3rd Summer School on Argumentation: Computational and Linguistic Perspectives

Warsaw, Poland

6th—10th September 2018

3rd Summer School on Argumentation:
Computational and Linguistic Perspectives

The School is organized by:

International Center for Formal Ontology, Faculty of Administration and Social Sciences, Warsaw University of Technology

Bialystok University of Technology

Institute of Philosophy, University of Warsaw

Institute of Informatics, University of Warsaw

Graduate School for Social Research (GSSR),

Institute of Philosophy and Sociology, Polish Academy of Sciences

ArgDiaP

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Magdalena Kacprzak

First published 2018

Contents

Preface

We are happy to present you with the proceedings of the Summer School on Argumentation: Computational and Linguistic Perspectives (SSA 2018) held on September 6—10 in Warsaw, Poland. It was the third event in the series of Summer Schools on Argumentation. The first Summer School on Argumentation took place at the University of Dundee in 2014 in the UK, the second took place at the University of Potsdam in 2016 in Germany.

The main aim of SSA 2018 is to provide attendees with a solid foundation in computational and linguistic aspects of argumentation and the emerging connections between the two. Furthermore, attendees gain experience in using various tools for argument analysis and processing, including hands-on experience and practical tasks.

The school consisted of tutorials from leading academics in argumentation and linguistics. You will find tutor's descriptions and tutorials' abstracts in this book. Moreover, SSA 2018 covered the Student Session which consisted of contributed talks and mentoring session (which allows students for meeting with a mentor and discussing their submissions in more details). Students presented their PhD projects addressing issues related to argumentation, dialogue and persuasion. Extended abstracts of the accepted submissions are printed in this book.

SSA 2018 was a part of Warsaw Argumentation Week (consisting of COMMA 2018, themed COMMA workshops, and the 16th ArgDiaP conference and MET-ARG and MET-RhET workshops).

Bartłomiej Skowron (SSA chair)
Magdalena Kacprzak (SSA co-chair)
Paweł Łupkowski (Student Session chair)

Warsaw/Bialystok/Poznan August 2018

Dear SSA Participant,

Welcome to the Warsaw Argumentation Week, WAW 2018 (6—16 Sept 2018)—a series of events dedicated to a variety of aspects, dimensions and approaches to argumentation. Its aim is to provide a platform for discussion between researchers representing the wide range of disciplines who try to understand this crucial, fascinating, yet extremely difficult, communication phenomenon.

The WAW series combines events associated with COMMA (Computational Models of Argument) and ArgDiaP (Argumentation, Dialogue, Persuasion). COMMA gathers a large international academic community interested in computational aspects of argumentation. Originated from the ASPIC project and initiated in 2006 in Liverpool, the COMMA conferences have been organised successfully every two years. Since 2014 COMMA has been collocated with the Summer School on Argumentation (SSA) and since 2016—with themed COMMA workshops. ArgDiaP is a Polish nationwide initiative dedicated to the issues of argumentation, dialogue and persuasion. Established in 2008, ArgDiaP has been continuously providing infrastructure facilitating the networking process and fostering research on argumentation in Poland, including the research of the Polish School of Argumentation. The organisation pursues its goals through several activities such as conferences, workshops, publications and summer schools.

Warsaw Argumentation Week opens with an event for the youngest generation of argumentation researchers. The 3rd Summer School on Argumentation aims to provide attendees with a solid foundation in computational and linguistic aspects of argumentation and the emerging connections between the two.

WAW 2018 comprises in total eight events:

- the interdisciplinary 3rd SSA graduate school (6—10 Sept);
- three COMMA workshops (11 Sept) on formal argumentation, argumentation & society, and argumentation & philosophy;
- the 7th COMMA conference (12—14 Sept);
- two workshops coorganised by ArgDiaP and the Polish Rhetorical Society (15 Sept) on legal argumentation, and rhetoric; and
- the 16th ArgDiaP conference (15—16 Sept) on "Argumentation and Corpus Linguistics".

Warsaw Argumentation Week is hosted by a number of academic institutions and departments in Warsaw and is coordinated by several researchers from Poland: the Polish School of Argumentation in cooperation with our colleagues from Germany and the UK.

We hope you will enjoy your stay in Warsaw and your participation in WAW!

Katarzyna Budzynska (WAW chair)

Warsaw August 2018

Programme

Thursday 6th Sept

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09:15–09:30 Welcome

09:30–11:00 Introductory Tutorial 1: Michał Araszkiewicz, *Introduction to argumentation theory across disciplines: AI and law*, Marcin Koszowy *Introduction to argumentation theory across disciplines: Philosophy and rhetoric*

11:00–11:20 Coffee break

11:20–12:50 SSA Tutor 1: Manfred Stede *Argumentative Microtexts: A multi-layer and multi-purpose corpus for theoretical and applied studies of argumentation*

12:50–14:10 Lunch break

14:10–15:40 Student Session I

15:40–16:00 Coffee break

16:00–17:30 Student Session II

18:00 Welcome to Warsaw (sightseeing tour)

Friday 7th Sept

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09:30–11:00 Introductory Tutorial 2: Katarzyna Budzynska, *Introduction to argumentation theory across disciplines: Computer science and computational linguistics*, Kamila Debowska-Kozlowska *Introduction to argumentation theory across disciplines: Linguistics and psychology*

11:00–11:20 Coffee break

11:20–12:50 Warsaw Tutor 1: Barbara Dunin-Kęplicz, Andrzej Szałas *Realistic models of beliefs in a paraconsistent and paracomplete setting*

12:50–14:10 Lunch break

14:10–15:40 SSA Tutor 1: Manfred Stede *Argumentative Microtexts: A multi-layer and multi-purpose corpus for theoretical and applied studies of argumentation*

15:40–16:00 Coffee break

16:00–17:30 SSA Tutor 2: Tim Norman *Argument in Human-Agent Teams*

18:00 Welcome Reception

Saturday 8th Sept

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09:30–11:00 SSA Tutor 2: Tim Norman *Argument in Human-Agent Teams*

11:00–11:20 Coffee break

11:20–12:50 Warsaw Tutor 2: Dariusz Kalociński *Modelling semantic negotiation*

12:50–14:10 Lunch break

14:10–15:40 SSA Tutor 3: Floris Bex *Evidential and Legal Reasoning in AI—the role of argumentation*

15:40–16:00 Coffee break

16:00–17:30 SSA Tutor 4: Jean Goodwin *Argumentative dialogues without dialogue types*

Sunday 9th Sept

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09:30–11:00 SSA Tutor 3: Floris Bex *Evidential and Legal Reasoning in AI—the role of argumentation*

11:00–11:20 Coffee break

11:20–12:50 Warsaw Tutor 3: Dominik Sypniewski *Argumentation in practice: negotiating the legal conditions of real estate contracts*

12:50–14:10 Lunch break

14:10–15:40 SSA Tutor 5: Martín Pereira-Fariña *Introduction to R for argument mining*

15:40–16:00 Coffee break

16:00–17:30 Mentoring Session

18:00 Social Dinner

Monday 10th Sept

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09:30–11:00 COMMA Tutor 1: Francesca Toni *Machine arguing: theories, systems and applications*

11:00–11:20 Coffee break

11:20–12:50 SSA Tutor 4: Jean Goodwin *Argumentative dialogues without dialogue types*

12:50–14:10 Lunch break

14:10–15:40 SSA Tutor 5: Martín Pereira-Fariña *Introduction to R for argument mining*

15:40–16:00 Coffee break

16:00–17:30 COMMA Tutor 2: Marcello D'Agostino *Depth-bounded reasoning and formal argumentation*

Tutors

Introductory Tutorial 1

Michał Araszkiewicz PhD (Legal Theory, 2010)—post-doc in the Department of Legal Theory at the Faculty of Law and Administration of the Jagiellonian University (Poland). The President of the ArgDiaP Association. Member of the Executive Commitee of International Association for Artificial Intelligence and Law (IAAIL). He has published more that 50 journal papers, monograph chapters and refereed workshop papers on legal theory, AI and Law, argumentation, legal epistemology, economic analysis of law, dispute resolution. PhD student at the Faculty of Philosophy, Co-editor of three contributed Springer volumes. Legal advisor (member of the Bar Council in Kraków).

