Quaestio-it.com – A social intelligent debating platform

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http://www.doc.ic.ac.uk/~ft/argumentation.html
http://www.quaestio-it.com

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ABSTRACT

Information sharing between online users has altered the way we seek and find information. Users have at their disposal a wide range of tools for exchanging opinions and engaging into discussions. This creates a vast amount of information and the need of a more strict structure and semantics in order to take full advantage of the information and automatically extract useful conclusions to support decision-making. In this paper we describe a framework, based on computational argumentation, for modeling and analysing social discussions, and demonstrate a question-and-answer web application, based on this framework, offering debating infrastructure for opinion exchanges between users and providing support for extracting intelligent answers to user-posed questions.

Keywords: debating platforms; question-and-answer websites; Computational Argumentation; Social Networks;

Introduction

Social networks, discussion platforms and forums have changed the way we interact on the web. Users can easily share and express their opinions, views and thoughts over a plethora of topics, as well as initiate conversations. This creates an overwhelming amount of user generated information in the form of discussions and debates which could greatly benefit decision-making but is currently hard to utilise at its full potential. One of the major reasons opposing the usability of this information is the lack of structure and semantics. A major sub-category of these platforms are question-and-answer (Q&A) websites where users turn to for asking questions and receiving answers when making important decisions.

In this paper we describe a Computational Argumentation framework that can model online conversations and identify the strongest opinions within such debates. We additionally demonstrate a prototype Q&A web application which provides an intelligent way for evaluating answers to questions, using the theoretical framework and mathematical models. The application, called quaestio-it, takes a novel approach on Q&A functionality and offers the infrastructure for discussing each answer to any user posted question. It imposes a basic structure for posting answers and comments and offers an interactive visualised way for browsing through conversations. Posted answers are open for debate and users can vote or post their attacking/supporting comments as arguments either on the answers or on other comments. The answers are then evaluated using techniques from Computational Argumentation, taking arguments and votes into account, with the best answer being identified and highlighted.

The next section presents the background in Computational Argumentation and particularly in Abstract Argumentation, followed by our methodology in extending the Abstract Argumentation framework for facilitating online debates. We continue by presenting features of the prototype web application and later discuss some existing tools in the Related Work section. Finally we conclude by identifying the key points of our approach and briefly provide our next steps.

Background

Computational Argumentation

Argumentation theory is the study of human behavior that aims to understand the key factors of reasoning for reaching conclusions, forming opinions and structuring arguments when engaging into conversations. Computational Argumentation can be defined as the merging of Argumentation Theory and Computer Science to provide solid frameworks for modelling argumentative discussions and enabling the implementation of systems that can analyse these discussions (Dung 1995). Computational Argumentation has found use in a number of fields where an agreement is required between two or more opposing opinions. Notably, computational argumentation can be beneficial to medicine (Craven, Toni, Cadar, Hadad, Williams 2012, Hunter, Williams 2010), law (Bench-Capon, Prakken, Sartor 2009), games (Gao, Toni, Craven 2012) and multi-agent systems (Fan, Toni, Hussain 2010).

Several argumentation frameworks exist that offer a way for modelling arguments and the relations between them. These frameworks can be divided into two sub-categories: (i)

Abstract Argumentation frameworks where arguments and their attacking relations are formalised without focusing on the internal form of the arguments (Dung 1995) and (ii) Structured or Deductive Argumentation frameworks where a more complex logical structure of the arguments is defined (Praken 2010, Dung, Kowalski, Toni 2009, Garcia, Simari 2004, Besnard, Hunter 2008). This paper focuses on Abstract Argumentation Frameworks and how to extend them for facilitating online debates and aiding decision-making.

Abstract Argumentation

The widely ~~used~~ Abstract Argumentation Framework (Dung 1995) provides a basic formalisation of the arguments and the attacking relations between them, and it applies certain semantics to resolve conflicts and derive the strongest arguments within a framework. In the context of online debates, these conflicts can represent opposing opinions on a certain subject (e.g. whether or not to buy a product). An argumentation framework is a pair consisting of: (i) a set of arguments and (ii) a binary relation representing the attacking relations between them (Dung 1995). Formally this is given by the following definition:

Definition 1: An Abstract Argumentation Framework (AF) (Dung 1995) is a pair $F = (A, R)$ *where A is a set of arguments and R is a binary attack relation on A* $(R \subseteq A \times A)$.

An AF can be easily represented as a directed graph, with each node representing an argument in A and each directed edge indicating an attack relation in R. We present a simple example that illustrates the importance and use of such frameworks.

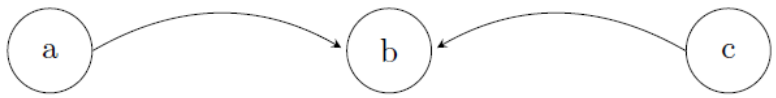

Figure 1 Argumentation Framework represented as a directed graph

Example 1: Consider the *AF* $F = (A, R)$, consisting of a set of arguments $A = \{a, b, c\}$ and their attacking relation $R = \{(a, b), (c, b)\}$. This simple framework can represent a number of real use case scenarios, e.g. a simplified version of a debate about using a specific drug for treating a patient: argument a states the drug to be used while arguments b and c propose reasons for not using the specific drug. Figure 1 shows the graphical representation of the framework, where nodes hold arguments and an edge from a first node to a second node represents an attack from the argument held at the first node against the argument held at the second node.

