Bottom-Up Argumentation

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Abstract. Online social platforms, e-commerce sites and technical fora support the unfolding of informal exchanges, e.g. debates or discussions, that may be topic-driven or serendipitous. We outline a methodology for analysing these exchanges in computational argumentation terms, thus allowing a formal assessment of the dialectical validity of the positions debated in or emerging from the exchanges. Our methodology allows users to be engaged in this formal analysis and the assessment, within a dynamic process where comments, opinions, objections, as well as links connecting them, can all be contributed by users.

1 Introduction

Online social platforms, such as Facebook[3], e-commerce sites, such as Amazon[4], and technical fora, such as TechSupport Forum[5] support the unfolding of informal exchanges, in the form of debates or discussions, amongst several users. Some of these exchanges may be topic-driven (e.g. is a particular holiday destination worth visiting? Which book by Umberto Eco is best? How can a software bug be fixed?). Others may be serendipitous (e.g. while discussing the recent tsunami in Japan one may end up debating pros and cons of nuclear power stations).

While it is acknowledged (e.g. in [11]) that computational argumentation could benefit these online systems by supporting a formal analysis of the exchanges taking place therein, virtually all of the existing work considering online systems and argumentation focuses on extracting argumentation frameworks of one form or another manually or semi-automatically from these exchanges. For example, Heras et al. [11] suggest the use of argument schemes as a way to understand the contributions in these exchanges, while Rahwan et al. [13] suggest to map these contributions onto the AIF (Argument Interchange Format), again using argument schemes as well as semantic web technology for editing and querying arguments. These works implicitly assume that the extraction of argumentation frameworks is down to "argumentation engineers" external

[3] http://www.facebook.com/
[4] http://www.amazon.com/
[5] http://www.techsupportforum.com/forums/

to/passively engaged in the exchanges, and "fluent" in (one form or another of) computational argumentation.

On the other hand, work in computational argumentation predominantly focuses on determining the dialectical validity of a set of arguments, a single argument, or a claim, supported by arguments, with respect to a given, statically defined argumentation framework. Several notions of dialectical validity have been defined (e.g. see [5, 8, 1]) and several systems, for some or several of these notions, are available (e.g. see [10, 9]).

We propose a methodology linking these two lines of work. Rather than assuming the intervention of "argumentation engineers" observing the exchanges, we envisage that the active participants in the exchanges are annotating them. In order for ordinary (rather than computational-argumentation fluent) users to be engaged in these annotations, we keep them very simple and graphical: annotations indicate that pieces of text in natural language are either *comments* or *opinions*, and *links* can be drawn to indicate source, support or objection. Opinions are expressed about comments, and comments and/or opinions can be linked to links too, very freely and in natural language as in online informal exchanges. We then propose an automated mapping from these annotations to an existing computational argumentation framework, Assumption-Based Argumentation (ABA) [7], paving the way to the automatic computation of the dialectical validity of comments, opinions, and links, and thus topics that these encompass. We envisage that users will add comments, opinions and links dynamically, in the same way exchanges grow over time in existing online systems.

We term our methodology *bottom-up argumentation* because it takes a grassroot approach to the problem of deploying computational argumentation in online systems:

- the argumentation frameworks are obtained bottom-up starting from the users' comments, opinions and suggested links;
- no top-down intervention of or interpretation by "argumentation engineers" is required;
- our automated translation feeds building blocks of arguments and attacks up to an argumentation system for determining computational validity;
- topics emerge, bottom-up, during the underlying process, possibly serendipitously.

We choose ABA as the underlying computational argumentation framework since it is the simplest system we are aware of that i) is well suited to support practical argumentative reasoning [4], ii) can distinguish arguments, support as well as attack amongst them, iii) can support defeasibility of information as the system evolves over time, iv) is equipped with a variety of well-defined semantics and computational counterparts for assessing dialectical validity.

We will focus in this paper on social networks as these allow for the most free kinds of exchanges, and are thus the most general setting in which to show our methodology.

The paper is organised as follows.

Darwin's natural selection rules supreme.

If you have ever been in GB you must have experienced washing your hands with separate taps. You know what I mean.

The picture shows a tap specimen now inhabiting Imperial College restrooms. You can clearly see a minor, but significant, mutation in the DNA of its ancestors. In particular, with respect to the "hardcore separate taps" variety, which used to live there not so long ago, cold and hot water are still separate, but they seem to have developed a form of symbiosis.

