



AI
2014

Max Bramer
Miltos Petridis *Editors*

Research and Development in Intelligent Systems XXXI

Incorporating Applications and
Innovations in Intelligent Systems XXII

Proceedings of AI-2014,
The Thirty-fourth SGAI International
Conference on Innovative Techniques
and Applications of Artificial
Intelligence

 Springer

Research and Development in Intelligent Systems XXXI

Incorporating Applications and Innovations
in Intelligent Systems XXII

Max Bramer · Miltos Petridis
Editors

Research and Development in Intelligent Systems XXXI

Incorporating Applications and
Innovations in Intelligent Systems XXII

Proceedings of AI-2014, The Thirty-fourth SGAI
International Conference on Innovative Techniques
and Applications of Artificial Intelligence

 Springer

Editors

Max Bramer
School of Computing
University of Portsmouth
Portsmouth
UK

Miltos Petridis
School of Computing, Engineering
and Mathematics
University of Brighton
Brighton
UK

ISBN 978-3-319-12068-3 ISBN 978-3-319-12069-0 (eBook)
DOI 10.1007/978-3-319-12069-0

Library of Congress Control Number: 2014951661

Springer Cham Heidelberg New York Dordrecht London

© Springer International Publishing Switzerland 2014

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Programme Chairs' Introduction

This volume comprises the refereed papers presented at AI-2014, the Thirty-fourth SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence, held in Cambridge in December 2014 in both the technical and the application streams. The conference was organised by SGAI, the British Computer Society Specialist Group on Artificial Intelligence.

The technical papers included new and innovative developments in the field, divided into sections on Knowledge Discovery and Data Mining, Machine Learning, and Agents, Ontologies and Genetic Programming. This year's Donald Michie Memorial Award for the best refereed technical paper was won by a paper entitled "On Ontological Expressivity and Modelling Argumentation Schemes using COGUI" by Wael Hamdan, Rady Khazem and Ghaida Rebdawi (Higher Institute of Applied Science and Technology, Syria), Madalina Croitoru and Alain Gutierrez (University Montpellier 2, France) and Patrice Buche (IATE, INRA, France).

The application papers included present innovative applications of AI techniques in a number of subject domains. This year, the papers are divided into sections on Evolutionary Algorithms/Dynamic Modelling, Planning and Optimisation, and Machine Learning and Data Mining. This year's Rob Milne Memorial Award for the best refereed application paper was won by a paper entitled "Combining Semantic Web Technologies with Evolving Fuzzy Classifier eClass for EHR-based Phenotyping: a feasibility study" by M. Arguello and S. Lekkas (University of Manchester, UK), J. Des (SERGAS, Spain), M.J. Fernandez-Prieto (University of Salford, UK) and L. Mikhailov (University of Manchester, UK).

The volume also includes the text of short papers presented as posters at the conference.

On behalf of the conference organising committee we would like to thank all those who contributed to the organisation of this year's programme, in particular the programme committee members, the executive programme committees and our administrators Mandy Bauer and Bryony Bramer.

Max Bramer, Technical Programme Chair, AI-2014.

Miltos Petridis, Application Programme Chair, AI-2014.

Acknowledgments

AI-2014 Conference Committee

Conference Chair

Prof. Max Bramer University of Portsmouth

Technical Programme Chair

Prof. Max Bramer University of Portsmouth

Application Programme Chair

Prof. Miltos Petridis University of Brighton

Deputy Application Programme Chair

Dr. Jixin Ma University of Greenwich

Workshop Organiser

Prof. Adrian Hopgood Sheffield Hallam University

Treasurer

Rosemary Gilligan University of Hertfordshire

Poster Session Organiser

Dr. Nirmalie Wiratunga The Robert Gordon University

FAIRS 2014

Giovanna Martinez Nottingham Trent University

UK CBR Organisers

Prof. Miltos Petridis University of Brighton
Prof. Thomas Roth-Berghofer University of West London

Conference Administrator

Mandy Bauer BCS

Paper Administrator

Bryony Bramer

Technical Executive Programme Committee

Prof. Max Bramer University of Portsmouth (Chair)
Dr. John Kingston Tribal Group
Prof. Thomas Roth-Berghofer University of West London
Dr. Nirmalie Wiratunga Robert Gordon University, Aberdeen

Applications Executive Programme Committee

Prof. Miltos Petridis University of Brighton (Chair)
Mr. Richard Ellis Helyx SIS Ltd
Ms. Rosemary Gilligan University of Hertfordshire
Dr. Jixin Ma University of Greenwich (Vice-Chair)
Dr. Richard Wheeler University of Edinburgh

Technical Programme Committee

Andreas Albrecht	Middlesex University
Ali Orhan Aydin	Istanbul Gelisim University
Yaxin Bi	University of Ulster
Mirko Boettcher	University of Magdeburg, Germany
Max Bramer	University of Portsmouth
Kryisia Broda	Imperial College, University of London
Ken Brown	University College Cork
Frans Coenen	University of Liverpool
Madalina Croitoru	University of Montpellier, France
Bertrand Cuissart	Universite de Caen
Ireneusz Czarnowski	Gdynia Maritime University, Poland
Nicolas Durand	University of Aix-Marseille
Frank Eichinger	Karlsruhe Institute of Technology (KIT), Germany
Adriana Giret	Universidad Politécnic de Valencia
Nadim Haque	Thunderhead.com
Arjen Hommersom	University of Nijmegen, The Netherlands
Adrian Hopgood	Sheffield Hallam University, UK
John Kingston	Tribal Group
Konstantinos Kotis	University of Piraeus
Ivan Koychev	Bulgarian Academy of Science
Fernando Lopes	LNEG-National Research Institute, Portugal
Jixin Ma	University of Greenwich
Stephen G. Matthews	De Montfort University, UK
Roberto Micalizio	Universita' di Torino
Lars Nolle	Jade Hochschule, Germany
Dan O'Leary	University of Southern California
María Dolores Rodríguez-Moreno	Universidad de Alcalá
Thomas Roth-Berghofer	University of West London
Fernando Sáenz-Pérez	Universidad Complutense de Madrid
Miguel A. Salido	Universidad Politécnic de Valencia
Rainer Schmidt	University of Rostock, Germany
Sid Shakya	BT Innovate and Design
Frederic Stahl	University of Reading
Simon Thompson	BT Innovate
Jon Timmis	University of York
Andrew Tuson	City University London
M.R.C. van Dongen	University College Cork
Graham Winstanley	University of Brighton
Nirmalie Wiratunga	Robert Gordon University

