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Ismail Badache, Mohand Boughanem

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A Priori Relevance Based On Quality and Diversity of Social Signals

Ismail Badache and Mohand Boughanem
IRIT - Paul Sabatier University, Toulouse, France
{Badache, Boughanem}@irit.fr

1. Introduction

► **Context:**

- Exploiting social signals to enhance a search.
- Do the quality and diversity of signals matter to capture relevant documents?

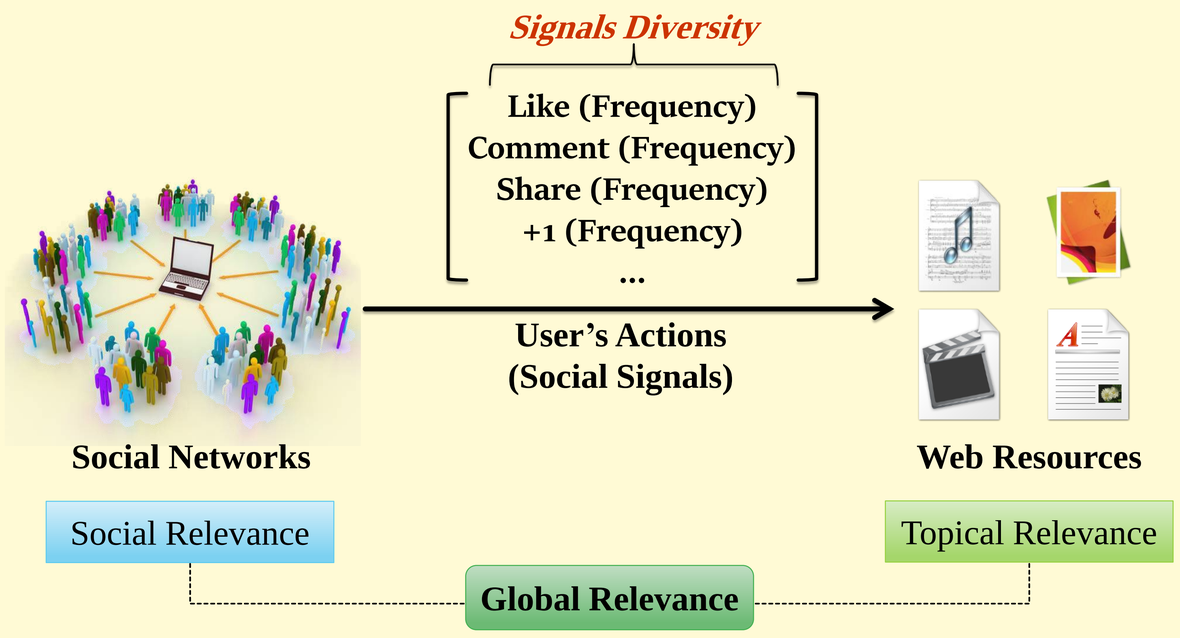


Figure 1. Global presentation of our approach

► **Hypothesis 1:** Diversity of signals associated with a resource is a clue that may indicate an interest beyond a social network or a community, i.e., a resource dominated by a single signal should be disadvantaged versus a resource with an equitable distribution of the signals.

► **Hypothesis 2:** Origin of social signals might impact the retrieval.

► **Research Questions:**

- How to *estimate* the signals diversity of a resource?
- What is the *impact* of signals diversity on IR system?
- Is there an *influence* of the social networks origin on the *quality* of their signals?

2. Social Signals Diversity

► Using language model to estimate the relevance of document D to a query Q.

$$P(D|Q) =^{Rank} P(D) \cdot P(Q|D) = \boldsymbol{P(D)} \cdot \prod_{w_i \in Q} P(w_i|Q) \quad (1)$$

$\boldsymbol{P(D)}$ is a document prior. w_i represents words of query Q.

► Signals are grouped according to their property $x \in \{P: Popularity, R: Reputation\}$
► The priors are estimated by a counting of actions a_i associated with D.

$$\boldsymbol{P_x(D)} = \prod_{a_i^x \in A} P_x(a_i^x) \quad (2)$$

► Smoothing $P(a_i^x)$ by collection C using *Dirichlet*:

$$\boldsymbol{P_x(D)} = \prod_{a_i^x \in A} \left(\frac{Count(a_i^x, D) + \mu \cdot P(a_i^x|C)}{Count(a_\bullet^x, D) + \mu} \right) \quad (3)$$

Where $\boldsymbol{P_x(D)}$ represents the a priori probability of D. $x \in \{P, R\}$ refers to the social property estimated from a set of specific actions. $Count(a_i^x, D)$ represents number of occurrence of action a_i^x on resource D. a_i^x designs action a_i used to estimate x property. $a_\bullet^x$ is the total number of signals.

