Classification of Debate Threading Models for Representing Decentralized Debates

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***Abstract*—We analyze Debate Threading Models for representing Peer-to-Peer Decentralized Debates. The challenge, we address, is how to structure arguments in debate on a clear topic such that they are informative to the users trying to make up their mind, and such as to foster reciprocal understanding of each of the views in the community. Moreover, to enable the participation of average skilled users, the technique for inputting the arguments may have to be *simple* (i.e., close to the common practice, which is a subjective criteria). Knowledge representation for serving human users has been an important area of study in Computer Science and Artificial Intelligence. The area has grown significantly with conferences on topics such as ontologies, collaborative filtering, semantic web, and argument maps. We study and compare the various existing structures for representing complex knowledge in understandable forms, focusing on their applicability to decentralized debates with arguments from general users. We believe that this is the first kind of work that deals with the issue above.**

Keywords: Related Work, Knowledge Representation, Threading Models for Arguments in Electronic Debates, Threading Model Classification, Debate Threading Model, Comparison between TED, YourView, and DDP2P

I. Introduction

One can observe that electronic arguments are significantly different from face to face debates. An effort was made over the centuries to find optimal ways of organizing face-to-face debates [1]. Research is needed to decide whether current electronic debates are carried out with the optimal debate threading models and debate representation, as a means of knowledge representation. P2P Petition Drives requires decentralized synchronization of equal peers' data [2]. The information being exchanged is about opinions and arguments in debates ocurring around the petitions. DirectDemocracyP2P is a possible implementation of this approach. The information that it exchanges is structured as a set of autonomous pieces of knowledge (objects). Each such object belongs to one of the supported types: organization, motion, justification, vote, news, translation, constituent, neighborhood, witnessing stance, peer or tester. The types of objects that are relevant for the debates are: motions, justifications, and votes. The other objects are relevant only in the measure in which they can validate the votes (e.g., organizations, neighborhoods, constituents and witness stances), help with communication (e.g., peer and tester) or help with usability (e.g., translations and news). Those objects and their mechanism of validation are part of different studies and are outside the scope of this research.

In petition drives, the only relevant voting alternative is *Support*, since legally for moving on a motion, one only counts the supports. Opposing votes are normally counted only by the final official referendum/ballot. They are present in DirectDemocracyP2P is a way of applying collaborative filtering to the motions viewed for gathering the needed support [2], [3]. In DirectDemocracyP2P, users can support somebody else's justification, as an alternative to providing his/her own justification. Justifications with large support can be favored by graphical user interfaces, as they may better represent the opinion of the group. DirectDemocracyP2P (DDP2P) system is Representing Decentralized Debates. Threads In a DDP2P application start with a motion that is relevant to a given organization. User can vote on motion with only single justification. DDP2P is counting opinions and justifications.

II. Related Work

A few researchers have already addressed the relationship between social network behavior and these networks' intended purposes [4]. This section highlights previous studies on the type and quality of collaboration based on social networks. In this report, the related work is presented and classified according to the means and purpose of the studied collaboration. We identify the following types of generic tools for collaboration, on an idea, between unsophisticated users:

- Arguments
- Thumb up/down
- Voting
- Threading

a) Arguments:: According to the Merriam Webster dictionary, argumentation is "the act or process of giving reasons for or against something: the act or process of making and presenting arguments" where an argument is "a statement or series of statements for or against something" [5]. The possibility to express arguments in favor of or in opposition to ideas is considered an important instrument in collaboration [6].

b) Thumb up/down:: An easy way to garner feedback on ideas and arguments is to let people show their opinion using simple tags such as a thumbs-up or a thumbs-down. Often this is done in systems where participants are not authenticated. Moreover, users can often use a thumbs-up tag for opposing arguments, thereby making it difficult to use these tags for extracting reliable statistics.

c) Voting:: Voting is an approach to measure the opinion of a certain group of people. Unlike the thumbs-up/thumbs-down practice mentioned above, commonly the identity of people involved in voting is verified and each person can vote only once. Therefore, a user cannot vote simultaneously on opposing arguments. Statistics about opinions can be reliably estimated.

d) Threading:: Many writers are skeptical about the usefulness of the comments or threads that are placed on common web forums [7], despite the large number of useful comments. However, the idea of abolishing comments is not popular. Users feel more motivated to visit forums where they can comment since they may believe in the impact of these comments.