Application Programme Committee

Hatem Ahriz	Robert Gordon University
Tony Allen	Nottingham Trent University
Ines Arana	Robert Gordon University
Mercedes Argüello Casteleiro	The University of Manchester
Ken Brown	University College Cork
Richard Ellis	Helyx SIS Ltd
Roger Evans	University of Brighton
Rosemary Gilligan	University of Hertfordshire
John Gordon	AKRI Ltd
Chris Hinde	Loughborough University
Adrian Hopgood	De Montfort University
Stelios Kapetanakis	University of Brighton
Jixin Ma	University of Greenwich
Miltos Petridis	University of Brighton
Miguel A. Salido	Universidad Politécnica de Valencia
Roger Tait	University of Cambridge
Wamberto Vasconcelos	University of Aberdeen
Richard Wheeler	Edinburgh Scientific

Contents

Research and Development in Intelligent Systems XXXI

Best Technical Paper

On Ontological Expressivity and Modelling Argumentation Schemes Using COGUI	5
Wael Hamdan, Rady Khazem, Ghaida Rebdawi, Madalina Croitoru, Alain Gutierrez and Patrice Buche	

Knowledge Discovery and Data Mining

Computationally Efficient Rule-Based Classification for Continuous Streaming Data	21
Thien Le, Frederic Stahl, João Bártolo Gomes, Mohamed Medhat Gaber and Giuseppe Di Fatta	

Improved Stability of Feature Selection by Combining Instance and Feature Weighting	35
Gabriel Prat and Lluís A. Belanche	

Towards a Parallel Computationally Efficient Approach to Scaling Up Data Stream Classification	51
Mark Tennant, Frederic Stahl, Giuseppe Di Fatta and João Bártolo Gomes	

Machine Learning

Following the Trail of Source Languages in Literary Translations 69
Carmen Klaussner, Gerard Lynch and Carl Vogel

Reluctant Reinforcement Learning 85
Chris Jones and Malcolm Crowe

**Preference and Sentiment Guided Social Recommendations
with Temporal Dynamics** 101
Xavier Ferrer, Yoke Yie Chen, Nirmalie Wiratunga and Enric Plaza

Agents, Ontologies and Genetic Programming

**Query Failure Explanation in Inconsistent Knowledge Bases:
A Dialogical Approach.** 119
Abdallah Arioua, Nouredine Tamani, Madalina Croitoru
and Patrice Buche

Benchmarking Grammar-Based Genetic Programming Algorithms . . . 135
Christopher J. Headleand, Llyr Ap Cenydd and William J. Teahan

**The Effects of Bounding Rationality on the Performance
and Learning of CHREST Agents in Tileworld.** 149
Martyn Lloyd-Kelly, Peter C.R. Lane and Fernand Gobet

Short Papers

An Autopoietic Repertoire 165
M.J. Wheatman

De-risking Fleet Replacement Decisions 171
Anne Liret, Amir H. Ansariipoor and Fernando S. Oliveira

**Reliability and Effectiveness of Cross-Validation in Feature
Selection** 179
Ghadah Aldehim and Wenjia Wang

Self-reinforced Meta Learning for Belief Generation 185
Alexandros Gkiokas, Alexandra I. Cristea and Matthew Thorpe

Applications and Innovations in Intelligent Systems XXII

Best Application Paper

Combining Semantic Web Technologies with Evolving Fuzzy Classifier eClass for EHR-Based Phenotyping: A Feasibility Study. . . . 195
M. Arguello, S. Lekkas, J. Des, M.J. Fernandez-Prieto and L. Mikhailov

Evolutionary Algorithms/Dynamic Modelling

Rail-Freight Crew Scheduling with a Genetic Algorithm 211
E. Khmeleva, A.A. Hopgood, L. Tipi and M. Shahidan

CR-Modified SOM to the Problem of Handwritten Digits Recognition 225
Ehsan Mohebi and Adil Bagirov

Dynamic Place Profiles from Geo-folksonomies on the GeoSocial Web 239
Soha Mohamed and Alia Abdelmoty

Planning and Optimisation

Hierarchical Type-2 Fuzzy Logic Based Real Time Dynamic Operational Planning System 255
Ahmed Mohamed, Hani Hagrass, Sid Shakya, Anne Liret, Raphael Dorne and Gilbert Owusu

A Hybrid Algorithm for Solving Gate Assignment Problem with Robustness and Tow Considerations 269
C.H. Yu and Henry Y.K. Lau

An Iterative Heuristics Algorithm for Solving the Integrated Aircraft and Passenger Recovery Problem 281
Zhang Dong and H.Y.K. Henry Lau

Machine Learning and Data Mining

A Framework for Brand Reputation Mining and Visualisation 301
Ayesh Alshukri, Frans Coenen, Yang Li, Andrew Redfern and Prudence W.H. Wong

A Review of Voice Activity Detection Techniques for On-Device Isolated Digit Recognition on Mobile Devices 317
M.K. Mustafa, Tony Allen and Lindsay Evett

