

Can You Give Me a Reason?: Argument-inducing Online Forum by Argument Mining

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ABSTRACT

This demonstration paper presents an argument-inducing online forum that stimulates participants with lack of premises for their claim in online discussions. The proposed forum provides its participants the following two subsystems: (1) **Argument estimator** for online discussions automatically generates a visualization of the argument structures in posts based on argument mining. The forum indicates structures such as claim-premise relations in real time by exploiting a state-of-the-art deep learning model. (2) **Argument-inducing agent for online discussion (AIAD)** automatically generates a reply post based on the argument estimator requesting further reasons to improve the argumentation of participants.

Our experimental discussion demonstrates that the argument estimator can detect the argument structures from online discussions, and AIAD can induce premises from the participants. To the best of our knowledge, our argument-inducing online forum is the first approach to either visualize or request a real-time argument for online discussions. Our forum can be used to collect and induce claim-reasons pairs rather than only opinions to understand various lines of reasoning in online arguments such as civic discussions, online debates, and education objectives. The argument estimator code is available at

<https://github.com/EdoFrank/EMNLP2018-ArgMining-Morio>

and the demonstration video is available at

<https://youtu.be/T9fNJfneQV8>.

CCS CONCEPTS

• **Information systems** → **Social networks**; • **Networks** → **Online social networks**; • **Computing methodologies** → **Discourse, dialogue and pragmatics**.

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KEYWORDS

Argumentation mining; Online forum; Neural network

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1 INTRODUCTION

Online forums are some of the best places to gather divergent perspectives on a controversial topic because many participants can discuss a topic without being limited by time or location. However, most participants in online forums are less likely to show premises (i.e., reasons) for their claims [3, 5]. For example, Figure 1 shows a histogram of the number of corresponding premises of a claim in an online civic discussion [3]. The figure illustrates that claims with zero or a single premise account for a large fraction, indicating that online discussions generally lack premises.

To address this issue, we propose a novel argument-inducing online forum (Figure 2) that can be used to not only collect but also induce reasoning in online discussions. The basic architecture of the proposed forum is almost the same as that of a classic forum comprising threads, where the forum has a log-in system, and participants can freely post their comments in threads. However, the proposed forum has the following two novel key features:

(1) **Argument estimator** is a visualizer of an argument structure based on argument mining. Argument mining is a newly emerging discipline that focuses on extracting claims and premises and inferring their structures from a discourse. In this work, we extended the solid argument mining scheme presented by Stab et al. [9]. We consider each post has independent arguments (an argument consists of one claim and possibly empty premises), and inferred the argument structure via a state-of-the-art deep learning model [4]. Then, we visualized the inferred arguments in the online forum in real time, indicating a color-coded claim or premise sentences and *reasoning* links that are indicated by arrows to ensure that the participants can recognize their argument.

(2) **The argument-inducing agent for online discussion (AIAD)** is a template-based agent that uses the inferred argument structure

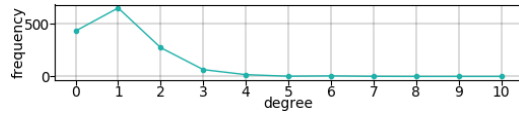


Figure 1: Histogram of a claim’s degree for an online discussion. The horizontal axis indicates the claim’s degree, where 0 denotes that claims without corresponding premises are counted.

that is intended to induce reasoning from participants. The agent is similar to debater agents, whereas the AIAD responds to a participant when a post contains a claim but with two or less premises. On a dialectical level, AIAD asks: “Can you give me an additional argument for your claim?” and encourages the user to answer a new argument accordingly.

Our experimental result demonstrates that the argument visualization and AIAD effectively support online discussions.

2 RELATED WORKS

Argumentation mining is a multi-disciplinary research field used to investigate reasoning processes such as logic, natural language processing, and machine learning. Additionally, argument mining is expected to be applicable for performing difficult tasks that require an understanding of human reasoning processes, not only for an automatic essay scoring [10] and debater system (e.g., IBM Project Debater) but also for supporting online discussions. Sato et al. [7] proposed an end-to-end debater that can generate argumentation for some values by specifying a controversial proposition. Although the debaters are successful applications of argument mining, few applications are available for online forums.