Besides collaborating on ideas, people also collaborate on projects by contributing work or resources [8], [9].

III. Knowledge Representation

The best example of the mechanism for Knowledge Representation is structured knowledge in tree or graph form of either classification, ontologies, or taxonomies. Many representation languages and mechanisms were developed to take advantage of these concepts: [10]

- Semantic Networks: A Semantic Network consists of a set of nodes that are linked by arcs [11].
- Conceptual Graphs: A conceptual graph connected between concepts nodes and conceptual relations nodes [12].
- Frame-based System: Frame based system is ordering knowledge into chunks (frames). Each frame contains information of how to use the frame and expectations if something is wrong [13], [14].

A. Major Knowledge Representation Types

Classification:

- Ontologies. The research in Ontologies deals with the establishment of languages that have no ambiguities. This language should be powerful enough to represent knowledge. For example, a message based on a standard ontology starts by a reference to the ontology version, and then has to follow its strict syntax. Ontologies define communities [15].
- Logic
  One of the techniques, that is used to store sentences within the computer, is mathematical logic. It is used in Knowledge databases such as those used by PROLOG and GOLOG. They are difficult to use with general users [16].
- Semantic Networks
  A Semantic Network consists of a set of nodes that are linked by arcs. In general, nodes represent concepts while arcs represent the relations between concepts [17].
- Mind Maps
  Mind Map is the name given to a tool or a means of expressing human ideas. It is drawn on a forked tree and relies on the pictures and words in the human memory. Since the human memory is a graphic memory, which depends on information linked with pictures, mind maps help to save and retrieve information easily. The use of mind maps is an innovative way to assist students to understand key information. Mind maps have the ability to provide students with an information retention strategy, integration of critical thinking, and problem solving skills [18].
- WordNet
  WordNet is a huge lexical database of English. It is a set of cognitive synonyms that have been collected from nouns, verbs, adjectives, and adverbs with a clear expression of concept [19].
- Argument Maps
  An Argument Map is a logic structure for arguments. It breaks up the argument into statement, reason, or fact. Also, it shows the relation between parts of the argument [20]. A lot of people have difficulty understanding complex arguments presented in textual form. An argument map is a graphical way to represent the complex relations between relevant statements. Therefore, it can improve human comprehension. It looks similar to a flowchart and a specialization/generalization hierarchy. There exist tools that can be used to build argument maps [21]. These argument maps have been built to help people better understand the issues related to a given problem. Arguments are frequently attached to emotions. In argument maps, there is no requirement for arguments to be objective. Simple and complex arguments are captured with the help of the diagram.

B. Uses and Purpose of Knowledge Representation Models

There are many benefits of formal Knowledge Representation Models.

Some mechanisms are intended to simplify automatic data mining. Data Mining is basically a process for inspecting and searching for specific information in large amounts of data. Other knowledge representation mechanisms are used to enhance human comprehension, such as mind maps, and argument maps. To evaluate arguments, different techniques are discussed in [22], [23]. Graphical representation of evidence-based dialogue, questions, ideas, pros, cons, and data helps in scientific reasoning [24]. In teaching, argumen-

tation mapping helps the student to build critical thinking skills [25].

IV. Threading Models for Arguments in Electronic Debates

A. Introduction to Threading Models

The relevant point to mention about threading models is that users can benefit in their decision making by exploring comments and justifications provided by others (e.g., on fora or various social networks). This exploration can be enhanced not only by search engines, but also by using hints provided by links generated by the comment authors themselves.

The whole World Wide Web was designed for improving information exploration based on links (here hyperlinks) [26]. The Internet fora and social networks took this a step further by hosting such links in a more compact way but typically at the expense of generality. Namely restrictions are added as to how many links are possible from each article item. The most common and simple restriction is one where each article (comment) can link to a single other article, to which it is a “reply". This structure, together with restrictions on the maximum chain of “replies", gives rise to the so-called tree structures seen on common Internet fora. A compact representation can be enabled by such rules.