Short Papers

Ontology-Based Information Extraction and Reservoir Computing for Topic Detection from Blogosphere’s Content: A Case Study About BBC Backstage 333
M. Arguello-Casteleiro and M.J. Fernandez-Prieto

A Study on Road Junction Control Method Selection Using an Artificial Intelligent Multi-criteria Decision Making Framework . . . 339
P.K. Kwok, D.W.H. Chau and H.Y.K. Lau

Research and Development in Intelligent Systems XXXI

Best Technical Paper

On Ontological Expressivity and Modelling Argumentation Schemes Using COGUI

Wael Hamdan, Rady Khazem, Ghaida Rebdawi, Madalina Croitoru,
Alain Gutierrez and Patrice Buche

Abstract Knowledge elicitation, representation and reasoning explanation by/to non computing experts has always been considered as a crafty task due to difficulty of expressing logical statements by non logicians. In this paper, we use the COGUI editor in order to elicit and represent Argumentation Schemes within an inconsistent knowledge base. COGUI is a visual, graph based knowledge representation editor compatible with main Semantic Web languages. COGUI allows for default reasoning on top of ontologies. We investigate its use for modelling and reasoning using Argumentation Schemes and discuss the advantages of such representation. We show how this approach can be useful in the practical setting of EcoBioCap where the different Argumentation Schemes can be used to lead reasoning.

1 Introduction

COGUI¹ (Conceptual Graphs User Interface) is a knowledge base editor in which knowledge is encoded as graphs and that supports sound and complete graph based reasoning operations. The COGUI editor will allow to encode knowledge bases expressed in a logical formalism encompassing Semantic Web main languages: RDF/S, OWL and Datalog+ [12]. COGUI graphs have a semantics in first-order logic (FOL) and reasoning tasks operate directly on the knowledge defined by the user (the graphs) and not on their translation into logical formulas [5]. COGUI can

¹ <http://www.lirmm.fr/cogui/>.

W. Hamdan · R. Khazem · G. Rebdawi
Higher Institute of Applied Science and Technology (HIAST), Damascus, Syria
e-mail: waelHamdan1977@gmail.com

M. Croitoru (✉) · A. Gutierrez
University Montpellier 2, Montpellier, France
e-mail: croitoru@lirmm.fr

P. Buche
IATE, INRA, Montpellier, France
e-mail: patrice.buche@supagro.inra.fr

import and export all major Semantic Web main languages (RDF/S, OWL, Datalog, CGIF, CogXML) and has been recently extended to support non-monotonic reasoning using default rules. This extension was developed given the need induced by practical applications to support inconsistent ontology based reasoning [2, 4].

Argumentation Schemes (AS) are used to classify forms of arguments people exchange in their daily life discourses. They are used to identify and evaluate common and stereotypical forms of arguments [13]. The Argument Interchange Format (AIF; [6]), largely based on AS, proposes an “unified Ontology” for argumentation. The first AIF Ontology was proposed by [10] and was based on Resource Description Framework Schema RDFS, this AIF-RDF Ontology was implemented in a Semantic Web-based system named ArgDF. This work was extended in [9] by introducing OWL-based AIF Ontology in Description Logic DL [1]. This ontology enabled automatic scheme classifications, instance classification, inference of indirect support in chained argument structures, and inference of critical questions. The model focused on typology and overall structure of the arguments and did not enable argument acceptability. Furthermore, the type of reasoning in AS is non-monotonic. The reasoning in this OWL Ontology is based on a subset of first order predicate logic thus non-monotonic reasoning is not supported (for more details please see the expressive overlaps among knowledge representation languages illustrated in [7]).

In this article we present an AIF compatible Ontology for modelling AS that extends the expressivity of the existing work to default rule base reasoning. The ontology is available in RDFS, OWL, Datalog+ or CogXML and has been built using COGUI. The model extends the various types of inference supported in [9] by supporting argument acceptability and enabling non-monotonic reasoning. We model the following AS: argument from expert opinion, argument from analogy, and argument from popular opinion. Our work distinguishes itself from the AIF Ontology not only by (1) the expressivity brought by default rules but also by (2) its practical application. Indeed, we model the various domain application statements (we will later explain this feature in more details) using logical facts. This distinguishes us from the model introduced by [9] which deals with statements as black-boxes and not logical facts made of grounded atoms one can reason upon. We will showcase next an example based on the COGUI to illustrate types of inference supported by our AIF Ontology and which are not supported in [9].

2 Motivating Example

The “argument from position to know” [14] has the following elements:

- **Position to know premise:** E is in a position to know whether A is true (false).
- **Assertion premise:** E asserts that A is true (false).
- **Conclusion:** A may plausibly be taken to be true (false).

The scheme has a set of critical questions, we mention for example the trustworthiness question: “Is E reliable?”.

