Strategies for Contributing to Collaborative Arguments[1]

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Abstract

The Argumentation Project at LRDC aims to support students in knowledge building by means of collaborative argumentation. A component of this project is a system for helping students generate arguments in a dialogical situation. Empirical research suggests that students generally have difficulty generating arguments for different positions on an issue and may resort to giving arguments that are insincere or irrelevant. Our system will assist the arguer by constraining him to respond relevantly and consistently to the actions of other arguers, suggesting appropriate ways to respond. This assistance will be provided by strategies derived from conversational maxims and "good conduct" rules for collaborative argumentation. We describe a prototype system that uses these strategies to simulate both sides of a dialogical argument.

Introduction

Argumentation is an important part of many intellectual activities, spanning situations as diverse as justifying a policy decision, proposing a new scientific theory, and determining whom to vote for in an election. Yet, secondary education has little impact on the ability to carry out a reasoned argument. [Perkins, 1985] found that students' ability to generate arguments for and against a position on an issue is generally disappointing and does not significantly improve between the first year of high-school and graduate school. Students' shortcomings in the area of reasoned discourse may be attributed, in part, to the scarce opportunities for this activity provided by secondary education. Where opportunities do exist – commonly in the form of essay writing, informal logic courses, and debate teams – they may promote a narrow view of argument. Studying argumentation only in the context of essay writing may cause students to confuse argument structure with essay structure [Lesgold, 1989]. Informal logic courses focus on identifying fallacies in individual argument steps, while ignoring the larger context in which the arguments are embedded and how arguments are generated. The debate format restricts the interaction between arguers and encourages an adversarial view of argument.

While recognizing the value of traditional uses of argument and methods of teaching argumentation, we are interested in fostering a different view and use of argument. Collaborative argumentation seeks to achieve a clear articulation of each arguer's perspective on an issue and of the beliefs and reasoning underlying it. Participants in collaborative arguments are not trying to win by any means available, as in some adversarial arguments; nor are they attempting to persuade, as do advertisements or propaganda. Collaborative argumentation occurs in some tutoring interactions [Cavalli-Sforza & Moore, 1992], in group design or decision-making, and in high-productivity team work. Collaborative argumentation helps to uncover both the common ground of different viewpoints and the areas of fundamental disagreement, suggesting starting points for building consensus and areas in need of further investigation.

Our research group is building a computer environment to support students in practicing collaborative argumentation. We envision the system as providing a "blackboard" on which two (or more) students record their argument in a graphical language that makes explicit the structure of the argument as it develops. Other environments have focused on graphical tools and languages for representing arguments [Smolensky *et al.*, 1987, Conklin & Begeman, 1988, Streitz, Hanneman, & Thuring, 1989]. While such tools will be an important part of the environment, our system will also assist students by suggesting and critiquing ways of contributing to an argument based on overall argument structure, and by providing on-line knowledge of different types of argument steps. In selected domains, it will be able to argue with a user and make content suggestions in an argument between users.

Although arguing in any domain requires knowledge of its content and its argumentation practices, some argumentation knowledge is shared across domains. In this paper, we describe the domain-independent strategies we use to guide the generation of collaborative arguments. We have only started building the practice environment, but we have used these strategies in a program that simulates an argument between two persons. The proposed strategies capture an intuitive understanding of the dynamics of a collaborative argument; therefore we think a computer coach can use them to

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guide an argument between students. Pedagogically, our approach differs from traditional ones in that we are concerned with helping students contribute to ongoing arguments as well as criticize isolated inferences. Our model of argument generation differs from [Reichman-Adar, 1984] in using prescriptive and explicit strategies. Unlike [Flowers, McGuire, & Birnbaum, 1982], we focus on non-adversarial arguments; we also base our strategies on general principles of argumentation rather than on abstract configurations of support and attack links.

Overview and Justification

In designing an environment for practicing collaborative argumentation, we were influenced by experimental results on high-school and first year college students' handling of argument analysis and generation [Lesgold, 1989, Lesgold *et al.*, 1990]. In generating arguments, some subjects did not think it necessary to support a claim with reasons, and many found it difficult to generate reasonable arguments for positions other than their own (as in [Perkins, 1985]). It was also common for subjects to respond to pieces of an argument separately, not considering how they might be related to each other; [Voss *et al.*, 1983] observed similar piecemeal behavior among novice problem-solvers in ill-structured domains. Finally, subjects tended to discard an entire argument if they could fault any part of it, thus removing the need for further analysis. These results suggest that students have difficulty handling the complexity of arguments and could benefit from an environment which reifies the structure of an extended argument and suggests ways of responding to and generating arguments.