Conversation Threading has been standardized for the IMAP email systems [27]. A common technical classification is:

- **Client based**: Microsoft Outlook, Thunderbird
- **Web based**: Gmail, Reddit, Slashdot

B. Examples of Threaded Fora Specializing in Debates

There are many fora on the Internet. They are frequently attached to articles in online newspapers or next to items in online shops or product rating sites. Here we focus on fora that are specially designed to support debates on ideas. Some of the other fora are occasionally used for debates around linked issues but they are not generally designed to help navigate or extract a conclusion for those debates.

The three fora that we have identified as specially designed for debates are:

- TED [28]
- YourView [21], [29]
- DebateDecide (Client-based version: DirectDemocracyP2P) [3], [30]

Of these fora, only TED is currently used spontaneously by real users. The other two fora (YourView and DebateDecide) have so far only been used by controlled groups as part of usage experiments.

e) Threading of TED : The TED website is claimed to be designed for helping in sharing ideas, supporting debates, and addressing questions about scientific topics for educational purposes. Comments in TED are threaded but the amount of support of the idea cannot be easily extracted.

f) Threading of the Forum “YourView": [31]

YourView is being developed as an experiment in visualizing political debates around elections. A fund was used to encourage a set of users to register, argue, and vote on issues relevant to the parties involved in a recent election in Australia. Comments are sorted by support or rejection of the motion.

YourView is an online platform for presenting debate comments and helping users to explore these comments by scoring them. Registered users have the right to vote and the ability to submit multiple comments with their vote. Moreover, the participant can give a thumbs up or thumbs down for any vote or comment (multiple simultaneously!). The score change produced by a thumbs up/down differs from user to user depending on a measure called the ”credibility score.” The ”credibility score” is computed with a secret formula based on the activities of the user and on the responses of others to these activities. In YourView, users do not really have the possibility to customize the formula for the credibility [31].

g) Threading of DebateDecide: As in YourView, comments are sorted by type of support of the motion that they answer [2].

C. Types of Threading Models for Arguments in Electronic Debates

Only a few types of Threading Models are common for Arguments in Electronic Debates:

- Single level of comments [29]: This has an article and the list of comments to it.
- Two levels [29]: This has the article, comments to it, and comments that answer comments in the first level.
- Unlimited hierarchy [32]: Comments can answer any previous comments.

From the perspective of the ordering of comments we have:

- Comments sorted by support and rejection of the article [29].
- Comments sorted by support and rejection of the comments that they answer [30].

V. Threading Model Classification

Threading Models can be classified based on the number of links into "Single-link"and "Multiple-links". Also, each class of link numbers (Single link and/or Multiple links) can be characterized based on the length of the allowed chains (Single-homogeneous, Single-heterogeneous, unlimited-homogeneous, unlimited-heterogeneous, limited-homogeneous, and limited-heterogeneous).

Threading Models can be classified into "Single-derivation"and "Multiple-derivations".

- Single-derivation: Single derivation of Threading Models provides one way down the chain [28]. The motion

has only one method to link with comments or justification.
For example:
Suppose we have the motion *"Children should drink milk daily"*
Suppose one user supports this motion with justification *"Milk is a health drink"*.
A second user rejects this motion with justification *"Children should drink juice daily"*.
The diagram in Figure 1 is an example of single-derivation.

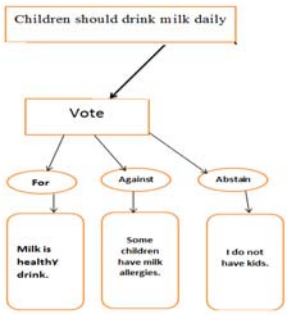

Figure 1: Example of Single-Derivation.

- Multiple-derivations: Multiple-derivations of Threading Models introduce multiple ways down the chain [30]. The motion has multiple methods to link with comments/justification, suggestion and/or request.
  For example:
  Suppose we have again the motion *"Children should drink milk daily"*.
  We have these derivations "Vote" and "Suggestion" which are indirect linked with each other by a motion. Suppose users submit reactions on the vote derivation as per the previous example.
  Others users can post proposals on the suggestion derivation *"Children should drink water daily." and "Ask your child's doctor"*
  In this example, there could be multiple suggestions. The diagram in Figure 2 is an example of motion interaction with multiple-derivations.