Besides, the population of "hardcore separate taps" (the only tap variety accounted for, until recently) seems to be on its way to extinction. Even in my hotel I couldn't find any.

This is quite impressive, considering that we are only in 2011.

Fig. 1. Initial post on Facebook

In section 2 we provide a concrete, motivating example for our methodology, of an exchange in a social network. We also discuss the main motivations for our proposed methodology. In section 3 we provide our basic system of annotations, in the context of the motivating example. In section 4 we give background on ABA. In section 5 we define the automated mapping between exchanges as given in section 3 and ABA, again illustrated for the motivating example. In section 6 we discuss some directions for future work and conclude.

2 Motivation

Let us consider a concrete case[6], where Facebook user Paolo Rossi posts the picture and comment shown in Figure 1.

[6] This is a real discussion that took place in Facebook. The comments have not been edited. We instead modified the users' names for reasons of privacy. As a disclaimer, this paper does not intend to take any position regarding the opinions in this illustration.

Fig. 2. Separate Taps discussion: comments (a)

This post does not have a precisely identified subject or purpose. There is a picture showing two separate taps controlling the water flow of a single faucet, from which two separate streams of water flow. The *comment* is intended to be humourous, but it does not say whether separate taps are inconvenient, or antiquate, although that may be implied. Then, as more Facebook users comment

Fig. 3. Separate Taps discussion: comments (b)

on this post (see Figures 2 and 3, where comments are labelled $C1, C2, \ldots, C14$), some *opinions* start to emerge between the lines, grounded in the comments, and people start discussing them, to express their agreement and bring additional *support* to comments/opinions of other users, or else to show disagreement and bring up *objections*. For example, the first three comments seem to agree, directly or indirectly, on the opinion (let us call it $O1$) that "separate taps are common in GB". $C1$ also seems to convey another opinion: "separate taps are antiquate" ($O3$). $O1$ and $O3$ together may support the further opinion that "GB is a backward country" ($O2$), although in a somehow implicit way. These relationships between comments and emerging opinions are of a positive nature, i.e., comments support certain opinions. However, there are also comments representing objections to opinions or to other comments. For example, $C3$ may support the opinion that "separate taps are inconvenient because they freeze/burn hands" ($O4$) whereas a different comment $C11$ supports a different, conflicting opinion, that "separate taps are not inconvenient as the basin solves temperature problems" ($O17$), hence we may read $O17$ as an objection to $O4$. A possible annotation of the Facebook exchange in terms of opinions, objections and links is given at the end of the paper. This annotation may be contributed by the users engaged in the exchange or by other users, external to the exchange.

It has been often said that the Web 2.0 is a place for grassroots. Actually, this is exactly what happens here. New contributions and ideas are produced and shared in an exquisitely serendipitous, bottom-up approach. In general, debates in the social Web start with no clear purpose. If the one who posts the first comment has a purpose in mind, he or she does not usually state it. Different is the case of structured debates, or polls in which the objective is clear, for instance choosing one among three possible dates for a meeting. Here instead we are looking at chains of pseudo-random posts, like we find in Facebook, in Amazon or at the bottom of an online newspaper's article. Sometimes such chains of posts converge to some topic, then again they may totally diverge and focus on some other topic. They may happen to never find a focus.

Despite these features, we can still abstract away and recognize, within these exchanges, *arguments*. But, unlike arguments in the computational argumentation literature, these arguments are not structured or relevant to any predefined topic, opinion or goal. They emerge, *bottom-up*, from the grassroots. From these arguments, a few mainstream opinions may emerge as the result of many comments, as if in a sort of "natural selection".

In this form of exchange we can identify a "struggle for existence" of arguments. The struggle determines what arguments will be most appreciated, upheld, agreed upon, and influential in the definition of the forthcoming generations of arguments, if we stick to the metaphor. But what are the forces that govern the struggle for existence of arguments in bottom-up argumentation? The rhetoric abilities of participants, their knowledge, their logical and social skills, all contribute greatly to the final result. But, since this is enabled by the presence of a social Web platform, the medium is also a player.

In this paper we outline a methodology for bringing computational argumentation (with its evaluative benefits) into these kinds of unstructured online exchanges while keeping the philosophy and style (simplicity, fun, freedom of expression) of the existing medium for social network. Indeed, we envisage that users can add further annotations, in the form of opinions grounded in/based on comments, objections, as well as (directed) links connecting them. The opinions are in the same format (free text) as the comments. Links are just graphical.