We address students' weaknesses by providing several types of assistance [Cavalli-Sforza, 1991]. The student and the system interact through a visual representation of the *argument graph* [Flowers, McGuire, & Birnbaum, 1982], which records the structure of a developing argument in terms of claims, supporting reasons, responses, and the results of other types of *argument actions* an arguer can take. The system keeps a taxonomy of possible actions and suitable response *tactics*. For example, tactics for responding to a *microargument* (support) for a claim include: 1) counterarguing the claim by arguing for an opposing claim, 2) attacking or requesting further elaboration of some aspect of the support, 3) or conceding the claim. Some tactics may be carried out in several ways. Both the action taxonomy and the argument graph are based on an augmentation of Toulmin's model [Toulmin, 1958] of argument, described briefly below.

In suggesting ways of responding to an action, the system also uses a set of *strategies* based on principles of cooperative conversation, standard practices of sound and effective argumention, and rules embodying the spirit of collaborative arguments. In collaborative arguments, the goal is not winning but critical exploration. Participants must be willing to put themselves at risk by articulating their reasoning, they must examine critically others' arguments, and they must respond to criticisms of their own arguments [Keith, Weiner, & Lesgold, 1990]. Some of our strategies rely on the changing level of support received by (pro)positions advanced by each arguer during the argument. This measure of support both shows the effect of applying the strategies and justifies their use.

Strategies for Contributing to Collaborative Arguments

Strategies for contributing to a collaborative argument are applied when one arguer completes his contribution and it becomes the other arguer's turn to respond. Deciding what action to take requires the following steps:

1. Determine *where* to address one's response. This yields candidate action *classes* with specific *targets*, e.g., "attack support 1" or "counterargue claim 1". An action class such as *attack support* subsumes other action classes, e.g., *attack premises* and *attack reasoning*, each of which might be instantiated in different ways using the arguer's beliefs and knowledge.
2. Eliminate poor candidates based on the action class and target. This may require considering the components of the target in greater detail. For example, a support is a complex structure relating multiple propositions (e.g., Microargument 1 in the example below, Figure 1(a)). One way of attacking support 1 is to attack any of the propositions it relies on, but attacking GROUNDS 3 is a poor choice because, presumably, this proposition is shared factual knowledge.
3. Try to instantiate the candidate actions using the arguer's beliefs, knowledge of the other arguer and of different types of reasoning.
4. Eliminate undesirable instantiations of actions.
5. Select the best of the remaining actions.

Steps 3-5 are applicable only to actions that construct microarguments or rebuttals (as opposed to requests for further support or concessions). Different strategies are used at different stages in the above process. We think of strategies used in step 1 as determining *where* to respond; strategies used in steps 2, 4, and 5 as determining *how* to respond.

Determining Where to Respond

Recency Preference. In a collaborative argument, each move is normally a response to the most recent question or challenge. This expectation of locally relevant responses is related to discourse focus and is also implicit in the model described by [Reichman-Adar, 1984]. Both the recency preference and the response tactics maintain continuity in the argument and encourage relevant responses.

Good Conduct Rules. Arguers may change the topic or shift attention to another part of the argument when they are at a loss for how to defend their position. In collaborative arguments these shifts are undesirable. Three rules of *good conduct* require locally relevant responses before changing topic. In the following rules, the term "challenge" is used to mean either an attack on an argument, or a request to provide further support or clarification for a part of that argument. The expression "live support for statement P" means that at least one of the arguments provided in support of P has not been dismissed. A "direct counterargument" against a statement P is an argument in support of P', where P' and P are mutually exclusive.

IF Arguer A *directly counterargues* a statement P by Arguer B AND P has no live support
THEN Arguer B must support P or challenge A's argument or abandon P

IF Arguer A *attacks an argument* in support of a statement P by Arguer B AND P has no other live support
THEN Arguer B must resupport P or challenge A's attack or abandon P

IF Arguer A *requests support or clarification* for a statement P by Arguer B AND P has no live support
THEN Arguer B must support or clarify P or abandon P

In keeping with the spirit of critical investigation, good conduct rules also constrain the challenger.

IF Arguer B responded to Arguer A's challenge AND did not abandon P
THEN Arguer A must challenge B's response OR concede P

Level of Support Heuristic. The support a microargument brings to a claim is as strong as its weakest component. Therefore, in choosing among the possible responses, an arguer should concentrate on supporting his own weak positions or weakening the other arguer's stronger positions.

