Discourse Summarization with Peer Production
Research Proposal

Tyler Friedman

PhD Applicant for Fall 2020
tylerifriedman@gmail.com

December 2019

Abstract. The modern tools we use for discourse are not well-equipped to handle controversy. There exist powerful semantic models for analyzing such complex discourse, but previous attempts to integrate them into tools for widespread use have proven unsuccessful. This issue has become increasingly pronounced as more and more of discourse moves into the digital realm, accelerating breakdowns in the way humans exchange ideas. At the same time, this digital shift has also initiated the phenomenon of peer production communities. These groups have a keen ability to produce goods and services that were previously considered infeasible, and in particular they have proven adept at collectively building repositories of knowledge. They continue, however, to struggle in their treatment of controversial topics. To fill this gap, I present a novel model for semantically representing discourse that is simple enough for widespread use, and then propose how a peer production community might use that model within the framework of a wiki to summarize online discussions concerning controversial topics of interest.

Keywords: Semantic discourse · Peer production · Collective sensemaking

1 Introduction

The means by which humans exchange ideas has changed dramatically over the last thirty years. Whereas this process was once confined to intimate settings, today it almost exclusively happens behind the digital barrier, either via more traditional outlets like journals and newspapers where content is now primarily produced and consumed online, or more modern, distributed platforms like blogs, forums, email lists, group chats, wikis, etc. that were explicitly designed for the web [1]. During this shift, unexpected challenges—e.g. bullying [2], trolling [3, 4], misinformation [5, 6], breakdowns in civility [7]—have emerged that call the utility of these tools into question.

Much effort has been spent trying to understand the extent to which these tools are failing us [3–6]. A stunning discovery is that in many cases it is not nefarious actors or design flaws but instead well-intentioned users that are unwittingly causing the most harm. Recent investigations into the 2016 Russian election influence campaign show that much of the Russian operation targeted the

anger, passion, and misinformation that Americans were already freely broadcasting across social media platforms [8]. Likewise, a recent analysis from MIT of how true and false news spreads on Twitter concludes that not only did falsehoods spread more widely and at a faster rate than the truth, but that it was humans, not robots, who were more likely to spread it [9]. This phenomenon is not limited to the confines of social media: there is growing evidence that a nontrivial percentage of peer-reviewed, academic research findings are false as well [10–13]. The closing example is a remarkable situation in which even a thoughtful, deliberative, and extensive discursive process among experts is unintentionally spreading misinformation. Whether due to design or human nature, it appears that useful, well-designed collaborative processes, from the benign to the sophisticated, are being challenged by good actors as well as bad.

One approach to this problem involves utilizing semantic models of discourse to break down complex discussions into manageable pieces [14–17]. None of these models, however, have proven capable for use by large-scale online communities. To fill this gap, I have designed a minimally-semantic model of discourse which is powerful enough to summarize complex online discussions, and simple enough, in theory, for use by a peer production group.

2 Related Work

2.1 Discourse

Modern technologies used for the collection and dissemination of discourse (i.e. Web 2.0 technologies [18]) are powerful, but the underlying principles they use are relatively simple. For microblogging, an individual shares packets of information in short bursts to their followers; for community forums, subcommunities organized by common interests share thoughts and ideas under self-moderation; for Q&A communities, newcomers ask questions and a dedicated group of experts attempt to answer them; and for wikis, groups of people cooperatively edit the same document. One of the challenges these communities face is that human discourse is incredibly complex [19], and does not always fit nicely into the rigid, simplified models for collaboration that these groups have assumed. There do exist powerful mechanisms for modeling the semantics of discourse–tools like Issue-Based Information Systems [14,15], Dialogue Mapping [16,17] and Rhetorical Structure Theory [20]–but they appear impractical for online communities in which ease of use is paramount for user growth and retention [21]. This is evidenced by numerous attempts in the late 2000s to create a semantic wiki [22–25]—a modified wiki that can support features like structured content, knowledge models, and reasoning [26]—that proved unsuccessful at scale. More modern approaches to this problem have focused more on building tools on top of existing infrastructure to improve the flow of information for the user [27–30], and less on designing fundamentally new ways for how the information is generated [31].