► Estimating signals diversity in a resource using diversity clue of *Shannon-Wiener*:

$$Diversity_s(D) = -\sum_{i=1}^{m} P_x(a_i^x) \cdot \log(P_x(a_i^x)) \quad (4)$$

Where m represents the total number of signals.

► The *Shannon* clue is often accompanied by *Pielou* evenness clue :

$$Diversity_s^{evenness}(D) = \frac{Diversity_s(D)}{MAX(Diversity_s(D))} = \frac{Diversity_s(D)}{\log(m)} \quad (5)$$

► The general formula of $\boldsymbol{P_x(D)}$ becomes as follows:

$$\boldsymbol{P_x(D)} = \left(\prod_{a_i^x \in A} P_x(a_i^x) \right) \cdot Diversity_s^{evenness}(D) \quad (6)$$

3. Experimental Evaluation

► **Dataset:**

- INEX IMDb Dataset.
- 30 INEX IMDb Topics and their relevance judgments.
- 7 social signals from 5 social networks.

Table 1. Exploited social signals in quantification

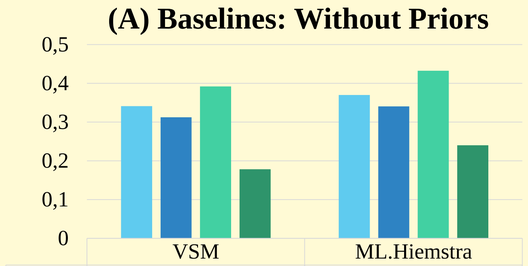
Property	Social signal	Social Network
Popularity	Number of *Comment*	Facebook
	Number of *Tweet*	Twitter
	Number of *Share(LIn)*	LinkedIn
	Number of *Share*	Facebook
Reputation	Number of *Like*	Facebook
	Number of *+1*	Google+
	Number of *Bookmark*	Delicious

Table 2. Instance of document with social signals

Document id	Like	Share	Comment	+1
tt1730728	30	11	2	0
	Bookmark		**Tweet**	**Share(LIn)**
	0		2	0

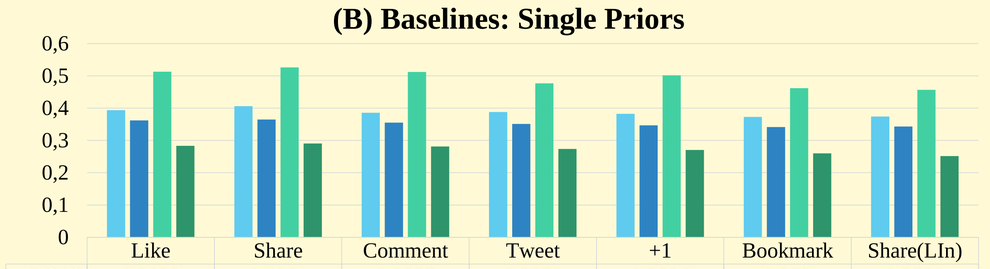
► **Results:**

(A) Baselines: Without Priors



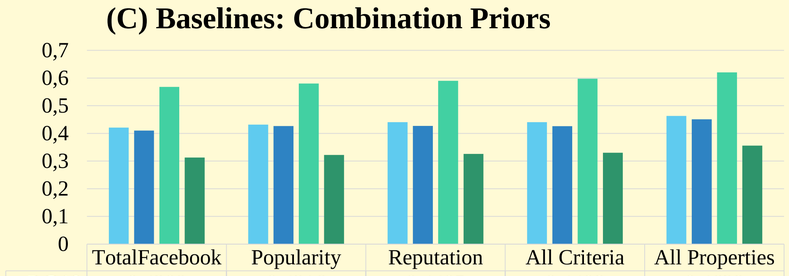
	VSM	ML.Hiemstra
P@10	0,3411	0,37
P@20	0,3122	0,3403
nDCG	0,3919	0,4325
MAP	0,1782	0,2402