Determining How to Respond

Response tactics and strategies for determining where to respond suggest a set of candidate actions specified in terms of the general type of action (e.g., support, counterargue, concede) and the target proposition or support relation. The following sets of strategies select a response through processes of elimination, instantiation, and voting.[2]

Eliminating Classes of Responses. The following strategies, implemented as a set of elimination rules, discard response classes that are inappropriate based on the target's content.

- *Avoid actions inconsistent with one's beliefs.* An arguer should avoid attacking a position he believes.
- *Avoid responses inconsistent with one's past actions in the argument.* If an arguer uses a proposition held by another arguer to support his own position, without necessarily believing it himself, he should not attack that proposition at a later time since this will invalidate his own argument.
- *Avoid wasteful actions.* An arguer should avoid actions that impact only propositions that have already been abandoned or conceded.

The first rule partially implements Grice's Maxim of Quality[Grice, 1975], the others are common sense planning advice.[3]

Eliminating Instantiations of Responses. To further weed out undesirable responses from the remaining candidates, the arguer must consider different ways in which he could instantiate them based on his knowledge and beliefs (step 3). The following rules are then used to eliminate potential responses that are undesirable based on the content of the propositions they use.

- *Avoid actions inconsistent with one's beliefs.* An arguer's action should not rely on propositions he believes to be false. This rule also implements Grice's Maxim of Quality.
- *Avoid responses inconsistent with one's past actions in the argument.* An arguer should not take actions that rely on the truth of propositions he attacked earlier in the argument, unless he later conceded them.
- *Avoid "irrational" responses.* An arguer should not directly counterargue a claim unless he can attack all existing live support for the claim since, if he cannot find fault with all justifications, he ought to accept the claim.
- *Avoid dangerous responses.* An arguer should avoid responses that use propositions on which an attack can be anticipated from knowledge of the other arguer, unless he is prepared to meet the challenge.

Selecting the Best Response. If more than one response survives the elimination phase, each of the following heuristics votes for responses meeting its criteria. The response with the most votes is selected.

- *Speak to audience.* An argument that appeals to beliefs of the other arguer is generally more persuasive.
- *Many-in-one.* An action is more effective if it helps the arguer in more than one way.
- *Prefer stronger arguments.* Depending on the domain, some microargument types may be preferred to others.

[2] Some of the elimination strategies should be relaxed if the arguer is playing devil's advocate, is constructing an indirect argument, and in some other situations.

[3] Really the first submaxim: "do not say what you believe to be false"; the second submaxim, "do not say that for which you do not have adequate evidence" is handled by requiring that claims be supported.

An Example

An example will show how the system, simulating two arguers, uses the strategies described above to guide the generation of a bilateral argument. Consider the following argument, whose structure is depicted by the argument graph of Figure 1(a).[4]

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[1] ANN: Israel has an obligation to
    return the West Bank (WB) to the
    Palestinians. It was their land and
    it's unfair for Israel to keep it.
[2] BOB: But it's highly undesirable for
    Israel to return the WB. It would be
    a threat to its security.
[3] ANN: On the contrary, returning the
    WB would improve Israel's security.
[4] BOB: How? Returning the WB would
    make it easier for the Palestinians
    to launch an attack on Israel.
[5] ANN: Yes, but if the Palestinians
    had the WB, they wouldn't want to
    attack Israel.
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The graph shows the arguers' microarguments and their interrelations, filling in implicit assumptions (in italics). The analysis of *support* (S) relations uses Toulmin's model [Toulmin, 1958]. Claims are supported by other situation-specific propositions, the *grounds* (g), and a more general principle, the *warrant* (w). A warrant may hold in general but admit of exceptions. The presence of exceptions is captured in the graph by a *rebuttal* (R) relation between a proposition and a support relation. Propositions may also be in an *opposition* relation, either *directly*, if the propositions are contradictory, or *indirectly*, if they denote opposition but on the basis of different modalities (criteria).

Bob can respond to Ann's first microargument [1] in a number of ways, for example, by arguing that "Israel does not have an obligation to return the WB because .." (a direct counterargument to claim 1), or by attacking some of Ann's grounds. Note that he cannot attack the proposition that "Israel holds the WB" since Bob presumably believes this too. In [2] he takes another option: he *indirectly counterargues* Ann's claim [1], which is based on a criterion of fairness, by appealing to a criterion of desirability. Figure 1(b) shows that, after Bob's response, Bob and Ann's claims each have some level of support (LOS), less than if unopposed but more than if directly opposed.[5]