2.2 Computer-mediated discourse

Beginning in the 1980s, researchers sought to understand how instantaneous communication sans physical colocation was affecting human interaction [32–34]. The field that this initial work spawned can broadly be referred to as computer-mediated discourse (CMD), where CMD is the communication produced when human beings interact with one another by transmitting messages via networked or mobile computers [1]. Within this framework, researchers have looked at the structure of this new discourse [35–37], the types of positive and negative interactions it fosters [35, 38–40], associated social cues [41, 42], etc.; in doing so, they have uncovered numerous technical and social barriers unique to this new medium [43–45]. For communities that interact entirely or almost entirely within the digital realm, the effects of these barriers are pronounced. Today, online communities are known to harbor all different forms of abuse [46–48], and neutral interactions commonly devolve into disputes and hostilities [49]. An open question remains whether CMD is causing this behavior, or simply amplifying it. Either way, it is a clear instance in which discourse online is being stressed to a significant degree.

2.3 Peer production

The digital shift in discourse has had at least one positive effect: it has uncovered the phenomenon of peer production communities, and in particular their knack for creating wildly useful products that upend traditional markets while brazenly defying standard models for work and remuneration [50]. A peer production community is a distributed group of peers who come together to produce a good or service [51]. In these groups, users who have never met collaborate and execute tasks without a classical hierarchical structure of authority. Peer production is the mechanism underlying five of the top one-hundred most visited websites in the world, and two of the top ten, as of December 2018 [52]; it is also responsible for the development of most of the technologies that underpin the internet [50]. Part of what makes these communities so intriguing is that they are able to produce widely impactful services and goods that would not normally be economically or logistically feasible under more traditional production mechanisms [50, 53]. Consequently, researchers seek to understand what factors affect a peer production group's ability to produce a good or service together: they try to find underlying motivations for why people are drawn to these communities [54], what challenges they face in successfully contributing [55, 56], what causes them to leave [57], and ultimately why a majority of these communities die off while a select few succeed [51].

One particularly fascinating aspect of peer production groups is their skill in creating repositories of knowledge [21]. After the web itself, the invention of the wiki was perhaps the premier catalyst for this phenomenon [58]. From a technological perspective, its novelty was that it not only allowed but incentivized users to instantly publish their ideas in a shared, collaborative space. This innovation

led directly to the world's largest social experiment in peer production and collective sensemaking to date: the ongoing Wikipedia project, the social dynamics of which are a highly active area of research [59–62]. While it was certainly not the first attempt to create a digital repository of knowledge [63], it has arguably been the most successful [64,65]. Other popular models for collective sensemaking that currently fill this space include Q&A communities (e.g. StackExchange, Quora) and discussion-based forums (e.g. Reddit). While these websites are widely successful and are among the most visited on the web today [52], the communities that effectively run these sites continue to face significant challenges in the way they handle controversy [66–71]. Recent efforts to mitigate these effects focus on developing advanced algorithms for controversy detection [66–70]. While effective at identifying when a controversy is occurring, these approaches do not alter the fundamental collaborative dynamics that cause these disputes.

3 Proposal

I have identified a gap in the literature when it comes to building tools for analyzing and summarizing controversial discussions online. Semantic wikis, combined with the right information model, offer a powerful framework for providing structure to unstructured conversations. Current attempts to build semantic wikis, however, are focused on large-scale data collection (e.g. Wikidata [72]) or applications for smaller-scale, organizational best-practices [31]. Further, more modern efforts to break down complex discourse online typically target the discussions of a specific community or category of communities [28,30,31,65–70], not the nature of discussions themselves. There is an opening for a tool which explicitly targets discussions as a whole as opposed to the discussions of a specific community or platform; one which takes a semantic approach to representing discourse, and which can convince a community to use that approach to summarize complex discussions from around the web from a neutral point of view. In other words, a reference work of discussions.

