A Quick Start Guide to Inference Anchoring Theory (IAT)

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May 2, 2022

Segmentation

Segmenting text (or transcribed speech) into units called *argumentative discourse units* (ADUs) is described in two parts. First, we describe analysing propositions: the contents of individual utterances. After describing relations between such propositions, we then return to the issue of segmentation to complete the description of how to map from original text to analysis, by looking at *locutions*.

- An *argumentative discourse unit* (ADU) is any text span which (a) has a **propositional content** anchored in either the locution (ADU) itself or a transition targeting this locution, regardless of whether or not that content is atomic; and (b) has **discrete argumentative function**, in that the propositional content stands in relation to one or more other propositions via one or more instances of inference, conflict or rephrase (described in Section 2).

1 Propositions

1.1 **Basics** Punctuation, delimitation, discourse indicators and other extraneous material that occurs at the boundaries of ADUs are always excluded from the ADU proper

1.2 **Reconstruction** Anaphoric references are typically reconstructed in the text associated with a proposition (i.e. the original text is edited to resolve, e.g., pronouns). The reconstructed ADU should have a form of full grammatical sentence (with subject, predicate, etc.) and should be understandable without the context of what previously has been said, but you should stay as close as possible to what originally has been said, i.e. include as little implicit material as possible.

1.3 **Reconstruction** Propositional content has to be always a sentence – it has have a subject, a verb, a predicate, etc. In other words, you have to reconstruct the missing, implicit material like with anaphoric references. For instance, for the utterance "I didn't say that", you have to reconstruct what she didn't say using the material before this utterance, e.g. if Trump said to Clinton "You said before that taxes should be increased" and she responds "I didn't say that" the propositional content of Clinton's EDU should be: "Clinton didn't say that taxes should be increased". **Exception: the pronoun "we" is not resolved.**

1.4 **Reconstruction** Do as much reconstruction as possible so that you end up with a full sentence which will be understandable without any context, i.e. without knowing what has been said before. At the same time, do as little reconstruction of an implicit material as possible so that you stay close to the original text which you annotate. Think about someone else looking at your analysis without the context of when and who said that. Apply test: "*Will this person be able to understand this sentence?*", i.e. whether this person will understand the argument when looking at the annotation which shows "I didn't say that" as an element of it (who didn't say and what wasn't said?). One the other hand you don't want to over-interpret - this way you might associate a speaker with a standpoint to which they didn't really committed themselves.

1.5 **Splitting** Utterances such as "Yes, but A" (or "No, A") have two segments: "Yes" and "A" ("No" and "A" resp.)

1.6 **Splitting** In many cases, a span will combine clauses that could be identified as separate ADUs. Examples include conjunctions ("A and B"), conditional clauses ("If A then B"), epistemic modalities ("I think that A") and ted speech ("Bob said that A"). In every case, each span with discrete argumentative function should be analysed separately. That said, each category is also associated with a most typical segmentation:

(a) Conjunctions are typically analysed as the two constituent conjunct ADUs because the conjunction itself rarely has discrete argumentative function (except in cases such as 'and'-introduction)

(b) The analysis of conditionals varies: any combination of the three spans ("If A then B", "A", and "B") might have discrete argumentative function

(c) Epistemically qualified statements are typically analysed as a single segment that drops the epistemic modality – e.g. "I think that A" is typically analysed as just, "A"

(d) Reported speech is almost always analysed into two ADUs the first corresponding to the complete span and the second to what was reported to have been said

> **Interruptions** In OVA+, interposed text can present a problem, e.g., "the liquid, because it is so dangerous, is not allowed in the building". In such cases, the text that is interrupted should be identified as one segment, and the interposed text as the other – i.e., in this example, there are two segments: (a) "the liquid, because it is so dangerous, is not allowed in the building"; and (b) it is so dangerous. The first of these two can then be edited to remove the interposed text.

> **Interruptions** In the case of interposed word order that interacts with reported speech such as "Bob, who is an expert, said A", the same rules are applied, allowing three segments to be identified: "Bob, who is an expert", "A", "Bob said A", (the last one is obtained by selecting the whole span of text and then by editing the node to delete "who is an expert")

2 Propositional relations

Relations between propositional contents are about a speaker's (intended) use of linguistic material. It is important that as analysts, we allow arguers to express not just good arguments, but poor, weak, incoherent and fallacious arguments. We are asking ourselves if a speaker intended the content of her utterance to be understood to be related to previous material in a given way.