Also, each class of derivation numbers (single derivation and/or multiple derivations) can be characterized based on the number of choices.

- Single-choice: All items under the derivation have the same semantic [28]. The diagram in Figure 3 is an example of the single-choice.
- Multiple-choices: The items under the derivation are classified by semantics under different choice names [29]. The diagram in Figure 4 is an example of Multiple-choices derivations.

The general augment structure of the Debate Threading Model of the DirectDemocracyP2P system is provided by

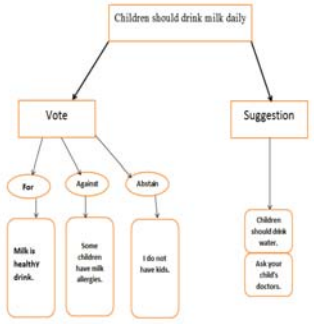

Figure 2: Example of Multiple-derivations

Figure 3: Example of the single-choice.

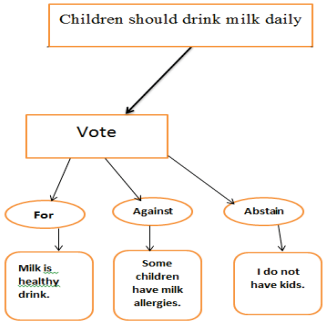

Figure 4: Example of multiple-choices.

the following set of rules:

CREATE (Organization)
PROPOSE (Science/Education/Religious/ Business)

CREATE (Motion)
PROPOSE (Topic/Question/Statement)

CREATE (Justification)
PROPOSE (explanation/ reasonable grounds)

VOTE (Motion/ Justification)
REQUEST (Explanation/ Reasonable grounds)
SUPPORT (Motion/ Justification) |

OPPOSE (Motion/ Justification) |
ABSTAIN (Motion/ Justification) |

CREATE (Motion).

In a DDP2P application, all debates and arguments start with a motion that is relevant to a given organization. The **organization** is a definition of a scope (set of relevant topics) and a constituency (set and weight of users) whose opinion is relevant to the decisions. A **motion** could be a topic, a question, a statement, or any idea that forms the subject of the debate between the parties, who are defined as being members of a given organization to which the motion is relevant. Every motion gets at most a **vote** by each constituent, whether they are for it or against it, with an optional **comment** to justify their stance. Anyone can add additional comments (justifications) to their own thread or give feedback to any previously posted comments (threads) by others. However, when submitting a second comment, a user automatically retracts his/her support for any previous comments. This allows the user to highlight a motion of interest and to see the corresponding participants' votes or replies.

VI. Debate Threading Models

TED's threading models can thereby be described as single-link and unlimited-homogenous while DDP2P is characterized as single-link and unlimited-homogenous chains. Next we give a formal definition of the threading model.

Definition 1 (Debate Threading Model): The set of restrictions placed on the number and type of links in an article item, as well as on the global rules on types and size of link chains, form a "*debate threading model*."

For a given threading model, multiple ways of graphically displaying the result to exit. For example, some items (i.e., at given depths in the tree) could be hidden until required by users. Otherwise, links can be shown graphically or the number or existences of connected items can just be mentioned. We want to separate the knowledge relations by users representation.

Definition 2 (Debate Representation Model): The set of rules describing how debate instances are graphically presented to viewers is called "*debate representation model*."

Some fora specialize on debates for specific topics: music, fashion, software bugs, and politics. Since some topics are more disputable than others, different threading models may be appropriate for different topics and, thus, fora.