Tutorial: *Introduction to argumentation theory across disciplines: AI and law*

The subject of the tutorial is the modeling of legal argumentation by means of formal and computational tools. We will investigate to what extent legal argumentation may be represented in an algorithmic manner and what are the current possibilities in this respect. The point of departure will be given by classical legal syllogism and then we will investigate how tools developed in the field of AI and law such as rule-based systems, argumentation frameworks, and argumentation schemes may be fruitfully applied to cover different aspects of legal reasoning. In the final part, we will consider the application of Machine Learning tools to the subject in question.

Marcin Koszowy is Assistant Professor in the Department of Philosophy and History of Law at the University of Białystok (Poland), postdoctoral researcher in the Institute of Philosophy and Sociology of the Polish Academy of Sciences, and member of the Centre for Argument Technology (ARG-tech). His research interests cover argumentation and dialogue, arguments from authority in deliberative discourse and in legal argumentation, dialogical ethos, and argument mining. Marcin serves as deputy president of the ArgDiaP Association that coordinates the activities of the Polish School of Argumentation. He has published 30 peer-reviewed papers, co-edited 6 special journal issues, and delivered 15 invited talks in Canada, Poland and Portugal.

Tutorial: *Introduction to argumentation theory across disciplines: Philosophy and rhetoric*

The aim of the tutorial is to give an overview of the wide range of philosophical and rhetorical tools and conceptual frameworks that are nowadays employed in the study of the complex phenomenon of argumentation. There are three disciplines which elaborated such tools: philosophy of argumentation, philosophy of language, and rhetoric. Philosophy of argumentation, amongst other tasks, allows us to study logos, i.e. argument structures and schemes. Next, philosophy of language may allow us to capture main features of argumentative speech acts such as illocutionary communicative intentions that link dialogue with argumentation. Finally, rhetoric may be helpful in enriching the description of inferential argumentation schemes (*logos*) with the characteristics of those communication structures that are related to the character of the speaker (*ethos*), including ethos supports and attacks, as well as the role of emotions in argumentation (*pathos*). A combination of these tools in argument studies may constitute a coherent ecosystem of philosophico-rhetorical devices allowing us to make sense of largescale argumentative texts in the different communication genres such as e.g. political debates, argumentation in the courtroom, and citizen dialogues.

Introductory Tutorial 2

Katarzyna (Kasia in short) **Budzynska** is an associate professor (senior lecturer) in the Institute of Philosophy and Sociology of the Polish Academy of Sciences (Poland), and a lecturer & Dundee fellow at Computing at the University of Dundee (UK). Her work focuses on communication structures of argumentation, dialogue and ethos. She is a member of the Centre for Argument Technology (ARG-tech) and a head of Computational Ethos Lab (CELab) which develops technologies for extracting, processing and visualising the information about the character of speakers. Budzynska has published 2 books and over 70 peer-reviewed papers, amongst which 19 appeared in international journals such as "Artificial Intelligence", "Argumentation" and "ACM Transactions on Internet Technology". In 2008, she co-founded, and has since then, coordinated the activities of a nationwide initiative ArgDiaP the main goal of which is to support the cooperation of representatives of the Polish School of Argumentation.

Tutorial: *Introduction to argumentation theory across disciplines: Computer science and computational linguistics*

In this tutorial, I will present recently rapidly growing area of argumentation in computer science and computational linguistics—argument mining. It is built upon text mining which provides techniques and methods for automated extraction of information from texts in natural language. The expansion of text mining is a response to the problem of Big Data, i.e. the problem of data being produced faster than we can process it.

More specifically—what can we mine? In sentiment analysis, we mine attitudes (positive, neutral, negative) towards something, e.g. we try to identify on Internet fora a number of people who like a new Mercedes vs. a number of people who does not like new Mercedes (application: stock market). In opinion mining, we mine people's opinions about products, e.g. people can think new Mercedes is too expensive or people can think new Mercedes is reliable (application: media analysis). The new area of argument mining allows for recognising not only what opinions people hold, but also why they hold them, e.g. people can think that new Mercedes is too expensive, because other cars from the similar class cost significantly less.

Kamila Debowska-Kozlowska is Assistant Professor in the Department of Pragmatics of English at the Faculty of English at Adam Mickiewicz University in Poznań (Poland). She works on argumentation and persuasion from the perspective of experimental, cognitive, affective, linguistic and social pragmatics. She has published in top journals such as Argumentation and has given talks on her research in The Netherlands, Norway, Switzerland, UK and Australia where she has cooperated with other researchers in argumentation and cognitive linguistics. She is a member of a nationwide initiative ArgDiaP that supports the cooperation of representatives of the Polish School of Argumentation. She is a co-organiser of Warsaw Reasoning Week that will take place in Warsaw, Poland in September 2018.

Tutorial: *Introduction to argumentation theory across disciplines: Linguistics and psychology*

This tutorial focuses on the psycholinguistic aspect of the studies on persuasion. The focal point of the talk is the concept of attitude defined as a global favourable, unfavourable or neutral evaluation of an attitude object (e.g. a social issue). The role of pathos (i.e. emotional reactions) in the generation and modification of an attitude is unravelled on the basis of the symbolic and ideological approach. The tutorial explains why an attitude system comprises beliefs, emotions, values, intentions to behave and describes the links between those elements. Persuasion models are presented that clarify how a conflict between internal attitude elements might enhance or hamper persuasive attempts. External aspects of an attitude change such as ethos (i.e. persuader's credibility) and pathos (i.e. emotional message appeals) and their relation to internal cognitive elements of an attitude are also pursued. Direct and indirect attitude measurement techniques in psycholinguistic research are discussed. Basic principles of research design on attitude change are explained (e.g. controlling the confounding variables) and the implementation of a computerized experiment that measures attitudes in the E-Prime software (i.e. constructing an experiment, pilot testing, formal data collection) is shown.

SSA Tutor 1

Manfred Stede is a professor of Applied Computational Linguistics at the University of Potsdam (Germany), where he directs the Discourse Research Lab. His work revolves around different aspects of discourse structure, and in recent years has focused on the manual and automatic annotation of argumentative structures. Much of this work used the "argumentative microtext corpus", which is a collection of short texts that have been annotated on a variety of different layers and thus allow for studying argumentation from different angles. Other current research projects investigate the role of discourse connectives for shallow discourse parsing, and the differences in creating coherence in spoken versus written language, and with social media as an in-between mode.

Tutorial: *Argumentative Microtexts: A multi-layer and multi-purpose corpus for theoretical and applied studies of argumentation*

In this tutorial, we first introduce an annotation scheme for the structure of argumentation in texts, and students will practice with annotating sample texts, which offer different kinds of difficulties. We then turn to the task of building these structures automatically and present two different technical approaches for doing so. Finally, we look "beyond" the bare tree structures that represent the argumentative relations (different kinds of support and attack) between units, and we consider additional layers of annotation that enrich the explanatory power: argumentation schemes, implicit assumptions, and certain semantic aspects of the textual units.

SSA Tutor 2

Tim Norman is Professor of Computer Science and Head of the Agents, Interaction and Complexity Group at the University of Southampton (UK). He read Electronic and Electrical Engineering at University of Wales, Swansea, then graduated in 1997 with a Ph.D. in Computer Science from University College London in the area of AI planning and scheduling. In 2000 he organised (with Chris Reed) the Symposium on Argument and Computation in Pitlochry, Perthshire, which brought together experts from across philosophy, law, logic, linguistics and computer science to explore and develop interdisciplinary research across these fields, and made some small contribution to the establishment of the COMMA series of conferences and the Argument and Computation Journal. His research interests in this area include the formal characterisation of imperatives, communicative norms, and models of deliberative dialogue. More recently he has been working with professional analysts to explore how representations of defeasible inference and the use of automated reasoning methods can support analyst teams where judgements entail a high risk of error in decision making. One important aim of this work is to develop community-driven open-source tools for the use of argumentation in real-world applications; see www.cispaces.org.