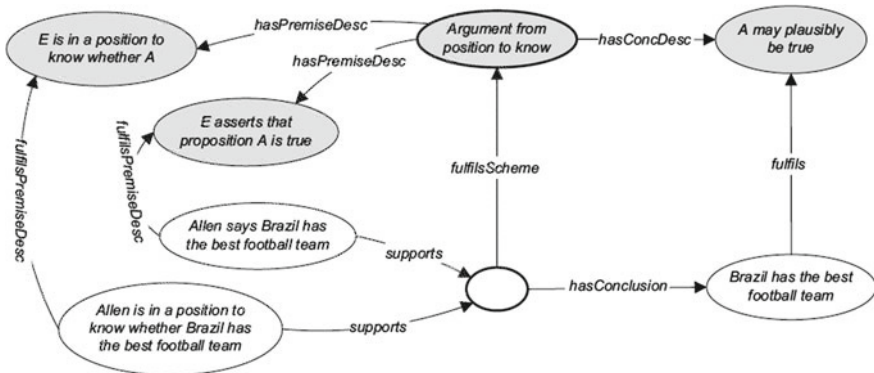


Fig. 1 “Argument from position to know” using ArgDF ontology

Figure 1 shows an argument network for this scheme using the underlying ontology of ArgDF [9]. This follows a graph based depiction of RDF and namely the nodes of the network representing subjects or objects of the RDF triple while the edges are labelled with the predicate. According to RDF/S semantics two nodes s and o linked by an edge labelled with p have the logical semantics of $p(s, o)$. In the case of Fig. 1 the nodes can represent either domain statements such as: “Brazil is the best football team in the world” or generic arguments such as: “E is in position to know whether A is true or false”. This means that we cannot reason further about Brazil being the best football team in the world (for instance inferring that Brazil won the World Cup). The statements are seen as black-boxes and we cannot reason about the knowledge contained in the black-boxes.

Rahwan et al. [9] proposed ontology does reasoning in order to retrieve argument instances semantically. More precisely, in this particular example, the necessary and sufficient conditions for an instance to be classified as an argument from position to know are as follows:

$$\begin{aligned}
 & ArgFromPositionToKnow(PresumptiveArgument \cap \\
 & \exists hasConclusion. KnowledgePositionStmnt \cap \\
 & \exists hasPremise. PositionToHaveKnowledgeStmnt \cap \\
 & \exists hasPremise. KnowledgeAssertionStmnt)
 \end{aligned}$$

Our proposed model (illustrated in Fig. 2) models all the grounded atoms as different pieces of knowledge, practically splitting the black-boxes of the previous model. This means that when we apply the rule of inference associated with this scheme we do not loose any expressivity as per existing work. However we additionally model the exceptions, and link them directly to the premises of the argument. In this example we link “LackOfReliabilityStmnt” to “Allen”. Exceptions in work of Rahwan are not treated in a non monotonic manner but they are pure syntactic flags not handled by any reasoning engine. This type of reasoning is supported in our model using the default rule associated with the scheme.

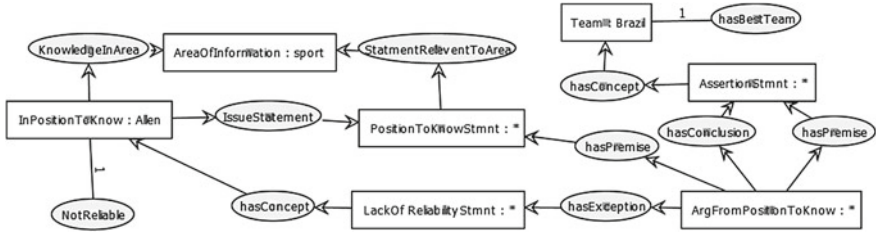


Fig. 2 “Argument from position to know” using our model

Furthermore, suppose we have another person “Martin”, also “in position to know” who says the opposite: i.e. “Brazil is not the best team”. The model of Rahwan will not capture the conflict unless we explicitly state (and thus not infer) that there is a conflict between these two arguments. In our model, and thanks to the rule defined in Fig. 6, we conclude that the conclusion statements of the two arguments (issued by “Allen” and “Martin”) are contradictory. Thereafter, the rule (depicted in Fig. 5) will infer the conflict scheme and the attack relations.

3 Background Notions

3.1 AIF Ontology

The AIF model was introduced by the research community to represent a consensus “abstract model” for argumentation in order to facilitate the exchange of semi-structured arguments among different argumentation systems. References [9, 10] illustrated the use of the proposed abstract model in argumentations systems by introducing concrete realizations. The AIF model is based on AS, and each AS in AIF has a name, set of premises, conclusion and a set of predefined critical questions. Critical questions are used to identify potential weaknesses of the argument and thus possibilities for the proponent to “attack” this argument.

3.2 Conceptual Graphs Knowledge Bases and Cogui

The Conceptual Graphs (CGs) formalism introduced by [8, 12] is a knowledge representation and reasoning formalism representing a subset of first order logic compatible with the major Semantic Web languages. A CGs knowledge base comprises the vocabulary part (also called support) that represents the domain ontology (equivalently the TBox in Description Logics, Datalog rules or RDF/S schema), and the assertions part called basic CGs (BCGs) that represents facts or assertions

(ABox, DB instances, RDF files etc.). The vocabulary is composed of two partially ordered sets by a specialization relation: a set of concepts and a set of relations of any arity (the arity is the number of arguments of the relation). The specialization relation is defined as: x is a specialization of X , if x and X are concepts, specialisation means that every instance (individual) of the concept x is also an instance of the concept X . A basic conceptual graph (BG) is a bipartite graph composed of: (i) a set of concept nodes, represents entities; (ii) a set of relation nodes, represents relationships between these entities or properties of them; (iii) a set of edges linking relation nodes to concept nodes. A concept node is labeled by a couple $t : m$ where t is a concept (and more generally, a list of concepts) called the type of the node, and m is called the marker of this node: this marker is either the generic marker, denoted by $*$, if the node refers to an unspecified entity, otherwise this marker is a specific individual name.

The CGs model comprises also more complex constructs such as complex first order rules (equivalent to tuple generating dependencies in databases or Datalog+ rules) and default rules (which allow for non-monotonic reasoning).

Rules: a rule expresses implicit knowledge of the form “if hypothesis then conclusion”, where hypothesis and conclusion are both basic graphs. This knowledge can be made explicit by applying the rule to a specific fact: intuitively, when the hypothesis graph is found in a fact, then the conclusion graph is added to this fact.

