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School of Information Sciences

PITT at TREC 2013 Session Track

Different Effects of Click-through and Past Queries on Whole-session Search Performance

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OUTLINE

- **Analysis of an old method using alternative evaluation approaches**
  - Are we really improving the performance?
  - Whole-session relevance?
  - Past query vs. click-through

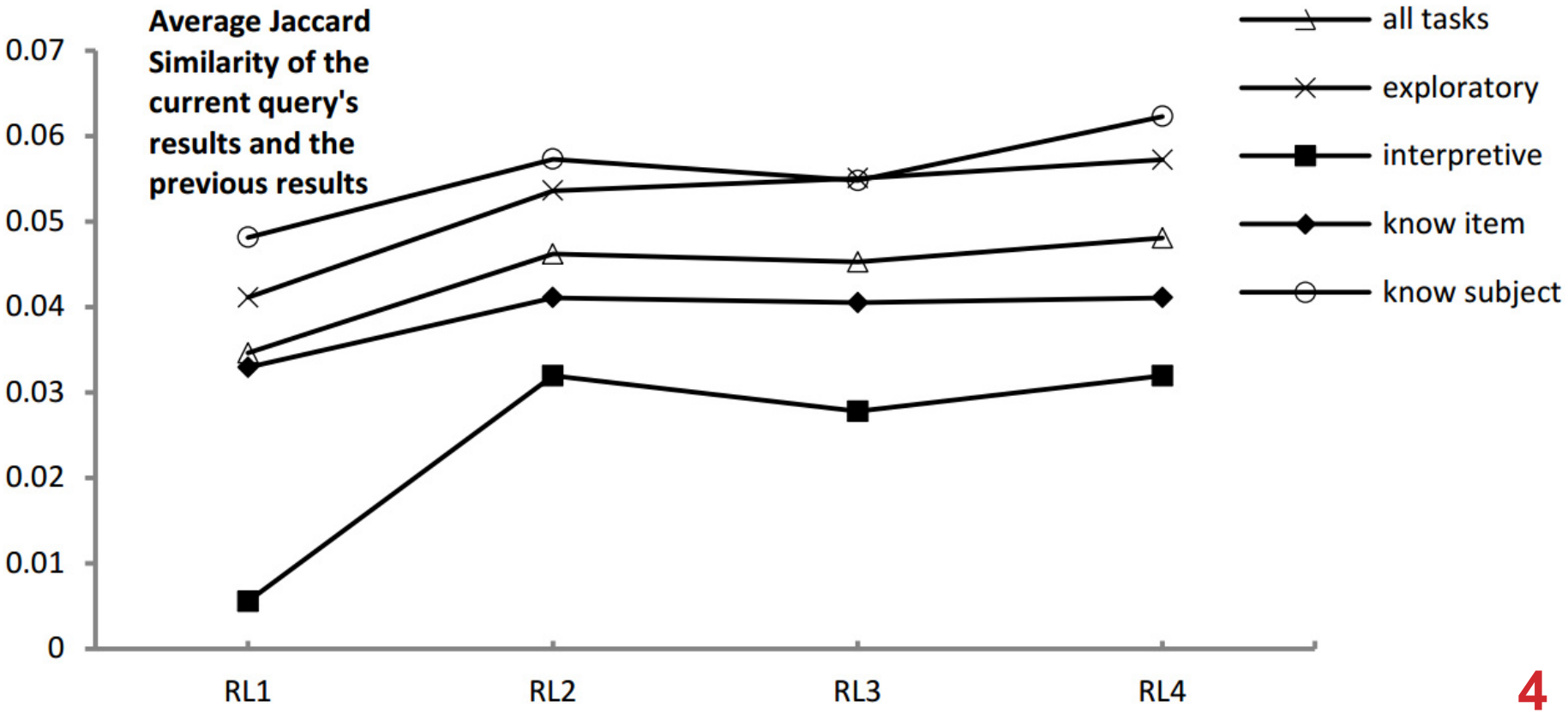
MOTIVATION

- **Using past queries and past click-through data as relevance feedback**
  - Pretty old idea

    e.g. context-sensitive RF (Shen, Tan & Zhai, SIGIR '05)
  - Seemingly very good performance
    - e.g. our systems in 2011 and 2012 (a variant of context-sensitive RF) were ranked at the top (by nDCG@10 of the last query)

MOTIVATION

- **Using past query and past click-through as relevance feedback**
  - Probably making results similar to previous results



MOTIVATION

- **Are we really improving the performance?**
  - The improvement of nDCG@10 may come from retrieving relevant documents found by previous queries?

