KEPS

Knowledge Enhanced Personalized Search

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基本概念

personalized search

external knowledge

entity-oriented search

difficulty of query entity linking

本文的工作

together these advantages

基本思路

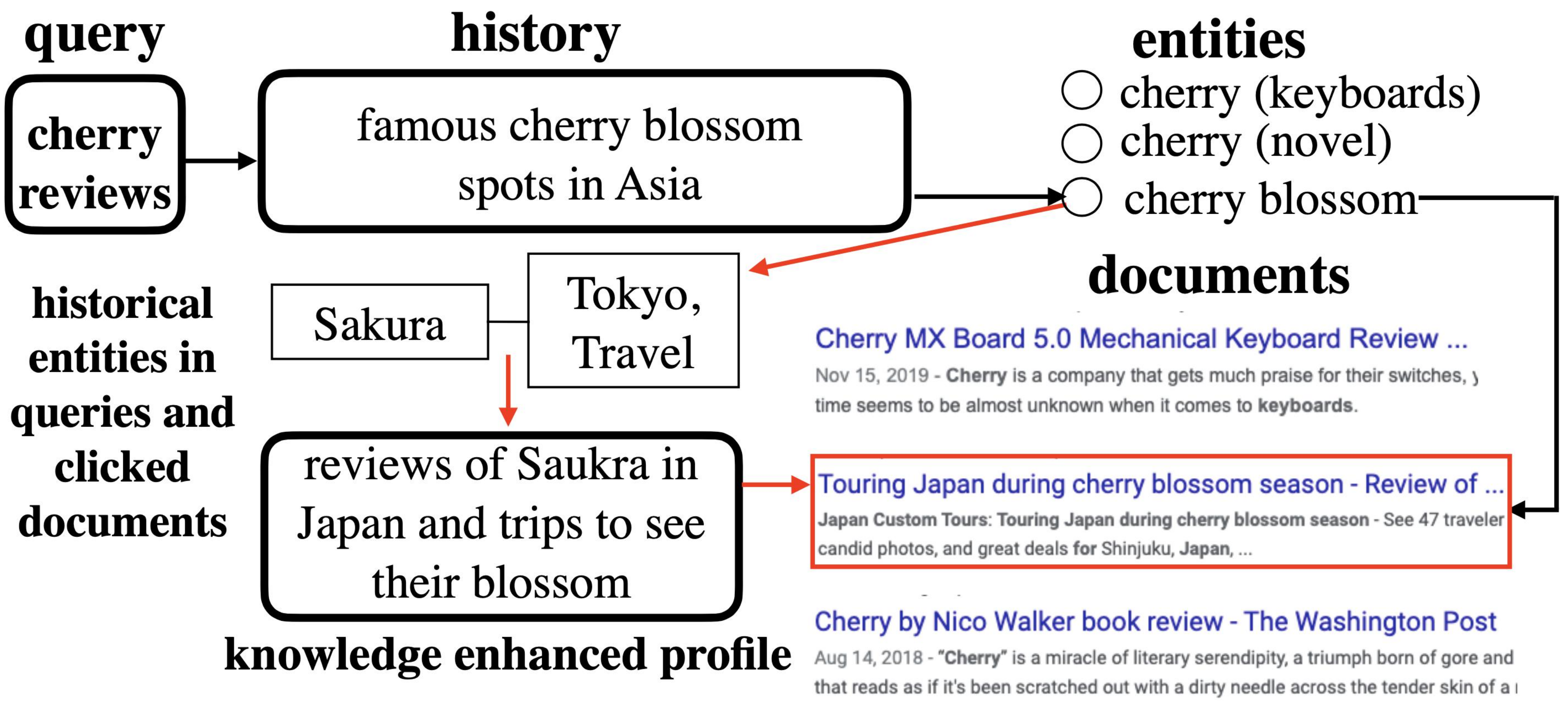

Figure 1: knowledge enhanced personalized search example

具体内容

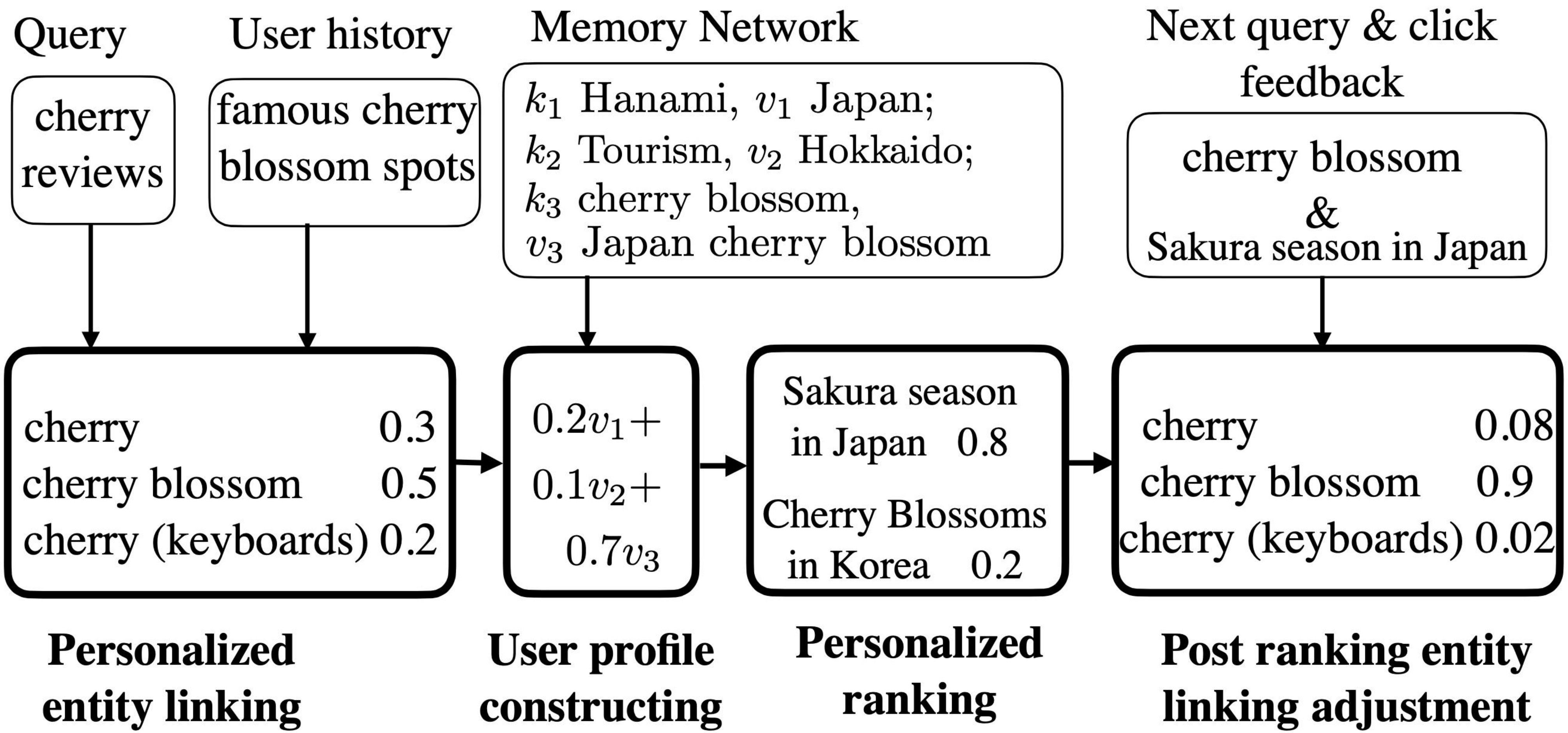

Figure 2: The KEPS framework.