3 Annotations

We will use the following terminology:

- *comment* stands for a "base-level" user comment, i.e. a comment posted in an online debate by a user; *comment*s will be denoted $C1, C2, \ldots$;
- *opinion* stands for a "meta-level" comment, containing information extracted or digested from part of one or more *comment*s or other *opinion*s, again by a user; *opinion*s will be denoted $O1, O2, \ldots$;
- *link*s are of two types:
  - continuous lines, connecting a target with one or more starting points marked by solid circles. These circles indicate either that an item at the starting point is the source for the information held at the end of the connecting line, if the starting point item is a *comment*, or that the starting point item provides support for the end point, if the starting point item is not a *comment*. These connecting lines can be seen as expressing a *basedOn* relation in the first case, and a *supportedBy* relation in the second;
  - dashed lines, again connecting a target with one or more starting points marked by solid circles. These lines indicate objections from the starting points (typically opinions) to the end point, and can be seen as expressing an *objection* relation.

In our motivating example, the *basedOn* relation is used to model that the source of $O1$ is $C1$; the *supportedBy* relation is used to model that $O1, O3$, together, support $O2$; the *objection* relation is used to model that $O17$ disagrees with $O4$. In general, *basedOn*, *supportedBy* and *objection* relations can also hold between a *comment* or *opinion* and another *basedOn*, *supportedBy* or *objection* relation. Indeed, in our motivating example, the *objection* to $O4$ originating from $O17$ is *basedOn* another *comment*, $C11$.

We will see how to map *comment*s, *opinion*s, and *link*s onto a computational argumentation framework. The idea (and expected benefit) is to determine which *opinion*s are acceptable given the current state of the discussion, in relation with other *comment*s/*opinion*s. As the exchange proceeds, different views will emerge and become more or less acceptable.

The dialectical process we are considering is full of implicit user assumptions. For example, if a user agrees on some *opinion* supported by some *comments*, we could say that the user "assumes" that such *comments* make sense, unless there are reasons not to do so. Likewise, if such *opinion* is subject to some *objections*, we could say that the user does not "assume" that such *objections* make sense, unless there are reasons to do so.

These considerations (as well as the reasons put forward in the introduction) make us believe that Assumption-Based Argumentation [7] is a very natural candidate framework for modeling bottom-up argumentation.

4 Assumption-based argumentation

Assumption-Based Argumentation (ABA) is a general-purpose argumentation framework where arguments and attacks between them are built from *ABA frameworks*, which are tuples $\langle \mathcal{L}, \mathcal{R}, \mathcal{A}, \overline{} \rangle$ where

- $(\mathcal{L}, \mathcal{R})$ is a *deductive system*, with $\mathcal{L}$ a language and $\mathcal{R}$ a set of inference rules,
- $\mathcal{A} \subseteq \mathcal{L}$, referred to as the set of *assumptions*,
- $\overline{}$ is a (total) mapping from $\mathcal{A}$ into $\mathcal{L}$, where $\overline{x}$ is referred to as the *contrary* of x.

In this paper, we assume that inference rules have the syntax $s_0 \leftarrow s_1, \ldots, s_n$ (for $n \geq 0$) where $s_i \in \mathcal{L}$. We refer to $s_1, \ldots, s_n$ as the *premises* and to s_0 as the *head* of the rule. If $n = 0$, we represent a rule simply by its head and we call the rule a *fact*. As in [6], we restrict attention to *flat* ABA frameworks, such that no assumption occurs in the head of a rule.

Rules may be domain-dependent or not, and some of the premises of rules may be assumptions. These can be used to render the rules defeasible. In this setting, contraries of assumptions can be seen as representing "defeaters".

An *(ABA) argument* in favour of a sentence $c \in \mathcal{L}$ supported by a set of assumptions $A \subseteq \mathcal{A}$ is a proof of c from A and (some of) the rules in $\mathcal{R}$. This proof can be understood as a tree (with root the claim and leaves the assumptions), as in [7], as a backward deduction, as in [6, 8], or as a forward deduction, as in [2], equivalently. For the purposes of this paper, we will use the notation $A \vdash_R c$ to stand for an argument for c supported by A by means of rules $R \subseteq \mathcal{R}$. When the rules can be ignored, we write an argument $A \vdash_R c$ simply as $A \vdash c$.

An argument $A \vdash c$ *attacks* an argument $A' \vdash c'$ if and only if $c = \overline{\alpha}$ for some $\alpha \in A'$.