Intuitively, the strongest arguments are the ones that can withstand attacks. In this example, arguments a and c are not being attacked while argument b is attacked by both other arguments. Therefore, we can safely conclude that arguments a and c are stronger than argument b and, in fact, the strongest within this framework. However, in more complicated frameworks, more sophisticated formal approaches are needed in order to resolve such conflicts and identify the stronger arguments. This functionality is provided through the use of argumentation semantics.

Argumentation Semantics

Argumentation semantics evaluate a framework and derive sets of “strongest arguments”, called extensions (Dung 1995). The “status” of each argument is, therefore, dependent on its presence in these extensions. In this paper we will only describe one of the basic and most widely used semantics: admissibility (Dung 1995). An overview and analysis of a wide range of semantics is provided in (Dung 1995) and (Baroni, Caminada, Giacomin 2011).

Definition 2: Given an $AF = (A, R)$*, a set of arguments* $S \subseteq A$ *is admissible* (Dung 1995) *if it attacks all arguments that attack S and it does not attack itself where a set of arguments X attacks a set of arguments Y iff* $\exists a \in X$ *and* $\exists b \in Y \in$ *such that* $(a, b) \in R$.

Argument sets *{b}* and *{c}* in example 1 are admissible since they neither attack themselves nor are being attacked by any other set of arguments. Argument set *{a}* is non-admissible since it does not counter-attack argument sets *{b}* and *{c}*.

Even though admissibility provides an adequate separation between “weak” and “strong” arguments within argumentation frameworks, it is not well-suited when a more expressive, non-binary classification is needed. For example, consider the following two scenarios: (i) argument a is attacked by argument b and (ii) argument a is attacked by both argument b and argument c. These scenarios are depicted in Figure 2 (left and right respectively). Admissibility would assume argument a as equally “weak” in both scenarios. But, in a debate context, argument a should be weaker in the second scenario. In these contexts a numerical representation of an argument's strength is more appropriate.

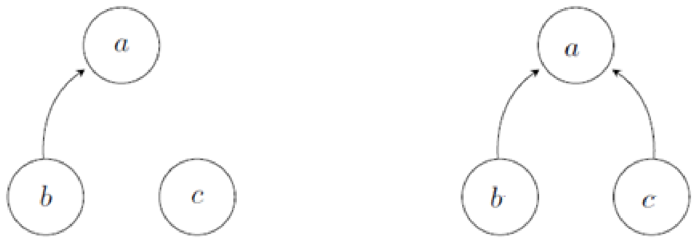

Figure 2 Scenarios illustrating the need of a numerical strength evaluation

Numerical Argumentation

In numerical argumentation systems (e.g. Matt, Toni 2008) each argument is evaluated and assigned a predefined-range value representing its strength, that is calculated by taking into account several factors. Within social discussions, as proposed in (Leite, Martins 2011), the strength of an argument can be calculated using its (positive or negative) votes and the attack relation between arguments within a debate. Leite and Martins introduce an extension of the Abstract Argumentation Framework, called Social Abstract Argumentation framework, which incorporates a voting mechanism to equip each argument with a number of positive and negative votes. The framework is a step towards applying computational argumentation concepts and algorithms in social discussions over the web where each argument may receive support or objections from a community.

Definition 3: A Social Abstract Argumentation Framework (Leite, Martins 2011) is a triple $< A, attacks, V >$ *where:*

- *A is a set of arguments*
- *R is a binary relation on A,* $R \subseteq A \times A$ *and*
- *V is a function that maps each argument to its positive and negative votes*
  $V : A \rightarrow N \times N$

Using a set of semantic operators, it is possible to devise a *Social Model* (see (Leite, Martins 2011) for details) that evaluates each argument within a framework and assigns to it an individual value representing its strength within the framework.

Proposed Methodology – Evaluation Algorithm

In this paper we propose an extension of the approach found in (Leite, Martins 2011) that includes an additional support relation between the arguments, as found in Bipolar Argumentation Frameworks (Cayrol, Lagasquie-Schiex 2005) in order to accommodate complicated structures found in online debates, and incorporates a more sophisticated mechanism for aggregating votes. The *Extended Social Abstract Argumentation Framework (ESAAF)* (Evripidou, Toni 2012) is defined as follows:

Definition 3: A Social Abstract Argumentation Framework is a tuple $< A, R_{+}, R_{-}, V >$*where:*

- *A is a set of arguments*
- R_{-} *is a binary relation of attacks on A,* $R_{-} \subseteq A \times A$
- R_{+} *is a binary relation of supports on A,* $R_{+} \subseteq A \times A$,
- *V is a function that maps each argument to its positive and negative votes*
  $V: A \rightarrow N \times N$

Given $a \in A, if\ V_{+}(a) = (p, n), V_{+}(a) = p$ *are the positive votes for a and* $V_{-}(a) = n$ *are the negative votes for a.*

Then, the *Admissible Social Model* evaluates an argument's strength by taking into account its votes, its attacking arguments and its supporting arguments. Given argument $a \in A, strength(a)$ is computed using the following recursive formula:

$$strength(a) = g(\sigma(a), f_{Att}(\sigma(a), attacks(a)), f_{Supp}(\sigma(a), supports(a)))$$ where:

1. $\sigma(a)$ is a function that calculates the social support (from the positive and negative votes)

2. $attacks(a)$ is the set of all attacking arguments to argument a

3. $support(a)$ is the set of all supporting arguments to argument a

4. $f_{Att}(\sigma(a), attacks(a))$ is a function for calculating the strength of an argument after taking into account its social support and the strength of its attacking arguments as follows:

$$f_{Att}(\sigma(a), attacks(a) = \sigma(a) \times (1 - m(attacks(a)))$$

where

$$m(set) = \begin{cases} 0 & \boldsymbol{if\ set = \emptyset} \\ strength(b) & \boldsymbol{if\ set = \{b\}} \\ strength(b_1) + m(\{b_2, \dots, b_n\}) - (strength(b_1) \times m(\{b_2, \dots b_n\})) & \boldsymbol{if\ set = \{b_1, \dots, b_n\}\ with\ n > 1} \end{cases}$$

Note that $f_{Att}((\sigma(\alpha), \{\}) = \sigma(a)$, namely when there are no attacks against argument a, f_{Att} boils down to calculating the social support $\sigma(a)$.

5. $f_{Supp}(\sigma(a), supports(a))$ is a function for calculating the strength of an argument after taking into account its social support and the strength of its supporting arguments as follows:

$$f_{Supp}\big(\sigma(a), supports(a)\big) = \sigma(a) + (\sigma(a) - \sigma(a) \times \Big(1 - m\big(supports(a)\big)\Big))$$

where m is defined as in item 4.

In other words, $supports(a)$ increases the value of an argument's social support by the same amount an equivalent attack would decrease it.

Note that $f_{Supp}((\sigma(a), \{\ \ \}) = \sigma(a)$, namely when there are no supports for argument a, f_{Att} boils down to calculating the social support $\sigma(a)$.

6. $g(f_{Att}(\sigma(a), attacks(a)), f_{Supp}(\sigma(a), supports(a))$ combines the social support of the argument, the argument's value after considering its attackers and the argument's value after considering its supporters. It is calculated as follows:

$$g(x, y, z) = \begin{cases} x\ if\ z = y = x\ (i.e. no\ supporting\ and\ attacking\ arguments) \\ y\ if\ z = x\ (i.e\ no\ supporting\ arguments) \\ z\ if\ x = 0\ (i.e\ no\ attacking\ arguments) \\ \frac{y+z}{2}\ otherwise \end{cases}$$

In our instantiation of this notion of strength we choose to take the lower bound of the

Wilson Score Interval (Wilson 1927) to define the social support function $\sigma(b)$ for $b \in A$ as follows:

$$\sigma(b) = \begin{cases} i & \boldsymbol{if}\ V_{-}(b) = 0\ \boldsymbol{and}\ V_{+}(b) = 0 \\ \left(V_{+}(b) + \frac{z_{\frac{\alpha}{2}}^{2}}{2t} - z_{\frac{\alpha}{2}}\sqrt{\frac{\left(V_{+}(b)\left(1 - V_{+}(b)\right) + \frac{z_{\frac{\alpha}{2}}^{2}}{4t}\right)}{t}}\right. \Big/ \left(1 + \frac{z_{\frac{\alpha}{2}}^{2}}{2}\right) & \boldsymbol{else} \end{cases}$$

Namely, if an argument b has not received any positive or negative votes, it is assigned a predefined value i. $V_{+}(b)$ is the number of positive votes on b, $t = V_{+}(b) + V_{-}(b)$ is the total number of votes and $z_{\alpha/2}$ is the $(1 - \alpha/2)$ quantile of the standard normal distribution where α is the confidence level we choose for our predictions. With a confidence level of 95% (i.e. $\alpha = 0.95$), $z = 1.645$.

The following example shows the use of our Admissible Social Model:

Example 2: Consider the following argumentation framework $< A, R_{+}, R_{-}, V >$ *with* $A = \{a, b, c\}, R_{-} = \{(c, a)\}, R_{+} = \{(b, a)\}$ *and the social support for each argument is (with* $V(x) = (V_x^{+}, V_x^{-})$ *for argument x):*

$$V_a^{+} = 10, V_a^{-} = 5$$
$$V_b^{+} = 4, V_b^{-} = 6$$
$$V_c^{+} = 4, V_c^{-} = 7$$

The following social support values are calculated using the Wilson Score as described above (with $i = 0.1$ and $\alpha = 0.95$)

$$\sigma(a) = 0.42$$
$$\sigma(b) = 0.17$$
$$\sigma(c) = 0.14$$

And the final calculation of their strength is calculated as follows:

$$strength(c) = g(\sigma(c), 0,0) = \sigma(c) = 0.14$$
$$strength(b) = g(\sigma(b), 0,0) = \sigma(b) = 0.17$$
$$strength(a) = g\left(\sigma(\alpha), f_{Att}\left(\sigma(\alpha), attacks(a)\right), f_{Supp}\left(\sigma(\alpha), supports(a)\right)\right)$$

where:

$$f_{Att}\left(\sigma(a), attacks(a)\right) = \sigma(a) \times \left(1 - m\left(attacks(a)\right)\right) = 0.42 \times 0.86 = 0.36$$
$$f_{supp}\left(\sigma(a), supports(a)\right) = \sigma(a) + \left(\sigma(a) - \sigma(a) \times \left(1 - m\left(supports(a)\right)\right)\right)$$
$$= 0.42 \times (0.42 - 0.42 \times (1 - 0.17) = 0.425$$