The kind of shift embodied in indirect counterarguments would be inadmissible in a more adversarial situation, but is an integral part of exploring multiple perspectives on an issue. It constrains permissible responses for Ann. For example, if Ann resupports her claim, the two arguers will be arguing past each other. Rather, she will need to respond directly to his argument, argue that the desirability criterion is not relevant to the discussion, or consider the relative weight of the two criteria.[6] In [3], Ann directly counterargues Bob's claim with a parallel microargument: appealing to the same motivational principle (the warrant), she argues to the opposite conclusion from contradictory grounds. This is a good move for Ann because it completely "neutralizes" the support for Bob's claim as shown in Figure 1(c). Ann's move is preferred over other actions by the *many-in-one critic*, because her grounds also attack Bob's grounds, and by the *speak to audience* critic, because it shares a proposition with Bob's support. Ann is able to counter Bob's argument directly because she can attack his grounds (and will do so in [5]); i.e., the *avoid irrational responses* critic does not apply.

The resulting configuration of parallel argument and counterargument arises frequently in controversial issues.[7] It constrains Bob's response options. He can resupport his claim [2] differently. He can shift criteria again, returning his attention to the initial argument in [1] or introducing yet another perspective. He can also try to find some fault with Ann's counterargument, although clearly he should not attack the warrant, on which his own argument depends. None of these actions, however, would address the underlying source of the disagreement, i.e., their contradictory grounds. Bob chooses to focus on this disagreement by supporting his own grounds while simultaneously attacking Ann's. As shown in Figure 1(d), Bob's action strengthens his line of argument at Ann's expense. His grounds for claim 2 overpower Ann's contradictory grounds, allowing claim 2 to "win out" over Ann's opposing claim 3.

Bob's action in [4] also activates the rule of Good Conduct for direct counterargument. Ann must respond by challenging Bob's argument, by supporting her grounds for claim 3, or by abandoning them. With her response in [5], she both supports her position and rebuts Bob's argument, and she does so using a shared belief. This has the effect of reversing the LOS situation: now Ann's claims 3 and 5 have support and Bob's claims 2 and 4 do not. Bob's eventual response in [6] will be subject to Good Conduct rules in two ways: 1) since Ann has responded to his challenge by supporting her grounds for claim 3, he must now address that re-

[4]The simulator's output and input, including the arguers' beliefs, are represented in a frame language.

[5]In the interface, the evolving argument graph will be depicted in a manner similar to Figure 1(a), and display the LOS attached to each proposition directly. Figures 1(b) through 1(e) are used here to illustrate different stages of the argument. Currently, we compute the LOS using a weighted sum scheme that takes into account rebuttals and oppositions; we are also evaluating alternative schemes (e.g., ECHO [Thagard, 1989]).

[6]We haven't yet addressed these types of response, really meta-arguments, but we will do so in the near future. We could use an additional Good Conduct Rule to post an obligation to consider the relative weight of the two criteria later in the argument.

[7]The similar "standoff" pattern analyzed by [Flowers, McGuire, & Birnbaum, 1982] differs from the present situation in two respects: 1) in a standoff, the arguer's and the opponent's grounds are not contradictory, and 2) in the present situation, the intent is not to dismiss the issue of security as a line of argument.