Several "semantics" for ABA have been defined in terms of sets of assumptions fulfilling a number of conditions. These are expressed in terms of a notion of attack between sets of assumptions, where $A \subseteq \mathcal{A}$ attacks $A' \subseteq \mathcal{A}$ if and only if there is an argument $B \vdash c$, with $B \subseteq A$, attacking and argument $B' \vdash c'$, with $B' \subseteq A'$.

In this paper we will focus on the following notions:

- $A \subseteq \mathcal{A}$ is *conflict-free* if and only if A does not attack itself;
- $A \subseteq \mathcal{A}$ is *admissible* if and only if A is conflict-free and attacks every $B \subseteq \mathcal{A}$ that attacks A;
- $A \subseteq \mathcal{A}$ is *preferred* if and only if A is (subset) maximally admissible.

Note that these notions can be equivalently expressed in terms of arguments, rather than assumptions, as shown in [8].

Given an ABA framework $\mathcal{F}$=$\langle \mathcal{L}, \mathcal{R}, \mathcal{A}, \overline{} \rangle$ and a (conflict-free or admissible) set of assumptions $A \subseteq \mathcal{A}$ in $\mathcal{F}$, the (conflict-free or admissible) *extension* (respectively) $\mathcal{E}_{\mathcal{F}}(A)$ is the set of all sentences supported by arguments with support a set of assumptions $B \subseteq A$:

$\mathcal{E}_{\mathcal{F}}(A) = \{s \in \mathcal{L} | \exists B \vdash s \text{ with } B \subseteq A\}$.

In the remainder of this section, we will use the following conventions. Uppercase letters denote variables that are implicitly universally quantified. Variables O, C, L are used to represent opinions, comments and links between them, respectively. Variables X, Y are used to represent items that can be either opinions or comments. Variable Z is used to represent items that can be either opinions or links. The rules/assumptions/contraries are to be intended as schemata, standing for all their ground instances over appropriate universes (for comments, objections and links). Assumptions are always of the form $asm(\_)$, where asm is either α (for assumptions about opinions), χ (for assumptions about comments), or λ/λ^a (for assumptions about continuous/dashed links). The contrary of assumption $asm(a)$ is of the form $c\_asm(a)$, for any a, formally: $\overline{asm(a)} = c\_asm(a)$.

5 An ABA mapping for bottom-up argumentation

In this section we show how comments, opinions and links, as envisaged in section 3, can be translated onto an ABA framework. This translation from an annotated exchange of views on the social Web into ABA can be performed automatically. The resulting ABA framework can then be fed into an ABA system, such as CaSAPI [10], to determine which items (opinions, links etc) can be accepted dialectically.

The ABA framework resulting from this translation consists of a domain-dependent part (facts and rules), directly obtained from the annotated exchanges, and a domain-independent part (facts, rules, assumptions and contraries) which is generic, but to be used in conjunction with the domain-dependent part.

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Domain-dependent Facts and Rules. For each *comment*, the ABA model contains a fact *comment*(C), where C is the comment's label. In our illustration, we have 14 facts: *comment*($c1$), *comment*($c2$), ..., *comment*($c14$).

For each *opinion*, the ABA model contains a fact *opinion*(O), where O is the opinion's label. In our illustration, we have 19 opinions: *opinion*($o1$), *opinion*($o2$), ..., *opinion*($o19$).

For each continuous link, the ABA model contains a fact *link*(L, Y, X), where L is the link's label (chosen to determine it univocally), Y the starting point item and X the target item. For our example, these links are listed in Table 1.

All these links are from *comment*s to *opinion*s or from *opinion*s to *opinion*s, except for the last three that are from *comment*s to *link*s.

For each dashed link (objection), the ABA model contains a sentence *alink*(L, O, X), where L is the link's label, O the attacked *opinion*, and X the objecting item. For our example, dashed links are listed in Table 2.

