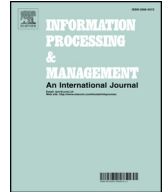




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News recommender systems – Survey and roads ahead

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ABSTRACT

More and more people read the news online, e.g., by visiting the websites of their favorite newspapers or by navigating the sites of news aggregators. However, the abundance of news information that is published online every day through different channels can make it challenging for readers to locate the content they are interested in. The goal of News Recommender Systems (NRS) is to make reading suggestions to users in a personalized way. Due to their practical relevance, a variety of technical approaches to build such systems have been proposed over the last two decades. In this work, we review the state-of-the-art of designing and evaluating news recommender systems over the last ten years. One main goal of the work is to analyze which particular challenges of news recommendation (e.g., short item life times and recency aspects) have been well explored and which areas still require more work. Furthermore, in contrast to previous surveys, the paper specifically discusses methodological questions and today's academic practice of evaluating and comparing different algorithmic news recommendation approaches based on accuracy measures.

1. Introduction

The newspaper industry has experienced a substantial transformation during the last twenty years. Today, readers can find various sources of news online, e.g., on the web presences of traditional newspaper companies, on digital-only news sites, or on news aggregation platforms provided, for example, by Google¹ or Yahoo!². Additionally, the digital form of information delivery allows publishers to distribute new or updated content in real-time, leading to an increased speed of publication. The availability of the various (often free) online news sources has led to a constant increase of users of such platforms (Newman, Fletcher, Levy, & Nielsen, 2016). At the same time, however, the abundance of available information and the constant update cycle make it increasingly challenging for readers to keep track of news that are most relevant to them.

Recommender Systems have shown to be a valuable tool to help users in such situations of information overload (Jannach, Zanker, Felfernig, & Friedrich, 2010). The main tasks of such systems are typically to filter incoming streams of information according to the users' preferences or to point them to additional items of interest in the context of a given object. During the past decades, significant advances in recommendation technology have been made. Recommenders have been successfully applied in a variety of domains, and the recommendable objects include movies, books, travel and tourism services, research articles, search queries, and many more (Beel, Gipp, Langer, & Breitinger, 2016; Borràs, Moreno, & Valls, 2014; Park, Kim, Choi, & Kim, 2012).

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News recommendation in general represents another application domain in which several of the known techniques for building automated recommendations can be applied. In fact, there have been a number of reported instances where such systems are being used in live environments to deliver news recommendations on popular websites (see, e.g., Chu et al., 2009; Das, Datar, Garg, & Rajaram, 2007; Kirshenbaum, Forman, & Dugan, 2012; Liu, Dolan, & Pedersen, 2010; Lommatzsch & Albayrak, 2015). However, news recommendation problems often have certain characteristics that are either not present at all or that are at least less pronounced in other domains. For example, in contrast to other domains like movie recommendation, the relevance of news items can change very rapidly (i.e., decline or re-increase due to recent real-life events) (Ahn, Brusilovsky, Grady, He, & Syn, 2007; Özgöbek, Gulla, & Erdur, 2014a) and the “item churn” is generally high (Das et al., 2007). In fact, since news web sites are often continuously updated, some articles can be superseded by a “breaking news” article on the same topic several times during a single day, which might require constant updates to the recommendation models. Another typical challenge in the news domain is that a user’s interest can dynamically change, depending on different contextual factors like the time of the day, the features of the user’s device (e.g., mobile phone vs. desktop), or the user’s current location (Campos, Díez, & Cantador, 2013; Kille, Hopfgartner, Brodt, & Heintz, 2013; Ma, Liu, & Shen, 2016).