- **We cannot answer the question without**
  - using whole-session evaluation methods
  - considering novelty in evaluation

ALTERNATIVE EVALUATION

- **Evaluate whole-session search performance**

- **Procedure**
  - A static session $\{q_1, q_2, \ldots, q_n\}$
  - For each q_k, generate results R_k based on $\{q_1, .., q_k\}$
  - Evaluate $\{R_1, R_2, \ldots, R_n\}$ for whole-session performance

- **Simulation of user querying behavior: no simulation**
  - User will not change the next query according to the previous results of systems & behaviors (e.g. click).

METRICS

- **Macro-average nDCG@10**

$$\frac{1}{m}\cdot\sum_{i=1}^{m}\left(\frac{1}{n-1}\cdot\sum_{j=2}^{n}nDCG@10\left(R_{ij}\right)\right)$$

  - Starting at the 2nd query of each session

METRICS

- **nsDCG@10**
  - Concatenate top 10 results of each query
  - Combine as a whole rank list for evaluation

    see details in session track overview of 2010

- **There are more complex methods**
  - Kanoulas, Carterette, D Clough, & Sanderson in SIGIR'11

METRICS

- **Instance recall (instRec)**
  - Used in old TREC interactive tracks
  - An instance is similar to a “nugget”
  - instRec measures the recall of all judged relevant instances (nuggets) all over the session

METRICS

- **Our calculation of instRec**
  - A document is considered as an instance (because no judgments of instance)
  - Concatenate top 10 results of each query

$$D_F = \bigcup_{i=1}^{n} \{D_i\}$$

  - Calculate recall of the concatenated results

$$\text{instRec} = \frac{|D_F \cap D_R|}{|D_R|}$$

METRICS

- **Instance recall gain (instRecGain)**
  - Evaluates each query's contribution to the session's instance recall
  - The instance recall contributed by the kth query's results D_k is:

$$\text{instRecGain}(D_k) = \text{instRec}\left(\bigcup_{i=1}^{k}\{D_i\}\right) - \text{instRec}\left(\bigcup_{i=1}^{k-1}\{D_i\}\right)$$

  - Then, we compute the macro-average instRecGain

METRICS

- **nDCG@10 (macro-average), nsDCG@10**
  - Do no consider novelty of results

- **instRec and instRecGain**
  - Do no consider ranking & graded relevance

METRICS

- **Macro-average inDCG@10**
  - (Jiang, He, Han, Yue, & Ni, CIKM'12)
  - Discount utility of relevant documents in a session based on their rankings in previous results
  - Then, calculate nDCG@10 of each query based on the discounted utility of documents at that moment

- **(Shokouhi, White, Bennett, Radlinski, SIGIR'13)**
  - *"sometimes the repeated results should be promoted, while some other times they should be demoted."*

METRICS

- **Average Jaccard Similarity (AvgJaccard)**
  - Not a performance measure, but helpful for analyzing novelty of search results.
  - For each unique pair of queries in the session, calculate the top 10 results' Jaccard similarity, and then calculate the mean value.