2.1 **Inference (Support, Default Inference, RA)** Holds between two propositions when one proposition is used in order to provide a reason to accept another proposition. Support may be of a specific kind, depending on the theoretical context an analyst is working in – Modus Ponens, Argument from Expert Opinion, and (the prima facie reasoning from) Perception are all examples of such kinds. If a support relation is not associated with a specific kind, it defaults to 'Default Inference.' Any given support is thus an Application of some Rule of inference, hence RA.

There can be several inference structures identified, with examples provided in the accompanying document:

(a) **Serial arguments** Serial arguments occur when there is an inference relation from a first proposition to a second proposition, and another inference relation from the second proposition to a third proposition.

(b) **Convergent arguments** Convergent arguments occur if there is an inference relation from a first proposition to a second proposition, and an independent inference relation from a third proposition again to the same second proposition.

(c) **Linked arguments** Linked arguments occur if there is an inference relation from a first proposition together with a second proposition to a third proposition.

(d) **Divergent arguments** Divergent arguments occur if there is an inference relation from a first proposition to a second proposition, and an independent inference relation from the first proposition to a third proposition.

2.2 **Conflict (Attack, Default Conflict, CA)** Holds between two propositions when one proposition is used in order to provide an incompatible alternative to another proposition. Conflict may also be of a given kind (e.g., Conflict from Bias, Conflict from Propositional Negation) and defaults to 'Default Conflict.' Note that conflict need not be symmetric. Some kinds (such as Conflict from Propositional Negation) typically are symmetric, which must be captured with two distinct Conflict relations, one in each direction. In contrast to inference, conflict is always structurally the same – it

has only one incoming and one outgoing edge.

There can be a few conflict structures identified, with examples provided in the accompanying document:

(a) **Rebutting Conflict** If a conflict relation targets a proposition (indicating the latter is not acceptable), then the conflict is rebutting.

(b) **Undermining Conflict** If a conflict relation targets the premise of another argument, then the conflict is undermining.

(c) **Undercutting Conflict** If a conflict relation targets the inference relation between two propositions, then the conflict is undercutting.

2.3 **Rephrase (Default Rephrase, MA)** Holds between two propositions when one proposition is used to rephrase, restate or reformulate another proposition. Rephrasing is not repeating: repetition involves multiple utterances with the *same* (i.e. just a single) propositional content. Rephrase involves different propositions connected through a variety of different relations, such as Specialisation, Generalisation, Instantiation, etc. Question answering often involves rephrasing because the propositional content of a question is stereotypically instantiated, resolved, or refined by its answer. In contrast to inference, rephrase is always structurally the same – it has only one incoming and one outgoing edge.

In contrast, conflict (CA) and rephrase (MA) structures are always the same – they have only one incoming and one outgoing edge.

3   Locutions

ADUs are typically directly analysed as *locutions* with an eye on both their propositional content and their discrete argumentative function. One locution typically has one propositional content (to which it is connected by illocutionary connections – see section 5).

Locutions typically have speakers (a term we use to encompass utterers in any medium) and may also have timestamps.

3.1 **Basics** ADUs expressing propositions may overlap and need not be minimal

3.2 **Reconstruction** Ellipsis, pronominalisation, etc., should not be reconstructed in the ADU (which should be simply a span of the original discourse material as uttered); however they *should* be reconstructed in the expression of the propositional content

3.3 **Speakers** Particularly in analysis of dialogues, speakers of particular utterances are identified as part of text of locutions by a convention: "SPEAKER: *ADU*". You should try to go back in the transcript backwards to try to identify the speaker, if it is not immediately clear. In case it is impossible, include as a name "Unknown" as the first name and "Speaker" as the last name.

> In OVA, you can associate a locution with either a pre-existing speaker or a new speaker – in the latter case you can type in the forename and surname (with usual capitalisation) which OVA will then prepend with a colon to the locution content. Once you've added a new speaker they'll be available for subsequent selection.

> Locutions should be created in order as they temporally appear in the transcript, and kept in that order on the right hand side.

> The maps should be clearly laid out, without too many overlapping nodes and edges

4 Transitions

Transitions (TA) connect locutions.

