Veracity of Big Data: Challenges

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Next Generation of Truth Discovery Systems

As online user-generated content grows exponentially, the reliance on Web and social media data is increasing. Truth discovery from the Web has significant practical importance as online rumor and misinformation can have tremendous impacts on our society and everyday life. One of the fundamental difficulties is that data can be biased, noisy, outdated, incorrect, misleading and thus unreliable. Conflicting data from multiple sources amplifies this problem and veracity of data has to be estimated. Beyond the emerging field of computational journalism and the success of online fact-checkers (e.g., FactCheck[1], ClaimBuster[2]), truth discovery is a long-standing and challenging problem studied by many research communities in artificial intelligence, databases, and complex systems and under various names: fact-checking, data or knowledge fusion, information trustworthiness, credibility or information corroboration (see [1] for a survey and [11] for a comparative analysis). The ultimate goal is to predict the truth label of a set of assertions claimed by multiple sources and to infer sources' reliability with no or few prior knowledge. One major line of previous work aimed at iteratively computing and updating the source's trustworthiness as a belief function in its claims, and then the belief score of each claim as a function of its sources' trustworthiness [14]. More complex probabilistic models have then incorporated various aspects beyond source trustworthiness and claim belief such as the dependence between sources [3; 2], the correlation of claims [10], the notion of evolving truth [4]. Recent contributions have further relaxed prior modeling assumptions to deal with

[1] www.factcheck.org/
[2] idir.uta.edu/claimbuster

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truth existence [15], approximate truth discovery [13; 7], truth evolution [8; 6], and applications in the context of social media and crowd sourcing [5; 9]. their evaluation depends on available samples of ground truth data. To the best of our knowledge, our work is the first one to apply an ensembling method to truth discovery and also the first to address the problem of ground truth data sample selection bias.

In this paper, we argue that the next generation of data management and data sharing systems need to manage not only volume and variety of Big Data but most importantly veracity of data. Designing truth discovery systems requires a fundamental paradigm shift in data management and goes beyond adding new layers of data fusion heuristics or developing yet another probabilistic graphical truth discovery model. Actionable and Web-scale truth discovery requires a transdisciplinary approach to incorporate the dynamic and cross-modal dimension related to multi-layered networks of contents and sources. Apart from the limitations of current truth discovery methods, we would like to highlight the following challenges.

Timely and Actionable Truth Discovery. Truth discovery from quasi real-time data could save lives in a humanitarian context for example. To be actionable, information extraction and truth discovery computation need to be streamlined, prioritized depending on the level of emergency and incompleteness of available information, and finally adjusted to the communities that will use the data (e.g., rescue team, NGOs). The long tail phenomenon problem (*i.e.* where very few sources provide the first information after a disaster) is amplified and highly time-dependent.

Cross-modal and Cross-lingual Truth Discovery. The agility of a truth discovery system is of utmost importance to efficiently extract and map information: (i) in various languages; (ii) in various data formats, structures, and semantics (e.g., texts, Web table, structured data, etc.); (iii) and conveyed by various media and technologies (e.g., tweets, instagram images, youtube videos, Web pages, etc.).

Estimation of Incompleteness, Biases and Errors in the Truth Discovery Process. Information without context can be easily distorted and misinterpreted. When a piece of information is extracted from its original content, channel or thread, it may lose its context along with important "semantic markers" that explain *when, where, how, why,* and *for which* purpose or audience it has been produced. Observation may also be incomplete and biased for various reasons, e.g., security and privacy concerns, format limitations, *observer's bias* or *disclosure bias*. Estimating the biases and errors along the entire truth discovery pipeline is crucial and challenging.

To overcome these challenges, we believe that an integrative framework is needed: (i) To define, in a principled way, a unified semantics of truth discovery; (ii) To proactively collect new evidences, contextual data, and external knowledge from multimodal data; (iii) To support continuous inference and belief revision for computing and updating data veracity estimates; (iv) And finally, to monitor and estimate errors and biases in the truth discovery process.

To address these challenges, we proposed DAFNA (*Data Forensics with Analytics*) at QCRI, an ambitious project for determining the veracity of cross-modal information from multiple Web sources. Beyond a first module demonstrated in [12], DAFNA's vision is to provide a platform for actionable and cross-modal truth discovery.

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