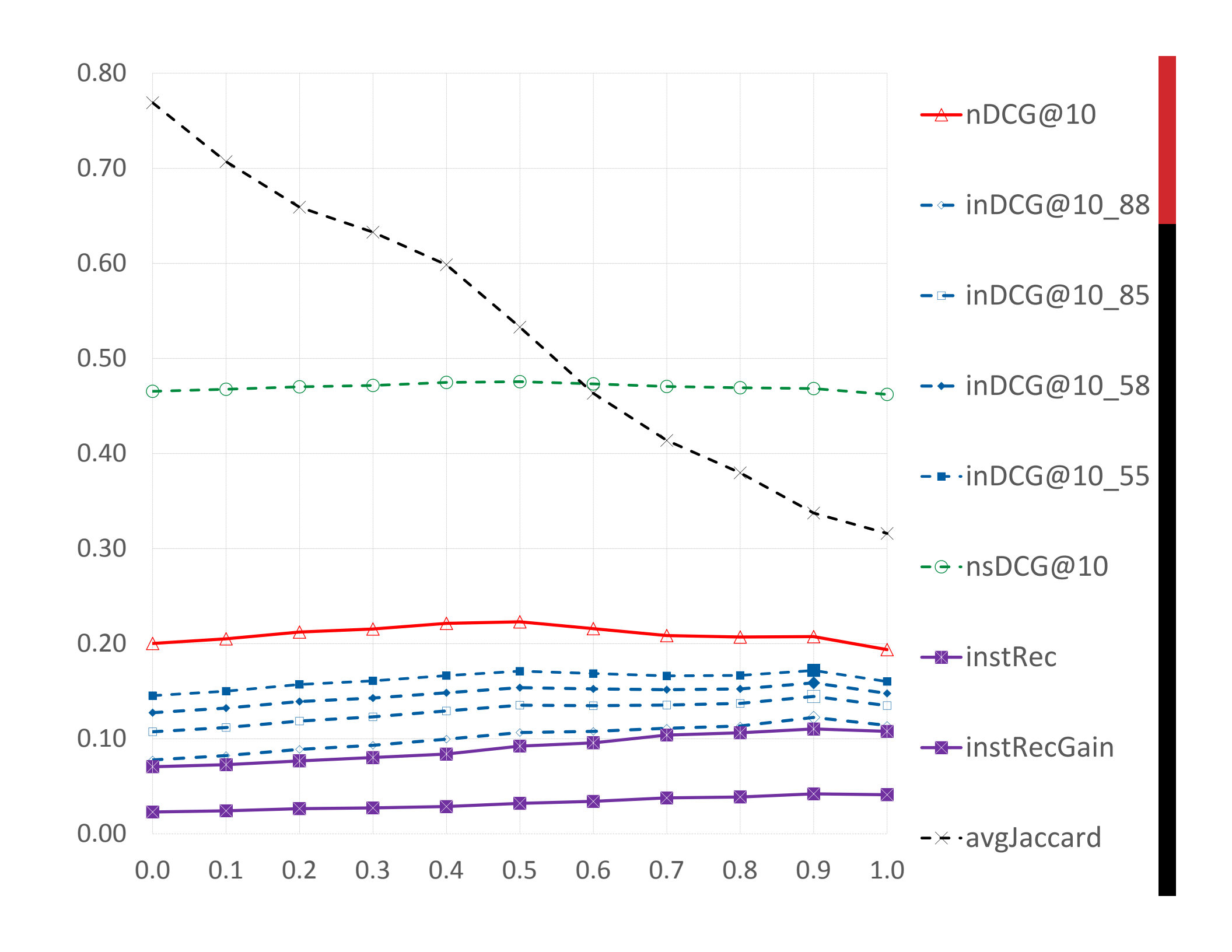
ANALYSIS ON AN OLD METHOD

- context-sensitive RF (Shen, Tan & Zhai, SIGIR '05)
- The "FixInt" method

$$P(w|\theta_k) = \alpha P(w|q_k) + (1-\alpha)\left[\beta P(w|H_c) + (1-\beta) P(w|H_q)\right]$$