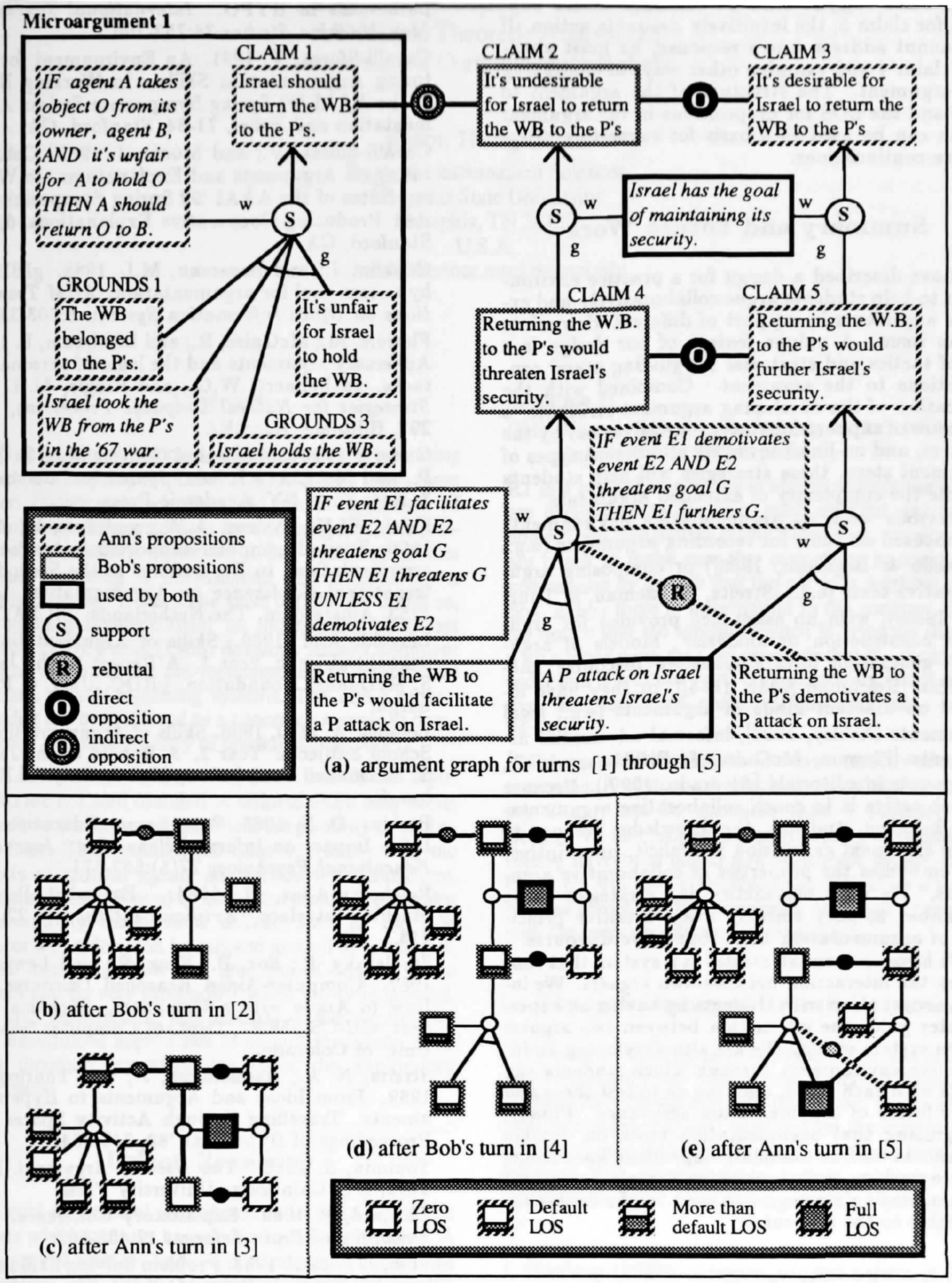

Figure 1. A sample argument with changes in Level of Support as the argument develops.

sponse; 2) since Ann has also attacked his only argument for claim 4 by providing a rebutting exception, he must now respond to that attack. Jointly, these rules suggest that he challenge Ann's support for claim 5, the intuitively desirable action. If he cannot address Ann's response, he must abandon claim 4 and examine other ways of continuing the argument. The structure of the argument to date and the LOS for propositions in the argument graph can be used as a basis for suggesting alternative continuations.

Summary and Future Work

We have described a design for a practice environment to help students argue collaboratively and explore arguments in support of different viewpoints on an issue. A unique feature of our design is a set of tactics and strategies for guiding users' contributions to the argument. Combined with the reification of the developing argument structure, a measure of support for statements advanced by the arguers, and on-line knowledge of different types of argument steps, these strategies will help students handle the complexity of extended arguments.

Previous work on argumentation environments has focused on tools for recording arguments (e.g., [Conklin & Begeman, 1988]) or composing argumentative texts (e.g., [Streitz, Hanneman, & Thuring, 1989]), with no assistance provided for argument construction or analysis. Models of argument generation have emphasized discourse phenomena [Reichman-Adar, 1984]), or they have focused on different kinds of arguments (e.g., legal arguments [Ashley, 1991], informal adversarial arguments [Flowers, McGuire, & Birnbaum, 1982], arguments in editorials [Alvarado, 1990]). Because our objective is to coach collaborative argumentation between students, the knowledge we use to guide argument generation is explicit, prescriptive, and embodies the properties of collaborative arguments. We want our tactics and strategies to be teachable, so they embody a few intuitive principles of argumentation and cooperative discourse.

We have used our strategies in a system that simulates the interaction between two arguers. We intend to test them with students by having an experimenter guide the interaction between two arguers as the system would. We are also developing an interactive environment through which students can argue with each other, allowing us to test these and other forms of argumentation assistance. Finally, recognizing that argumentation relies on domain specific as well as domain-independent knowledge, we are working on incorporating domain-dependent argumentation strategies as part of the assistance available to the student.

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