Tutorial: *Argument in Human-Agent Teams*

A key aim underpinning the development of computational models of argument is to build systems that are effective in support of human interaction and decision-making. Achieving this certainly depends upon an understanding of how people argue and how computational models reflect good argumentative reasoning. Equally, however, we must understand how tools based on these insights have impact on individual and group behaviour. In this tutorial, I will explore the potential for argumentation-based models in support of human-agent teams. Support both for dialogue and for reasoning will be considered, and we will have a hands-on session with a tool developed for intelligence analysis (CISpaces).

SSA Tutor 3

Floris Bex is Professor of Data Science and the Judiciary (TILT, Tilburg University, Netherlands) and Assistant Professor Intelligent Systems (ICS, Utrecht University, Netherlands). He is interested in how people reason, how this reasoning can be captured in formal models and how it can be supported and improved using AI technologies. His main area of investigation are the computational, philosophical, linguistic and legal aspects of argumentation, linking mathematical models with more natural representations of argument and discourse. Floris is keen to improve argumentation practice by developing tools that can be used to analyse and make transparent complex reasoning involving (big) data. His main application area concerns legal & forensic reasoning.

Tutorial: *Evidential and Legal Reasoning in AI—the role of argumentation*

There are many techniques in the broad field of Artificial Intelligence that focus on legal decision-making, legal reasoning and reasoning with legal evidence. For example, statistical algorithms have been proposed to predict decisions by judges in the European Court of Human Rights, and Bayesian Networks have been applied to reasoning with legal evidence. The question we will ask ourselves during the tutorial is: what is the role of argumentation? Are arguments necessary, and are computational techniques based on argumentation useful? We will explore these questions through hands-on exercises in which we will study and model the arguments in different legal cases.

SSA Tutor 4

Jean Goodwin is SAS Institute Distinguished Professor of Communication at North Carolina State University (US), and a member of the Leadership in Public Science cluster. Her work is in rhetoric, focusing on civic argumentation and in particular on the communication of science in policy controversies, on the normative dimensions of arguing, and on the reasonableness of taking an expert's statements on trust. Goodwin received her bachelor's degree in mathematics and her J.D. from the University of Chicago, and her Ph.D. in communication arts from the rhetoric program at the University of Wisconsin-Madison. Her essays have been published in international journals in communication, philosophy and the sciences. She has served as a consultant on initiatives by the American Association for the Advancement of Science and the Union of Concerned Scientists to define the appropriate roles of scientists as advocates.

Tutorial: *Argumentative dialogues without dialogue types*

Pragmatic theories model argumentation as dialogues among agents in which standpoints are advanced and challenged. These theories encourage us to shift attention from formalizations of (informal) logics to formalizations of social practices. One common approach assumes that dialogues come in types determined by goals, having rules that ensure the goals will be reached. This presentation lays out an alternative approach—one that does not invoke dialogue types, common goals or pre-established rules. According to the normative pragmatic program, the orderly exchange of arguments is an achievement of the agents themselves; it is designed. In particular, agents create local norms governing their interaction by taking on carefully tailored responsibilities for what they are saying. We will consider two paradigm cases: how experts give their utterances authoritative force, and how advocates create circumstances in which their proposals will receive serious consideration. In addition, we will test out the the normative pragmatic approach by applying it to ordinary argumentative discourse.

SSA Tutor 5

Martín Pereira-Fariña is a post-doctoral researcher in the Faculty of Philosophy at University of Santiago de Compostela (Spain). He received his bachelor's degree in philosophy and his Ph.D. in computer science at the same university. His work is mainly focused on different theoretical aspects of argumentation and word and sentence similarity in a dialogical context. He is also contributing to the development of computational tools for argument mining in R. More recently, he is involved in the investigation of the role of argumentation in cultural heritage research; in particular, the use ethos in public debates about contested monuments and the connection between argument structure and conceptual modelling. He has published more than 20 papers in international conferences and journals in the fields of philosophy, argumentation and computer science.

Tutorial: *Introduction to R for argument mining*

R is a language programming that has been gaining importance in the last years, especially in those fields different from computer science, such as linguistics, humanities or social sciences, because it is simple, powerful and free. In this tutorial, we first introduce the basic data types, programming structures and graphical resources in R oriented to natural language processing and argument mining. Next, we will practice with sample texts some basic tasks in argument mining (such as segmentation, searching of discourse indicators, etc.) and how the results can be presented using different kinds of visualisations.

Warsaw Tutor 1

Barbara Dunin-Kęplicz is a full Professor of Computer Science at the Institute of Informatics of University of Warsaw (Poland) and, formerly, also at the Institute of Computer Science of Polish Academy of Sciences (Poland). Her research interests concentrate around logics in computer science and artificial intelligence, including paraconsistent, paracomplete and doxastic reasoning. She works on unconventional models used in reasoning about dialogues and action and change. She is a recognised expert in multiagent systems and one of the pioneers in the area of modelling BDI systems. She co-authored a book "Teamwork in multiagent systems. A formal approach" and published over 100 journal and conference papers as well as book chapters.

Andrzej Szałas is a full Professor of computer science at the Institute of Informatics of Warsaw University (Poland) and at the Department of Computer and Information Science of Linköping University (Sweden). He works in the area of logics in computer science and artificial intelligence. His scientific interests include non-classical logics, second-order logic, paraconsistent and paracomplete reasoning, commonsense reasoning, approximate reasoning, modal and doxastic reasoning, rule languages, databases and descriptive complexity. He (co-)authored 6 books and over 130 journal and conference papers. He is also a consultant for IT companies.

Tutorial: *Realistic models of beliefs in a paraconsistent and paracomplete setting*

In the presence of dynamically changing real-world data, humans, robots and software agents have to cope with imperfect information. This issue manifests itself in incomplete and/or inconsistent information which, in turn, seriously affects a variety of beliefs different types of dialogues and argumentation are based on. Heuristic techniques for completing missing beliefs or disambiguating inconsistencies are inherently nonmonotonic. Traditional approaches to beliefs and non-monotonic reasoning suffer from high complexity. Moreover, belief changes/revisions, often needed in the course of dialogues, make the complexity even worse.

During the lecture we shall discuss an alternative approach where we make three important shifts: (a) using paraconsistent, paracomplete and modular rather than classical reasoning; (b) querying belief bases rather than applying logical entailment; (c) using belief shadowing rather than belief updates/revisions. We will present a tractable framework for belief bases and belief shadowing, based on a doxastic extension of a four-valued, rule-based language 4QL. The language allows for paraconsistent, paracomplete and modular reasoning, and provides a simple to use tools for lightweight forms of nonmonotonic as reasoning with incomplete and/or inconsistent beliefs. The framework enjoys an open-source implementation and is ready for experimental and educational use.

The presented techniques will be illustrated by applications to speech acts specifications and their use in selected forms of dialogues. We will also indicate research directions which may be interesting for the Argdiap community.

Warsaw Tutor 2

Dariusz Kalociński is an assistant professor in the Institute of Philosophy at the University of Warsaw (Poland), affiliated with the Department of Logic. Currently, he is a postdoctoral researcher in the Social Models of Semantics Learning: Acquisition and Evolution of Quantifier Meaning project, led by Nina Gierasimczuk, and funded by the Polish National Science Centre (NCN). His research interests lie in language learning and language evolution, especially in the context of more abstract semantic entitites such as quantifiers. He is interested in how various pressures, such as social influence or communicative efficiency, help shaping natural language, and how this influence might be captured in formal models. Apart from language-related topics, his work focuses on computability theory, including computational complexity and recursive function theory.