Opinions can be supported by comments, or by other opinions, or by both. For each *opinion*, the ABA framework contains:

Table 1. continuous links

link(l_1_1,o1,c1).	*link*(m_2_1_3,o2,o1).	*link*(m_2_1_3,o2,o3).
link(l_2_19,o2,o19).	*link*(l_3_1,o3,c1).	*link*(l_3_2,o3,c2).
link(l_3_3,o3,c3).	*link*(l_4_3,o4,c3).	*link*(l_5_4,o5,c4).
link(l_6_5,o6,c5).	*link*(m_7_6_7,o7,c6).	*link*(m_7_6_7,o7,c7).
link(l_8_8,o8,c8).	*link*(l_8_9,o8,c9).	*link*(l_9_9,o9,c9).
link(l_10_9,o10,c9).	*link*(l_11_9,o11,c9).	*link*(l_12_9,o12,c9).
link(l_13_11,o13,c11).	*link*(l_14_12,o14,c12).	*link*(l_14_18,o14,o18).
link(l_15_9,o15,c9).	*link*(l_15_10,o15,c10).	*link*(l_16_9,o16,c9).
link(l_17_11,o17,c11).	*link*(l_18_12,o18,c12).	*link*(l_19_13,o19,c13).
link(l_19_14,o19,c14).	*link*(l_l_4_17_11,l_4_17,c11).	
link(l_l_11_12_9,l_11_12,c9).	*link*(l_l_16_15_9,l_16_15,c9).	

Table 2. Dashed links

alink(l_4_17,o4,o17).	*alink*(l_9_10,o9,o10).	*alink*(l_11_12,o11,o12).
alink(l_11_18,o11,o18).	*alink*(l_18_11,o18,o11).	*alink*(l_16_15,o16,o15).
alink(l_17_7,o17,o7).	*alink*(l_17_19,o17,o19).	

– one or more rules $basedOn(Z) \leftarrow C, \ldots, L, \ldots$ indicating the *link*s and *comments*on which item Z is based;
– one or more rules $supportedBy(Z) \leftarrow O, \ldots, L, \ldots$ indicating the *link*s and *opinions*supporting item Z.

For our example, the *basedOn* relations are listed in Table 3 and the *supportedBy* relations are listed in Table 4. Note that links from multiple starting points (such as that between $c6, c7$ and $o7$) are modeled by a single rule, whereas multiple independent links (such as that between $c1$ and $o3$, or between $c2$ and $o3$) are modeled by multiple rules. Absence of links is modelled by rules with an empty body (facts).

Domain-independent Facts, Rules, Assumptions, Contraries. Domain-independent facts and rules are used as follows.

– We rely on an *opinion* O if we can rely on other *comments* on which O is based (if any) and/or on *opinions* that support O (if any), and if it is legitimate to assume O. Therefore the following ABA rule is used, for all *opinions* O:

$$O \leftarrow basedOn(O), supportedBy(O), \alpha(O), opinion(O).$$

The defeasibility of an *opinion* O is modeled by the assumption $\alpha(O)$.
– We rely on a *comment* C if it is legitimate to assume C. Therefore the following ABA rule is used, for all *comments* C:

$$C \leftarrow \chi(C), comment(C).$$

Table 3. *basedOn* relations

basedOn(o1)	← c1,l_1_1.	*basedOn*(o2)	← .
basedOn(o3)	← c1,l_3_1.	*basedOn*(o3)	← c2,l_3_2.
basedOn(o3)	← c3,l_3_3.	*basedOn*(o4)	← c3,l_4_3.
basedOn(o5)	← c4,l_5_4.	*basedOn*(o6)	← c5,l_6_5.
basedOn(o7)	← c6,c7,m_7_6_7.	*basedOn*(o8)	← c8,l_8_8.
basedOn(o8)	← c9,l_8_9.	*basedOn*(o9)	← c9,l_9_9.
basedOn(o10)	← c9,l_10_9.	*basedOn*(o11)	← c9,l_11_9.
basedOn(o12)	← c9,l_12_9.	*basedOn*(o13)	← c11,l_13_11.
basedOn(o14)	← c12,l_14_12.	*basedOn*(o15)	← c9,l_15_9.
basedOn(o15)	← c10,l_15_10.	*basedOn*(o16)	← c9,l_16_9.
basedOn(o17)	← c11,l_17_11.	*basedOn*(o18)	← c12,l_18_12.
basedOn(o19)	← c13,l_19_13.	*basedOn*(o19)	← c14,l_19_14.
basedOn(l_4_17)	← c11,l_l_4_17_11.	*basedOn*(l_11_12)	← c9,l_l_11_12_9.
basedOn(l_16_15)	← c9,l_l_16_15_9.		

