Argumentation and explanation in the context of dialogue

Floris Bex¹ and Katarzyna Budzynska²

Abstract. Whilst computational argumentation and computational explanation have both been studied intensively in AI, models that incorporate both types of reasoning are only just starting to emerge. The two forms of reasoning need to be clearly distinguished, as they may influence dialogue protocol and strategy. We show that this distinction can be made by considering the speech acts used to put forth the reasoning structures. Using the language of the Argument Interchange Format, ideas from speech act theory are integrated into a conceptual model that allows us to perform both argumentative and explanatory reasoning.

1 INTRODUCTION

Reasoning can be characterized as the process of moving from certain starting statements, assumptions or premises, to other statements, conclusions [17]. At the same time, reasoning is also the outcome of this process (i.e., the product), a static structure. Reasoning is typically used in the context of argumentation, where premises are offered as proof of a conclusion or a claim often in order to persuade someone or settle an issue. However, reasoning is also used in the context of explanation, where the explanans (facts to be explained) are explained by a coherent set of explananda (facts that explain). The usual purpose of explanation is not necessarily to convince someone but rather to help someone understand why the explananda are the case. In this paper, we aim to explore the similarities and differences between argumentation and explanation and make a first step towards an integrated computational model of the two.

Both argumentation and explanation are well-presented in their respective sub-fields of AI. A number of computational models of argumentation have emerged and matured in the past twenty-or-so years [10] and the computational aspects of the dialectics of argument (cf. [6]) and of the structure of argument [9] are well understood. Computational models for explanation are mainly based on the technique of abductive (model-based) reasoning, which has been studied in the context of medical and system diagnosis (e.g. [3, 8]); other examples of computational explanation are [4], who models explanatory dialogues, and [14], who uses explanations for natural language understanding. Despite the important role explanations can play in argumentative dialogue, there have not been many attempts to combine argumentation and explanation into one formal model. Perhaps the most thorough work thus far is [2], who combines structured arguments (cf. [10]) with abductive-causal reasoning into one model of inference to the best explanation. Other formal work that mentions both explanation and argumentation is [8].

Argumentation and explanation are often used in concert when performing complex reasoning: explanations can themselves be the subject of argumentation or they may be used in an argumentative way. Hence, we need a model that integrates argumentation and explanation. In such a model, the two types of reasoning should be clearly distinguished, because argumentation and explanation have different properties and in a dialogical setting the difference can influence protocol and strategies of dialogue. This distinction is not always easy to make because of the overlap between argumentation and explanation and the shifting between them in complex dialogue. It is even more complicated in the case of “reasoning-as-product”, that is, distinguishing between static arguments and explanations, which often have a similar (logical) structure.

In our opinion, the only way to distinguish between argumentation and explanation is by looking at the context in which the reasoning was originally performed. In this paper, we concentrate on the contextual property of the intention of the speaker. We are interested in how to represent the connection between the intentions and the static reasoning structure under consideration. In this paper, we show that this connection can be made by using ideas from speech act theory [15]. More specifically, not the propositional contents of a speech act (i.e. that which forms the static reasoning structure) but rather the illocutionary force of the speech act in a dialogue determines whether reasoning is argumentation or explanation. We will use the conceptual model of the Argument Interchange Format [5, 12] so as to provide a model that is not tied to any specific dialogue or argument formalism.

The rest of this paper is organized as follows. In section 2 we elaborate on the (structural and contextual) similarities and differences between argumentation and explanation and we give some intuitive examples of both types of reasoning. Section 3 discusses our ideas for a conceptual framework for argumentation and explanation. Finally, section 4 discusses some preliminary conclusions and ideas for future research.