Gurkan et al. [2] proposed a deliberatorium, which is a platform for large-scale online discussions, to consider argumentation in a discussion. The platform introduces a logic-centered argumentation map, and it differs from other platforms such as Wikipedia and chat systems. Their experimental results indicated that the system can successfully provide summaries but cannot commit to mediating a discussion.

3 SYSTEM OVERVIEW

The proposed system has the following important subsystems: i) an argument estimator that functions as a visualizer of argument structures and ii) an AIAD that functions as an argument-inducing agent.

After inputting the username and password, the participants can post their opinions to a thread (Figure 2). The full thread is available on the left side of the figure. Clicking on one thread can lead to another. Moreover, creating a new thread with a controversial topic by clicking the “CREATE NEW TOPIC” button at the top right or top left in Figure 2 is permissible.

When a thread appears on the web page, the visualized argument structure discriminated by the argument estimator is shown. By focusing on the cursor of a post, we can understand the argument structure presented in the post. Each sentence or clause is color-coded, where the blue sentence indicates a premise and red indicates a claim. The color-coded arrows in posts point out the

inner-post relationship that represents a support or attack reasoning: the arrow direction is a conclusion, while the tail is a premise. Because we introduce the scheme of an argument tree, an argument comprises one claim and a (possibly empty) set of premises, and a maximum of one relation source for each sentence is allowed; the relationships are always trees. In addition, we can understand the inter-post interaction (IPI) that represents a support or attack relation from the sentences of the focused post. For example, a kangaroo’s post involves two premises, two claims, and one post-to-post relationship between the post and its parent post, as shown in Figure 2.

Figure 3 shows an overview of the system’s flow when the participants post comments on a forum. Our forum comprises the following four parts: user interface on a web browser, server-side database, argument estimator, and AIAD. We developed an original user interface and APIs that operate through the following six steps: (1) The participant posts a comment to our forum. (2) The document in the post is parsed into sentences or propositions and recorded into the database. (3) The argument estimator module detects the change of record in the database, discriminating either claim or premise and relations between the claim and premises in the thread. (4) The inferred argument structure is recorded by the database; thus, the argument is visualized on the user interface. (5) The AIAD, in turn, detects the change in the argument structure in the database. (6) The AIAD generates a comment and responds to a poorly reasoned post.

3.1 Argument Estimator

Argument estimator predicts argument structures through machine learning. Given that our forum supports Japanese and English discussions, we introduced a different technique and dataset for each language to train the estimator.

In Japanese discussions, we use the same dataset of Morio et al. [3]. Because the dataset automatically separates a document into sentences, we can consider that argument component candidates are already given. In this work, we employ a state-of-the-art model: parallel constrained pointer architectures (PCPAs) [4], which analyzes the sentence-level argument structure in threads. PCPA is a neural architecture that uses pointer networks [6], where PCPA can effectively discriminate between sentence types (i.e., claim, premise, or non-argumentative) and relations (inner-post relation (IPR) as well as IPI) in the thread.

PCPA achieves a significant reduction in its time complexity because it constrains the search space when discriminating between IPR and IPI. Formally, given n_p and n_s , which are the averages of the number of posts per thread and sentences per post, respectively, the standard approach needs $O(n_p^2 * n_s^2)$ during computation. However, PCPA uses only $O(n_p * n_s^2)$. Therefore, our argument estimator provides a rapid result during testing, thus supporting a real-time inference. Generally, the inference process consumes less than 1 s.

In English discussions, we use an original token-level dataset obtained from *ChangeMyView*¹ in Reddit.² The dataset is annotated in token level (but not sentence level). Therefore, we should point

¹<https://www.reddit.com/r/changemyview/>

²The dataset is not yet publicly available; however, we will make it public soon.