To meet this need, I propose a crowdsourced reference work of literature reviews on controversial subjects. That is, a collection of articles–written by volunteers–which summarize and review the most important things that have been said (i.e. "discussions") about disputed topics from a neutral point of view. The primary innovation of this proposed reference work is a new model for representing discussions.

> **Model.** A discussion on a subject can be represented as the sum of three atomic structures: *writings*, the creative works we produce to try to make sense of the subject; *statements*, the subsequent claims we derive from these writings; and *questions*, the unknowns arising when two or more of these statements contradict.

Together, I refer to these structures as "contextual information", and the model itself as "Sunesis" (*understanding* in Greek). The idea is to create a collection of documents which articulate the contextual information–writings, statements,

and questions (WSQs)–one would need in order to understand the discussion surrounding subjects of interest. I hypothesize that one can improve their understanding of a complex subject if they have structured access to the most important WSQs pertaining to it.

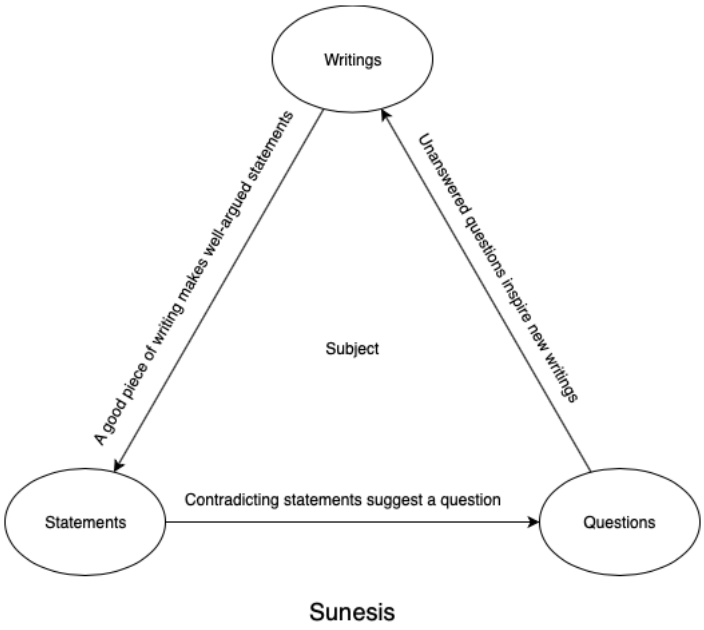

Fig. 1: Semantic Discourse Model

I propose a semantic wiki as the means for implementing this model, but not in the traditional sense. A semantic wiki (lit. "meaning" wiki) implies a body of knowledge structured with semantic tags in a way that is readable both by humans and machines. In short, a wiki which gives meaning to information. What I am proposing is also a wiki which gives meaning to information, but via the existence (or absence) of internal links between articles instead of via semantic tags. The idea is a wiki in which each individual article is composed of structured text and internal hyperlinks as in a regular (syntactic) wiki, but where the links themselves denote a meaningful relationship between two distinct types of information. Links in a regular wiki already provide some measure of semantic relatedness [73] by default; what I am suggesting instead is a wiki with an older, more powerful framework for denoting meaning between distinct ideas: a wiki in which articles can cite each other.

In Wikipedia, there is no such notion. Inline citations do play a critical role in the overall verifiability of Wikipedia [74], but they are reserved for external sources. This is for good reason: each article is a conduit of external sources,

but not a source in itself. In the catalog of contextual information that I am proposing, however, this is no longer the case. Instead of citing an external piece of writing (e.g. an op-ed, academic publication, news report), an editor can now cite the article in the wiki which catalogs and provides a direct reference to that writing. Or an article in the wiki which catalogs an academic publication might cite articles which catalog important questions that the work answers and/or raises. Or when describing a particularly nasty dispute, an editor can cite the article which catalogs the underlying question, as well as the articles which catalog the opposing claims being made. In this new "semantic wiki" framework, inter-article linking takes on a whole new meaning. Functionally, each citation is similar to the familiar internal hyperlink of a regular wiki, but I hypothesize that the meaning underlying the former is considerably more dynamic and expressive.