Tutorial: *Modelling semantic negotiation*

This tutorial will focus on several approaches to computational modelling of semantic negotiation. The main goal of such models is to provide a high-level, computational or algorithmic description of hypothetical mechanisms by which communicating agents can arrive at similar semantic representations. Apart from that, such models help us understand how various pressures (social, cognitive, environmental) might affect semantic negotiation and shape emerging meanings. We will look at models of meaning coordination between dyads (pairs of agents) and at population-level dynamics. Our toolbox will include methods and algorithms from diverse domains: Markov chains, computer simulations, reinforcement learning, evolutionary game theory, signalling games etc.

Warsaw Tutor 3

Dr **Dominik Sypniewski** is a head of real estate&constructions practice in Góralski&Goss Legal. His professional expertise covers administrative law issues related particularly to real estate, the investment and construction process (zoning and construction law) and real estate transactions of different type. He is also assistant Professor at the Faculty of Administration and Social Science of the Warsaw University of Technology (Poland). He graduated law at Warsaw University as well as public economics at the Warsaw School of Economics. During his academic career he was a visiting scholar at Georgetown University Law Centre as a fellow of Polish–U.S. Fulbright Commission and short-term visiting lecturer in Turkey, Portugal, Estonia and South Korea. Author of He has written many publications on real estate and administrative law and co-authored a commentary on Construction Law (LexisNexis) and template letters, filings and agreements related to real estate and the investment and construction process (Wolters Kluwer). Member of Warsaw Bar Association.

Tutorial: *Argumentation in practice: negotiating the legal conditions of real estate contracts*

Can the art of argumentation be useful in the practice of negotiating contracts? During the tutorial there will be presented two cases regarding the course of negotiations of business and legal conditions of two real estate transactions. In the first case, one party of the negotiations has a stronger position, in the other parties will have equal negotiating positions. Relations between business assumptions and the proposed legal conditions and their justification will be presented. During the tutorial, I will also show argumentative tactics in the selection of arguments and their types, presenting them in specific phases of negotiations, as well as examples of the use of defence tactics.

COMMA Tutor 1

Francesca Toni is Professor in Computational Logic in the Department of Computing, Imperial College London (UK) and the funder and leader of the CLArg (Computational Logic and Argumentation) research group. Her research interests lie within the broad area of Knowledge Representation and Reasoning in Artificial Intelligence, and in particular include Argumentation, Logic-Based Multi-Agent Systems, Logic Programming for Knowledge Representation and Reasoning, Non-monotonic and Default Reasoning. She graduated, summa cum laude, in Computing at the University of Pisa, Italy, in 1990, and received her PhD in Computing in 1995, from Imperial College London. She has coordinated two EU projects, received funding from EPSRC and the EU, and awarded a Senior Research Fellowship from The Royal Academy of Engineering and the Leverhulme Trust. She is currently Technical Director of the ROAD2H EPSRC-funded project. She has co-chaired ICLP2015 (the 31st International Conference on Logic Programming), is currently co-chair of KR 2018 (the 16th Conference on Principles of Knowledge Representation and Reasoning). She is a member of the steering committe of AT (Agreement Technologies), the Executive Committee of the Board of ALP (the Association for Logic Programming), corner editor on Argumentation for the Journal of Logic and Computation, and in the editorial board of the Argument and Computation journal and the AI journal.

Tutorial: *Machine arguing: theories, systems and applications*

Within AI, argumentation is about empowering machines with the capability to argue, so as to resolve conflicts, fill gaps in incomplete information and provide explanations for any outcomes obtained by machine arguing. In this tutorial I will overview a variety of existing theories for modeling argumentation in AI, including abstract, (some forms of) bipolar and (some forms of) structured argumentation frameworks, under a variety of so-called semantics, ranging from extension-based, labelling-based, and gradual semantics; I will also touch upon extensions of these frameworks with preferences and probabilities. I will then provide an overview and hands-on session on a number of argumentation systems, including abaplus, Arg&Dec and proxdd and abagraph. I will conclude with an illustration of a number of concrete applications of machine arguing, in medical, legal and social settings.

COMMA Tutor 2

Marcello D'Agostino is currently Professor of Logic at the Dept. of Philosophy, University of Milan (Italy). From 1987 to 1991 he was a doctoral student at the Computing Laboratory, University of Oxford where received his Ph.D. with a thesis on the computational complexity of logical calculi. After his PhD he was employed with research positions at the Department of Computing, Imperial College, London (1991–1995), in the Logic and Computation Group directed by D.M. Gabbay. He then moved to the University of Ferrara in 1996 as assistant professor and qualified as full professor in 2001. In 2015 he moved to the University of Milan where he is now Director of the Doctoral school in Philosophy and human sciences.

Tutorial: *Depth-bounded reasoning and formal argumentation*

Logic started with Aristotle as an attempt to provide a prescriptive formal theory of human reasoning. Starting from the end of the XIX century, as a result of its interaction with mathematics and computer science, the original motivation was largely lost—with the only notable exception of Gentzen-style natural deduction methods—to re-emerge in the last few decades as a result of the growing interest for human-oriented computing (HOC) and in connection with the new field of cognitive science. However, at present, both HOC and cognitive science can hardly benefit from the formal models that have been developed within the paradigms of mathematical and computational logic. There are essentially three major problems:

Problem 1. Logicians have so far focused on giving a normative characterization of consequence relations that comply with some notion of deductive inference (e.g., as one that transmits truth from the premisses to the conclusion), but their models are not scalable: they can reflect only the logical competence of *ideal* agents with *unlimited resources* and, therefore, fail to have any explanatory or prescriptive value for real-world resource-bounded agents. This is known as the problem of *logical omniscience*.

Problem 2. The rational behaviour of real agents is very seldom the result of a deductive process starting from universally accepted axioms or normative principles. Typically, it is the result of a "dialectic" process in which an argument A in support of a certain thesis can be attacked by a counter-arguments B that attempts to undermine some of the premisses on which A is based. However, A can be defended from such attacks by means of other arguments that attack B on one of its premisses, and so on. Under certain conditions certain sets S of arguments may emerge, at a given stage of the argumentation process, as (provisionally) successful—and their conclusions as (provisionally) justified. On the other hand, mathematical logic is inspired by the notion of proof in an axiomatized theory and is therefore far removed from real argumentation practice.

In this tutorial I will briefly review these three problems and provide the basic background notions that are necessary to address the growing scientific literature on the subject or resource-bounded reasoning and formal argumentation. The students will be involved in practical tasks concerning the construction of logical arguments and counterarguments in a multi-agent environment with bounded resources.

Student sessions

Thursday 6th Sept

Student Session I

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14:10–14:30 Alison R. Panisson. *Towards a Framework for Argumentation Schemes in Multi-Agent Systems*

13:30–14:50 Remi Wieten. *Probabilistic Decision-Making Based on Arguments and Scenarios (ProbAS)*
14:50–15:10 Rory Duthie. *Recognising Ethos in Natural Language*

15:10–15:30 Carlo Taticchi. *PhD Thesis Proposal: A Concurrent Argumentation Language for Negotiation and Debating*

15:40–16:00 Coffee break

Student Session II

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16:00–16:20 Bruno Yun. *How Can You Mend a Broken Inconsistent KBs in Existential Rules Using Argumentation*

16:20–16:40 Dominic De Franco. *Personalising Argumentation Within Persuasive Technology*

16:40–17:00 Weiwei Chen. *Aggregation of Argumentative Stances*

Abstracts

Aggregation of Argumentative Stances

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1. Thesis Summary

When several agents are engaged in a debate, we may wish to aggregate their stances into a global view which represents the consensus of the group. Abstract argumentation [5] provides tools for modelling stances of agents at different levels of abstraction. An abstract argumentation framework is a set of arguments together with a binary attack-relation defined on this set. By indicating for every pair of arguments that is being considered in a debate whether the first attacks the second, an abstract argumentation framework can be used to model an agent's argumentative stance. By identifying for every argument whether it is acceptable under the same abstract argumentation framework, an agent's stance can be represented by a set of arguments. Similar question has received attention from authors in the past decade or so (see, e.g., [1, 4, 8, 9]).