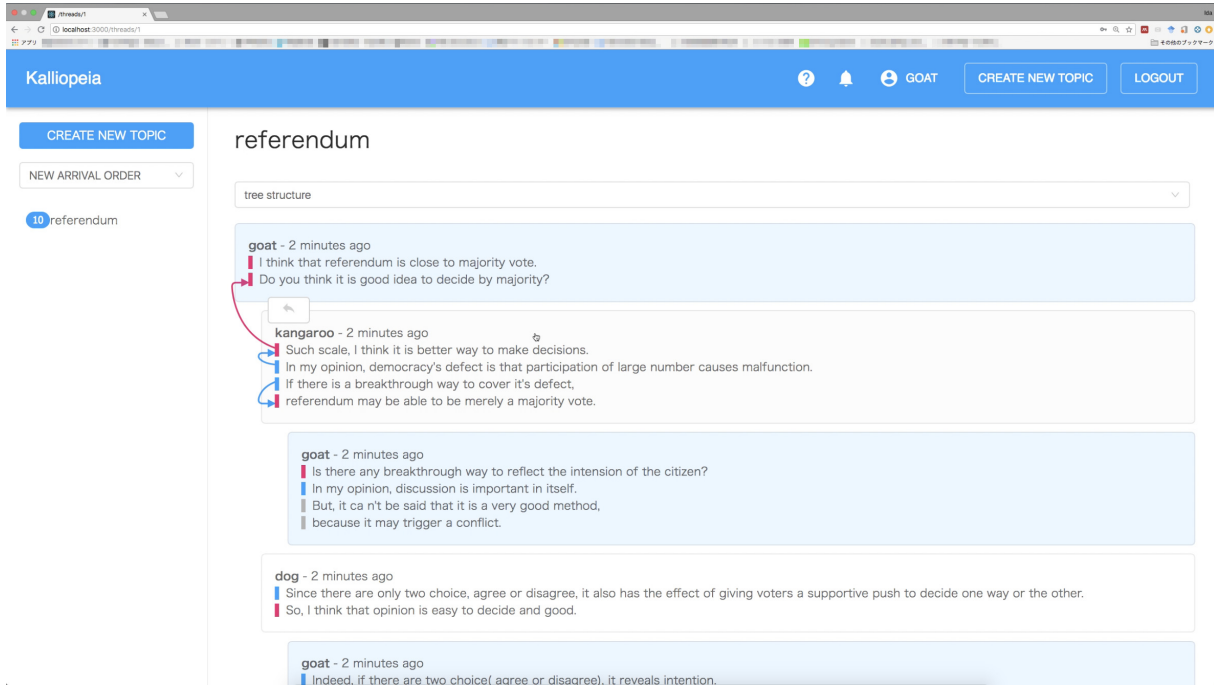


Figure 2: Thread view of our online forum. Arrows appear only when the cursor is placed above a post. The discussion was conducted in Japanese. Therefore, all posts are translated from Japanese into English; however, this forum can also support English discussions.

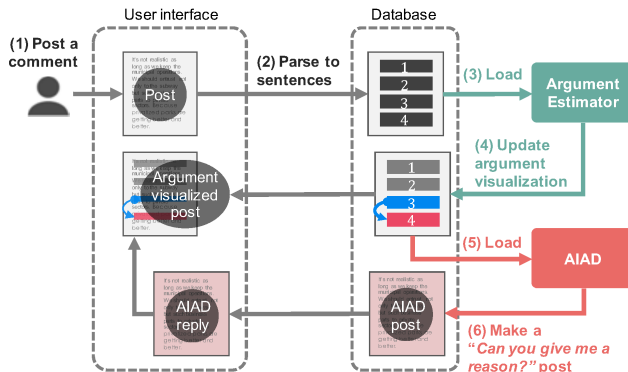


Figure 3: System Overview

out the proposition boundaries before using PCPA because PCPA assumes that propositions are given.³ Hence, the task is considered to be a sequence tagging problem (this procedure corresponds to (2) in Figure 2). We exploit the bi-directional LSTM (BiLSTM) and conditional random fields (CRFs), which is commonly used for the argument mining task [1, 8]. After proposition detection, we employed PCPA in the same manner as in the Japanese discussion.

³This approach is not anomalous. Potash et al. [6] also provided the assumption that proposition boundaries are already given.

3.2 AIAD

According to the results obtained from the argument estimator, the AIAD module, in turn, generates a response to a participant to drill down the claim by inducing its premises behind a claim, forming a *Can you give me a reason?* sentence. The possible target sentence to which AIAD responds is determined using a simple rule-based technique. The target sentence should be in the newest post for each participant, and the following restrictions are considered based on our preliminary experiments.

- The target sentence should be a claim and have fewer than two premises.
- The target post is not a reply to the AIAD.
- The target post has more than one reply after the AIAD's comments.