Therefore:

$$strength(a) = g(0.42, 0.36, 0.49) = \frac{0.36 + 0.49}{2} = 0.425$$

The example illustrates that even though argument *a* is attacked, its final strength evaluation is higher than un-attacked arguments *b* and *c* since it receives the support from argument *b* and additionally a large percentage of positive votes. Within social discussions the strength evaluations would reflect the status of an expressed opinion within the conversation. Higher strength indicates acceptable opinions (with respect to the other users). The next section describes the implemented prototype which is based on the theoretical extensions and models discussed above. It goes through all features and identifies the main characteristics that can aid in decision-making.

Methodology - Platform

Quaestio-it[1] is a web-based Q&A debating platform that lets user open topics, ask their own questions, post answers, comment and vote. It provides an interactive way of engaging into conversation regarding any question within the platform. Through the evaluation algorithm described in the previous section, the best answers and best comments, having the highest evaluation strength are highlighted. The strength is also visible through the visualisations in which stronger answers and comments (in terms of the underlying evaluation framework and algorithm) are visibly larger. This section presents all the features and capabilities of the prototype implemented.

Within the platform, each answer is open for discussion and users can post their comments, as supporting or attacking arguments, expressing their agreement or disagreement to the answer respectively. Subsequent levels of comments are regarded as attacks or supports to the parent comment/argument. Therefore, this creates a debate that can be modelled with the use of the Extended Social Abstract Argumentation Framework as defined in definition 3. In order to obtain the relations between arguments within a debate, each user, when posting an argument, has to explicitly state the nature of the comment (i.e. attacking or supporting argument). However, provisions and preliminary work were done for using natural language processing and sentiment analysis for automatically identifying these relations. Answers and comments are then evaluated based on the Admissible Social Model which takes into account supporting/attacking arguments and positive/negative votes. Finally, the best answer for each question is highlighted depending on the evaluation of the model. The rest of this section goes through all the features and capabilities of the platform implemented.

Browsing

Quaestio-it offers an interactive way for browsing through topics. Figure 3 shows a screenshot of the visual map of the website where all topics are represented as bubbles and their respective size indicates their participation rate in terms of active contributors (i.e. the number of users that have either posted a question, an answer, a comment or voted). Therefore, the most active topics stand out in terms of their size.