Default rules: CGs default rules are based on Reiter's default logics in [3, 11]. They are defined by a tuple $DR = (H, C, J_1 \dots J_k)$, where H is called the hypothesis, C the conclusion and J_1, \dots, J_k are called justifications of the default. All components of DR are themselves basic CGs. The intuitive meaning of a CG default is: if H holds for all individuals, then C can be inferred, provided that no justification J_i (for all i from 1 to k) holds.

Negation in Conceptual Graphs is represented by the means of the negative constraints which are basic graphs with the semantic that if they occur in the knowledge base the knowledge base is inconsistent. Please note that this specific kind of negation is equivalent to the negation used by the OWL and Description Logics as well as the integrity constraints used by databases. We can also impose positive constraints, that is, pieces of knowledge that need to appear in the graph (and the fact that it does not appear renders the graph inconsistent). Both constraints will be used later on for modelling purposes.

In the following section let us introduce the basic ontology which will include the support of the CGs, rules of inference and constraints.

4 AIF Ontology for Argumentation Schemes

The backbone of the AIF Ontology is shown in Fig. 3 and follows the model of the ontology defined in [9]. The hierarchy of concepts includes on the top level: *Statements* that describe statements which could be issued, *Schemes* which describe arguments made up of statements. Three type of schemes are defined. The first

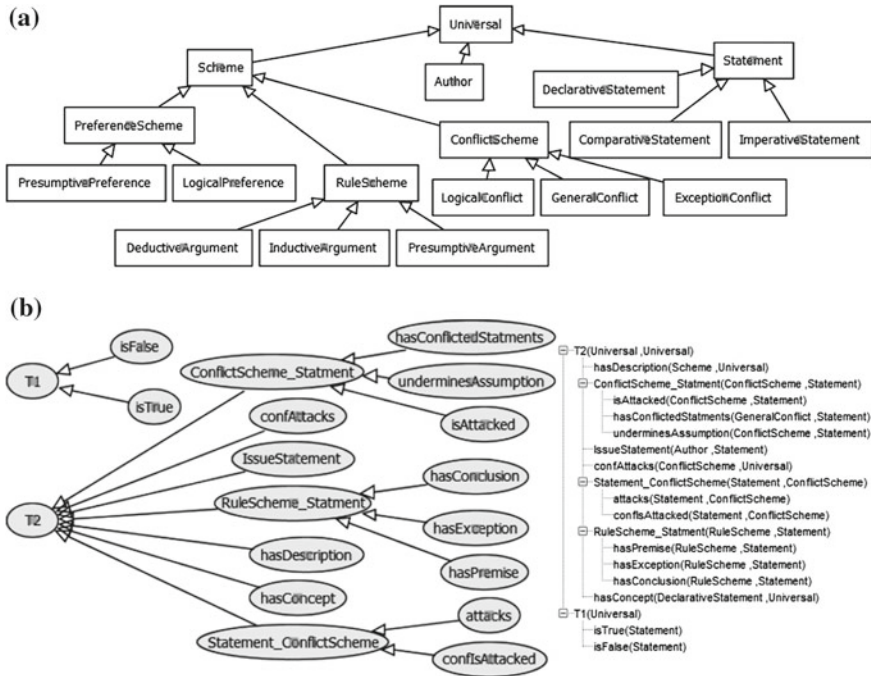


Fig. 3 AIF ontology. a Concept types. b Relation types

scheme is the rule scheme that defines types of arguments that could be defined. The second is a conflict scheme that represents the attack relations between arguments. The third is the preference scheme and it includes logical and presumptive preference. The relation types defined between arguments in *ruleScheme* and *Statements* are: *hasPremise*, *hasConclusion* and *hasException*. These relations denote that an argument may have premises, conclusions and exceptions respectively. A statement could attack a *conflictScheme* through the relation *attack* and could be attacked by this scheme with the relation *conflictAttacked*. Other relation types denote the facts that a statement may be true (*isTrue*) or false (*isFalse*).

After defining the backbone of concepts and relations, we need to impose the constraints to ensure model consistency. We use a positive constraint to say that every argument has at least one premise and one conclusion as illustrated in Fig. 4a. In order to ensure that every argument has at most one conclusion we use a negative constraint as shown in Fig. 4b.

Attacks among Arguments: Specializations of the concept *conflictScheme* are used to represent attacks among different arguments, *GeneralConflict* instances capture simple symmetric and asymmetric attacks among arguments, while *ExceptionConflict* instances represent exceptions to rules of inference.

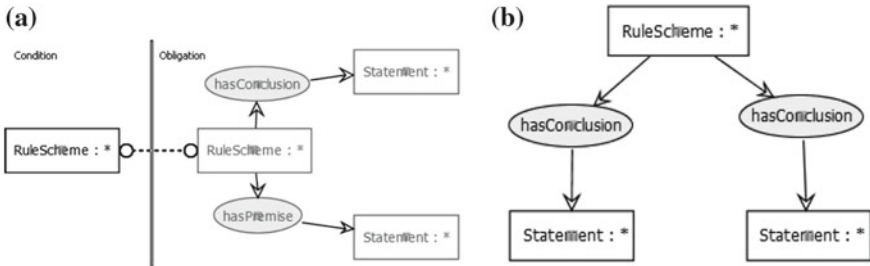


Fig. 4 Conclusion constraints. **a** Positive constraint. **b** Negative constraints