We generate a comment by using a template-based technique. The comment comprise the target sentence (i.e., claim sentence), greetings, and *Can you give me an additional argument for your claim?* or *Do you have any premise or evidence for this claim?*, as presented:

Thanks for your comment!
 >> “the target claim sentence”
 Do you have any premise or evidence for this claim?

When	Yes	Sometimes	No
creating an own claim	4	3	9
reading other posts	7	7	2
looking back a discussion	9	3	4

Table 1: Survey related to “When did you view the argument visualization in a discussion?”

Group Discussion topic	A		B	
	1-AIAD	2-Baseline	2-AIAD	1-Baseline
#Sentences per post	3.46	2.9	2.6	1.79
#Premises per claim	2.6	1.2	2.33	0.69
Premise (%) per post	61	54	48	27

Table 2: Statistics of the participant replies to AIAD

4 EXPERIMENTS

4.1 Experimental Setting

A total of 16 Japanese undergraduate students participate in the online discussion. The participants are randomly divided into two groups (i.e., “Group-A” and “Group-B”), and the participants in each group discussed the following two topics: The first is “Limitation of activity time of a club in middle and high schools in Japan,” and the second is “Ban on agreement about the starting date of companies’ recruitment activities in Japan.” Further, we introduce the random-inducing agent as a baseline. This agent randomly chooses the target sentence from the last post of each participant. The AIAD joins the former topic discussion of Group-A and the latter topic discussion of Group-B. The random inducing agent joins the latter topic discussion of Group-A and the former topic discussion of Group-B. In addition, the participants do not know that the comments by the agents are automatically generated.

4.2 Experimental Result

Finally, 585 posts are submitted in the discussions. Based on the survey after the discussions, 14 of the 16 participants answered that our forum is accessible for discussions. Table 1 summarizes the effectiveness of the argument visualization. The table shows that the argument estimator is extensively used when the discussion flow is reviewed.

Figure 4 shows the representative of the AIAD’s response post, which can capture the Squirrel’s claim and induce the participant’s premises. Table 2 summarizes the statistics of participant’s replies to AIAD. It presents that the participant’s replying posts to AIAD tend to contain a large number of sentences, including the premises.

5 DEMONSTRATION SCENARIO

In the demonstration, we will present how our online forum works for English users. Further, the online forum will be opened during the conference dates. We will show the argument visualization using the argument estimator and then immediately present the argument structures. In addition, the argument-inducing agent (AIAD) will ask *Can you give me an additional argument for your claim?* when the reasoning is insufficient. Generally, the actual discussions occur during the demonstration.

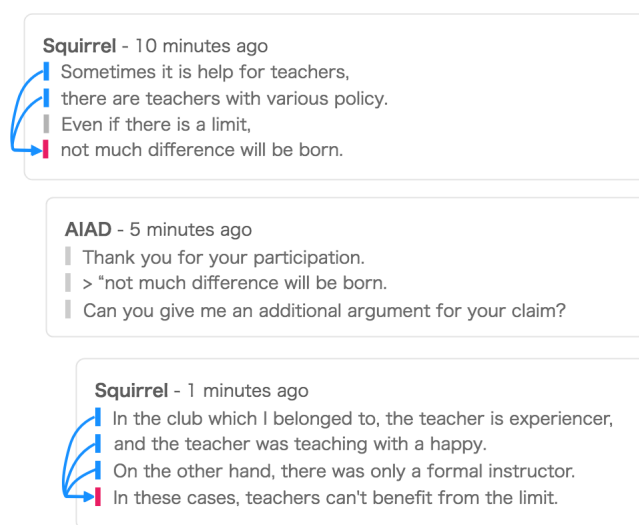


Figure 4: Post of AIAD, which successfully induced squirrel’s premises. This discussion was conducted in Japanese language and then translated to English, as presented in the figure.

6 CONCLUSION

This paper presented a novel online discussion forum that can encourage participants and induce additional arguments by using argument visualization and an argument-inducing agent based on argument mining. The argument visualization subsystem visualizes the argument structures that contain claims, premises, and reasoning relations by using a state-of-the-art deep learning technique. The agent that employs a template-based technique induces the premises of their claims by replying to a participant when the premises in their comments are insufficient. The experimental results demonstrated that the AIAD is effective for inducing premises in online discussions. The future work involves proposing a more effective visualization method, thereby improving the template algorithms and a large-scale English discussion.

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