I have implemented the features listed above in a prototype at [75]; additional implementation details are available at [76, 77]. Moving forward, I will integrate popular features from Wikipedia such as user permissions, rollbacks, templates, and requests for comments that will allow the site to function at scale. Then, I will approach individual communities of inquiry with a well-defined area of expertise and study them as they attempt to collaborate and pool their knowledge on the site. I will study how well they interact with other users and in what ways they are able to successfully contribute to the project, if any. I will also use various psychological metrics to quantify a user's understanding of a complex topic when they visit a page on this site versus a corresponding page on Wikipedia. A key innovation of this system is that it may be able to account for the repetitive, unproductive cycle of discourse that frequently transforms civil discussions on controversial, complex topics into chaos and misinformation; hence, I will also study how effectively this tool can deflect and/or manage those types of harmful contributions.

I plan to spend the first two years of my program fulfilling course requirements, refining the prototype, immersing myself within the current literature of discourse representation and peer production, and performing empirical studies to understand the state of the practice and the needs of these communities. This will culminate in a dissertation proposal detailing how my proposed system works and what metrics I will use to study its effectiveness. In year three, I will build the system to full specification and perform an initial study on its ability to cope with particularly controversial topics. In years four and five, I will study this tool in a wide variety of contexts, and execute a research program with discrete projects suitable for undergraduate student involvement.

References

1. S. C. Herring and J. Androutsopoulos, "Computer-mediated discourse 2.0," *The handbook of discourse analysis*, vol. 2, pp. 127–151, 2015.
2. J. Juvonen and E. F. Gross, "Extending the school grounds?—bullying experiences in cyberspace," *Journal of School health*, vol. 78, no. 9, pp. 496–505, 2008.
3. C. Hardaker, "Trolling in asynchronous computer-mediated communication: From user discussions to academic definitions," 2010.