[1]www.quaestio-it.com

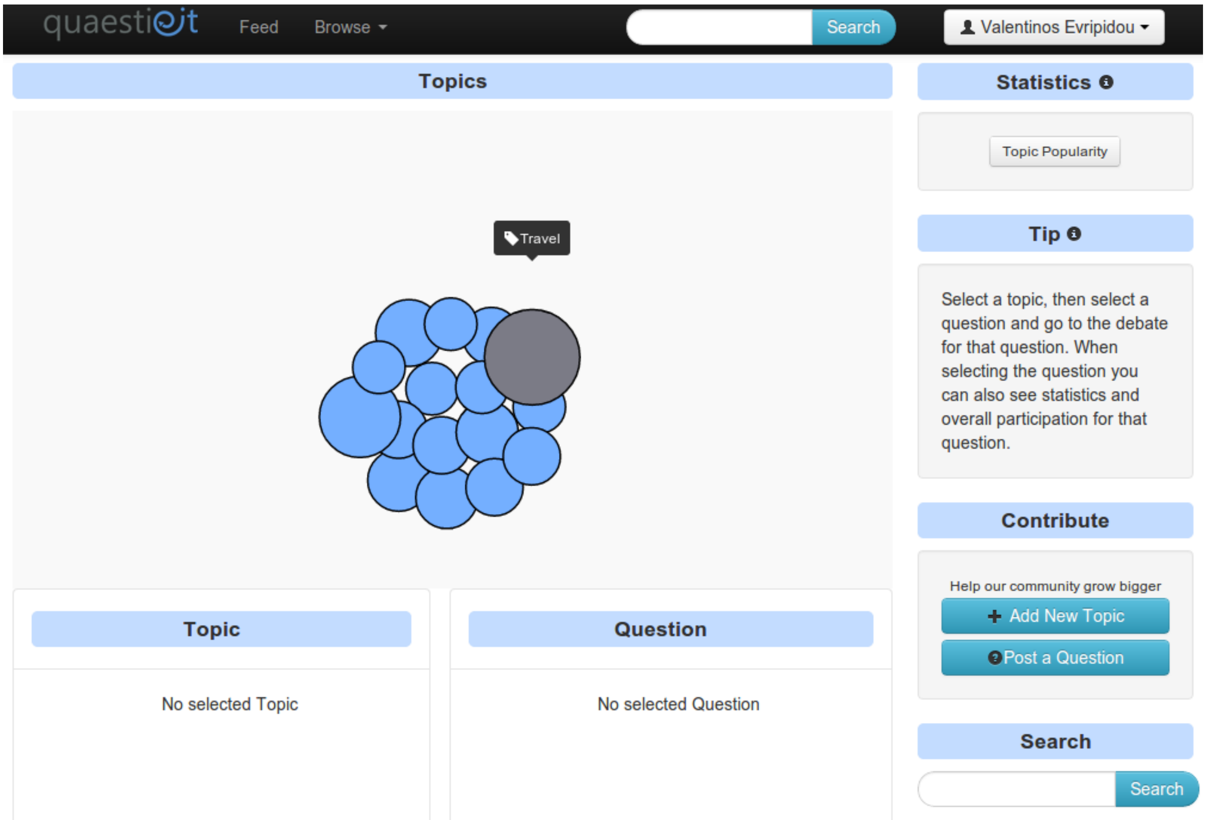

Figure 3 A screenshot showing the visualisations of topics in quaestio-it.com

Hovering over each topic displays additional information and by clicking it a user is redirected to a visualisation of all the questions within the topic as shown in Figure 4. When selecting a topic, additional statistics are shown on the bottom left of the screen that include: total number of questions, answers, comments (arguments) and votes within the topic. Each bubble (representing the questions) varies in size depending on its participation rate and additional statistics are shown for the selected question by clicking on it. This gives an insight to the users about the popularity of each topic and each question.

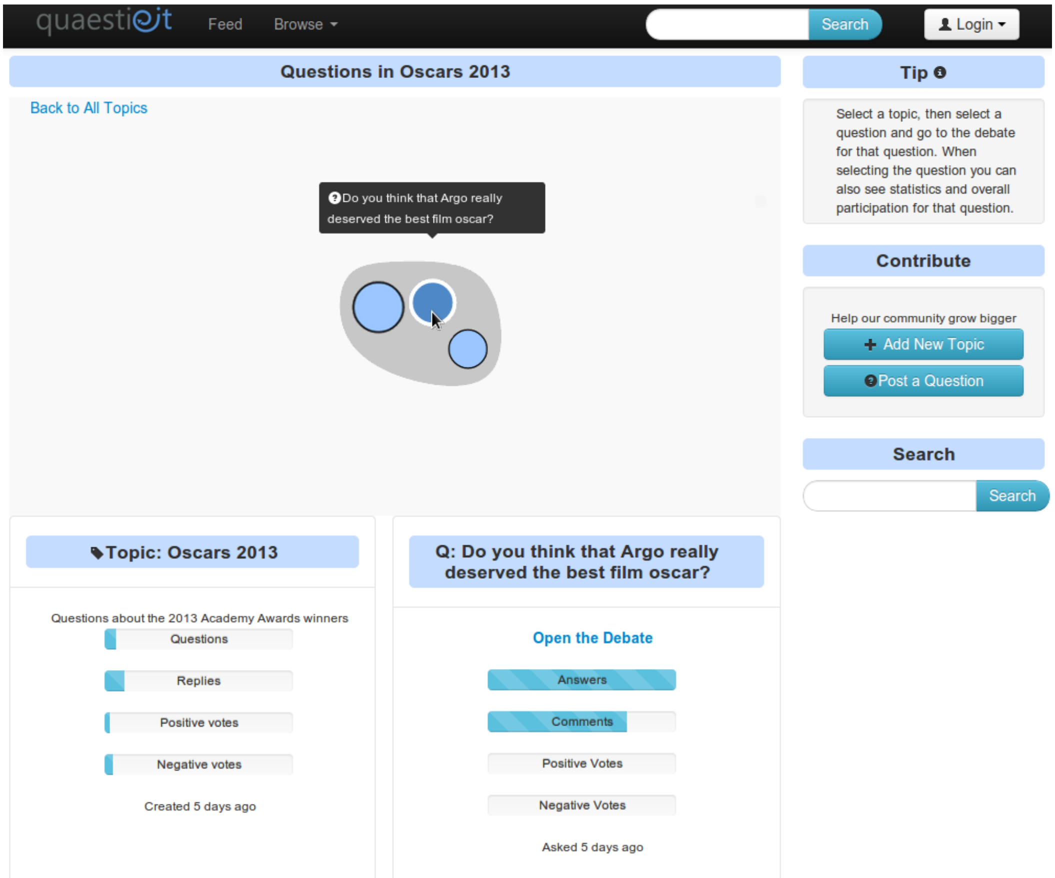

Figure 4 A screenshot showing the visualisation of questions in quaestio-it.com

Debating

Quaestio-it provides an alternative view of the conversations that can be more informative, interactive and aid in decision-making. Figure 5 shows a screen-shot of the debate about whether or not the film Argo deserved the best film Academy Award. On the right-hand side, the debate is represented as a tree where: (i) the root node corresponds to the initial question, (ii) its immediate children correspond to the answers and (iii) all other subsequent level nodes are comments (i.e. supporting or attacking arguments on the answers). The edges connecting the nodes indicate the relations between question, answers and arguments. Dashed edges indicate direct answers to the question, while straight, red (-) or green (+), edges show attacking or supporting arguments on the answers or on other arguments (as posted by the users).