Table 4. *supportedBy* relations

supportedBy(o1)	← .	*supportedBy*(o2)	← o1,o3,m_2_1_3.
supportedBy(o2)	← o19,l_2_19.	*supportedBy*(o3)	← .
supportedBy(o4)	← .	*supportedBy*(o5)	← .
supportedBy(o6)	← .	*supportedBy*(o7)	← .
supportedBy(o8)	← .	*supportedBy*(o9)	← .
supportedBy(o10)	← .	*supportedBy*(o11)	← .
supportedBy(o12)	← .	*supportedBy*(o13)	← .
supportedBy(o14)	← o18,l_14_18.	*supportedBy*(o15)	← .
supportedBy(o16)	← .	*supportedBy*(o17)	← .
supportedBy(o18)	← .	*supportedBy*(o19)	← .

The defeasibility of a *comment* C is modeled by the assumption $\chi(C)$.

- We rely on a continuous *link* L if it is legitimate to assume L. Therefore the following ABA rule is used, for all continuous *links* L:

$$L \leftarrow \lambda(L), link(L, \_, \_).$$

The defeasibility of a continuous *link* L is modeled by the assumption $\lambda(L)$.

- We rely on a dashed *link* L to provide an attack against X given Y if it is legitimate to assume L and if the attacker Y holds. The following rule is then used:

$$c\_\alpha(X) \leftarrow Y, \lambda^a(L), alink(L, X, Y).$$

The defeasibility of a dashed *link* L is modeled by the assumption $\lambda^a(L)$.

- All *opinions*, *comments*, *links* are in principle legitimate. Therefore the sentences $\alpha(O), \chi(C), \lambda(L), \lambda^a(L')$ are possible assumptions for all O, C, L, L' in our universe of symbols such that *opinion*(O), *comment*(C), *link*(L), *alink*(L') hold.
- Finally, the following contraries are given:

$$\overline{\alpha(O)} = c\_\alpha(O). \quad \overline{\chi(C)} = c\_\chi(C). \quad \overline{\lambda(L)} = c\_\lambda(L). \quad \overline{\lambda^a(L)} = c\_\lambda^a(L).$$

6 Conclusions

We have outlined a generic methodology to benefit exchanges of views in social networks (but also e-commerce systems or technical fora) by deploying computational argumentation. We have taken the view to modify only minimally the existing style for social networks, and allow users to unearth opinions and links. We have supported our proposal by means of a concrete illustration on top of Facebook. Our methodology consists of 1) allowing users to comment on exchanges, thus adding to and refining them; 2) applying a formal mapping from these augmented exchanges onto an (assumption-based) argumentation framework; 3) use standard argumentation semantics to provide an informed view to users as to the dialectical validity of the positions debated.

There are several directions for future work. We mention just a few here.

We have ignored the possibility of feedback by users, e.g. using the Like button in Facebook. These need to be incorporated within our methodology.

We have introduced a separation between "base-level" (the comments as in existing social net sites) and a "meta-level" (our opinions, links etc). We envisage that these will need to blend eventually, and that, for example, opinions may feed back into comments.

We have proposed an annotation for enriched exchanges in social networks, that we believe has the right level of simplicity and ease of use for ordinary users while at the same time being easily translatable into ABA. It would be interesting to see whether existing annotations used in sense-making tools, such as Cohere [3], would be suitable and/or would lend themselves to be mapped onto ABA format.

We envisage to use ABA as the underlying mechanism for computational argumentation. A novel bottom-up tool for computing extensions will be required for ABA to support a query-independent evaluation of arguments.

We have glossed over the choice of argumentation semantics: experimental psychology may be able to provide us with hints as to which semantics is the most suited. It may be possible that none of the existing semantics for argumentatin may be appealing or suitable, as indicated, in a different setting, in [12].

We also need to design effective methods and incentives that encourage users to annotate their discussions. For example, it will be important to understand how bottom-up argumentation may increase users satisfaction and engagement in online conversations. To this end, we will need to run empirical and theoretical investigations.

The theoretical implications of bottom-up argumentation will also be subject of further research. For example, if we asked several different users to independently mark up the same discussion, we would obtain different results. Would this be a problem? How would different mark-ups relate with each other?

We did not elaborate on concrete ways to exploit bottom-up argumentation in existing or future social networks. Clearly, if we want to use it as a run-time support for users on a large scale, some further analysis needs to be done to understand the computational complexity of the underlying reasoning. Suitable user testing and benchmarking tasks will also have to be designed and carried out. A more thorough study must also be done in order to make our methodology better defined and structured. With this article we mean to describe the general ideas that, if successful, may underlie a groundbreaking use of computational argumentation, for the benefit of communities of non-argumentation-savvy individuals.