$$P(w|H_c) = \frac{1}{k-1}\sum_{i=1}^{k-1} P(w|C_i)$$

$$P(w|H_q) = \frac{1}{k-1}\sum_{i=1}^{k-1} P(w|q_i)$$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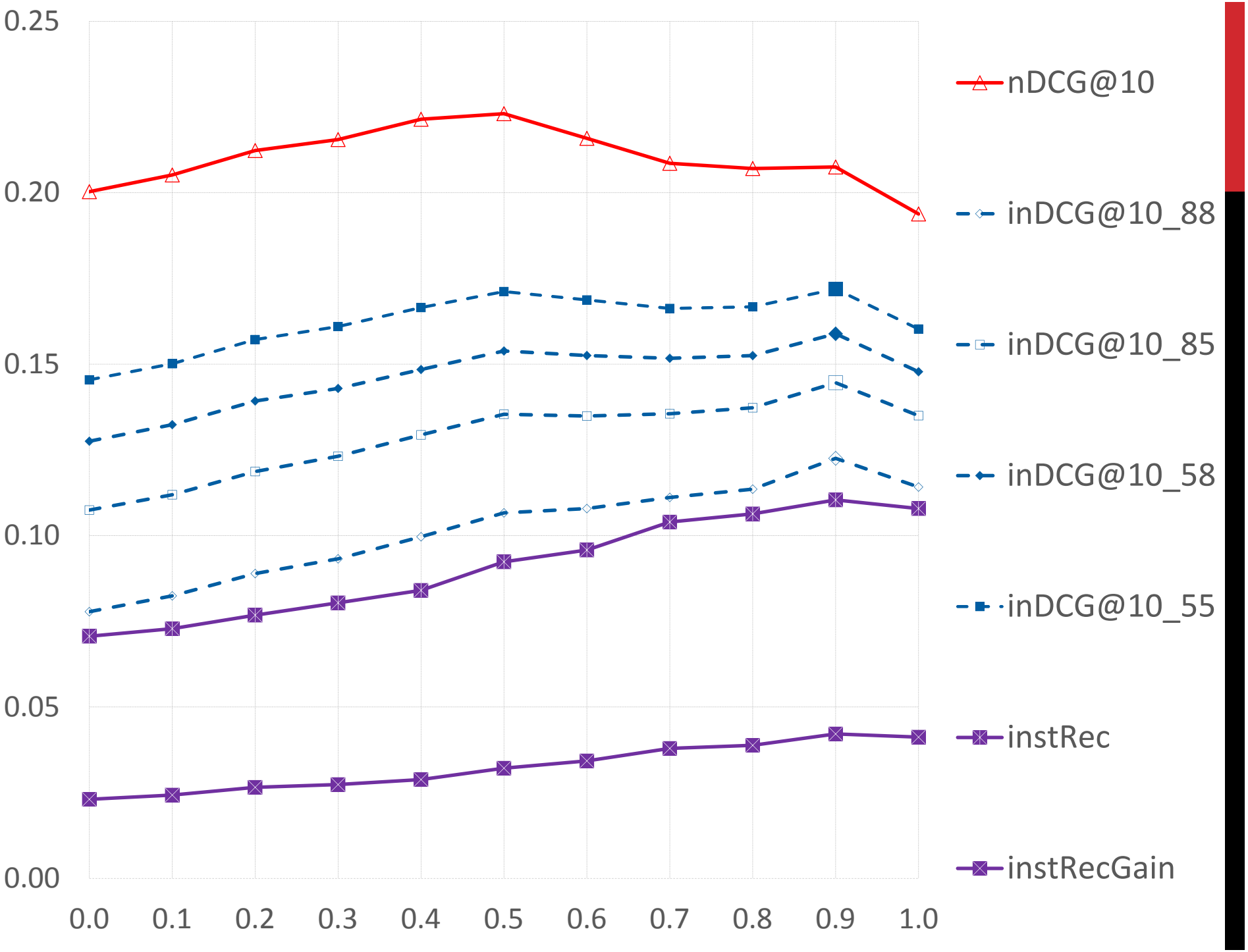
inDCG@10_58