4. S. Herring, K. Job-Sluder, R. Scheckler, and S. Barab, "Searching for safety online: Managing" trolling" in a feminist forum," *The information society*, vol. 18, no. 5, pp. 371–384, 2002.
5. Y. L. Huang, K. Starbird, M. Orand, S. A. Stanek, and H. T. Pedersen, "Connected through crisis: Emotional proximity and the spread of misinformation online," in *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, pp. 969–980, ACM, 2015.
6. C. Budak, D. Agrawal, and A. El Abbadi, "Limiting the spread of misinformation in social networks," in *Proceedings of the 20th international conference on World wide web*, pp. 665–674, ACM, 2011.
7. A. D. Santana, "Virtuous or vitriolic: The effect of anonymity on civility in online newspaper reader comment boards," *Journalism Practice*, vol. 8, no. 1, pp. 18–33, 2014.
8. N. Confessore and D. Wakabayashi, "How Russia harvested American rage to reshape US politics," *New York Times*, 2017.
9. S. Vosoughi, D. Roy, and S. Aral, "The spread of true and false news online," *Science*, vol. 359, no. 6380, pp. 1146–1151, 2018.
10. J. P. Ioannidis, "Why most published research findings are false," *PLoS medicine*, vol. 2, no. 8, p. e124, 2005.
11. O. S. Collaboration *et al.*, "Estimating the reproducibility of psychological science," *Science*, vol. 349, no. 6251, p. aac4716, 2015.
12. C. F. Camerer, A. Dreber, F. Holzmeister, T.-H. Ho, J. Huber, M. Johannesson, M. Kirchler, G. Nave, B. A. Nosek, T. Pfeiffer, *et al.*, "Evaluating the replicability of social science experiments in nature and science between 2010 and 2015," *Nature Human Behaviour*, vol. 2, no. 9, p. 637, 2018.
13. K. S. Button, J. P. Ioannidis, C. Mokrysz, B. A. Nosek, J. Flint, E. S. Robinson, and M. R. Munafò, "Power failure: why small sample size undermines the reliability of neuroscience," *Nature Reviews Neuroscience*, vol. 14, no. 5, p. 365, 2013.
14. J. Conklin and M. L. Begeman, "gibis: A hypertext tool for exploratory policy discussion," *ACM Transactions on Information Systems (TOIS)*, vol. 6, no. 4, pp. 303–331, 1988.
15. W. Kunz and H. W. Rittel, *Issues as elements of information systems*, vol. 131. Citeseer, 1970.
16. H. Bunt, J. Alexandersson, J.-W. Choe, A. C. Fang, K. Hasida, V. Petukhova, A. Popescu-Belis, and D. R. Traum, "Iso 24617-2: A semantically-based standard for dialogue annotation.," in *LREC*, pp. 430–437, Citeseer, 2012.
17. M. G. Core and J. Allen, "Coding dialogs with the damsl annotation scheme," in *AAAI fall symposium on communicative action in humans and machines*, vol. 56, Boston, MA, 1997.
18. T. O'reilly, "What is web 2.0," 2005.
19. J. P. Gee, *An introduction to discourse analysis: Theory and method*. Routledge, 2004.
20. W. C. Mann and S. A. Thompson, "Rhetorical structure theory: Toward a functional theory of text organization," *Text-Interdisciplinary Journal for the Study of Discourse*, vol. 8, no. 3, pp. 243–281, 1988.
21. M. Sharratt and A. Usoro, "Understanding knowledge-sharing in online communities of practice," *Electronic Journal on Knowledge Management*, vol. 1, no. 2, pp. 187–196, 2003.
22. S. Schaffert, "Ikewiki: A semantic wiki for collaborative knowledge management," in *Enabling Technologies: Infrastructure for Collaborative Enterprises, 2006. WET-ICE'06. 15th IEEE International Workshops on*, pp. 388–396, IEEE, 2006.