2 SIMILARITIES AND DIFFERENCES

Argumentation is a type of reasoning used in a specific probative function, to prove a claim [17]. By its very nature, it involves some sort of opposition between parties¹ and reasons are not just given to support for a conclusion but also to remove an opponent’s doubts about this conclusion. For example, a reasoningα ⊢ β is argumentation when β is questioned (dubious) and a proponent of this argument uses α not only to support β, but also to remove an opponent’s doubts about β. Explanation, on the other hand, has not as its main goal to prove but rather to explicate why something is the case. Explanation

¹ Hence the use of the term “calculi of opposition” for argumentation-theoretic semantics that allow one to calculate the acceptability of arguments.
in its purest form is not inherently dialectical and an explanation is
given to help the other party, not to convince them. Consider the fol-
lowing example. Say I arrive at work at ten in the morning and my
boss asks why I am late. I can either explain to him that the bridge
was open and that I had to wait or I can argue that I am not “late”,
because my contract does not specify the exact hours I have to be at
the office. In first case, I am answering my boss’ question by explain-
ing to him what caused my being late. In the latter case, I am arguing
against my boss claim that I am late.

Argumentation and explanation are often used in conjunction. Ex-
planations can themselves be the subject of argumentation, as one
may argue in support or in opposition of a particular explanation or
parts of it. For example, if my boss questions my explanation by ar-
guing that I never cross a bridge on my way to work, I can argue (e.g.
by providing evidence) that I do. Furthermore, explanations may be
used in an argumentative way, as having someone agree to a partic-
ular explanation of a phenomenon might help us to persuade them.
For example, if my boss accepts my explanation for being late I might
convince him not to fire me.

Because argumentation and explanation are often intertwined in
complex reasoning, they can sometimes be hard to distinguish from
one another. However, it is important that we do distinguish the two
types of reasoning. Apart from providing a measure of conceptual
neatness, there are also more concrete reasons for not confusing the
two types of reasoning. One of them is that circular arguments
are usually considered fallacious while circular explanations are not.
Take [18]’s recession example. An economist is asked why the econ-
omy is in recession in a certain state at present, and she replies:
“Right now a lot of people are leaving the state, because taxes are
too high”. But when asked why taxes are so high, she responds:
“Well, a lot of people are unemployed, because of the recession”.
The economist has not committed the fallacy of arguing in a circle,
“Well, a lot of people are unemployed, because of the recession”.

One possible way of distinguishing between argumentation and
explanation might be to look at the product of reasoning, that is, the
argument and explanation is that the type of reasoning used might
influence the allowed and desired moves in a dialogue. The ways in
which to correctly respond to an explanation are different from the
ways in which one should respond to argumentation; for example, it
does often not make sense for the other party to deny the explananda
whilst it does make sense to deny the conclusion of an argument.
Similarly, a request for information is often better met by explaining
something than by arguing that something is the case.

One possible way of distinguishing between argumentation and
explanation might be to look at the product of reasoning, that is, the
argument or the explanation put forth, and the structure and type of
this product. At first sight, it often seems an explanation is abductive
and causal whilst an argument is modus-ponens style, non-causal
reasoning. The basic idea of abductive inference is that if we have a
general rule \( \alpha \rightarrow \beta \), meaning \( \alpha \) causes \( \beta \), and we observe \( \beta \), we are allowed to infer \( \alpha \) as a possible explanation of \( \beta \). In contrast,
argumentation is often seen as reasoning from a premise \( \alpha \) to a
conclusion \( \beta \) through an inference rule \( \alpha \rightarrow \beta \), where this rule need
not necessarily be causal. However, as it turns out it is also possible
to give abductive or causal arguments (see e.g. [19]’s argument from
evidence to hypothesis and causal argument). Similarly, one may per-
form explanatory reasoning by taking a rule \( \beta \rightarrow \alpha \), meaning \( \beta \) is
evidence for \( \alpha \) (see [2] for a discussion on evidential and causal rea-
soning).

In our opinion, the distinction between argumentation and expla-
nation is not one that is inherent to the product of reasoning, the static
structure. Rather, the distinction follows from the dialogical context
in which the reasoning was originally performed. In order to deter-
mine this context, we need not just look at the original intention of
the speaker but also at the broader dialogical context, such as the ut-
terance that was replied to by the speaker and the intentions of the
other participants. In other words, the context is largely determined
by the speech acts that were performed (see e.g. [16] for the very
basic concepts of the speech act theory needed in this paper).

