Persistence in Recommender Systems: Giving the Same Recommendations to the Same Users Multiple Times

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Abstract. How do click-through rates vary between research paper recommendations previously shown to the same users and recommendations shown for the very first time? To answer this question we analyzed 31,942 research paper recommendations given to 1,155 students and researchers with the literature management software Docear. Results indicate that recommendations should only be given once. Click-through rates for 'fresh', i.e. previously unknown, recommendations are twice as high as for already known recommendations. Results also show that some users are 'oblivious'. It frequently happened that users clicked on recommendations they already knew. In one case the same recommendation was shown six times to the same user and the user clicked on it each time again. Overall, around 50% of clicks on reshown recommendations were such 'oblivious-clicks'.

Keywords: recommender systems, persistence, re-rating, research paper.

1 Introduction

Recommender systems became popular in many domains during the past decades and content-based and collaborative filtering became the two most dominant approaches. Some researchers in the field of collaborative filtering analyzed the effect of letting users re-rate items. They found that correlation between original ratings and new ratings was low and only 60% of users gave the same rating as before [1]. Amatriain et al. showed that it might be better to letting users re-rate items than showing new ones. By doing so accuracy of recommender systems increased by around 5% [2].

We wonder whether re-showing recommendations might make sense in general. For instance, a user might miss a recommendation the first time, simply because he was in a hurry and did not pay attention to the recommendation. In this case it would make sense for a recommender to be persistent and to display the same recommendation again. To the best of our knowledge 'recommendation persistence' has not been studied so far.

2 Research Objective and Methodology

Our goal was to find out if and how often it makes sense to display the same recommendations to the same users. To answer this question we analyzed empirical data from the

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literature management software Docear [4] which features a research paper recommender system [3]. The recommender system recommends research papers to users regardless of whether papers were previously recommended to the users or not. We analyzed how click-through rates (CTR) between recommendations shown only once and CTR of recommendations shown multiple times differed. CTR expresses how much percent of the delivered recommendations were clicked. For instance, if 12 recommendations were clicked out of 1,000 delivered ones, CTR would be 1.2%. CTR basically measures the 'precision' of the recommendation algorithm under the assumption that a clicked recommendation is a 'good', i.e. useful, recommendation. For further details on Docear and its recommender system (e.g. how recommendations are generated and displayed) see [3, 4].

3 Results

31,942 recommendations were shown to 1,155 users for the first time and from the 31,942 recommendations 1,677 were clicked, which equals a click-through rate of 5.25% (Table 1). From the 31,942 recommendations 2,466 were shown a second time to 375 distinct users and 154 recommendations were clicked (CTR 6.24%). From the 2,466 recommendations 574 were displayed a third time and CTR was 6.97%. Also for the fourth iteration CTR was still rather high (6.55%). Based on these results one might conclude that it could make sense to display recommendations at least two or three times because for these reiterations CTR was significantly higher than for the first one ($p<0.05$).

Table 1. Reiterations and click-through rate (CTR)

		Reiteration									
		1	**2**	**3**	**4**	**5**	**6**	**...**	**11**	**...**	**21**
	Users	1,155	375	97	38	12	6		-		1
	Impressions	31,942	2,466	574	229	112	71		2		1
	No clicks	30,265	2,312	534	214	100	68		2		1
	Clicks	1,677	154	40	15	12	3		-		-
	CTR, overall	5.25%	6.24%	6.97%	6.55%	10.71%	4.23%		0.00%		0.00%
	1st click	1,677	97	14	8	7	-		-		-
Obliv.-clicks	**2nd click**	-	57	13	1	2	1		-		-
	3rd click	-	-	13	3	2	1		-		-
	4th click	-	-	-	3	-	-		-		-
	5th click	-	-	-	-	1	-		-		-
	6th click	-	-	-	-	-	1		-		-
	Σ Obliv. clicks	-	57	26	7	5	3		-		-
	% Obliv. clicks	0%	37%	65%	47%	42%	100%		-		-
	CTR, 1st click	5.25%	3.93%	2.44%	3.49%	6.25%	0.00%		0.00%		0.00%

The picture changes when looking at more detail into the data: around 50% of all clicks on reshown recommendations are 'oblivious-clicks' (Table 1, lower part). We define an 'oblivious click' as a click on a recommendation that the user should know already, because he clicked it previously. For instance, 574 recommendations were shown three times. 40 of these recommendations were clicked which equals a CTR of