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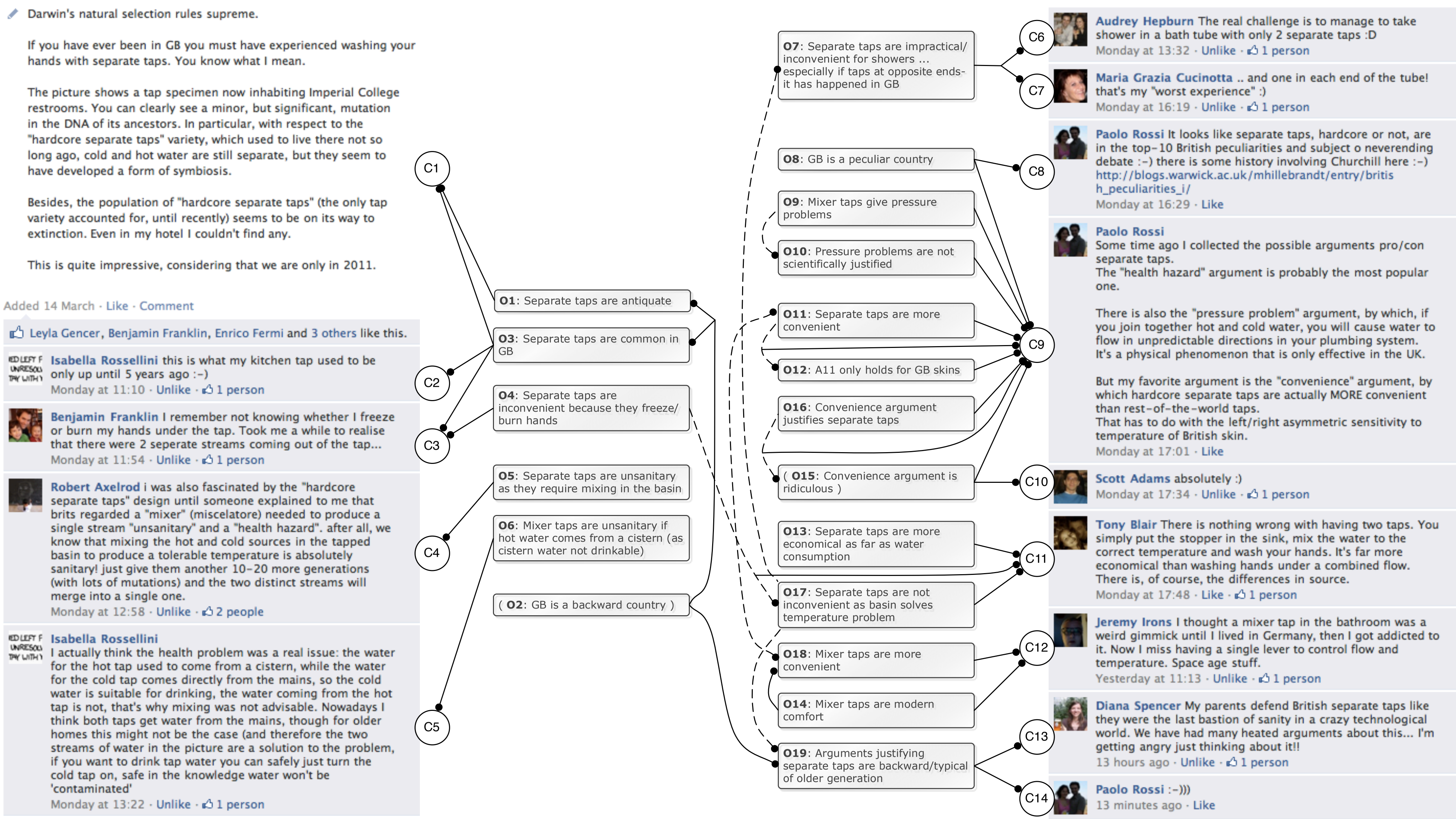