4.1 **Basics** A transition captures a response or a reply and embodies a functional relationship between predecessor locution and successor locution. TAs capture temporal relation as well, but only to a very limited extent - in the sense that the response will always happen later than the locution to which it responds. But the response can refer to something that happened much earlier in the dialogue.

4.2 **Types of TAs** Transitions are of many types, though there are not many good names for these types – our example is *substantiating* used in responding to a challenge. These types of transitions available in a given dialogue type (or context, or activity type) is governed by the protocol in use in that context. A protocol (or dialogue game) is a high level specification of the set of transition types that are available. Usually in practical analysis, TAs are left untyped, and default, therefore, to "Default Transition". Each instance is an Application of a scheme of Transition, hence TA node

4.3 **Adjacency** Transitions often hold between adjacent segments, but not always – a significant minority capture long-distance relationships in cases where, for example, a claim is returned to and given additional support, or an earlier question is refined, and so on. On the other hand, because transitions capture a functional response relation, they never hold in opposition to temporal flow. That is, the directionality of transitions is the same as the temporal ordering. Because the transition structure is branching, however, it is not necessarily possible to reconstruct an absolute ordering over all locutions from TA connections alone

4.4 **Mirroring propositional relations** If you find a long-distance relation on the side of propositional relations (RAs, CAs and MAs between a proposition and another proposition that was said some time long before), then you need to also annotate the connection on the dialogical side which links through TA the locutions for these propositional contents. In this way, you show that the later locution is a response to something which happened some time earlier in the dialogue.

5 Illocutionary connections

Illocutionary connections (IC) link locutions with propositions & propositional relations (i.e. right hand side of the IAT diagram with its left hand side). They are based on the concept of illocutionary force introduced by speech act theory (see e.g. Searle 1969, Searle and Vanderveken 1985). The act $F(p)$ is a communicative act which ties together the locution the propositional content p through the illocutionary force F of, e.g., asserting p, asking about p, requesting p, ordering p, promising p and so on.

5.1 **Basics** Each locution will typically anchor a single illocutionary connection, but may anchor more than one

5.2 **Types of ICs** There is no prescribed set of illocutionary schemes, i.e. types of illocutionary forces (any more than there is are prescribed sets of inference, conflict or transition schemes). Illocutionary schemes suitable for negotiation (that might involve, e.g., *offer* and *reject*) might be different from those involved in a court (where *testify* and *object* might be more appropriate).
That said, many domains share a number of schemes. These commonly applicable schemes are described below:

(a) **Asserting (A)** The speaker S is *asserting p* to communicate his opinion on p. It does not imply that S really believes p: it is rather a public declaration to which the speaker can be held.

(b) **Questioning (Q)** S is *questioning whether p* when S formulates p as interrogative sentence of the form using a Yes/No question or a Wh-question. In both cases, the propositional content is treated as underspecified – as a disjunction for a yes/no question (so, "Is it the case that p?" has the content, "It is or is not the case that p") or as a lambda sentence for a Wh-question: (so, "What time is it?" has content, "The time is x"). We distinguish three categories of questioning: *Pure Questioning (PQ)*, *Assertive Questioning (AQ)*, and *Rhetorical Questioning (RQ)*. In the case of PQ, S is asking for the hearer H's opinion on p: whether H believes p, or not, or has no opinion on p. AQ and RQ, in contrast, carry some degree of assertive force. For AQ, S not only seeks H's opinion on p, but also indirectly publicly declares his own opinion on p. This IC is typically linguistically strongly signalled by cues such as "Isn't it the case that...", "Can we agree that...", "Doesn't...". Finally for RQ, S is grammatically stating a question, but in fact is only conveying that he does (or does not) believe p. A good

test for deciding between RQ and AQ is to check whether it is discursively possible for H to reply to a given question, e.g., whether his response "Yes" to the question "Does the pope wear a funny hat?" would be treated as irrational (or humorous or naive) discursive behaviour.

(c) **Challenging (Ch)** When S is *challenging p*, S declares that he is seeking (asking about) the grounds for H's opinion on *p*. Challenges are a dialogical mechanism for triggering argumentation.