According to the pragmatic theory of speech act, argumentation and
explanation can be treated as different speech acts. A speech act
\( F_{\alpha} \), such as: claim, why?, consists of an illocutionary force \( F \) and
a propositional content \( \alpha \). An illocutionary force is an intention
of uttering a propositional content. That is, the performer of a speech
act may utter \( \alpha \) with an intention of asserting, asking, promising and
so on.

Originally, Searle & Vanderveken recognized argumentation as an
instance of content’s property, i.e. argue is a speech act consisting
of an assertive illocutionary force of uttering \( \alpha \) which is a conclu-
sion intended to be supported by premises that the performer of the
speech act provides: “When one argues that \( P \) one asserts that \( P \)
and gives reasons which support the proposition that \( P \), normally with
the perlocutionary intention of convincing the hearer that \( P \)” [16, p.
184]. Observe that in such an account premises of a reasoning are
hidden. For example, the argumentation “I am not late, because my
contract does not specify the exact hours I have to be at the office”
has to be formalized as argue, where \( p \) represents the conclusion “I
am not late”, while the premise “My contract does not specify the
exact hours I have to be at the office” remains unexpressed in the
formalization.

We use a different approach proposed in [1], where argumentation
and explanation are both instances of illocutionary acts that repre-
sent a relation between premises and conclusions: argue(\( \alpha, \beta \)) and
explain(\( \alpha, \beta \)), where \( \alpha \) denotes a conclusion and \( \beta \) denotes premises.
The distinction between argumentation and explanation cannot just
be made by looking at the original speech act; one also needs to con-
sider the broader dialogical context. In the next section, we show how
this can be represented in the AIF+.

3 SPECIFICATION IN THE AIF+

In this section, we present how in general the AIF+ describes argu-
ment and its context (Section 3.1). Then, we propose how to model
argumentation and explanation in the AIF+ (Section 3.2) and finally
we show how they can be represented as a context of reasoning (Sec-
 tion 3.3).

3.1 Architecture of the AIF+

The AIF+ [13] is a dialogical extensions to the Argument Interchange
Format, AIF (see e.g. [5]). The AIF is an attempt to bring together
a wide variety of argumentation technologies so that they can work
together. The AIF+ extends this approach by allowing to explicitly
handle the context of dialogue in which a reasoning is put forth. It en-
ables to connect the locutions uttered during a dialogue (argument\(_2\))
and the underlying arguments expressed by the content of those lo-
cutions (argument\(_1\))

In the AIF+, the argument, is represented by two kinds of nodes:

- information (I-) nodes, which refer to data, and
- scheme (S-) nodes, which refer to the passage between informa-
tion nodes, which are classified into three groups:
  - rule application (RA-) nodes which correspond to inference or
    support,
conflict application (CA-) nodes which correspond to conflict or refutation,

preference application (PA-) nodes which correspond to value judgments or preference orderings.

The argument is also described by two types of nodes:

- location nodes (L-), which refer to utterances and constitute a subclass of information nodes, and
- transition application (TA-) nodes, which refer to the passage between locations and constitute a subclass of rule application nodes.

The TA-nodes are governed by the protocol of a dialogue system, recording e.g. that a given assertion has been made in response to an earlier question [12] shows two examples of protocols that can be represented in the AIF+: the Two Party Immediate Response (TPR) [7] and Argument Scheme Dialogue (ASD) [11].

The interaction between argument and argument is captured by means of two types of illocutionary application (YA-) nodes [12]:

- the YA-nodes between I-nodes and L-nodes, and
- the YA-nodes between RA-nodes and TA-nodes.

For example, an YA-node may represent the relation between an assertion claims with its propositional content \( \alpha \). The YA-link is determined and warranted (authorized) by the constitutive rules for speech acts [15]. These rules determine what constitutes a successful speech act. For example, an assertion may be unsuccessful and attacked, if its performer did not have enough evidence for the statement or he declared what he actually disbelieves.

3.2 YA-nodes

In this section, we propose the specification of argumentation and explanation in the AIF+. We will illustrate it on the example adapted from [18].

Allen The Evanston City Council should make it illegal to tear down the city’s old warehouses.
Beth What’s the justification for preserving them?
Allen The warehouses are valuable architecturally.
Beth Why are they so valuable?
Allen The older buildings lend the town its distinctive character.