Darwin's natural selection rules supreme.
If you have ever been in GB you must have experienced washing your hands with separate taps. You know what I mean.
The picture shows a tap specimen now inhabiting Imperial College restrooms. You can clearly see a minor, but significant, mutation in the DNA of its ancestors. In particular, with respect to the "hardcore separate taps" variety, which used to live there not so long ago, cold and hot water are still separate, but they seem to have developed a form of symbiosis.
Besides, the population of "hardcore separate taps" (the only tap variety accounted for, until recently) seems to be on its way to extinction. Even in my hotel I couldn't find any.
This is quite impressive, considering that we are only in 2011.
Added 14 March · Like · Comment
Leyla Gencer, Benjamin Franklin, Enrico Fermi and 3 others like this.
Isabella Rossellini this is what my kitchen tap used to be only up until 5 years ago :-)
Monday at 11:10 · Unlike · 1 person
Benjamin Franklin I remember not knowing whether I freeze or burn my hands under the tap. Took me a while to realise that there were 2 seperate streams coming out of the tap...
Monday at 11:54 · Unlike · 1 person
Robert Axelrod i was also fascinated by the "hardcore separate taps" design until someone explained to me that brits regarded a "mixer" (miscelatore) needed to produce a single stream "unsanitary" and a "health hazard". after all, we know that mixing the hot and cold sources in the tapped basin to produce a tolerable temperature is absolutely sanitary! just give them another 10-20 more generations (with lots of mutations) and the two distinct streams will merge into a single one.
Monday at 12:58 · Unlike · 2 people
Isabella Rossellini
I actually think the health problem was a real issue: the water for the hot tap used to come from a cistern, while the water for the cold tap comes directly from the mains, so the cold water is suitable for drinking, the water coming from the hot tap is not, that's why mixing was not advisable. Nowadays I think both taps get water from the mains, though for older homes this might not be the case (and therefore the two streams of water in the picture are a solution to the problem, if you want to drink tap water you can safely just turn the cold tap on, safe in the knowledge water won't be 'contaminated'
Monday at 13:22 · Unlike · 1 person
C1
C2
C3
C4
C5
O1: Separate taps are antiquate
O3: Separate taps are common in GB
O4: Separate taps are inconvenient because they freeze/ burn hands
O5: Separate taps are unsanitary as they require mixing in the basin
O6: Mixer taps are unsanitary if hot water comes from a cistern (as cistern water not drinkable)
(O2: GB is a backward country)
O7: Separate taps are impractical/ inconvenient for showers ... especially if taps at opposite ends- it has happened in GB
O8: GB is a peculiar country
O9: Mixer taps give pressure problems
O10: Pressure problems are not scientifically justified
O11: Separate taps are more convenient
O12: A11 only holds for GB skins
O16: Convenience argument justifies separate taps
(O15: Convenience argument is ridiculous)
O13: Separate taps are more economical as far as water consumption
O17: Separate taps are not inconvenient as basin solves temperature problem
O18: Mixer taps are more convenient
O14: Mixer taps are modern comfort
O19: Arguments justifying separate taps are backward/typical of older generation
C6
C7
C8
C9
C10
C11
C12
C13
C14
Audrey Hepburn The real challenge is to manage to take shower in a bath tube with only 2 separate taps :D
Monday at 13:32 · Unlike · 1 person
Maria Grazia Cucinotta .. and one in each end of the tube! that's my "worst experience" :)
Monday at 16:19 · Unlike · 1 person
Paolo Rossi It looks like separate taps, hardcore or not, are in the top-10 British peculiarities and subject o neverending debate :-) there is some history involving Churchill here :-) http://blogs.warwick.ac.uk/mhillebrandt/entry/britis h_peculiarities_i/
Monday at 16:29 · Like
Paolo Rossi
Some time ago I collected the possible arguments pro/con separate taps.
The "health hazard" argument is probably the most popular one.
There is also the "pressure problem" argument, by which, if you join together hot and cold water, you will cause water to flow in unpredictable directions in your plumbing system. It's a physical phenomenon that is only effective in the UK.
But my favorite argument is the "convenience" argument, by which hardcore separate taps are actually MORE convenient than rest-of-the-world taps.
That has to do with the left/right asymmetric sensitivity to temperature of British skin.
Monday at 17:01 · Like
Scott Adams absolutely :)
Monday at 17:34 · Unlike · 1 person
Tony Blair There is nothing wrong with having two taps. You simply put the stopper in the sink, mix the water to the correct temperature and wash your hands. It's far more economical than washing hands under a combined flow. There is, of course, the differences in source.
Monday at 17:48 · Like · 1 person
Jeremy Irons I thought a mixer tap in the bathroom was a weird gimmick until I lived in Germany, then I got addicted to it. Now I miss having a single lever to control flow and temperature. Space age stuff.
Yesterday at 11:13 · Unlike · 1 person
Diana Spencer My parents defend British separate taps like they were the last bastion of sanity in a crazy technological world. We have had many heated arguments about this... I'm getting angry just thinking about it!!
13 hours ago · Unlike · 1 person
Paolo Rossi :-)))
13 minutes ago · Like