Personalized Entity Linking

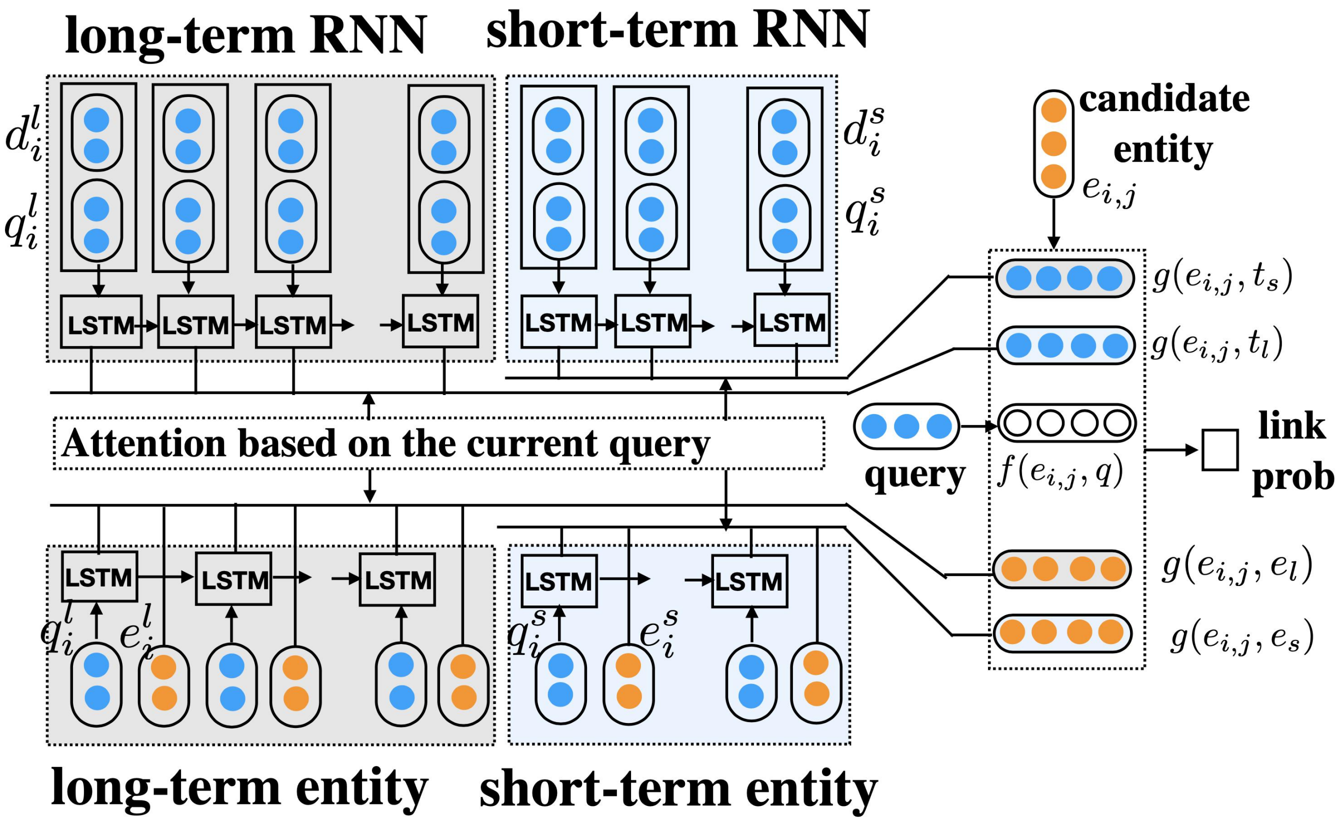

Figure 3: Structure of personalized entity linking.

$$p_{i,j} = \mathcal{F}(e_{i,j}|q, \mathcal{H}) = \frac{\exp(\mathrm{MLP}(f(e_{i,j}, q) \oplus f(e_{i,j}, \mathcal{H})))}{\sum_{k=1}^{n_i} \exp(\mathrm{MLP}(f(e_{i,k}, q) \oplus f(e_{i,k}, \mathcal{H})))},$$

$$f(e_{i,j}, q) = \tanh(\boldsymbol{e}_{i,j}^{\mathsf{T}} * \mathrm{MLP}(\boldsymbol{q})) \oplus \mathrm{MLP}(\boldsymbol{l}_{i,j}),$$

$$g(\boldsymbol{x}, \boldsymbol{y}) = \tanh(\boldsymbol{x}^T * \mathrm{MLP}(\boldsymbol{y}))$$

$$f(\boldsymbol{e}_{i,j}, \mathcal{H}) = g(\boldsymbol{e}_{i,j}, \boldsymbol{t}_s) \oplus g(\boldsymbol{e}_{i,j}, \boldsymbol{t}_l) \oplus g(\boldsymbol{e}_{i,j}, \boldsymbol{e}_s) \oplus g(\boldsymbol{e}_{i,j}, \boldsymbol{e}_l)$$