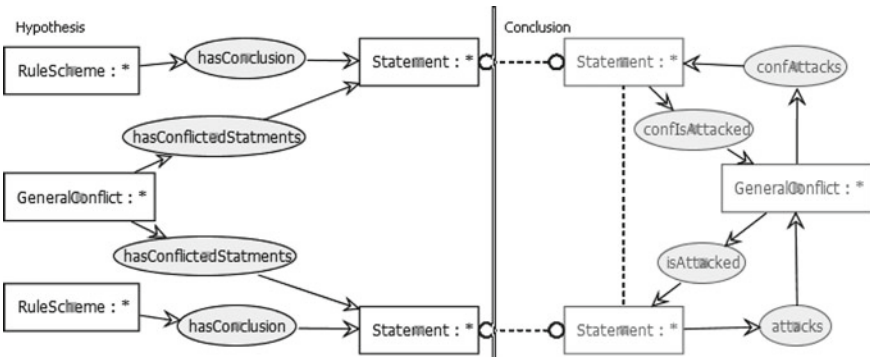


Fig. 5 Symmetric conflict rule

We first define the rule for the symmetric attack between two arguments as follows: if two statements S_1, S_2 belong to the concept *GeneralConflict* through the relation $hasConflictedStatements(GeneralConflict, Statement)$, i.e. there is a conflict between these two statements, and if one statement appears in the conclusion of argument A and the other appears in the conclusion of argument B, we say that there is a symmetric attack between the arguments A and B. Figure 5 illustrates the symmetric conflict rule. The rule semantics is as follows: *if* $\forall S_1, S_2 \in Statement, \exists GF \in GeneralConflict$, such that $hasConflictedStatements(GF, S_1), hasConflictedStatements(GF, S_2)$ and *if* $\exists A_1, A_2 \in RuleScheme$, such that $hasConclusion(A_1, S_1)$ and $hasConclusion(A_2, S_2)$ then there is a symmetric conflict defined by the relations: *confAttacks, confAttacked, attacks* and *isAttacked*.

In addition to the general conflict rule defined above, we define in Fig. 6a the rule that models the relation $hasConflictedStatements(GeneralConflict, Statement)$ as follows: when a statement S is plausible to be evaluated “true” and “false” at the same time, then the two instances of S : S_1 (evaluated “true”) and S_2 (evaluated “false”) belong to the relation $hasConflictedStatements$. Thus, having S_1, S_2 belong to the relation $hasConflictedStatements$ and using the previous rule we conclude that

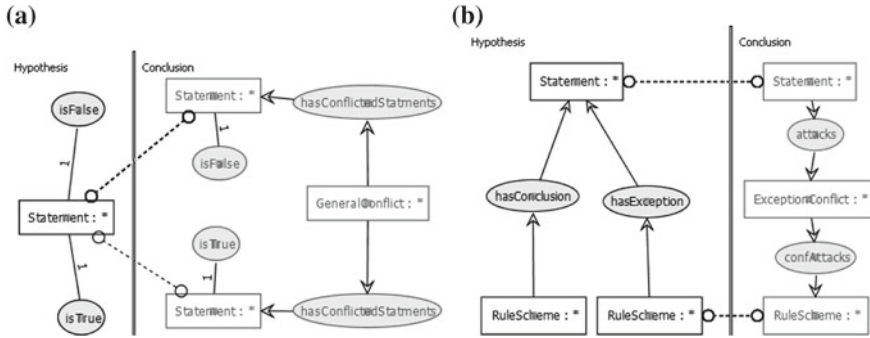


Fig. 6 Conflict constraints. **a** Statement contradiction. **b** Except conflict rule

if S_1 and S_2 appear in the conclusions of two arguments A and B, then there will be a symmetric attack between A and B.

The second type of conflict is the exception conflict (please see Fig. 6b), and this is the case when the statement is the conclusion of an argument A and at the same time the exception of other argument B. In this case the conclusion of the argument A attacks the argument B through the concept *ExceptionConflict*.

5 Modelling Argumentation Schemes

Our methodology for modelling new AS includes the following three steps:

- **STEP 1—Ontology enriching.** We enrich the vocabulary of our AIF Ontology with new concepts and relation types, add a concept that represent the new scheme as descendent of rule scheme and add concepts according to critical questions.
- **STEP 2—Rules definition.** We define the rules of inference that will enable AS inference (i.e. identifying the schemes) and critical questions inference.
- **STEP 3—Default rules definition.** We introduce the default rules that will define the non-monotonic reasoning. The generic inference rule used is defined as follows: “If an argument conforms to an AS, we conclude that its conclusion is true, unless one of its exceptions holds”.

Let us now explain how we apply this methodology in order to define three Argumentations Schemes.

6 COGUI Implementation of Argumentation Schemes

6.1 Argument from Expert Opinion

In many forms of arguments people cite an authority to back up their point of view. In other words they indicate that someone (the authority cited) could give reasons that back up the statements they defend. This form of arguments is called “appeal to authority” or “argument from position to know”. Depending on the type of the cited authority, the AS would be “Argument from Expert Opinion” if the authority is an expert, or “Argument from Witness Testimony”, if the person is a witness in the situation at hand. This type of arguments comes with common critical questions such as questioning the reliability of the authority, more precisely: is the cited person an authority? or is the authority an authority in the domain under discussion?

We will model the scheme “argument from expert opinion” as a sub-scheme of the scheme “argument from position to know” (for the lack of space, we will not present the full modeling of “argument from position to know”, and only a part of it is depicted in the motivating example). The Scheme [14] has the following elements:

- **Expertise premise:** The source E is an expert in the domain D that is containing proposition A.
- **Assertion premise:** E asserts that A is true (false).
- **Conclusion:** A may plausibly be taken to be true (false).

Critical questions are:

1. Expertise: How credible is expert E?
2. Trustworthiness: Is E reliable?
3. Consistency: Is A consistent with the testimony of other experts?
4. Backup evidence: Is A supported by evidence?

