Beyond Position Bias: Constructing More Reliable Click models for Web Search Engines

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How many signals are adopted in search ranking?

- SEO site: 100+
- Yahoo LTR task: 700+
- Content, Hyperlink structure
- User behavior, Timeliness, Credibility, …
- Relevance feedback from search users

* More clicks => higher rankings?
Relevance Feedback

* A naïve idea: user click = voting for relevance
  * 百度 => www.baidu.com; 清华 => tsinghua.edu.cn
  * 163 => mail.163.com; 搜狗 => d.sogou.com

* Possible problem: position bias
Possible problem: presentation bias

Possible problem: user behavior credibility
Constructing Click Models

* Examination hypothesis to avoid position bias
  
  \[ C_i = 1 \rightarrow R_i = 1 \]
  
  \[ C_i = 1 \rightarrow E_i = 1, R_i = 1 \]

* Cascade model:
  
  \[ P(E_{i+1} = 1|E_i = 1, C_i) = 1 - C_i \]

* Dependent click model (DCM):
  
  \[ P(E_{i+1} = 1|E_i = 1, C_i = 0) = 1 \]
  
  \[ P(E_{i+1} = 1|E_i = 1, C_i = 1) = \lambda_i \]

* User browsing model (UBM):
  
  \[ P(E_i = 1|C_{1...i-1}) = \lambda_{r_i, d_i} \]

* Other models: DBM, CCM, ...
Problems with existing models

- Search results are not always examined sequentially
  - Revisit clicks happen a lot
- Search results do not appear the same
  - Appearance of vertical results are different
- Users have different behavior preference
  - Some clicks more, some examines more

Our work: constructing click models considering revisiting / presentation bias / user credibility
Revisiting happens a lot for search users

Eye tracking experiments (Lorigo et.al, 2005) show that lots of people revisit to previous skipped results

Chinese SE (Sogou): 24.1% sessions contain revisiting

English SE (Yandex): 61.5% sessions contain revisiting
**THCM: From ranking sequence to time sequence**

Forward event: \( P(E_{t(i+1)} = 1 \mid E_{ti} = 1) = \alpha \)

Backward event: \( P(E_{t(i-1)} = 1 \mid E_{ti} = 1) = \gamma \)
Incorporating Revisiting Behaviors

- THCM: performance
  - Improvement compared with existing models
  - Works well on both hot and long-tail queries
Presentation bias for vertical results

70% SERPs contain all kinds of vertical results (Sogou, 2012)

Certain kinds of vertical results are more attractive than ordinary results (e.g. image/video results)
Incorporating presentation bias

- Presentation bias for vertical results
  - Global effect
    - Image results cause global CTR increasing
  - Application results ...
  - Local effect
    - Some results are more attractive
Presentation bias for vertical results

Eye-tracking results show similar findings

How to describe these biases (on-going)

Presentation bias model (PBM): attraction bias, global bias, first place bias, sequence bias.
Incorporating user credibility

* User credibility and preference
  * Avg. number of clicks, Avg. position of clicks
  * Search experts, results crawlers, user who has blind faith in search engines, …
Incorporating user credibility

- How to describe user preference
  - Examination preference
    \[ P(E_i = 1|u, t) = \frac{1}{1 + \exp(-\alpha_i, t - \epsilon_u)}; \]
  - Click preference
    \[ P(C_i = 1|E_i = 1, u, q) = \frac{1}{1 + \exp(-\beta_d, q - \gamma_u)}; \]
Incorporating user credibility

* Performance Evaluation
  * Prediction of search user behaviors
    * Better than UBM/Cascade/logistic models
  * Prediction of relevance from feedback information
    * Works even better for lower-ranked results
Thank you

Any comments?

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