In my thesis, I investigate the problem of aggregation of argumentative stances at two levels. At the first level, I analyse in what circumstance the semantic properties agreed by the individuals will be preserved under aggregation. At this level, we make use of recent results in graph aggregation [6]. At the second level, I analyse the scenario of extension aggregation, i.e., a group of agents who each take an individual view on the merits of an extension, and we aggregate such extensions. At this level, we make use of known results in judgment aggregation [7].

At both levels, we are interested in the aggregation of individual points of view in the context of abstract argumentation. Even though the techniques are different, the preservation results are similar. At both levels, some properties are easy to preserve, such as conflict-freeness. Enforcing the preservation of some properties leads to rules that are unacceptable from an axiomatic point of view. This indicates that these properties are too demanding and relaxing the requirements of preservation is necessary.

2. Aggregation of Argumentation Frameworks

At this level, we aggregate argumentation frameworks by aggregating attacks. Every individual framework shares the same set of arguments but disagrees on which attacks are acceptable. We study the problem of aggregation of argumentation frameworks by indicating which attacks between the arguments are in fact acceptable. The attacks are used as the individual information to obtain the output framework under aggregation. For example, under the majority rule, only the attacks supported by the majority of agents will appear in the output framework. In the meantime, the semantic properties represent high-level agreements among agents. One example of the semantic properties is a set of arguments being the grounded extension. Given a set of arguments which is the grounded extension of every individual argumentation framework, we want to find out under what circumstance this set of arguments also is the grounded extension of the output argumentation framework.

We analyse in what circumstance the semantic properties agreed by every individual will be preserved under aggregation. At this level, a given semantic property that is supported by the majority of individuals could be violated in the output framework. This is similar to the Condorcet Paradox in the theory of preference aggregation.

We show that some desirable semantic properties can be preserved by desirable rules: every quota rule preserves conflict-freeness; the nomination rule preserves admissibility and stability. In the meantime, some negative results show that only aggregation rules that are clearly unacceptable from an axiomatic point of view (namely, so-called dictatorships) can preserve the most demanding semantic properties: no rule with desirable properties preserves the property of being the grounded extension, argument acceptability under different semantics, or the properties which reduces semantic ambiguity, namely, acyclicity and coherence. See [2] for more details.

3. Aggregation of Alternative Extensions

At the above level, only attacks have been considered during aggregation. But in some scenarios, we may wish to vote on arguments instead of attacks. Agents may disagree on which arguments are acceptable, and they would want to aggregate such arguments directly. In this scenario, every individual confronts with the same argumentation framework and proposes different sets of arguments.

At this level, we aggregate alternative extensions by quota rules under the same argumentation framework. The question we ask is whether certain high-level properties of extensions that all individual agents agree on will be preserved under aggregation. For example, if all agents report extensions that are conflict-free, will the collective extensions returned by the majority rule be conflict-free as well?

We show that for some properties, there are quota rules that guarantee their preservation. For example, a quota rule F_q for n agents with quota q preserves conflict-freeness if and only if $q > \frac{n}{2}$; every quota rule F_q for n agents with a quota $q > \frac{n}{2}$ preserves admissibility for all argumentation frameworks AF with $\text{MaxDef}(AF) \leqslant 1$ in which $\text{MaxDef}(AF)$ is the maximum number of attackers of an argument that itself is the source of an attack. While the preservation of conflict-freeness and admissibility are possible, for the more demanding properties it is impossible to do so in general. More details are available in [3].

4. Acknowledgment

For his support I would like to express my sincere gratitude to Ulle Endriss.

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Weiwei Chen is a third-year Ph.D. student.

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Recognising Ethos in Natural Language

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1. Ethos in Natural Communication

Automatically extracting (mining) arguments (reasoning) has become an ever growing area of research, due to the crucial role they play in trying to persuade others in all forms of society from day-to-day conversation to political debate. Fewer research has been conducted on the automatic extraction of ethos (the character of the speaker) [1, 1356a] despite the sometimes more influential role it plays in persuading. As seen in elections where a stronger character might outweigh their reasoning behind policy.

Example 1 Mr. John Moore said, *My hon. Friend is assiduously pursuing his constituents' interests.*

Example 2 Mr. Bruce Grocott said, *Is it not the simple truth that the Government are making the country sick?*

Example 3 Mr. John Moore said, *I bow to my hon. Friend's distinguished past and detailed knowledge of these matters.*

Example 4 Mr. Patrick Jenkin said, *I believe that the Government were right to have the courage to bring forward the necessary measures to bring public expenditure under control.*

Using Aristotle's definition for inspiration, ethos is further specified as a property of an individual or group of individuals which can be supported (Example 1) or attacked (Example 2). An ethotic sentiment expression (ESE) must then contain a source (in Example 1 "Mr. John Moore"), a target (in Example 1 "hon. Friend" and "Government" in Example 2) and the polarity of the statement on the linguistic surface (underlined words show positive polarity in Example 1,3,4 and negative polarity in Example 2).

While ethos may be supported or attacked, there are also a set of three ethos elements that can be utilised as rhetorical strategies for these supports and attacks: practical wisdom referring to having knowledge; moral virtue when knowledge is revealed (i.e. honesty); and goodwill when the knowledge is shared (i.e. giving the best advice to others) [1, 1378a]. Example 1 can be further annotated with an ethos type—goodwill in this case—due to the fact that the audiences ("constituents" in this case) interests are being pursued. In Example 2, goodwill is also annotated due to the government making the audience ("country") sick. Example 3 refers to practical wisdom due to "detailed knowledge" and Example 4 refers to moral virtue due to the government having "courage".

2. Ethos Mining

The first step to recognising ethos in natural language is through ethos mining which builds upon methods and techniques developed for sentiment analysis and opinion mining (*cf.* [12]), argument mining (*cf.* [15, 11]) and deep learning (cf. [9]). In argument argument structure is automatically identified using machine and deep learning [14, 5]. Sentiment analysis and opinion mining focuses on the opinions people hold and the polarity of these opinions, again using machine learning [16]. Advances in text classification have been made through Recurrent Neural Networks (RNN) [18, 10] and Convolutional Neural Networks (CNN) [7, 17] using word embeddings. Some image classification has used modular CNNs containing both image and text data [13].

In previous work, the first corpus of ethos supports and attacks was built from UK parliamentary data consisting of 60 transcripts and introduced a pipeline of NLP techniques to automatically extract and visualise ethotic statements (ESEs) [4]. This consists of existing methods, Part-of-Speech (POS) tagging and an SVM-based sentiment classifier, as well as our own rule-based techniques, anaphora resolution, rule-based expression recognition, a reported speech filter ($F1$-score 0.70 overall) and our own visualisation method (`http://www.arg-tech.org/EthanVis`).

More recently in [3], the corpus (adding 30 extra transcripts for training data) and the pipeline from [4] were updated and reformed: entities (politicians, political parties, the government etc.) and the words related to them are extracted using manual rules defined from universal dependencies (UD); external data from Wikipedia is introduced to increase the robustness and reliability of the anaphora resolution module in [4] ensuring constituencies are linked to politicians; the techniques for ESE / Non-ESE classification are updated with entity and word features along with raw text, part-of-speech tags, UD tags and polarity tags to create a Deep Modular Recurrent Neural Network (DMRNN) novel for text classification [3] ($F1$-score 0.74 and macro $F1$-score 0.83) inspired by modular networks in image classification; the sentiment classification algorithms proposed for the binary classification are also updated by introducing new sentiment lexicons (macro-averaged $F1$-score 0.84); and a graph based approach visualises ethotic supports and attacks (+/-ESEs) for groups and individual politicians.

Finally, in [2] the corpus and the automatic output (+/-ESEs) of the pipeline in [3] have been built upon to manual annotate and classify types of ethos support and attack [2] for the first time. In the new pipeline +/- ESEs are broken into separate features: entity relations (EXT) from [3] are combined with POS tags for a new EXT/POS module; the raw ESE text; ESE polarity; and a plural and proper nouns (NNS/NNP) presence module. These were passed to a principal component analysis (PCA) module after-which two classification tasks (pairwise and One vs all used in [6, 8]) determine the ethos support and attack type. Overall this new pipeline shows promising results ($F1$-scores ranging from 0.53 to 0.77) for classifying practical wisdom, virtue and goodwill.