inDCG@10_55
nsDCG@10
instRec
instRecGain
avgJaccard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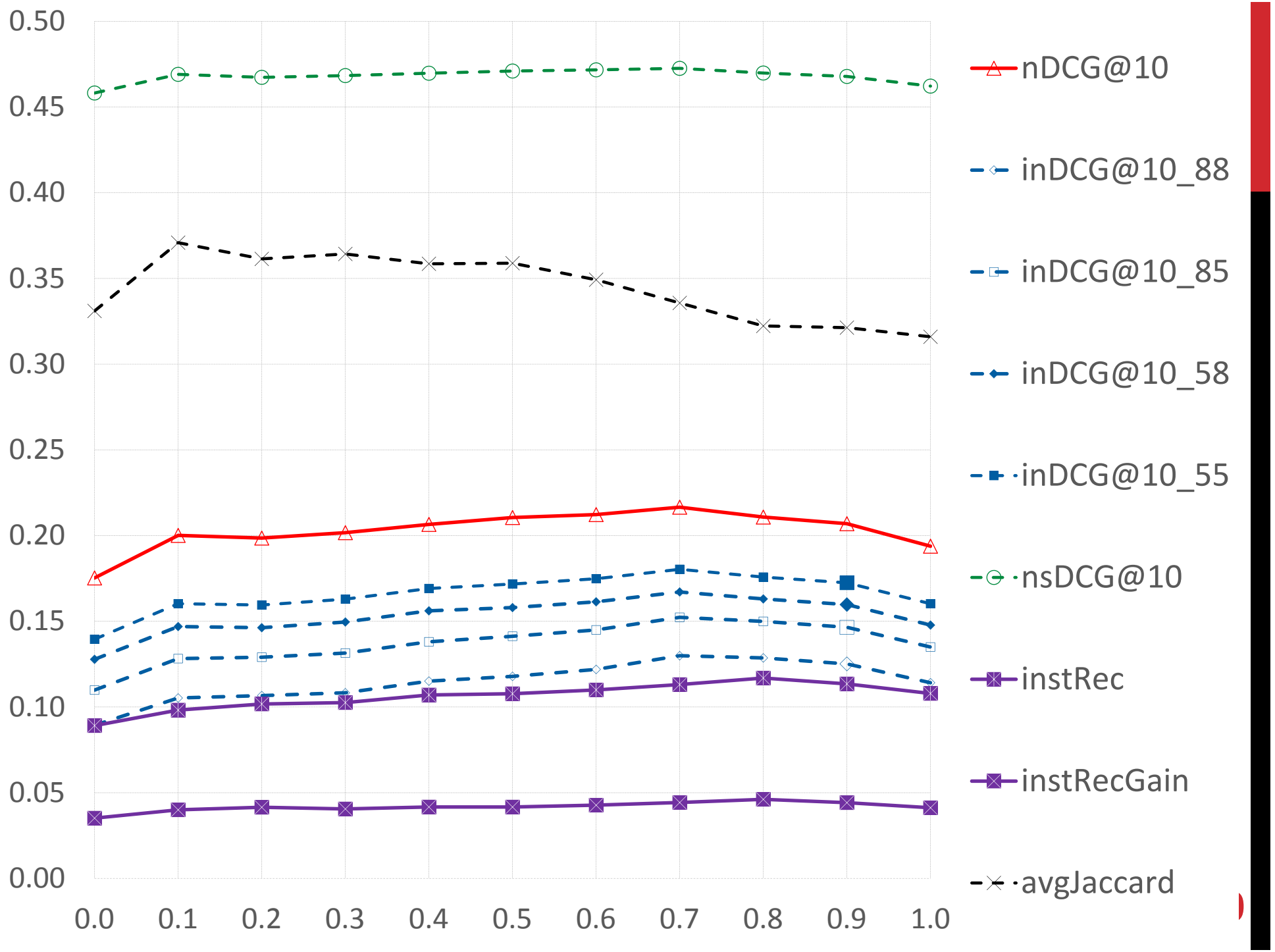
inDCG@10_88
inDCG@10_85
inDCG@10_58
inDCG@10_55
instRec
instRecGain

