Introduction to the Special Issue on Reproducibility in Information Retrieval: Tools and Infrastructures

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1 INTRODUCTION

Information Retrieval (IR) is a discipline that has been strongly rooted in experimentation since its inception. Experimental evaluation has always been a strong driver for IR research and innovation, and these activities have been shaped by large scale evaluation campaigns such as *Text REtrieval Conference (TREC)*[1] in the US, *Conference and Labs of the Evaluation Forum (CLEF)*[2] in Europe, *NII Testbeds and Community for Information access Research (NTCIR)*[3] in Japan and Asia, and *Forum for Information Retrieval Evaluation (FIRE)*[4] in India.

IR systems are getting increasingly complex. They need to cross language and media barriers; they span from unstructured, via semi-structured, to highly structured data; and they are faced with diverse. complex and frequently underspecified (ambiguously specified) information needs, search tasks, and societal challenges. As a consequence, evaluation and experimentation, which has remained a fundamental element, has in turn become increasingly sophisticated and challenging.

Replicability and *reproducibility* of the experimental results are becoming a primary concern in many areas of science [8, 12] and, in particular, in computer science as also witnessed by the recent ACM policy on *Artifact Review and Badging*[5].

Also the IR research community is increasingly focused on issues concerned with the replicability and reproducibility of the experimental results [1, 4, 5, 9, 11, 13]. We now commonly find questions about the extent of reproducibility of the reported experiments in the review forms of all the major

[1] https://trec.nist.gov/
[2] http://www.clef-initiative.eu/
[3] http://research.nii.ac.jp/ntcir/index-en.html
[4] http://fire.irsi.res.in/
[5] https://www.acm.org/publications/policies/artifact-review-badging

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IR conferences, such as SIGIR, CHIIR, ICTIR and ECIR, as well as journals, such as ACM TOIS. We also witness the raise of new activities aimed at verifying the reproducibility of results: for example, the "Reproducibility Track" at ECIR since 2015 hosts papers which replicate, reproduce and/or generalize previous research results while CLEF/NTCIR/TREC REproducibility[6] (CENTRE) is a new joint evaluation activity, started in 2018, to assess and quantify the extent of replicability and reproducibility of our experimental results [7].

Nevertheless, it has been repeatedly shown that best TREC systems still outperform off-the-shelf open source systems [1–3, 10, 11]. This is due to many different factors, such as using default configuration instead of tuning on a specific collection, or lack of the specific and advanced components and resources adopted by the best systems. It has been also shown that additivity is an issue, since adding a component on top of a weak or strong base does not produce the same level of gain [3, 10]. This poses a serious challenge when off-the-shelf open source systems are used as stepping stone to test a new component on top of them, because the gain might appear bigger starting from a weak baseline.

Moreover, as it also emerged from a recent survey within the SIGIR community [6], while there is a very positive attitude towards reproducibility and it is considered very important from a scientific point of view, there are many obstacles to it such as the effort required to put it into practice, the lack of rewards for achieving it, the possible barriers for new and inexperienced groups, and, last but not least, the (somehow optimistic) researcher's perception that their own research is already reproducible.

Overall, the above considerations stress the need and urgency for a systematic approach to reproducibility in IR. Indeed, repeatability, reproducibility, and generalizability of experiments and results cannot be taken for granted. We need to emphasize these aspects as key requirements if we wish to continue to reliably and durably advance research and technology in the field. In turn, we need to actively pursue them as a core part of our experimental methodology and practice.

In this special issue of JDIQ, we aspire to provide an overview of innovative research at the intersection of information retrieval and data quality, from theory to practice, with a focus on challenges, solutions, and experiences in reproducibility of IR experimental results.

The special issue is split into two parts, each one containing 4 papers. The first part concerns evaluation campaigns, experimental collections, the way they are built, and the methodology we adopt to analyse the experimental results from the perspective of the challenges posed by reproducibility. The second part deals with tools and infrastructures to ease the reproducibility of experiments in IR.

Several of the articles included in this part of the special issue refer in one form or another to infrastructures and tools to ease running experiments and support their reproducibility.

In evaluation campaigns, the evaluation data sets are usually distributed to participants for performing local experiments. This leads to the known problems of reproducibility, but is also not feasible when privacy issues or intellectual property rights prohibit distribution of the data. Hopfgartner et al. describe in "Evaluation-as-a-Service for the Computational Sciences: Overview and Outlook" the alternative approach of keeping the data in a central site, to where executables have to be uploaded for experimentation. This ensures a high degree of reproducibility, but also poses certain limitations on the kind of experiments that can be performed. The article discusses these aspects as well as the motivations of the stakeholders.

Yang et. al in "Anserini: Reproducible Ranking Baselines Using Lucene" describe the Anserini IR toolkit which facilitates conducting ad-hoc retrieval experiments and helps in reproducing

[6] http://www.centre-eval.org/

state-of-the-art results using modern tools in an efficient and scalable way, even over large Web collections.

The paper "Reproducible Web Corpora: Interactive Archiving with Automatic Quality Assessment" by Kiesel et al. proposes a platform to allow crawling and archiving Web pages in a way which allows to reproduce also the interaction of the user with a page within a browser. This improves with respect to current static crawling approaches, where just the Web page is saved for subsequent indexing and experimentation. Moreover, Kiesel et al. describe and make openly available a corpus built with the proposed approaches, analysing its reproducibility quality.

Finally, Roy et al. in "To Clean or not to Clean: Document Preprocessing and Reproducibility" tackle one often overlooked issue when reporting experiments which, instead, makes an impact on the reproducibility of the experiments. Indeed, the way in which IR tools and pipelines perform document pre-processing and cleaning is typically not reported in papers but Roy et al. study the compelling case of Web search and how documents are pre-processed, e.g. how HTML tags and Javascript are removed and dealt with, and show the impact that the different alternatives have on the reproducibility of the results.

Reviewers

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