Walton points out that Allen’s first response is argumentation, while a second one is explanation. We follow this assumption without further considerations.

In the dialogue between Allen and Beth (see Fig. 1), the argument consists of five speech acts represented by I-nodes (we use abbreviation L to denote subsequent location nodes). The argument consists of three propositions represented by I-nodes (I; means subsequent information nodes). The interaction between the arguments and the argument, is described by means of the YA-nodes. The speech acts L1, L2, L3, and L4 have assertive illocutionary force connecting them with propositional contents I1, I2, and I3, respectively. The passage between L1 (resp. L2, L3) and L1 (resp. L2, L3) is represented by YA1 (resp. YA2, YA3). The illocutionary node YA4 (resp. YA5) links the directive L5 (resp. L6) and its propositional content I5 (resp. I6); not all YA-nodes are assertive schemes.

The most interesting is the complex type of illocutionary force which could be treated as intention of arguing and explaining. In the AIF+, the complex illocution is represented by the YA-nodes between RA-nodes and TA-nodes [12]. In Fig. 1, there are two such nodes: YA3 and YA5. According to the assumption made above, YA3 corresponds to argumentation and YA5 to explanation. The illocution YA5 links Allen’s response to Beth’s challenge (i.e. TA2) with the argument “The warehouses are valuable architecturally” for the claim “The Evanston City Council should make it illegal to tear down the city’s old warehouses” (i.e. RA1). This captures the intuition that Allen’s argumentation is invoked by Beth’s challenge. On the other hand, the illocution YA3 links Allen’s response to Beth’s request for information (i.e. TA1) with the explanation “The older buildings lend the town its distinctive character” for the claim “The warehouses are valuable architecturally” (i.e. RA3). This captures the intuition that Allen’s explanation is invoked by Beth’s request for information.

Observe that we could represent argumentation and explanation as YA3 and YA7, respectively. However, in such a representation they are indistinguishable from simple assertion. Assigning argumentation and explanation to the TA- and RA-nodes captures the intuition that they are social processes that emerge from the interaction between agents such that one agent responds to interlocutor’s request for justification or explanation.

3.3 Context of reasoning

In Section 2, we emphasized that argumentation and explanation can be distinguished not by the structural properties of an underlying reasoning, but by its contextual properties. In this section, we propose how to model argumentation and explanation as a context of reasoning.

In the AIF+, the context of reasoning structure is represented by argument in which a reasoning was performed, as well as by the interaction between argument and argument. The structural indistinguishability of argumentation and explanation means that the same structure may be either argumentation or explanation depending on the intentions of the speaker who performed a given speech act. Consider the following dialogue between John and Ann.
John: The warehouses are valuable architecturally.
Ann: Why? I don’t think so!
John: The older buildings lend the town its distinctive character.

Observe that in this dialogue we have the same reasoning structure (argument) as in the previous dialogue: “The warehouses are valuable architecturally, since the older buildings lend the town its distinctive character”, however, the intentions of providing the premise are different in the case of John and in the case of Allen. That is, John utters the premise “The older buildings lend the town its distinctive character” to argue (prove) the conclusion “The warehouses are valuable architecturally”, while Allen utters the same premise to explain (make understandable) the conclusion.

REFERENCES

4 CONCLUSIONS AND FUTURE WORK
In the paper, we propose the basic framework for representing argumentation and explanation as the context of reasoning with the use of the AIF++ language. We propose to model them as the YA-nodes that link together the TA-nodes and the RA-nodes. The TA-nodes correspond to the response of an interlocutor in a dialogue that consists in giving the justification (in the case of argumentation) or explanation. The RA-nodes correspond to the reasoning structure which originates from the interaction between interlocutors in a dialogue. Thus, we show how illucutionary force can be used to distinguish between the two types of reasoning. This presents a good basis for further research on the subject. In particular, it would be interesting to see how the semi-formal AIF+ specification relates to a more formal framework for argumentation and explanation, such as [2].

ACKNOWLEDGEMENTS
We gratefully acknowledge the support of EPSRC under grant EP/G00347/1 for Floris Bex, and the support from Polish Ministry of Science and Higher Education under grant N N101 009338 for Katarzyna Budzynska.