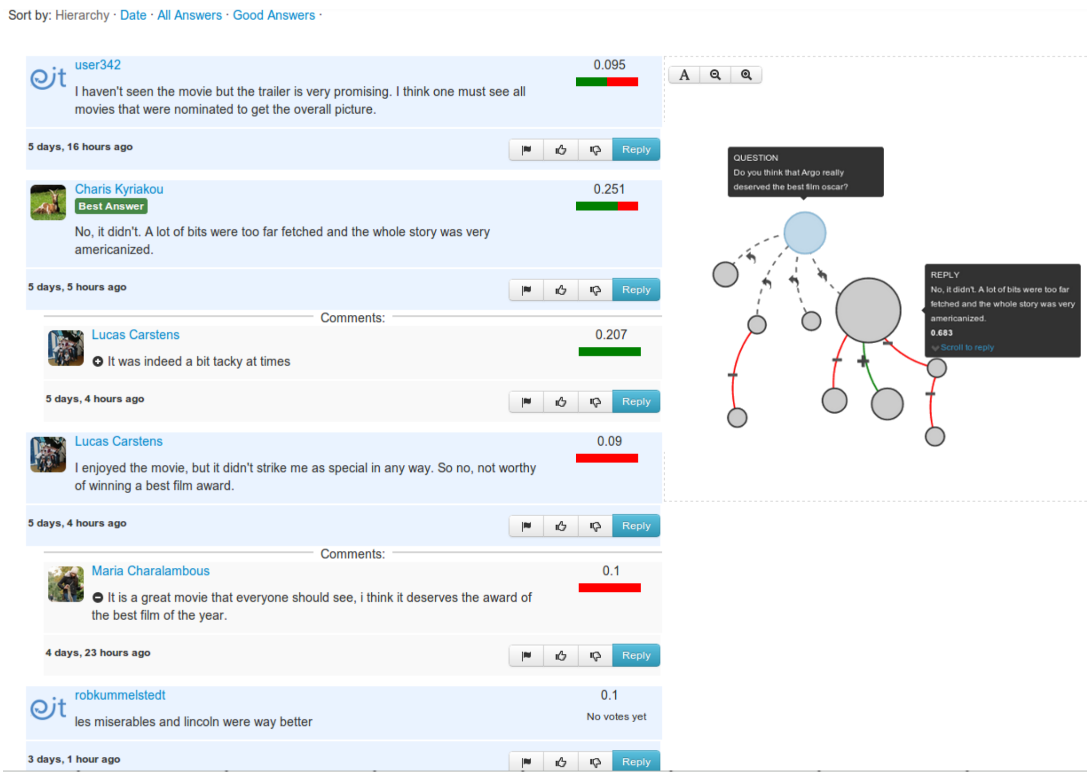

Figure 5: A screen-shot showing a debate in quaestio-it.com

Nodes vary in size depending on the strength evaluation from the Admissible Social Model. This provides a quick insight about the dominant (strongest) answers and comments for a particular question. Hovering over each node displays additional information for each comment or answer including its text and calculated strength. On the left-hand side, a more conventional view is being presented to the user showing the stream of answers and comments. Further information is shown, including the positive/negative votes ratio, strength evaluations and all available actions to the user. The available actions to the user include: (i) posting a reply and (ii) voting positively, negatively or indicating that a comment is irrelevant, malicious or spam. After a predefined number of "spam" votes on an argument or an answer are disregarded alongside their sub-tree of comments. In (Scheuer, Loll, Pinkwart, McLaren 2010) the authors distinguish five representation styles when it comes to visualising arguments: linear representation, threaded, graph, container and matrix. Our platform is offering both graphical and threaded representation styles that are "highly expressive", familiar to users and intuitive.

Private Rooms

Private discussions within the platform can be initiated through the use of "private rooms" where a user, when creating a topic, can select to make it private and send invites to selected users to participate. Each user can create or be invited to multiple private rooms.

Logging

A logging mechanism was implemented in order to store additional information about the users and about each debate. This includes logging all user actions for later use in analysis, modelling a user's reputation or constructing further visualisations. Initial steps were taken towards implementing the latter where the data was used to visualise the sentiment of a user towards the community and the sentiment of the community towards a user.

Natural Language Processing

As mentioned earlier a user needs to explicitly state the nature of his/hers argument when posting. Alternative methods have been investigated in order to seamlessly integrate an automatic extraction of these relations. Some initial work has been done into integrating a sentiment classifier for automatically selecting the type of the argument (attack or support). Figure 6 shows the classifier's output, integrated within the quaestio-it when posting an argument. It uses a Naïve Bayes classifier to determine the type of the statement input by the user (supporting or attacking statement) (Michael 2013). This only affects the identification of the arguments into supports or attacks. In (Schneider, Groza, Passant 2013), where a detailed analysis of several debating platforms is conducted, the authors identify that one of the main obstacles in applying argumentation within social websites is the amount of human effort required. Our approach minimises the actions required by users when posting arguments. Future work is needed however to improve the predictions of the classifier.

General Features

Several other features are offered by the website to enrich its usability and promote its use. It includes an easy login mechanisms through social networks (currently Facebook, Twitter and Google+), as well as a standard registration mechanism. The home page of the website presents a news feed to the users for showing the top, latest and unanswered questions. Within each topic and discussion it includes related topics and questions, and additionally it provides standard searching functionality on topics, questions and answers.

Figure 6: A screen-shot showing the result of the sentiment classiffer

Technical Details

We used a wide range of programming languages and web frameworks that were used for the implementation of the web platform. For the back-end (server-side) we have used Python with the Django Web Framework as it was found to be the most appropriate due to its security, scalability, flexibility and speed.