Due to the high practical relevance of the news recommendation problem and its specific challenges, a considerable number of research works has been published on this topic in particular within the last ten years. Many of these works propose novel algorithmic approaches to generate personalized recommendations. These algorithms are typically evaluated using offline experimental designs and existing log data. In recent years, however, recommender systems research in a variety of domains has shown that it is also important to evaluate recommendations in a more user- or system utility-oriented way (Ekstrand, Harper, Willemsen, & Konstan, 2014; Jannach & Adomavicius, 2016; Jannach, Resnick, Tuzhilin, & Zanker, 2016; Knijnenburg, Willemsen, Gantner, Soncu, & Newell, 2012; Pu, Chen, & Hu, 2011). These developments have also led to a number of alternative forms of assessing the quality of the recommendations, e.g., in terms of diversity (Jannach, Lerche, Kamekhosh, & Jugovac, 2015; Shani & Gunawardana, 2011; Vargas & Castells, 2011).

With this work, we consider these recent developments and provide an overview of what has been achieved in the last ten years with respect to the different challenges in the news recommendation domain. Based in this analysis, we identify existing research gaps and potential areas for future research. In contrast to some previous overview works like (Borges & Lorena, 2010; Li, Wang, Zhu, & Li, 2011c; Özgöbek et al., 2014a), we however focus not only on the underlying algorithmic approaches used to create the recommendations, but also on questions related to the empirical evaluation and the user perception of such systems. To provide a starting point for future research, we finally also report insights from a set of experiments, which highlight the importance of short-term model updates when standard accuracy measures are applied in the evaluation.

The paper is organized as follows. Next, in Section 2, we briefly summarize how we selected existing research works for consideration in our survey. Afterwards, in Section 3, we discuss the various challenges of news recommendation in more detail and review existing algorithmic approaches to deal with these challenges. Then, in Section 4, we provide a survey of today’s academic practice of benchmarking and evaluating different technical approaches. Our paper ends with an outlook on possible directions for future research in Section 5.

2. Survey method and research scope

To develop the survey part of the paper, we investigated, in a structured way, more than 140 research articles that appeared between 2005 and 2016 in relevant computer science and information systems publication outlets. Fig. 1 shows how many NRS papers were considered in this time frame per year. The trend of the graph indicates that research interest in the topic of news recommendation has grown steadily over the years to the point that news has become an important sub-topic in the RS research field.

Regarding the scope of our review, we focus on papers that describe approaches for “classical” news recommendation scenarios, e.g., on news aggregation sites. Similar technical approaches can in many cases be applied for “news feed filtering” problems, for

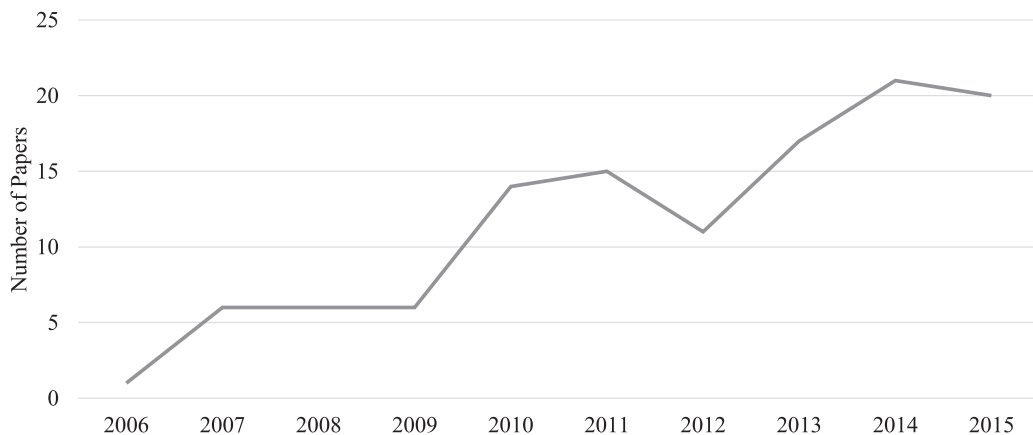


Fig. 1. Number of NRS papers per year. As the survey only covered 2016 until August, this year was excluded.

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