(d) **Agreeing (Agr)** Agreeing is used for expressing a positive reaction, i.e. when the speaker S declares that they share the opinion of the interlocutor. This can take the basic form of signalling such as "Yes", "Indeed", "Most definitely", "Sure", but may as well be a complete sentence. Note that it is not "Yes" on its own that is a bearer of agreement: this is "Yes" as a *reaction to (in relation to)* e.g. an assertive question, that is conveying agreement. Thus this type of IC is anchored in the transition between, in our example above, locution which anchors AQ and the locution "Yes". Agreeing takes as a content a proposition earlier uttered with which the agreement has been expressed (in example – with the propositional content of AQ).

(e) **Disagreeing (Disagr)** Disagreeing is used for expressing a negative reaction, i.e. when S declares not to share the interlocutor's opinion. This can take the form of utterances which have similar meaning to "No" (e.g. "I'm not saying that", "Actually, that's not correct", "Definitely not", "No, it's not") or it can be an utterance with a complete propositional content. In the same way as agreeing, the force of disagreeing being anchored in a transition captures the idea that the full reconstruction of this IC structure (and then its automatic recognition) requires knowing not only that the disagreement has been expressed, but also *at what* the disagreement was targeted. This IC takes as its content a relation of conflict.

(f) **Restating (Rest)** *Restating* is used for expressing the relation of rephrase between propositional contents, i.e. it anchors MA between two propositions in TA between two locutions which takes these propositions as their contents). This can take the form of an utterance that slightly modifies the original content of the locution being restated. When Clinton says: "I want to invest in you. I want to invest in your family.", the latter sentence is a rephrase of a former one. The rephrase relation differs from repeating: "I want to invest in your family" is not a pure repetition of "I want to invest in you", as the propositional content is a specification of what sort of investing is meant by the speaker.

(g) **Arguing (Arg)** S is *arguing* when he defends a standpoint. This IC is signalled by linguistic cues such as "therefore" and "because", however, these indicators occur infrequently in spoken natural language. Arguing takes as a content a relation of inference (i.e. an RA). In other words, the *inference relation* between two propositional contents – a premise and a conclusion (the left hand side of the IAT diagram) is anchored in the *transition relation* between two matching locutions (the right hand side of the diagram) by means of an illocutionary force called *Arguing*.

(h) **Default Illocuting** If an illocutionary connection does not match the guidelines for any IC described above, then it can be labelled *Default Illocuting*. This illocutionary connection is also currently used to connect an MA to its TA anchor when the MA is being used to answer a question.

5.3 **Reported speech** This is not a type of IC, but it accompanies the occurrences of IC in the discourse, when one speaker reports what another speaker said. In case of reported speech, the original locution contains the text as it was said, e.g. TAPPER: Senator Rubio, last October, you said that you're, quote, "generally very much in favor of free trade". This locution is linked with the locution being reported (RUBIO: I'm generally very much in favor of free trade) using *Asserting*.

5.4 **Repetitions** This again is not a type of IC. If the second locution repeats the content of the first locution, then the content of the second locution is the same as the content of the first one. The content of the second locution is anchored in this locution via an appropriate IC annotated according to the guidelines defined above. In implementation, identity conditions for propositions are currently effectively string matching (hence the need for anaphoric and deictic reconstruction).

5.5 **Connections with propositional relations** All RAs, CAs and MAs must be anchored through ICs in TAs.

6 Further reading

- K. Budzynska, M. Janier, C. Reed, P. Saint-Dizier (2016) Theoretical Foundations for Illocutionary Structure Parsing, *Argument and Computation*, IOS Press, vol. 7, no. 1, pp. 91-108

- M. Janier, M. Snaith, K. Budzynska, J. Lawrence, C. Reed (2016) A System for Dispute Mediation: The Mediation Dialogue Game, *Frontiers in Artificial Intelligence and Applications. Proc. of 6th International Conference on Computational Models of Argument (COMMA 2016)*, Pietro Baroni, Thomas F. Gordon, Tatjana Scheffler, Manfred Stede (Eds.), vol. 287, IOS Press, pp. 351-358.

7 Annotation software

The OVA+ argument diagramming tool

OVA+ is an online tool for argument analysis facilitating the representation of the structure of argumentative discourse. You can start using OVA+ freely at the website `ova.arg.tech`. A manual for using OVA+ is available at `arg.tech/index.php/projects/ova-2/`.

The AIFdb and AIFdb Corpora repositories

Analyses produced with OVA+ can be saved as 'argument maps' in AIFdb, an online searchable repository of analysed arguments freely available at `aifdb.org`. The argument maps can be collected in corpora at `corpora.aifdb.org`.