User Profile Constructing

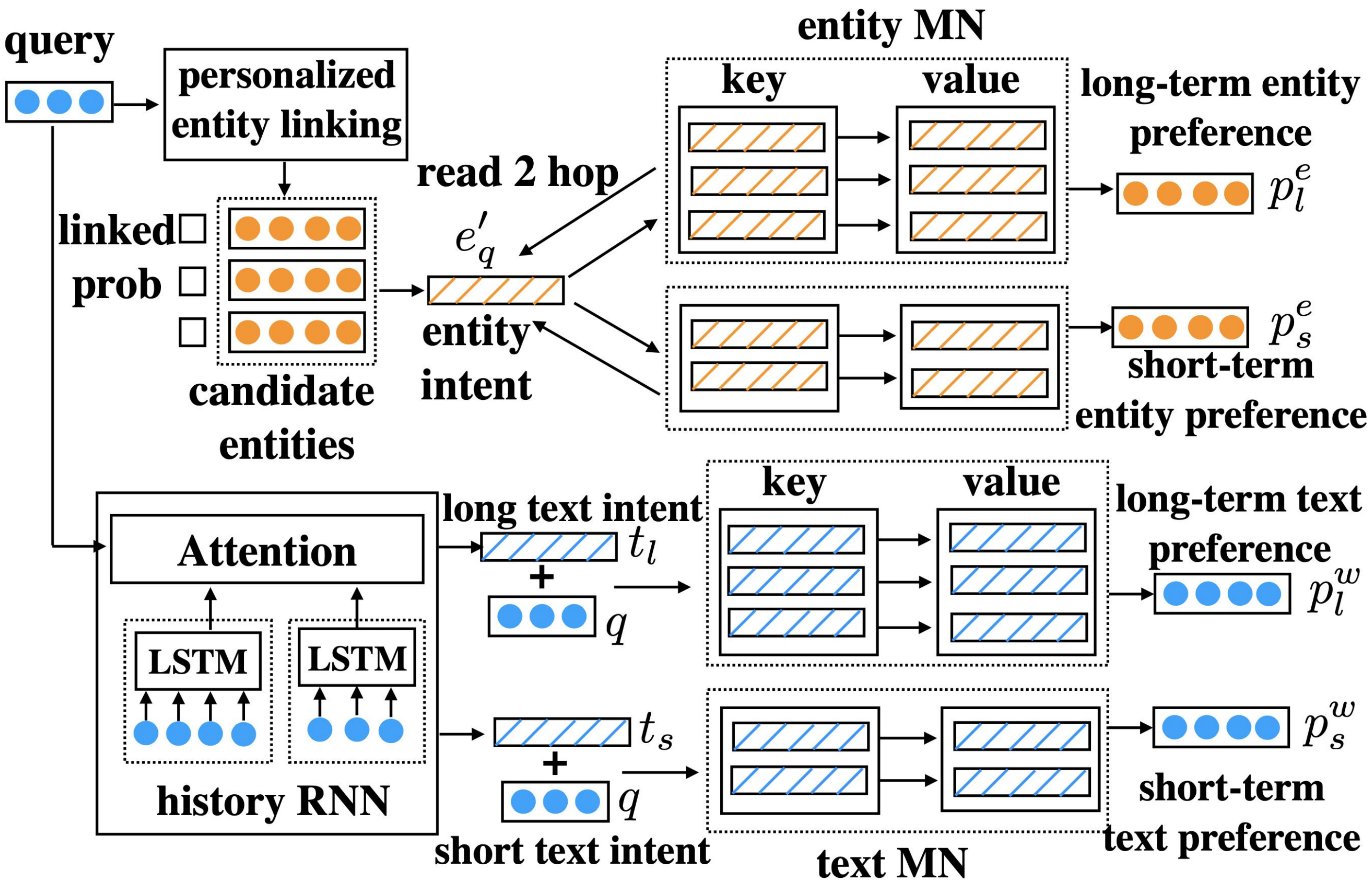

Figure 4: Structure of preference profile constructing.

$$\mathbf{K}_s = [\boldsymbol{k}_1^s, ..., \boldsymbol{k}_{|Q_s|}^s] = [\boldsymbol{e}_1^s, ..., \boldsymbol{e}_{|Q_s|}^s],$$
$$\mathbf{V}_s = [\boldsymbol{v}_1^s, ..., \boldsymbol{v}_{|Q_s|}^s],$$

$$\mathbf{K}_s = [\boldsymbol{k}_1^s, ..., \boldsymbol{k}_{|Q_s|}^s] = [\boldsymbol{q}_1^s, ..., \boldsymbol{q}_{|Q_s|}^s]$$
$$\mathbf{V}_s = [\boldsymbol{v}_1^s, ..., \boldsymbol{v}_{|Q_s|}^s],$$

Personalized Ranking

$$\mathcal{F}(d|q,\mathcal{H}) = \mathrm{MLP}(f(d \oplus \mathcal{I}) \oplus f(d,\mathcal{P}) \oplus f(d,q)),$$