(B) Baselines: Single Priors



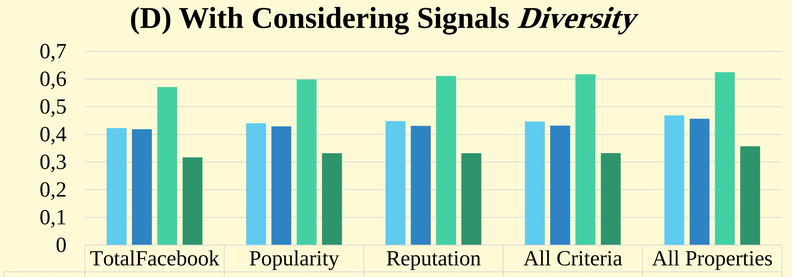
	Like	Share	Comment	Tweet	+1	Bookmark	Share(LIn)
P@10	0,3938	0,4061	0,3857	0,3879	0,3826	0,373	0,3739
P@20	0,362	0,3649	0,3551	0,3512	0,3468	0,3414	0,3432
nDCG	0,513	0,5262	0,5121	0,4769	0,5017	0,4621	0,4566
MAP	0,2832	0,2905	0,2813	0,2735	0,2704	0,26	0,2515

(C) Baselines: Combination Priors



	TotalFacebook	Popularity	Reputation	All Criteria	All Properties
P@10	0,4209	0,4316	0,4405	0,4408	0,4629
P@20	0,4102	0,4264	0,4272	0,4262	0,4509
nDCG	0,5681	0,5801	0,59	0,5974	0,6203
MAP	0,3125	0,3221	0,326	0,33	0,3557

(D) With Considering Signals *Diversity*



	TotalFacebook	Popularity	Reputation	All Criteria	All Properties
P@10	0,4227	0,4403	0,448	0,4463	0,4689
P@20	0,4187	0,4288	0,4306	0,4318	0,4563
nDCG	0,5713	0,5983	0,611	0,6174	0,6245
MAP	0,3167	0,332	0,3319	0,3325	0,3571

4. Quantitative and Qualitative Analysis

Figure 2. Signals % in the relevant documents

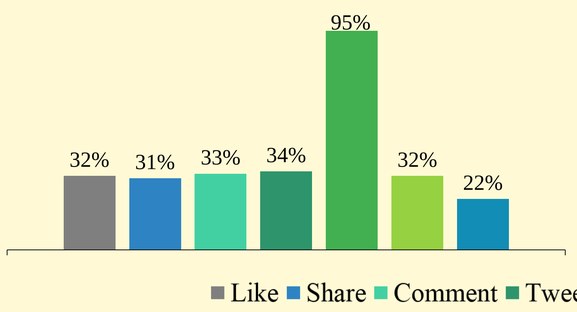


Figure 3. Relevant documents % containing signals

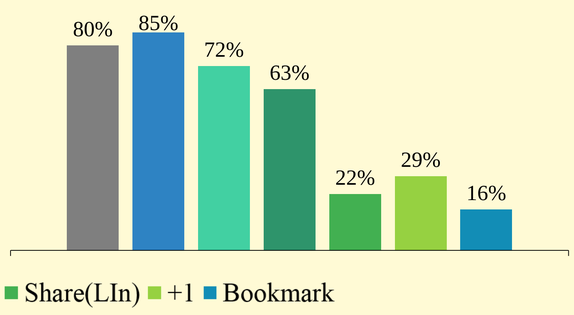


Table 3. Statistics on the distribution of the signals in the documents (relevant and irrelevant)

	Relevant documents containing signals			Relevant documents without signals	Irrelevant documents	
	Number of documents	Number of actions	Average	Number of documents	Number of actions	Average
Like	2210	800458	362,1981	555	1678040	61,6133
Share	2357	856009	363,1774	408	1862909	68,4012
Comment	1988	944023	474,8607	777	1901146	69,8052
Tweet	1735	168448	97,0884	1030	330784	12,1455
+1	790	23665	29,9556	1975	49727	1,8258
Bookmark	429	5654	13,1794	2336	20489	0,7523
Share (LIn)	601	**40446**	67,2985	2164	**2341**	0,0859
	Total relevant: 2765				Total irrelevant: 27235	