23. C. Lange and M. Kohlhase, "Swim: A semantic wiki for mathematical knowledge management," in *Emerging Technologies for Semantic Work Environments: Techniques, Methods, and Applications*, pp. 47–68, IGI Global, 2008.
24. J. Baumeister, J. Reutelshoefer, and F. Puppe, "Knowwe: a semantic wiki for knowledge engineering," *Applied Intelligence*, vol. 35, no. 3, pp. 323–344, 2011.
25. T. Kuhn, "Acewiki: A natural and expressive semantic wiki," *arXiv preprint arXiv:0807.4618*, 2008.
26. S. Schaffert, F. Bry, J. Baumeister, and M. Kiesel, "Semantic wikis," *IEEE software*, vol. 25, no. 4, pp. 8–11, 2008.
27. A. X. Zhang, M. S. Ackerman, and D. R. Karger, "Mailing lists: Why are they still here, what's wrong with them, and how can we fix them?," in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, pp. 4009–4018, ACM, 2015.
28. A. X. Zhang, L. Verou, and D. Karger, "Wikum: Bridging discussion forums and wikis using recursive summarization," 2017.
29. A. X. Zhang and J. Cranshaw, "Making sense of group chat through collaborative tagging and summarization," *Proceedings of the ACM on Human-Computer Interaction*, vol. 2, no. CSCW, p. 196, 2018.
30. J. A. Larusson and R. Alterman, "Wikis to support the "collaborative" part of collaborative learning," *International Journal of Computer-Supported Collaborative Learning*, vol. 4, no. 4, pp. 371–402, 2009.
31. A. Di Iorio and D. Rossi, "Capturing and managing knowledge using social software and semantic web technologies," *Information Sciences*, vol. 432, pp. 1–21, 2018.
32. D. E. Murray, "Composition as conversation: The computer terminal as medium of communication," *Writing in nonacademic settings*, pp. 203–227, 1985.
33. D. E. Murray, "The context of oral and written language: A framework for mode and medium switching," *Language in society*, vol. 17, no. 3, pp. 351–373, 1988.
34. K. Severinson Eklundh, *Dialogue processes in computer-mediated communication: A study of letters in the COM system*. PhD thesis, LiberFörlag, 1986.
35. N. K. Baym, "The emergence of community in computer-mediated communication.," 1995.
36. S. C. Herring, "Grammar and electronic communication," *The encyclopedia of applied linguistics*, pp. 1–9, 2012.
37. N. S. Baron, "Discourse structures in instant messaging: The case of utterance breaks," *Language@ Internet*, vol. 7, no. 4, 2010.
38. J. T. Hancock, "Digital deception," *Oxford handbook of internet psychology*, pp. 289–301, 2007.
39. J. S. Donath, "Identity and deception in the virtual community," in *Communities in cyberspace*, pp. 37–68, Routledge, 2002.
40. P. Bou-Franch, N. Lorenzo-Dus, and P. G.-C. Blitvich, "Social interaction in youtube text-based polylogues: A study of coherence," *Journal of Computer-Mediated Communication*, vol. 17, no. 4, pp. 501–521, 2012.
41. S. Kiesler, J. Siegel, and T. W. McGuire, "Social psychological aspects of computer-mediated communication.," *American psychologist*, vol. 39, no. 10, p. 1123, 1984.
42. J. B. Walther, "Impression development in computer-mediated interaction," *Western Journal of Communication (includes Communication Reports)*, vol. 57, no. 4, pp. 381–398, 1993.
43. R. Bromme, R. Jucks, and A. Runde, "Barriers and biases in computer-mediated expert-layperson-communication," in *Barriers and biases in computer-mediated knowledge communication*, pp. 89–118, Springer, 2005.

44. R. Bromme, F. W. Hesse, and H. Spada, *Barriers and biases in computer-mediated knowledge communication: and how they may be overcome*, vol. 5. Springer Science & Business Media, 2006.
45. L. Rourke and H. Kanuka, "Barriers to online critical discourse," *International Journal of Computer-Supported Collaborative Learning*, vol. 2, no. 1, pp. 105–126, 2007.
46. A. Massanari, "# gamergate and the fappening: How reddit's algorithm, governance, and culture support toxic technocultures," *New Media & Society*, vol. 19, no. 3, pp. 329–346, 2017.
47. A. Filipacchi, "Wikipedia's sexism toward female novelists," *The New York Times*, vol. 24, 2013.
48. G. Wang, *Combating Attacks and Abuse in Large Online Communities*. University of California, Santa Barbara, 2016.
49. C. Shirky, "Group as user: Flaming and the design of social software," in *The Best Software Writing I*, pp. 211–221, Springer, 2005.
50. Y. Benkler *et al.*, "Peer production and cooperation," *Handbook on the Economics of the Internet*, vol. 91, 2016.
51. Y. Benkler and H. Nissenbaum, "Commons-based peer production and virtue," *Journal of political philosophy*, vol. 14, no. 4, pp. 394–419, 2006.
52. "Top websites." http://www.quantcast.com/top-sites/. Accessed: 2018-12-22.
53. Y. Benkler, A. Shaw, and B. M. Hill, *Peer production: A form of collective intelligence*. Cambridge, MA: MIT Press, 2015.
54. M. M. Wasko and S. Faraj, "Why should i share? examining social capital and knowledge contribution in electronic networks of practice," *MIS quarterly*, pp. 35–57, 2005.
55. I. Steinmacher, T. Conte, M. A. Gerosa, and D. Redmiles, "Social barriers faced by newcomers placing their first contribution in open source software projects," in *Proceedings of the 18th ACM conference on Computer supported cooperative work & social computing*, pp. 1379–1392, ACM, 2015.
56. J. Maddock, A. Shaw, and D. Gergle, "Talking about talk: Coordination in large online communities," in *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, pp. 1869–1876, ACM, 2017.
57. P. B. Brandtzæg and J. Heim, "User loyalty and online communities: why members of online communities are not faithful," in *Proceedings of the 2nd international conference on INtelligent TEchnologies for interactive enterTAINment*, p. 11, ICST (Institute for Computer Sciences, Social-Informatics and . . . , 2008.
58. B. Leuf and W. Cunningham, "The wiki way: quick collaboration on the web," 2001.
59. J. Im, A. X. Zhang, C. J. Schilling, and D. Karger, "Deliberation and resolution on wikipedia: A case study of requests for comments," *Proceedings of the ACM on Human-Computer Interaction*, vol. 2, no. CSCW, p. 74, 2018.
60. B. Keegan, D. Gergle, and N. Contractor, "Hot off the wiki: Structures and dynamics of wikipedia's coverage of breaking news events," *American Behavioral Scientist*, vol. 57, no. 5, pp. 595–622, 2013.
61. B. M. Hill and A. Shaw, "Consider the redirect: A missing dimension of wikipedia research," in *Proceedings of The International Symposium on Open Collaboration*, p. 28, ACM, 2014.
62. B. M. Hill and A. Shaw, "Page protection: another missing dimension of wikipedia research," in *Proceedings of the 11th International Symposium on Open Collaboration*, p. 15, ACM, 2015.