Intention Relevance

$$f(d,\mathcal{I}) = g(\boldsymbol{d},\boldsymbol{t}_s) \oplus g(\boldsymbol{d},\boldsymbol{t}_l) \oplus g(\boldsymbol{d}^e,\boldsymbol{e}_q) \oplus g(\boldsymbol{d},\boldsymbol{e}_q)$$

Preference Relevance

$$f(d,\mathcal{P}) = g(\boldsymbol{d},\boldsymbol{p}_s^w) \oplus g(\boldsymbol{d},\boldsymbol{p}_l^w) \oplus g(\boldsymbol{d}^e,\boldsymbol{p}_s^e) \oplus g(\boldsymbol{d}^e,\boldsymbol{p}_l^e)$$

Query relevance

$$f(d,q) = g(\boldsymbol{d},\boldsymbol{q}) \oplus \mathrm{MLP}(\boldsymbol{f}_d) \oplus f_m,$$

d,q is the text embedding of the query and document，f_d is click features，f_m is interactive word-entity duet matching features(EDRM [ACL18]).$f\ m\ f\ d$

Post-ranking Entity Linking Adjustment

$$p_{i,j}^{t} = p_{i,j}^{t} + {\boldsymbol{e}_{i,j}^{t}}^{\top} * \boldsymbol{W} * \boldsymbol{d}_{e}^{t},$$

$$p_{i,j}^{t} = \frac{\exp(p_{i,j}^{t})}{\sum_{k=1}^{n_i^t} \exp(p_{i,k}^{t})},$$

$$p_{i,j}^{k} = p_{i,j}^{k} + \mathrm{MLP}({\boldsymbol{e}_{a}^{t}}^{\top} * \boldsymbol{W}_1 * \boldsymbol{e}_{i,j}^{k} \oplus {\boldsymbol{q}^{t}}^{\top} * \boldsymbol{W}_2 * \boldsymbol{q}^{k}), \qquad 1 <= k <= t-1$$

$$\boldsymbol{e}_{a}^{t} = \sum_{j=1}^{n_a^t} p_{a,j}^{t} * \boldsymbol{e}_{a,j}^{t}$$

When conduct post-ranking adjustment, our main idea is: firstly select the entity with the highest linking probability which reflects the user’s intention; then use this entity to adjust the linking prob- abilities of entities associated with other mentions in the session.

Traaning

$$l = \sum_{u} \sum_{S} \sum_{q \in S} \sum_{d^-, d^+ \in \mathcal{D}} \max(0, 1 - f(q, d^+, \mathcal{H}) + f(q, d^-, \mathcal{H})),$$

where u denotes user, S denotes session, H is user's search history, q denotes query, and d + represents the positive documents while d − represents others in the document list D associated with q .

实验内容

Model	MAP		MRR		AR		Precision@1		Precision@3		Precision@5	
Ad-hoc Search models												
Knowledge Enhanced Personalization models												
HRNN-Entity	.5444†‡	-0.66%	.5565†‡	-0.63%	10.4791	-2.07%	.4783†‡	-2.23%	.5676†‡	-0.77%	.6073	-1.09%
KEPS	**.6903**†‡*	+25.97%	**.7044**†‡*	+25.79%	**5.0645**†‡*	+50.67%	**.6124**†‡*	+25.18%	**.7578**†‡*	+32.48%	**.8118**†‡*	+32.21%

Model	MAP		MRR		AR		Precision					
							P@1		P@3		P@5	
PSGAN	.5480	-	.5600	-	10.2670	-	.4892	-	.5720	-	.6140	-
KEPS-noEntity	.6618*	+20.77%	.6771*	+20.91%	5.6227*	+45.24%	.5868*	+19.95%	.7239*	+26.56%	.7805*	+27.12%
KEPS-noPSLink	.6700*	+22.27%	.6842*	+22.18%	5.4799*	+46.63%	.5929*	21.20%	.7320*	+27.97%	.7889*	+28.48%
KEPS-noMN	.6547*	+19.47%	.6691*	+19.48%	5.7821*	+43.68%	.5782*	+18.19%	.7129*	+24.63%	.7719*	+25.72%
KEPS-noAdjust	.6811*	+24.29%	.6942*	+23.96%	5.2180*	+49.18%	.6020*	+23.06%	.7456*	+30.35%	.8017*	+30.57%
KEPS-QR	.6481*	+18.27%	.6609*	+18.02%	5.6743*	+44.73%	.5637*	+15.23%	.7089*	+23.93%	.7748*	+26.19%
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Thanks