3. Conclusion

This paper has described advances in the new sub-field of ethos mining involving: creating the first corpus of ethos supports and attacks and types; the first automatic classification of ethos supports and attacks and types; the creation of novel deep learning methods (DMRNN) for extracting ethos; and the first set of ethos analytics. Ethos mining pipelines can now be applied to large amounts of data, determining the relationships between politicians not normally seen by the general public and providing insights between these relationships and political positions previously unidentified.

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Personalising Argumentation Within Persuasive Technology

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Abstract. Within the context of E-Health Coaching, we aim to improve the persuasiveness of Behaviour Change Support systems by personalising the argumentation. Initial work has involved a review of the relevant literature, developing a matrix to measure persuasiveness and utilising this framework within multiparty dialogue.

Keywords. Argumentation, Persuasive Technology, E-Health Coaching

1. Introduction

Since perception, evaluation and choice are primarily a non-conscious phenomena, [3] much of Behaviour Change Support Systems (BCSS) focus on eliciting behaviour change through subconscious methods. Recent advances in virtual e-coaching may now make it possible to incorporate more sophisticated, personalised dialogue between the user and the system and as such focus on the underlying user's beliefs, through personalised argumentation.

1.1 Literature Review

A literature review was carried out from the classic modes of persuasion introduced by Aristotle [1], through to the reintroduction of the "New" Rhetoric by Perelman [9] and the focus once more on the audience being persuaded. Together with Toulmin's [12] proposal to reject a purely formal and abstract approach to argument analysis and instead focus on "substantial" arguments, this inspired the work of Walton on dialogue types [14] and argumentation schemes [15] as well as Van Eemeren's pragma-dialectic approach [13]. Dung's [5] work on developing an abstract argumentation framework has resulted in a vast array of research into computational models of argumentation including formal dialogue games [16] and a whole argument web infrastructure [2].

Models of human behaviour such as those by Fogg [6] have led to a whole new field in persuasion technology and further models such as the Persuasion Systems Design [7] framework and the Transforming Sociotech Design model [11]. With research from Psychology on belief and behaviour change and from medical argumentation on shared decision making, incorporating a personalised argumentation based approach to behaviour transformation is now viable.

2. Council of Coaches & Health Information Behaviour

In September 2017 we began working on the European Council of Coaches project (Couch) [8] which aims to develop a virtual council of autonomous coaches to assist people with their health goals. The University of Dundee's role is to implement the multi-party argumentation framework to enable the coaches to act as fully autonomous, intelligent agents that can utilise arguments to persuade each other and the user. To ensure Couch meets the needs of its users, we are conducting a diary study into the health information behaviour of potential users. This will provide user requirements as well as information regarding what sources participants found most persuasive.

3. Measuring Persuasiveness & Motivational Interviewing

To implement persuasive arguments in a BCSS, we must measure and evaluate whether and/or how a user has been persuaded. To gain these insights we developed an evaluation matrix [4] that provides a framework and an iterative approach to measure, evaluate and improve the persuasiveness of a BCSS. As well as the evaluation approach, other dimensions include the persuasive approach taken and the persuadee themselves. Considering these factors allows us to personalise the persuasive interaction, aiming to increase it's persuasiveness.

To envision how a shared decision approach to health coaching could be conceptualised in a virtual environment, we conducted multi-party coaching sessions between various health professionals and an actor playing the role of the patient. Analysis of the session's transcripts led us to conduct further research into motivational interviewing and goal setting techniques. From these techniques, we developed a protocol for a multi-party, goal-setting dialogue game in which multiple health coaches can contribute in order to find a goal that is acceptable to both the patient, and the coaches. [10].

4. Persuasion in Multiparty Dialogue

To increase our understanding of persuasion within multiparty argumentation, we devised an experiment incorporating several metrics from our evaluation matrix. We are testing for the persuasiveness of several variables including the number of virtual characters, the gender of the characters, as well as the argumentative style (authoritative or peer). We are also measuring the relationship between how persuasive the system is perceived by the user, how susceptible the user is to persuasion and the actual resulting behaviour change of the participants.

5. Summary

From the health information behaviour study we hope to gain insights into the types of sources participants found the most persuasive. Together with the results of our study on persuasion in multi-party dialogue, the background research from our literature review and the initial work on the dialogue game, we will look at utilising extensive user data to build a precise user model on which to base a personalised, persuasive argumentation strategy.

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Towards a Framework for Argumentation Schemes in Multi-Agent Systems

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Abstract. Communication is one of the most important aspects of multi-agent systems. Recently, argumentation-based approaches have stood out among other communication techniques in multi-agent systems, receiving special interest from the community, given that such approaches provide an expressive form of communication allowing agents to justify their positions. However, only few practical work applying argumentation in multi-agent systems can be found in the literature. In our work, we have made some advances that help to fill the gap between theoretical and practical work on applying argumentation in multi-agent systems, through a more in-depth consideration of agent-oriented programming languages and multi-agent platforms when developing an argumentation framework. In particular, we have been investigating a framework for argumentation schemes in multi-agent systems, which allows to use argumentation schemes to specify the reasoning patterns agents are able to use in that multi-agent system/application.

Keywords. Multi-Agent Systems, Argumentation, Argumentation Schemes

1. Introduction

Communication is essential in Multi-Agent Systems (MAS) [1]. Recently, argumentation-based approaches started to play an important role in MAS, showing promise as an approach to agents reason about their mental attitude, e.g., goals, beliefs, etc., as well as to agents communicate with other agents using arguments [2]. In our previous work, we have made some contributions towards the application of argumentation techniques to MAS, i.e., contributions on applying argumentation-based reasoning [3, 4, 5, 6] and argumentation-based dialogues [7, 8, 9, 10] in MAS. Although we have

developed a practical argumentation framework in MAS combining our previous work, it can be observed that different MAS applications could need different reasoning patterns for argumentation, which are commonly studied as Argumentation Schemes (AS). For example, there are AS that are specific for analysing the provenance of information [11], AS for reasoning about trust [12], AS for arguing about transplantation of human organs [13], our own work on AS for implementing data access control between smart applications [14], and so forth. Thus, considering that different MAS applications could have different requirements regarding the reasoning patterns for argumentation necessary in that system, we propose an argumentation framework for AS in MAS, extending our previews work.

2. Argumentation Schemes in Multi-Agent Systems

Argumentation schemes have some particularities that make them difficult to model in computational languages, mainly because they represent stereotypical reasoning patterns that are considered defeasible [15]. Thus, though some work in the literature suggest to represent AS using defeasible inference rules [16, 17], checking the acceptability of arguments instantiated from such AS using argumentation frameworks as ASPIC+ [18], DeLP [19], and others [4, 3], the role of critical questions seems to be missing. That occurs because critical questions might point out doubts not only about the premises and inference rules used in an argument but also about presumptions used in that reasoning pattern, which are not explicitly present in the argument [15]. Thus, how an agent identifies the critical questions that apply to an argument when evaluating it?

There are two natural ways to solve this particular problem. The first could be to represent all assumptions as additional premises/information within an argument. However, this approach could overload arguments with (usually) unnecessary information, making them difficult to be translated into natural language, when implementing interface agents for human-machine communication for example. The second option is to make all agents aware of such reasoning pattern (including the associated critical questions). Thus, agents are able to identify from which argumentation scheme an argument has been instantiated, as well as to use the associated critical questions when evaluating such argument. Considering the current directions on the development of MAS inspired by the concept of *open* systems [20], we argue that the second solution is better than the first one, and the current representation of arguments in MAS requires AS to be shared by all agents in a MAS.