63. M. Hart, "Gutenberg: the history and philosophy of project gutenberg," *Project Gutenberg*, vol. 2, 1992.
64. J. Giles, "Internet encyclopaedias go head to head," 2005.
65. A. Kittur and R. E. Kraut, "Harnessing the wisdom of crowds in wikipedia: quality through coordination," in *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, pp. 37–46, ACM, 2008.
66. S. Dori-Hacohen and J. Allan, "Detecting controversy on the web," in *Proceedings of the 22nd ACM international conference on Conference on information & knowledge management*, pp. 1845–1848, ACM, 2013.
67. S. Dori-Hacohen and J. Allan, "Automated controversy detection on the web," in *European Conference on Information Retrieval*, pp. 423–434, Springer, 2015.
68. A.-M. Popescu and M. Pennacchiotti, "Detecting controversial events from twitter," in *Proceedings of the 19th ACM international conference on Information and knowledge management*, pp. 1873–1876, ACM, 2010.
69. E. Borra, E. Weltevrede, P. Ciuccarelli, A. Kaltenbrunner, D. Laniado, G. Magni, M. Mauri, R. Rogers, and T. Venturini, "Societal controversies in wikipedia articles," in *Proceedings of the 33rd annual ACM conference on human factors in computing systems*, pp. 193–196, ACM, 2015.
70. A. Kittur, B. Suh, B. A. Pendleton, and E. H. Chi, "He says, she says: conflict and coordination in wikipedia," in *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 453–462, ACM, 2007.
71. A. Aggarwal, C. López, and I.-H. Hsiao, "The role of comments' controversy in large-scale online discussion forums," in *Proceedings of the 27th ACM Conference on Hypertext and Social Media*, pp. 179–182, ACM, 2016.
72. D. Vrandečić, "Wikidata: A new platform for collaborative data collection," in *Proceedings of the 21st international conference on world wide web*, pp. 1063–1064, ACM, 2012.
73. I. H. Witten and D. N. Milne, "An effective, low-cost measure of semantic relatedness obtained from wikipedia links," 2008.
74. F. Å. Nielsen, "Scientific citations in wikipedia," *arXiv preprint arXiv:0705.2106*, 2007.
75. "Idealogs." https://www.idealogs.org/. Accessed: 2019-11-11.
76. "Sunesis." https://www.idealogs.org/@0x2. Accessed: 2019-11-11.
77. "Reciprocal linking." https://www.idealogs.org/@0xB. Accessed: 2019-11-11.