

Argumentation-based collaborative intelligence analysis in CISpaces

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Abstract. We present the CISpaces framework, a collaborative virtual space for intelligence analysts for the elaboration of information to explain a situation. CISpaces supports the analysis of conflicting information in collaboration exploiting argumentation schemes to structure and share analyses, crowd-sourcing to collect information and provenance to establish the credibility of hypotheses.

Keywords. Intelligence analysis, argumentation schemes, crowd-sourcing, provenance

The CISpaces framework. Intelligence analysis is the elaboration of information to form hypothetical explanations for a situation. The output is typically used, for example, to inform government strategies, or provide warning for threats [1]. Collaborative analysis permits an extensive review of evidence and complements analysts' information [1]. Different modes of collaboration may take place: a group of expert analysts may share and analyse information together; or an analyst may request information from a group of collectors that have access to certain resources. Collaborative analysis requires analysts to be informed of the origins of information. We present *CISpaces: Collaborative Intelligence Spaces* for supporting intelligence analysis. CISpaces enables analysts to deal with inconsistent information, provides support for tracing information and analysis to their sources, and facilitates this process by enabling collaboration.

CISpaces tools. In this demo we present a prototype of the CISpaces interface aimed at supporting an analyst in generating more robust hypotheses in collaboration. The example presented shows different teams of analysts engaged in the investigation of water contamination. CISpaces delivers support via the following Web services: *i) an evidential reasoning service*, supporting analysts in drawing inferences in collaboration and forming arguments structured by argumentation schemes (i.e., defeasible patterns of reasoning that commonly occur in human dialogue [6]); *ii) the crowd-sourcing service*, enabling analysts to post requests for aggregated information from groups of collectors; *iii) the provenance reasoning service*, facilitating the storage and retrieval of provenance data (i.e., the set of entities, activities, and actors that have caused an entity to be [2]). The CISpaces interface includes the *WorkBox*, an analytical space for an analyst to construct

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hypotheses, and the *ChatBox* that enables different collaboration modes. In the *WorkBox* analysts elaborate hypotheses by importing new information or adding new claims in the form of nodes. Analysts can draw supporting or defeating links between nodes forming arguments and related attacks. The links can be annotated to provide additional meta-information regarding the conflict or support. We exploit the use of patterns of reasoning provided by argument schemes [6] for supporting analysts to construct well-formed arguments; critical questions drive further analysis. We use schemes for evidential reasoning including [6]: the *argument from cause to effect* to form links between events; the *argument from identification of agents* to connect actors, locations, and resources associated with the hypotheses; and the *argument for provenance* to validate information [5]. The use of structured argumentation facilitates automated reasoning: the system maps the *WorkBox* view to an argumentation framework for identifying acceptable conclusions [4]. Although CISpaces follows a graphical representation of arguments similar to other argument-mapping tools [3], the focus of CISpaces is to enable collaboration.

Collaboration in CISpaces. Different forms of collaboration are supported in our current prototype through the *ChatBox*: collaborative debate, information retrieval through crowd-sourcing, and reasoning about provenance. A debate between analysts is used to analyse individually formed arguments in collaboration and exchange supporting or defeating evidence. Analysts can click and drag part of the analysis in their personal space to the *ChatBox* and proceed with the analysis in collaboration. An analyst may also canvas a group of collectors for information. These requests are managed by the crowd-sourcing service that aggregates and prepares the results. These results may be misleading if partial analyses considered independent are, in fact, dependent. A combination of reputation and comparison of overlapping data from different members is used to detect bias and mitigate it [7]. The system presents the outcome to the analyst who can critically question the information acquired in deciding how to integrate it through the use of an *argument from generally accepted opinion* [6]. A further interaction is between analysts and the system for inspecting the provenance records and resolving conflicts by introducing provenance data in the reasoning process. Analysts are supported in assessing the credibility of information and previous analyses using argument schemes for provenance that consider where, when, how and by whom certain claims have been made.

Conclusions. The CISpaces framework supports collaborative intelligence analysis. In future work, we plan to enhance the support to analysts in identifying critical areas that require further analysis, in guiding analysts during the debate using appropriate dialogue protocols, and evaluating our system with the help of field experts.

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