

A User Centered News Recommendation System

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ABSTRACT

Spending an uncontrolled quantity and quality of time on digital information sites is affecting our well-being and can lead to serious problems in the long term. In this paper, we present a sequential recommendation framework that uses deep reinforcement learning to capture the users' short and long-term interests, with a proposed use case of blending social news with recommended micro-learning informative news items that can help users derive useful outcomes out of their presence online.

CCS CONCEPTS

• **Information systems** → **Personalization**; **Recommender systems**; • **Computing methodologies** → **Sequential decision making**.

KEYWORDS

News recommendation, Micro-learning, Deep reinforcement learning, Actor-Critic, Social media

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1 INTRODUCTION

People are inundated with information online through news reporting sites, broadcasting websites, and other sources as media sites continue to evolve. To cope with the continuously growing data, online services resort to recommendation [8]. Recommendation systems have been shaping the way users see information and thus affecting their behaviors and decisions. The consistent growth and expansion in digital and social media services and their personalized characteristics lead to enormous growth in the number of different online news platforms and a huge expansion in the number of users. The overabundance and excess usage of digital news platforms present a possible impairment to personal well-being [6].

Various scientists have studied the effects of compulsive use of digital news and social media platforms. To start with, [11] studied the overuse of social media by working nurses and noticed

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that it caused poor physical and mental performance at work. [2] founded that uncontrolled usage of online news platforms affects mental health and negatively influences cognitive abilities and decision-making skills. Another study performed on social media consumers [15] implied that social media users are more prone to psychological difficulties and declined emotional abilities. People spending excessive time on social media notice deterioration in performance productivity and intellectual abilities [9]. Moreover, social media causes many cases of regretful actions and behaviors due to many reasons including misunderstanding and misjudging posts and news, frustration, and excess time spent online [18]. In addition, these problems have escalated during the corona pandemic where according to a longitudinal study conducted at the University Medical Center Hamburg Eppendorf time spent on social media increased by 66 percent on weekdays in young individuals. A survey conducted nationwide in China [13] mentioned that 46.8 percent out of 6416 participants noted an increased consumption of digital media throughout the pandemic.

People who are capable of improving the quality of time spent online reduce the possible drawbacks of their excessive digital presence [17]. Users should be able to cope with the huge digital information overload to maintain a healthy well-being. To help users improve the quality of time spent online, we propose a user-centered recommendation system that aims to improve the outcome of the consumer's online experience by recommending micro-learning informative news in addition to the recommended social news. In this paper, we introduce the idea of a well being aware recommendation system and start by laying the grounds for a general news recommendation system. Section 2 proposes the idea of a well-being aware recommendation system. In Section 3 , we lay the grounds for a general news recommendation framework and we point out future research directions in Section 4.

2 WELL-BEING AWARE RECOMMENDATION SYSTEM

The focus on recommender systems in e-commerce, social media and news sites is in many cases business and profit-oriented [14, 16]. The main aim of traditional recommendation systems is to improve users' engagement, enhance customer experience and thus increase profit, sales and popularity [10, 12]. However, these systems aim to increase profit while neglecting the long-term effects on users' well-being.

On the other hand, micro-learning has recently started to emerge as a promising tool for pedagogical delivery within different sectors [3]. Micro-learning heavily depends on the domain but it can generally be defined as small and simple learning units presented to the user briefly and quickly [1]. In [4] the authors discussed the use

of social media as a tool for micro-learning specifically in higher education. They discussed the specific characteristics that enable social media to act as a rich and productive platform to promote learning. They also defined a guideline for teachers to incorporate and design micro-learning in the online world.

Taking into account the effectiveness, and acceptability of micro-learning on the one hand, and the positively perceived effect of embedding micro-tasks in Facebook feeds on the other hand [7], one of the core ideas we propose is to inject personalized micro-learning news items in social news feed, and evaluate whether this approach of diversifying recommendations improves the outcome of the online experience and time spent passively consuming and scrolling social feeds. The proposed system aims to recommend engaging news that improves long-term satisfaction and at the same time improves the outcome of time spent online by injecting informative news. As a first step, we propose a news recommendation framework and proof-of-concept based on deep reinforcement learning, specifically tailored to aggregated social streams and news recommendation, and able to earn the right combination of diverse news taking into account real-time user actions. In the future, we aim to incorporate informative micro-learning news as a main news category and test our algorithm on it.

3 THE PROPOSED FRAMEWORK

We model the sequential interactions between the news items and users as a Markov Decision Process and utilize reinforcement learning and the Actor-Critic method [5] to dynamically update recommendations according to the users' real-time feedback.

The Actor aims to output a specific action represented by an item. It should learn and optimize the recommendation policy. The Critic in its turn takes the current state and the action produced by the Actor to calculate the value function that represents whether the recommendation matches the user's interests. The input to the Actor is the user's history of news previously viewed. It creates an initial state for the user, updates this state after each new interaction with an item, and generates a new item to be recommended to the user. The Actor is designed as an encoder-decoder model. The encoder consists of a GRU layer and an attention mechanism that takes the user's history and produces the state of the user. This representation is then inputted to the decoder that is designed using a GRU layer to produce an item recommendation.

The Critic takes as an input the current state s and the action a outputted by the Actor and tries to compute a value function $Q(a, s)$. Due to its nonlinearity, we utilize a deep neural learning network to learn and approximate the value function. After each recommendation, the Critic will evaluate the action taken to decide whether things have gone better or worse than expected. This evaluation is done by the usage of the Temporal difference (TD) learning error. The Critic is trained by minimizing the loss TD^2 . The Actor is trained with the goal of maximizing the overall reward.

4 CONCLUSION AND FUTURE PROSPECTS

In this paper, we discussed the idea of designing recommender systems that can inject micro-learning informative news to improve the outcome of the time spent online. As a first step, we presented a news recommender system architecture that sequentially treats

interactions between the user and the news items to recommend news of different categories. Next, we aim to utilize this algorithm while considering different categories including informative news that may help improve the outcome of the online experience. To evaluate the effectiveness of our solution, we plan to conduct an online experiment using an application that incorporates our recommendation algorithm and measures the ability of a user to learn and improve his experience online by the incorporation of feedback collecting questions and surveys.

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