douglas Walton applies Carneades in the study of refuting arguments. The system is utilized to analysing cases of argument attack, challenge, critical questioning, and rebuttal. The paper clarifies the meaning of such terms as 'attack', 'rebuttal', 'refutation', 'challenge', 'defeater', 'undercutting defeater', 'rebutting defeater', 'exception', and 'objection'. A seven step procedure for seeking a refutation or objection is introduced.

The paper authored by Paweł Łoziński also contains the idea of applying Carneades in argument analysis. After giving a characteristic of Carneades, the author proposes a method of incremental analysis of arguments. Incremental analysis is confronted with argument analysis within Carneades. Whereas the method employed within Carneades relies on the search for arguments pro and con the given goal and building argumentation graph, the method of incremental argument analysis proposed by Łoziński is based on the search algorithm for choosing the exploration paths. The rationale for introducing the new method of argument analysis is given.

Edward Bryniarski, Zbigniew Bonikowski, Jacek Waldmajer, and Ur-

szula Wybraniec-Skardowska postulate protocols concerning information networks, real interactivity systems and administering knowledge in such systems. Within the proposed account, protocols define the rules of building real dynamic epistemic logics and approximated semantics for these logics. This task is realized by employing epistemic operators related to types of communicating acts. The logical relationships related to the use of the epistemic operators are illustrated by a diagram called the square of epistemic operators. The logical relationships described within the diagram constitute the point of departure for introducing axioms for real dynamic epistemic logics. The authors extend the semantics of real dynamic epistemic logics by proposing methods of lower and upper approximation of evaluation of formulas. On the basis of those methods the 'approximation Kripke models' are defined. Some applications of the proposed tools in argument use are discussed.

The next two articles make use of Pragma-Dialects as a tradition which developed tools applicable to the inquiry into the intersection between argumentation theory and computer science. The paper authored by Jacky Visser, Floris Bex, Chris Reed, and Bart Garssen is the result of cooperation between the researchers from the Amsterdam School of pragma-dialectics and the Argumentation Research Group (ARG) (University of Dundee). It offers an original connection of two kinds of tools of argument analysis and evaluation, i.e., the Argument Interchange Format (AIF) designed by the representatives of the ARG and the pragma-dialectical model of critical discussion developed by the Amsterdam School. The pragma-dialectical model of argumentation has found so far numerous applications in the various branches of inquiry into language, reasoning and argument. The authors seek for another significant application of this model, which has not been systematically examined yet. The formalized approach to the pragma-dialectical model of a critical discussion is introduced. This account is in accord with the core research in the intersection between argumentation theory and computer science, which is of particular importance for the research in Artificial Intelligence. In order to deal with arguments computationally, at least part of models of arguments needs to be represented by means of the formal tools. The paper treats the pragma-dialectal model as a point of departure for designing a dialogue protocol which allows agents to play out a dialectical game in order to test the tenability of one agent's standpoint. Within the proposed account, the AIF allows the translation of a dialogue protocol in terms of its core ontology. The core ontology provides a directed graph data structure which allows for representing arguments. The AIF is treated as a universal language unifying various argumentation frameworks. Two-

fold benefits of this approach are indicated: (a) the possibility of building a normative natural language discussion model; (b) the possible implementation of the formal approach to the pragma-dialectical discussion model in an inquiry into the overlap between argumentation theory and Artificial Intelligence.

In the article which combines the tradition of pragma-dialectics with computer science, Marcin Lewiński introduces the concept of dialectical trade-offs in an argumentative discourse. Dialectical trade-offs are defined as clashes between different dialectical rules stipulated in the ideal models of argumentation, that arise in actual circumstances. The paper provides methods of dealing with the dialectical trade-offs in designing protocols for computer-mediated deliberation. The paper gives reasons for placing dialectical trade-offs on the map of the crucial fields of inquiry into the overlapping fields of argumentation theory and computer science. Lewiński makes use of the key concepts elaborated within the pragma-dialectical model of critical discussion, in particular the concept of strategic manoeuvring in an argumentative discourse. Derailments of strategic manoeuvring are discussed in terms of the choice between the good and the bad. In the context of applying the language and methods of pragma-dialectics, the nature of dialectical trade-offs is examined. Finally, loose protocols vs. formal systems for computer-aided argumentation are discussed. The proposed account of dialectical trade-offs is designed as a new tool which allows identifying and eliminating dialectical trade-offs spotted within the internet discussion forums.

The transformations of the methods of discussion in the network society are discussed by Karolina Stefanowicz, who delves into the topic of the impact of information technology on the communication process. In particular, social media are examined in terms of the new networking tools. Possible applications of the 20th century philosophical conceptions of public sphere in developing methods of analysing new tools for social communication are considered. The author characterizes the consequences of using main tools of the new social dialogue and the consequences of its use. The opportunities and threats of applying new tools of communication are examined.

From what has been presented above, the efforts of joining various research perspectives and approaches to argument and reasoning are noticeable within the recent strands of inquiry into the overlap between argumentation theory and computer science (esp. Artificial Intelligence). I owe special thanks to Chris Reed, Robert Kublikowski, Rafał Lizut, Kazimierz Trzęsicki, Dariusz Surowik, and Ewa Wasilewska-Kamińska for their valuable comments on this volume.

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