We model this scheme as follows:

- STEP 1—Ontology enriching. We add a concept named *ArgFromExpert Opinion* to represent the scheme as descendent of rule scheme. In order to model the expertise premise, we add the concept *ExpertStmnt* as descendent of *DeclarativeStatement*. This statement is translated as an *Expert* E issues a *Statement* through the relation *IssueStatement*, and the issued statement belongs to a *domainOfExperience* in which E has enough expertise. The statement *AssertionStmnt* denotes that E asserts that A is true (false) which is the assertion premise, and also denotes the conclusion of the argument which is A may plausibly be taken to be true (false).
- STEP 2—Rules definition. The rule could be written as: “if a rule scheme *R* has a premise of type *ExpertStmnt* and has a premise of type *AssertionStmnt* which is also its conclusion then *R* belongs to *ArgFromExpertOpinion*”. This is formally depicted in Fig. 7.

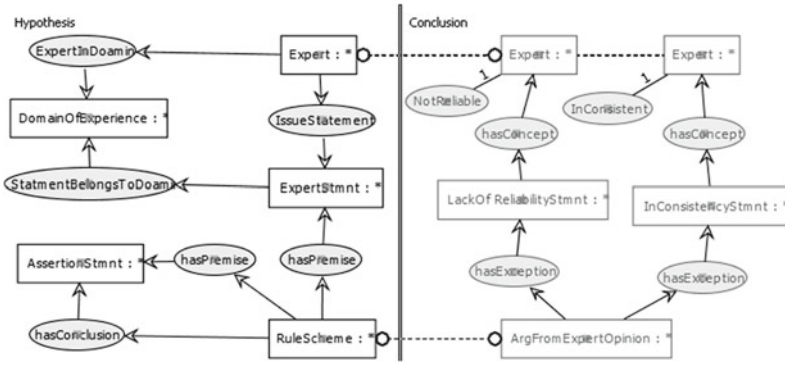


Fig. 7 Expert rule

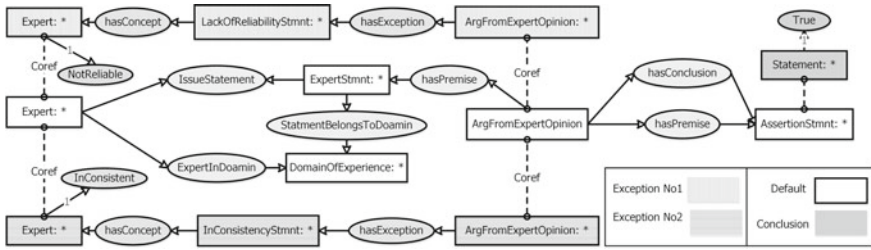


Fig. 8 Expert default rule

- STEP 3—Default rules definition. The default rule is formulated as: “If a statement *S* is issued by an expert *E* in the domain of the statement *S*, we conclude that *S* is true, unless for example the expert *E* was not reliable or inconsistent with other experts”. Figure 8 depicts this rule.

6.2 Argument from Analogy

The AS for argument from analogy can be represented as follows (please see [15] for more details):

- **Similarity Premise:** Generally, case C1 is similar to case C2
- **Base Premise:** A is true (false) in case C1.
- **Conclusion:** A is true (false) in case C2.

The critical questions which are:

1. Are C1 and C2 similar in the respect cited?
2. Are there differences between C1 and C2 that would tend to undermine the force of the similarity cited?

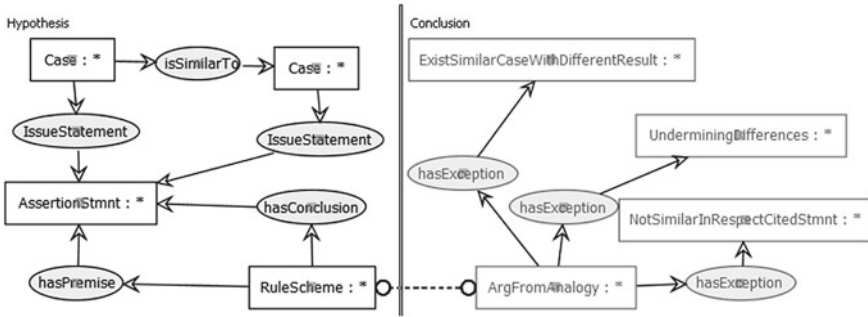


Fig. 9 Analogy rule

3. Is there some other case C3 that is also similar to C1, where A is false (true)?

The COGUI methodology to implement this scheme is as follows:

- STEP 1—Ontology enriching. Since we consider two similar cases C_1, C_2 , we obviously need to add the concept *Case* and the relation *isSimilarTo*. We also refer to the fact that a statement S is true in case C by stating that: S is issued by the *Case C*. Thus, the argument could be written as follows: if a statement S is issued by a case C_1 , and if C_2 is similar to C_1 , then S will be also considered as issued by the case C_2 . We finally need to add the concepts *NotSimilarInRespectCited*, *UnderminingDifferences*, and *ExistSimilarCaseWithDifferentResult* for representing the three critical questions respectively.
- STEP 2—Rules definition. The rule could be written as: “if a rule scheme R has first premise: statement S is issued by case C_1 , and if R has a second premise: there exists a case C_2 which is similar to C_1 , and has a conclusion: the statement S is also issued by case C_2 , then the scheme R belongs to *ArgFromAnalogy*”. This is formally depicted in Fig. 9.
- STEP 3—Default rules definition. The default rule for this scheme could be formulated as: “if a statement S is issued by a *Case C1* and if exists a case C_2 which is similar to C_1 , then we conclude that S is true in case C_2 , unless the similarity was not in the respect cited, or there were undermining differences, or if there exists a case C_3 which is similar to C_1 and in which S is not true (false)”. Figure 10 depicts a COGUI modelling of this rule (in order to have a readable and less complicated diagram we consider only two of the exceptions: *NotSimilarInRespectCited* and *ExistSimilarCaseWithDifferentResult*).