We are considering two alternative ways to represent shared AS in MAS. The first would be specifying AS during the conception of a MAS (in their organisational specification) [17]. In such approach, all agents will be aware of the AS available in that system, as well as they will be aware of which AS they have permission to use, and in which context. This approach allows us more control over how and which agents will use such arguments. The second alternative is to represent AS in shared databases, e.g., [21, 22].

3. Conclusion

Our work aims to develop a practical framework for AS in MAS. In our argumentation framework, AS are shared by agents, and agents are able to execute argumentation-based reasoning through an internal representation of such AS and their associated critical questions using an extended version of our previous work [4, 3]. Also, agents are able to use arguments instantiated from AS in argumentation-based dialogues, in which an agent is able to identify which argumentation schemes the sender has used to instantiate the received argument, and with this information, it is able to identify the appropriate critical questions to ask [23].

Besides the benefits of a practical argumentation framework, some preliminary results show that our framework allows us to reach some computational benefits using shared AS, for example, agents are able to communicate enthymemes (shorter messages) instead of arguments [23]. Also, depending on the protocol used, agents are able to communicate fewer messages, given that the critical questions also guide the scope of an argumentation-based dialogue. Protocols for argumentation-based dialogues using AS is part of our ongoing research.

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Alison R. Panisson is a 4th year PhD student, his advisor is Prof. Rafael H. Bordini.

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PhD Thesis Proposal: A Concurrent Argumentation Language for Negotiation and Debating

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Abstract. My PhD thesis proposal is to define a concurrent language for negotiation and debating through the use of argumentation. In our system, communication between intelligent agents (for instance, for content negotiation in a web server, or automatic debating systems) will be modelled as Argumentation Frameworks. High-level primitives will be provided in order to implement interactions, taking into account belief revision notions from *AGM* and *KM* theory. Furthermore, we plan to introduce in our language concepts as 'ownership" for arguments and semantics preserving operations for better modelling real case applications.

Keywords. argumentation, agents, concurrent, negotiation, debate

The Argumentation Theory provides models for evaluating arguments that interact with each other. In his seminal work [1], Dung introduces a representation for Argumentation Frameworks in which arguments are abstract, that is their internal structure, as well as their origin, is left unspecified. Abstract Argumentation Frameworks (AFs) have been widely studied from the point of view of the acceptability of arguments and the extension-based semantics and, recently, several authors have investigated the dynamics of AFs. The works in this direction take into account different kinds of modification (addition or removal of arguments and attacks) and borrow concepts form belief revision with different purposes, for example updating an AF [2], characterizing equivalence between AFs [3], or also for enforcing arguments [4].

Proposal. In the following, we present an overview of the work we aim to realize during the PhD thesis. The main contribution will be the definition of a concurrent argumentation language for modelling negotiations and debates. In particular, our language will allow modelling concurrent processes, inspired by notions as the *Ask-and-Tell constraint system* [5]. Besides specifying a logic for arguments interaction, our language could model debating agents (e.g., chatbots) that take part in a conversation and provide arguments. AGM and KM theory [6, 7] give operations (like expansion, contraction, revision, extraction, consolidation and merging) for updating and revising beliefs on a knowledge base. Looking at such operations, the language will be endowed with primitives for the specification of interaction between agents through the fundamental operations of adding (or removing) arguments and attacks. Additional constructs of the language could also be designed accordingly to a thorough study of interaction schemes among arguments [8]. These specific constructs could allow modelling more complex operations in the perspective of providing a straightforward mechanism for representing debating agents. For example, one might want to modify an AF by adding an attack in such a way that the set of extensions is preserved w.r.t. a certain semantics. We already studied this kind of dynamics in AFs from the point of view of the *robustness*, a notion we introduced in some previous work [9, 10] and that is defined as the property of an AF to withstand changes. In [11] we also studied the conditions that an expansion operator w.r.t. the attacks has to satisfy in order to preserve the semantics, and we plan to implement these conditions as special guards.

Logic frameworks for argumentation, as the one presented in [12], have been introduced to fulfil the operational tasks related to the study of dynamics in AFs, such as the description of AFs, the specification of modifications, and the research of extensions. Although some of these languages could be exploited to implement applications based on argumentation, for instance to model debates among political opponents, none of them considers the possibility of having concurrent interactions. This lack represents a significant gap between the reasoning capacities of AFs and their possible use in real life tools. Moreover, despite in real life cases is always clear which part involved in a debate is stating

a particular argument or is conducting an attack toward an opponent, AFs do not hold any notion of "ownership" for arguments or attacks, that is, any bond with the one making the assertion is lost. For this purpose, our language will allow attaching labels on (groups of) arguments and attacks of AFs, in order to preserve the information related to who added a certain argument or attack, extending and taking into account the work in [13, 14]. Finally, we could integrate into our language notions coming from multi-agent systems and agent argumentation, for instance, exploring dialogue games [15].

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Probabilistic Decision-Making Based on Arguments and Scenarios (ProbAS)

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Bayesian networks (BNs) [1] are probabilistic reasoning tools that are being applied in many complex domains where uncertainty plays a role, including forensics and law [2]. A BN consists of a graph, which captures the independence relation among the modelled domain variables, and locally specified (conditional) probability distributions that collectively describe a joint probability distribution. BNs are well-suited for reasoning about the uncertain consequences that can be inferred from the evidence in a case. However, especially in data-poor domains, their construction needs to be done mostly manually, which is a difficult, time-consuming and error-prone task [3]. Domain experts such as crime analysts and legal experts typically do not have the relevant mathematical background to construct BNs, which means that they have to rely on so-called BN engineers to aid in the construction process.

Thus despite the increased power that a BN could bring with respect to, for example, evidence aggregation and sensitivity analysis, many experts resort to using qualitative reasoning tools such as argument diagrams and mind maps [4], Wigmore charts [5] and scenarios [6].

The aim of the ProbAS project is to explore how the benefits of BNs can be exploited while allowing domain experts to use the tools and techniques they are familiar with. Specifically, the following research questions are addressed:

Q1. How are arguments, scenarios and probabilities used in actual decision-making under uncertainty?

Q2. How can arguments and scenarios be used to construct and compare (partial) BNs?

Q3. How can mathematical and computational techniques be used to refine and choose between constructed BNs?

In our research up till now, we have mainly focused on Q2. The initial scenario—and/or argumentation-based analysis of a problem conveys information about relations and uncertainties, which can inform the design of a BN. In previous research, Bex and Renooij [7] contributed to this idea by proposing a heuristic for constructing BN graphs from structured arguments [8]. Their approach suffices for automatically constructing an undirected graph. However, for setting arc directions, as required for the directed BN graph, the authors resort to the standard approach used in BN construction: the BN engineer and domain expert together specify the arc directions using the notion of causality as guiding principle [1]. The resulting BN graph then has to be verified and refined manually in terms of the independence relation it represents.

In our recent research, we investigated whether the process of setting arc directions can be (partly) automated. To this end, we studied the (in)dependencies that a BN graph corresponding to structured arguments represents for multiple possible configurations of arc directions. We were able to establish which configurations of arc directions in the BN graph are desirable by comparing the reasoning patterns captured by the BN graph to the reasoning present in the original arguments. Based on our findings, we proposed a refinement of the heuristic of Bex and Renooij that fully specifies the directions in which arcs should be directed in BN graphs corresponding to argument structures without attack relations [9]. In our current research, the focus lies on extending this heuristic to a broader class of arguments including attack. As we are justified to assume from a legal perspective that information regarding causality is present in the domain expert's original argument-based analysis [11, 10], we studied how this information can be exploited in constructing BN graphs [12]. Preliminary results show that, for a broad class of arguments including attack relations in which causality information is specified, a completely directed BN graph can be automatically constructed. Moreover, causality information provides for constraining several conditional probabilities distributions.

In our future research of Q2, we will focus on deriving more probabilistic constraints on BNs given (structured) arguments. One of the difficulties here is that the exact probabilistic interpretation of arguments and evidence, and hence the various types of constraints on a BN, is a contentious issue, see also [7, 13, 14]. There are different ways to interpret arguments probabilistically, and different aspects of argumentation frameworks can be incorporated as constraints on probabilities.