VII. Comparison between TED, YourView, and DDP2P

As we mentioned previously, this study focuses on three fora for electronic debate (TED, YourView and DDP2P). We can compare these fora across some criteria to better understand differences. Table I compares between TED, YourView and DDP2P

	TED	YourView	DDP2P
Voting	None	Count the voting, topics and participants	Count the voting
Comments(justifications)	Comments not classified	Comments classified by vote	Justifications classified by vote
Threads	Comments threaded as Reply-To	Comments threaded as Reply-To	Justification threaded as Answer-To
Emotion thumb up/down	Part of comments	Part of comments	None
Metrics of ordering	Ordering by date	Ordering by date, credibility	Number of votes and/or date
Threading models	Only Single link, unlimited, homogeneous	Only Single link, homogeneous	Only Single link, unlimited, heterogeneous
Comments by participants	Unlimited comments	Unlimited comments	Only Single justification
Life span	limited	limited	Unlimited
Relations of comments	Replies and replies to replies	Unlimited replies	Unlimited replies with vote
Display of relation	Embed tree	Embed tree	Linked derivation

Table I: Comparison between TED, YourView, and DDP2P, from the perspective of their support for debates

Criteria:
In this paper we provide the comparison between TED, YourView, and DDP2P from the perspective of their support for debates.

- Voting:
  It is a score that counts the number of supports. This criterion has as domain:
  - None
  - Count the votes
  - Other score (Count comments, topics, participants, credibility, etc)

  TED has a debate representation model that is not structured by the type of voting.
- Comments/Justifications:
  These are arguments presented by voters. The domain of this criteria is:
  - Not Classified
  - Classified by Vote

  TED does not provide a structured comment section. All comments are in the same column and the user, once again, has to go through each of them to assess the decision behind each comment. While YourView uses the term argument, and DDP2P uses the term"Justification" to identify any argument entered by the users, the concept is similar to the other two fora. Both YourView and DDP2P provide a structured comment/justification section that is organized by voting choice.
- Threads:
  Threads are graphs/trees of arguments and relations between those arguments. TED and YourView calls the relation Reply-To. DDP2P calls the relation Answer-To.
- Emotion Thumb (Up/Down):
  This is a feature that allows the users to express their emotional support of an argument by selecting "Up" when they agree and "Down" for disagreement. Some platforms do not offer this feature while others have it available. The domain for this criteria is:
  - Part of voting
  - Separate from voting
  - None

  TED does not have a feature that allows the users to express their emotion (Thumbs Up/Down). YourView

allows the users to express their emotion by selecting Thumbs Up/Down for any comment. DDP2P allows each user to exercise a Thumbs Up/Down selection one time only, as part of its vote.

- Metrics of Ordering:
  This is a sorting option that allows the user to order the comments and arguments. The domain for this criteria is:
  - Ordering by date
  - Ordering by the number of votes
  - Ordering by credibility
- Threading Models:
  They are the general rules on types and size of link chains (Homogeneous or Heterogeneous). Homogeneous: all links have the same semantic: e.g. refutation. Heterogeneous: links can have different semantics: e.g. refutation, support. There are a several types available:
  - Single-homogeneous
  - Single-heterogeneous
  - unlimited-homogeneous
  - unlimited-heterogeneous
  - limited-homogeneous
  - limited-heterogeneous
- Comments by participants:
  This is the possible number of comments by participants. The domain for this criteria is:
  - Unlimited comments [29].
  - Only Single justification [30].
- Life span:
  It is the maximum amount of times that users are allowed to participate by votes or comments. The domain for this criteria is:
  - Limited [28], [29].
  - Unlimited [30].
- Relation of comments:
  There can exist relations between comments. The domain for this criteria is:
  - Replies and replies to replies [28].
  - Unlimited replies [29].
  - Unlimited replies with vote [30].
- Display of relationships of comments/threads:
  Here we classify techniques used to display the relation of comments. The domain for this criteria is:
  - Embed tree [28].
  - Linked derivation [30].

Threading models of TED have only single link and are unlimited-homogeneous.

VIII. Conclusion

Threading models for representing decentralized debates constitute a relatively unexplored field of research. This area significantly relates to many different activities in our lives such as communication, chatting, argumentation, and education. Here, we introduce a classification of debate threading models. We identified some generic tools for collaboration on an idea (Arguments, Thumbs up/down, Voting, Threading, etc. On the Internet, we can find many fora attached to some blogs and other sites that provide the users with a comment/justification opportunity. However, most of the time, they are not designed to provide or extract a conclusion on any ongoing debate. There are three platforms we focused on in this report (TED, YourView, and DDP2P) that are designed to structure comments for electronic debates.

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