reports that headlines in Trending Stories "tend to focus on Mr. Trump or celebrities" (**?**).

Broader Implications

Audit Methods To study Apple News we used scraping, sock-puppet, and crowdsourced auditing. While these techniques have been employed in previous audit studies, we next reflect on our experience of how we found each technique helpful for addressing different aspects of our audit framework, in hopes this can inform future audit studies.

First, audit studies should consider crowdsourcing whenever real-world observation is important, or when seeking higher parallel throughput in the data collection process. By using the crowd, we were able to assess the degree of personalization Apple News performs in practice, rather than fully relying on simulated sock-puppet data. Also, since resource constraints limited us to run at most two simulators at a time, crowdsourcing allowed us to significantly increase the throughput of our data collection, as many crowd workers could take screenshots in parallel.

Sock-puppet auditing – using computer programs to impersonate users (**?**) – is most helpful for isolating variables that might affect a given system. Sock puppets provide clear and precise information about the input to an algorithm in cases where the crowd falls short. For example, precise temporal synchronization was still challenging with crowdworkers, as 6.7% of screenshots from the crowd showed times that did not match the requested time in minutes, and even screenshots at the correct hour and minute may have been unsynchronized if seconds were taken into account. On the other hand, when using sock puppets, we could perform time-locked data collection on multiple devices with same-second precision.

Lastly, we found the scraping audit most helpful for extended data collection, and we suggest scraping whenever researchers seek continuous data or to monitor over time. While we initially deployed a crowdsourced method for the extended data collection (**?**), we found that we could not rely on the crowd for consistent data over time. Namely, in the United States, it was difficult to collect screenshots between the hours of 1am and 5am. However, after observing no evidence of personalization or localization in our initial experiments, we needed data from just one user account. We could therefore scrape content from a single simulated device to run the extended data collection.

It should be noted that we categorize our Appium-based data collection as a scraping audit since it centers around "repeated queries to a platform and observing the results" (**?**), however, we used a simulated iPhone to impersonate a user, making it somewhat of a hybrid with sock-puppet auditing. The Apple News platform lacks a public or private endpoint from which to scrape stories, so our experiment required additional layers of operation – every data point we collected required simulating a user opening the application, refreshing for new content, locating buttons, and pressing buttons, thus requiring more time to collect data compared to a traditional scrape.

Audit Framework To guide this work, we developed a conceptual framework that articulates three common aspects of a curation system that an audit might address: mechanism, content, and consumption. We showed how each of these aspects can have consequences for individual users, publishing companies, and even political discourse. As news curation systems change, consequential aspects may also change and prompt an expanded or revised framework.

Still, future research might leverage our proposed framework for auditing other content curators, revising and elaborating it to suit the nuances of specific systems. We believe this framework helps advance towards a conceptual "audit standard" for curation systems, which might allow the research community to compare and contrast different curation platforms, as well as characterize the evolution of a single platform over time.

Conclusion

This paper introduced, motivated, and applied an audit framework for news curation systems. We showed how a system's mechanism and content have personal, political, and economic implications in society, and developed a specific research framework accordingly. To demonstrate this framework, we focused on Apple News. To our knowledge, we are the first to analyze this platform in-depth. We employed several audit methods to analyze the app's update frequency, content adaptation, source concentration, and more. Results showed that the human-curated Top Stories section features fewer stories per day and exhibits greater source diversity and greater source evenness compared to the algorithmically-curated Trending Stories section. We discussed how these differences in mechanism and content reflect differences between the algorithmic and editorial curation logics underpinning the two sections. We offer our framework for reuse, revision, and elaboration to any researchers studying sociotechnical news curation systems.

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