Django[2] is a web framework entirely built on Python that focuses on implementing data-driven web applications. It follows the Model-View-Controller (MVC) design pattern providing a clear separation

[2] www.djangoproject.com

between an application's interface (View), its data (Model) and the business logic (Controller) as shown in Figure 5. The Controller acts upon the Model for adding, updating or deleting data; the View offers the interaction with the user and forwards the calls to the controller depending on the user's actions and the Model sends events to the View after each change in the data for updating the interface.

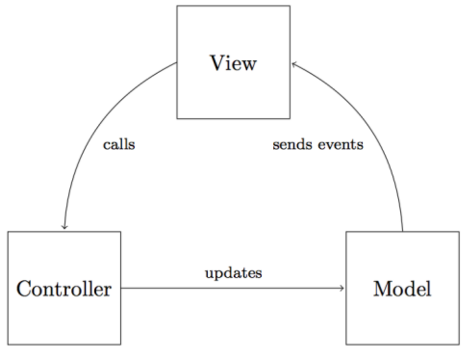

Figure 5 MVC Architecture

The client-side of the web application is built in HTML, CSS and Javascript. An important aspect of the client implementation is the interactive visualisation of the debates, which are provided by the Data Driven Documents (D3.js). D3.js[3] is a JavaScript visualisation library that provides the infrastructure for binding data to a Document Object Model. It can be used to create HTML elements such as tables or interactive SVG graphs for visualising any kind of data and providing interactivity through browser events (e.g. mouse click, hover etc.).

Evaluation

Even though the platform is in an initial state we are trying to get users engaged in a number of settings where they are asked to debate on several topics. An initial contest was conducted within the Department of Computing at Imperial College London, where students were actively involved in a number of debates within a fixed period of time during which they were asked to support their statements and views. At the end of the contest the winners were the ones with the strongest opinions as calculated by the Admissible Social Model described in the previous section. A total number of 134 users and 959 arguments were collected during the initial tests of the platform. A more thorough user evaluation is needed in order to validate the theoretical and practical methods used.

Related Work

This section provides a brief overview of existing tools that share similarities with the Q&A application implemented. We identify two main categories of such systems: (i) debating platforms and (ii) Q& A websites. We also compare our tool with existing decision making methods.

[3] www.d3js.org

Existing Tools

Debating Platforms

Several online platforms exist which provide the means to enforce or visualise online debates and discussions that are not only limited to products and businesses but can successfully be applied to any subject including politics, economics, religion, etc. Below we describe the most popular systems.

Debate.com[4] offers a well structured debating system that follows strict rules and lets users engage into a conversation regarding a particular topic. In each debate only two participants can exchange opinions and all others take the role of observers which determine the outcome of the debate by voting for the participant they side with. The debate is organised into fixed length rounds which are decided prior to the beginning and at each round one of the two participants is declared winner if his arguments accumulate the highest number of votes. The final winner of the debate is the user who won the highest number of rounds.

debategraph[5] is an online tool providing a visualisation mechanism for representing any form of debate. Users can engage into a conversation around a central idea, stating their supporting or attacking arguments. The purpose of the tool is simply to visualise the conversation without providing any formal or informal result of the debate which is left entirely up to the user to conclude. No visual aid is provided by the tool to enhance popular or unpopular arguments. Moreover, each node in the graph can contain a sub-graph of a debate on the topic of the nodes argument.

Livingvote[6] offers a debating platform that has the advantage of voting on each argument in a debate. Every debate consists of arguments supporting or attacking an initial statement, which in their turn have arguments supporting or attacking them and registered users can either vote on the existing arguments or add their own. Although livingvote.org incorporates the notion of social support for each argument it does not compute an outcome for a debate, but only presents the accumulated votes for each argument. Additionally it does not take into account the sub-arguments and their respective votes, which support or attack their parent argument.

iDebate[7] provides a strict debating platform where users can debate on a topic by providing statements for or against an initial position. Each statement can consist of an argument and a counter argument which all users can later improve. At the beginning and end of each debate users vote from a distinct set of vote types (strongly for, mildly for, mildly against, strongly against, don’t know) which are then compared. The website does not provide any voting functionality on arguments or on points/counters point and the result of the debate is calculated by a vote aggregation on the two sides of the initial position.

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[4]www.debate.org
[5]www.debategraph.org
[6]www.livingvote.org
[7] www.idebate.org

Question and Answer Websites

This section gives a brief overview of the most popular Q&A websites that share a number of functionalities with quaestio-it as described in the previous section.

answersbag[8] Users can ask questions, post answers and comment on answers. Comments are restricted to two levels of nesting and do not affect an answer's rating which is calculated from the "likes" it has received. Furthermore, questions can be rated in terms of their popularity. The website provides a point system for identifying and rewarding good contributors.

answers[9] Users are only allowed one answer for each question and all other users can contribute to improving the answer. Additional voting consists only of feedback on whether or not an answer addresses the question well.

stackexchange[10] A network of specialised sites, mostly for IT questions, where users can post their questions, answers and comments. Each user can up-vote or down-vote answers. Voting is the main mechanism for choosing the best answers, along with users accepting answers for their own questions. Commenting on answers is restricted only to one level and does not affect an answer's rating, even though users can mark comments as informative. Reputation points, earned through participation, give users more functionality such as voting which is not available for new users.

quora[11] Within Quora each user's vote has a different weight depending on the user's activity (i.e. votes from users posting good answers have greater weight than others). Answers are rated using an algorithm based on votes, users profiles and spam/gaming detection techniques[12]. Commenting is more complex than the previously described platforms as Quora allows an infinite number of nested comments. However, these comments do not numerically contribute to an answer's rating.

answers.yahoo[13] In Yahoo Answers users can ask their questions and define a time frame for them to be answered, during which voting and answering takes place. Afterwards, the best answer is chosen either from aggregating the votes or is selected by the user that asked the initial question. There is no functionality for further commenting on answers. It uses reputation algorithms to promote participation by increasing the limits each user has (in terms of the number of allowed votes/questions/answers) depending on their activity.