ANALYSIS ON AN OLD METHOD

- **context-sensitive RF (Shen, Tan & Zhai, SIGIR '05)**
- **Past queries**
  - Can lead to serious decline of results' novelty (Jaccard similarity can increase from 30% to 80%)
  - When we optimize the system by nDCG@10, FixInt gets 10% - 20% improvements on nDCG@10, but also about 20% increase in avgJaccard and 10% decline of instRec.
  - No significant improvements on instRec
    - 0.1079 ➔ 0.1104 (max) in 2011 dataset
    - 0.0881 ➔ 0.0896 (max) in 2012 dataset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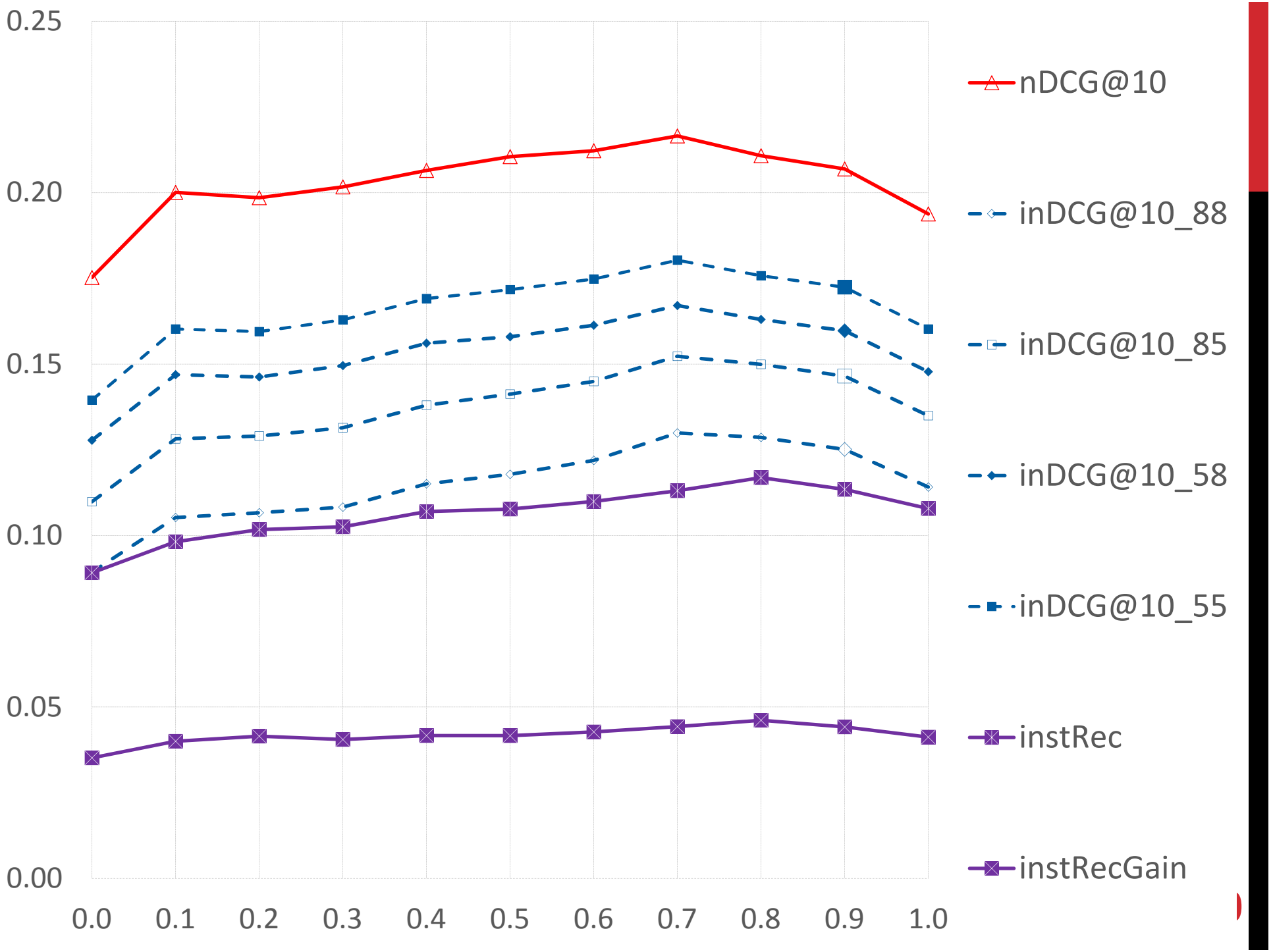
avgJaccard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inDCG@10_58
inDCG@10_55
instRec
instRecGain

ANALYSIS ON AN OLD METHOD

- **context-sensitive RF (Shen, Tan & Zhai, SIGIR '05)**
- **Click-through**
  - Slight increase of avgJaccard (less than 10%)
  - Improvements of nDCG@10 comparable to those using past queries (10% - 20%)
  - About 10% Improvements on instRec
    - 0.1079 ➔ 0.1169 (max) in 2011 dataset
    - 0.0881 ➔ 0.1007 (max) in 2012 dataset
  - Still, when we optimize the system by nDCG@10, we cannot get maximum performance on instRec
  - Parameters are not stable in 2011 & 2012 (probably due to the different distribution of session types)

ANALYSIS ON AN OLD METHOD

- **context-sensitive RF (Shen, Tan & Zhai, SIGIR '05)**
- **Metrics**
  - Pearson's r of metrics' values on 121 parameter settings

	TREC 2011		TREC 2012	
	nDCG@10	instRec	nDCG@10	instRec
nDCG@10	1.000	-0.235	1.000	0.245
nsDCG@10	0.985	-0.244	0.994	0.204
inDCG@10_88	-0.013	0.956	0.496	0.952
inDCG@10_85	0.227	0.874	0.703	0.852
inDCG@10_58	**0.483**	**0.719**	**0.773**	**0.793**
inDCG@10_55	**0.686**	**0.530**	**0.875**	**0.675**
instRec	-0.235	1.000	0.245	1.000
instRecGain	-0.226	0.979	0.228	0.992
avgJaccard	0.413	-0.957	0.180	-0.890

TAKE HOME MESSAGES

- **Click-through vs. past queries**
  - If you are also using past queries as positive relevance feedback information, probably you should re-evaluate your “improvements”.

- **Metrics**
  - We may need to consider novelty, no matter the task is a single-query task or a whole-session search task (considering people may wrongly use past queries to enhance nDCG@10)

- **Optimization**
  - Optimizing the parameters for nDCG@10 is risky, usually you cannot balance other evaluation metrics such as instRec

- **Thank you!**