6.3 Argument from Popular Opinion

The argument from popular opinion as described by [14] is: If a large majority (everyone, nearly everyone, etc.) accepts A as true, this would be evidence that A is generally accepted. The structure of the scheme include the following elements:

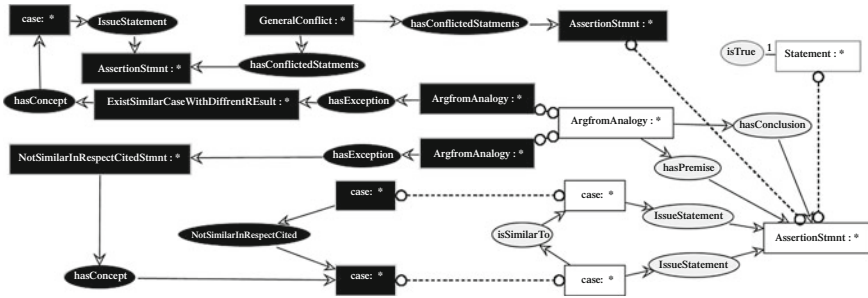


Fig. 10 Analogy default rule

- **General acceptance premise:** A is generally accepted as true.
- **Presumption premise:** If A is generally accepted as true, it gives reason for A.
- **Conclusion:** There is a reason in favor of A.

The following two critical questions match the scheme:

1. What evidence, such an appeal to common knowledge, supports the claim that A is generally accepted as true?
2. Even if A is generally accepted as true, are there any good reasons for doubting that it is true?

The COGUI methodology to represent this scheme is as follows:

- **STEP 1—Ontology enriching.** We refer to the fact that the statement *S* is generally accepted by public opinion by stating that: *S* is issued by *PublicOpinion*. Therefore, the statement *S* is the premise and the conclusion of the rule scheme. Consequently we enrich our ontology with the concepts *ArgFromPublicOpinion* and *PublicOpinion*. We need also to add the concept *LackOfEvidence* and the relation *issuedWithLackOfEvidence(statement)* for the first critical question, and the concept *ExistGoodReasonsForDoubting* and relation *hasGoodReasonsForDoubting(statement)* for the second critical question.
- **STEP 2—Rules definition.** The rule could be written as: “if a statement *S* is issued by a *PublicOpinion* and if *S* is the premise and the conclusion of a rule scheme *R*, then *R* belongs to *ArgFromPublicOpinion*”. This is formally depicted in Fig. 11.
- **STEP 3—Default rules definition.** The default rule for this scheme could be formulated as: “if a statement *S* is issued by a *PublicOpinion*, we conclude that *S* is true, unless there is a lack of evidences or there is good reasons for doubting”. Fig. 12 includes a modeling of this rule.

Acknowledgments The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007–2013) under the grant agreement no FP7-265669-EcoBioCAP project.

References

1. Baader, F., Calvanese, D., McGuinness, D.L., Nardi, D., Patel-Schneider, P.F. (eds.): *The Description Logic Handbook: Theory, Implementation, and Applications*. Cambridge University Press, Cambridge (2003)
2. Baget, J.-F., Croitoru, M., Fortin, J., Thomopoulos, R.: Default conceptual graph rules: preliminary results for an agronomy application. In: ICCS. Springer, Berlin (2009)
3. Boley, H., Kifer, M., Patranjan, P.-L., Polleres, A.: Rule interchange on the web. *Reasoning Web*, pp. 269–309. Springer, Berlin (2007)
4. Buche, P., Cucheval, V., Diattara, A., Fortin, J., Gutierrez, A.: Implementation of a knowledge representation and reasoning tool using default rules for a decision support system in agronomy applications. In: GKR, pp. 1–12. Springer, Switzerland (2013)
5. Chein, M., Mugnier, M.-L., Croitoru, M.: Visual reasoning with graph-based mechanisms: the good, the better and the best. *Knowl. Eng. Rev.* **28**(3), 249–271 (2013)
6. Chesñevar, C.I., McGinnis, J., Modgil, S., Rahwan, I., Reed, C., Simari, G.R., South, M., Vreeswijk, G., Willmott, S.: Towards an argument interchange format. *Knowl. Eng. Rev.* **21**(4), 293–316 (2006)
7. Grosz, B.N., Horrocks, I., Volz, R., Decker, S.: Description logic programs: combining logic programs with description logic. In: *Proceedings of the 12th International Conference on World Wide Web*, pp. 48–57 (2003)
8. Mugnier, M.-L., Chein, M.: *Graph-based knowledge representation*. Advanced Information and Knowledge Processing. Springer, London (2009)
9. Rahwan, I., Banihashemi, B., Reed, C., Walton, D., Abdallah, S.: Representing and classifying arguments on the semantic web. *Knowl. Eng. Rev.* **26**(4), 487–511 (2011)
10. Rahwan, I., Zablith, F., Reed, C.: Laying the foundations for a world wide argument web. *Artif. Intell.* **171**(10–15), 897–921 (2007)
11. Reiter, R.: A logic for default reasoning. *Artif. intell.* **13**(1), 81–132 (1980)
12. Sowa, J.F.: *Conceptual Structures: Information Processing in Mind and Machine*. Addison-Wesley, Boston (1984)
13. Walton, D.: *Argumentation Schemes for Presumptive Reasoning*. Psychology Press, London (1996)
14. Walton, D.: *Fundamentals of Critical Argumentation*. Cambridge University Press, Cambridge (2006)
15. Walton, D., Reed, C., Macagno, F.: *Argumentation Schemes*. Cambridge University Press, Cambridge (2008)

Knowledge Discovery and Data Mining