We identify these platforms as closely related to the implemented Q&A application and believe that Q&A functionality and debating platforms would benefit from argumentation algorithms and concepts by offering more intelligent evaluation of the answers. Our methodology can provide a more complete approach in evaluating all aspects of a debate by calculating the strength of each argument and sub-argument posted by users. It uses votes to

[8] www.answerbag.com
[9] www.answers.com
[10] www.stackexchange.com
[11] www.quora.com
[12] www.quora.com/Quora-product/What-is-Quoras-algorithm-formula-for-determining-the-ordering-ranking-of-answers-on-a-question
[13] www.answers.yahoo.com

identify the overall sentiment of a community towards an argument and combines debating and voting to highlight the correct answer. This is a unique feature of quaestio-it when compared with all other systems.

Decision Methods

Multiple Criteria Decision Aid

As described in (Belton and Pictet 2013) a Multiple Criteria Decision Aid Model is comprised of the following elements:

(i) alternatives which are a number of actions that can solve a specific problem,
(ii) criteria, with which each alternative is evaluated
(iii) evaluations which assess the performance of the alternatives
(iv) weights, that balance the importance of the criteria, and
(v) an aggregation algorithm that combines all the elements.

We can derive the following connections between our proposed methodology and MCDA systems. The alternatives can be seen as (some of) the answers given for a specific question. Some answers can also be interpreted as assessment of the value to be attributed to attributes. Each answer is an alternative correct solution to the initial questions, or an assessment of the value of an attribute. The criteria can be viewed as a broad concept in which we evaluate whether the answer is correctly addressing the initial question or whether the attribute has a certain value. Evaluations can be directly linked to the strength evaluation of each answer (alternative/attribute), which shows its performance on how it addresses the question. This performance is given by the amount of agreement or disagreement from a community. Weights are not currently in use in our approach as we consider each answer (alternative/attribute) having the same type of criteria (i.e. does a community believe that this answer is the correct one? Or that an alternative has a certain attribute with some value?). Finally, the aggregation algorithm is the direct equivalent of our proposed Admissible Social Model, which aggregates all the information from votes and arguments to evaluate each alternative and provide its evaluation.

A main difference between our approach and conventional MCDA Decision Systems is that in our setting information is not static and can organically grow depending on the engagement of a community. Results are dynamic and not all alternatives are known from the begining. Indeed our approach can be seen as a specific decision problem in a distributed, open-ended dynamic form.

Social Networks and Decision Systems

As described in (D. J. Power, G. Phillips-Wren 2012), in a survey conducted by (Bulmer and DiMauro 2011) within 97 organisations around the world, it was found that 80% of the participants can accelerate their process of decision making and strategy development by engaging in online communities. In (R. Meredith, P. O'Donnell 2012) the authors describe a general framework for understanding the role of social media within Business Intelligence Systems and highight that the social aspect of decision-making is crucial to understanding organizational behaviour.

We believe that our proposed methodology and implemented platform can be used in such environments and benefit decision makers by acquiring knowledge and information from an online community.

Conclusions and Future work

As identified in (Schneider, Groza, Passant 2013) the requirements of using argumentation in the social web is that arguments must be: (i) identified, (ii) resolved, (iii) represented and stored, and (iv) presented to the users. Quaestio-it addresses all four requirements in the following ways:

- Arguments are identified and resolved by the users through the selection of the type of the arguments, or identified by Natural Language Processing.

- Arguments are represented and stored within the platform as trees and their strength evaluated automatically

- Arguments can be queried and presented to the users through visualisations, searching, and browsing through the website.

In terms of the specific application area of questioning and answering tools, Q&A websites provide easy access for opinion exchanges on the web, that can be used to support decision making. Users can find answers on general or specialised questions and can benefit from this knowledge-sharing when taking important decisions. However, these platforms do not provide the means for further enhancing information and are restrictive when additional feedback is required on each answer. Quaestio-it offers debating infrastructure and a more intelligent way for evaluating the answers on each question. Moreover, the visualisations aim at providing a more engaging environment for users to contribute and can be very informative without the time-consuming need of going through all the answers.

A number of new features are currently under consideration and development including: (i) improvement of the textual analysis for the automatic extraction of the relations between the arguments requiring more sophisticated Natural Language Processing techniques, (ii) more intelligent and personalised evaluations depending on a user's social network profile and (iii) a more expressive framework for describing the relations between arguments (i.e. degree of agreement or disagreement). Additionally, we are currently exploring and implementing a debating platform within an e-learning environment where students and lecturers can interact in more interactive setting, as well as applications in the engineering design field (Baroni et al. 2013) (Cabanillas et al. 2013).

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