For Q1, we will perform an ongoing case study at the Dutch Police and the Netherlands Forensic Institute. In previous research, the most commonly used tools and techniques used by crime analysts to structure and visualise evidence were identified [15, 16]. For Q1, we will (further) investigate the ways in which scenarios, arguments and uncertainty are related to these techniques and tools.

For Q3, we aim to mathematically study the relations between consistent second order distributions on possible BNs and the constraints derived from arguments and scenarios. Initial raw estimates of probabilities can be elicited, which can be used to perform sensitivity analyses and to establish bounds on a probability of interest. The results of these analyses can be used to determine for which nodes it is important to accurately elicit the involved (conditional) probabilities. In addition, we will design computational techniques for comparing alternative BNs under construction, using comparison measures such as difference in outcomes, complexity and robustness.

For Q3, we also aim to design formal argumentation protocols and schemes for discussions about BNs, which can be used to elicit further constraints and resolve conflicts among domain experts. In related research, Keppens [17] proposed an argumentation-based approach for reasoning about probability distributions. This approach allows domain experts to reason about potential sources of vagueness, ambiguity and inaccuracy of subjective probabilities, and thereby facilitates the validation of probabilistic models such as BNs. Keppens primarily aims to build a formal

and computational model, in which the effect of rejecting a particular argument on a conclusion variable can be calculated. Initial explorations on how discussions about Bayesian modelings of complex criminal cases actually take place in practice were performed by Prakken [18], who analysed discussions on Bayesian modelings between experts on their argumentation structure. Within the ProbAS project, we aim to further pursue both lines of research.

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How Can You Mend a Broken Inconsistent KBs in Existential Rules Using Argumentation

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Argumentation is a reasoning method in presence of inconsistencies that is based on constructing and evaluating arguments. In his seminal paper [6], Dung introduced the most abstract argumentation framework which consists of a set of arguments, a binary relation between arguments (called attack) and an *extension-based semantics* to extract subsets of arguments, representing consistent viewpoints, called *extensions*. Recently, another way of evaluating some arguments was proposed: *ranking-based semantics*, which ranks arguments based on their controversy with respect to attacks [3], i.e. arguments that are attacked "more severely" are ranked lower than others. Extension-based semantics and ranking-based semantics are the two main approaches that I plan to focus on in my future works.

Logic-based argumentation [1] consists in instantiating argumentation framework with an inconsistent knowledge base expressed using a given logic that can be used in order to handle the underlying inconsistencies. It has been extensively studied and many frameworks have been proposed (assumption-based argumentation frameworks, DeLP, deductive argumentation or ASPIC/ASPIC+, etc.). In my current work, I chose to work with a logic that contains existential rules and to instantiate a deductive argumentation framework already available in the literature [5] with it. I made the choice of existential rules logic because of its expressivity and practical interest for the Semantic Web. Working with existential-rules instantiated argumentation frameworks is challenging because of the presence of special features (n-ary conflicts or existential variables in rules) and undecidability problems for query answering in certain cases.

Reasoning with an inconsistent knowledge base needs special techniques as everything can be entailed from *falsum*. Some techniques such as repair semantics [4] are based on the set of all maximal consistent subsets (repairs) of the knowledge base but usually do not give a lot of answers to queries. We propose to use argumentation in a general workflow for selecting the best repairs (mendings) of the knowledge base.

The research question of my thesis is: ***"How can a non expert mend an inconsistent knowledge base expressed in existential-rules using argumentation?"***

In a first work, I addressed the lack of consideration of the existing tools for handling existential rules with inconsistencies by introducing the first application workflow for reasoning with inconsistencies in the framework of existential rules using argumentation (i.e. instantiating ASPIC+ with existential rules [9]). The significance of the study was demonstrated by the equivalence of extension-based semantics outputs between the ASPIC+ instantiation and the one in [5].

Then, I focused on the practical generation of arguments from existential knowledge bases but soon realised that such a generating tool was nonexistent and that the current argumentation community did only possess randomly generated or very small argumentation graphs for benchmarking purposes [7]. I thus created a tool, called DAGGER, that generates argumentation graphs from existential knowledge bases [12]. The DAGGER tool was a significant contribution because it enabled me to conduct a study of theoretical structural properties [11] of the graphs induced by existential-rules-instantiated argumentation frameworks as defined in [5], but also to analyse the behaviour of several solvers from an argumentation competition [16] regarding the generated graphs, and I studied whether their ranking (with respect to performance) was modified in the context of existential knowledge bases.

It is worth noticing that the number of arguments in [5] is exponential with respect to the size of the knowledge base. Thus, I extended the structure of arguments in [5] with minimality, studied notions of core [2] and other efficient optimisations for reducing the size of the produced argumentation frameworks [13]. What was surprising was that applying ranking-based semantics on a core of an argumentation framework gives different rankings than the rankings obtained from the original argumentation framework [10]. The salient

point of this paper was the formal characterisation of these changes with respect to the proposed properties defined in [3].

In my first two years of PhD, I made an analysis of the argumentation framework instantiated with existential rules and made several optimisations for managing the size of the argumentation graph. I also introduced a workflow for mending knowledge bases using argumentation [15]. In this workflow, subsets of arguments are extracted (viewpoints) and the ranking on arguments is "lifted" to these viewpoints to select the best mending. It is worth noticing that we also provided different desirable principles that the workflow should satisfy.

In the last year, I plan to first study the following question: "In which ways do argumentation methods perform better than classical methods for knowledge bases mending ?" Indeed, I expect argumentation to work well for mending knowledge bases because of the following reasons: (1) ranking-based semantics are generally easy to compute and follow several desirable principles [3], (2) argumentation represents pieces of consistent knowledge as nodes and the inconsistencies as attacks. The ability of using argumentation paths (sequence of attacks) is often neglected or ignored in traditional logic.

Lastly, I plan on comparing argumentation methods with more logical methods [14] based on inconsistency measures and export all of my results by applying them on previously studied real world use-cases obtained in the framework of the agronomy Pack4Fresh project [8].

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Useful Polish words and phrases

in english	in polish	phponetics
Hello (formal)	Dzień dobry	[dzeń dobri]
Hello (informal)	Cześć	[tʃeɕtɕ]
Goodbye	Do widzenia	[do veedzeńa]
Good night	Dobranoc	[dobranots]
Please/here you are	Proszę	[proʃe]
Thank you	Dziękuję	[dzeŋkuye]
I'm sorry/Excuse me	Przepraszam	[pʃepraʃam]
My name is ...	Nazywam się...	[nazivam sɕ ...]
I don't understand	Nie rozumiem	[ńe rozumyem]
Where is it?	Gdzie to jest?	[gdze to yest]
I'm looking for ...	Szukam ...	[ʃukam]
Where's the toilet?	Gdzie jest toaleta?	[gdze yest toaleta]
Where is the hotel ...?	Gdzie jest hotel ... ?	[gdze yest hotel]
How can I get there?	Czym tam dojechać ?	[tʃim tam doyehatɕ]
At which stop should I get off?	Na którym przystanku mam wysiąść?	[na kturim pʃistanku mam viɕońɕtɕ]
How much is it?	Ile to kosztuje?	[eele to koʃtuye]
Can I have my bill, please	Proszę rachunek	[proʃe rahunek]
Where can I change money ?	Gdzie można wymienić pieniądze?	[gdze moʃna vimyeńeetɕ pyeńondze]
exchange	kantor wymiany walut	[kantor vymeeani valut]
airport	lotnisko	[lotńeesko]
railway station	dworzec kolejowy	[dvoɜets koleyovi]
in left/in left side	w lewo	[v levo]
in right/in right side	w prawo	[v pravo]
to keep straight on	prosto	[prosto]
back	z powrotem	[spovrotem]
backwards	do tyłu	[do tiwu]
forward	do przodu	[do pɜodu]
to move on	iść dalej	[eeɕtɕ daley]

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WiFi network name: konferencja
password: fallmeeting18