One Query, Many Clicks: Analysis of Queries with Multiple Clicks by the Same User

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*Technion ~ Yahoo Research
Research conducted during an internship at Yahoo Research
A Search in the web...

Yahoo!

RealClearPolitics - Election 2016 - General.

2016 Election: Clinton vs. Trump - 270toWin

2016 General Election: Trump vs. Clinton - Polls

Trump Closing the Gap: The Latest From All The Key...

2016 Election Forecast | FiveThirtyEight

Clinton's Fibs vs. Trump's Huge Lies - The New

2016 Trump vs. Clinton Presidential Election Polls...
Multi-Clicks Pose an Opportunity for Search Engines

- **Represent Complex information needs**
  - cannot be satisfied with a single web page
  - for example: performing a market research, looking for the symptoms of a disease, reviewing scholarly literature

- **Posed by engaged users**
  - long interaction time
  - beneficial for users [Singer et al.]

- **Difficult and rare queries**
  - most frequent query appeared 23 times in our dataset

Applications of Multi-Click Queries

- Improved user interface
- Aggregation of search results
- Strategies of advertisement
- Better usage of click data

Can we understand from the interaction whether the user has a complex information need?
An example – Hero Card

Russia
Country

Russia, also officially known as the Russian Federation, is a sovereign transcontinental state in Eurasia. At 17,075,200 square kilometres, Russia is the largest country in the world, covering more than... wikipedia.org

Capital: Moscow
Population: 142,423,773 (July 2015 est.)
Area: 17,098,242 sq km
GDP: $3.718 trillion (2015 est.)
Currency: Russian rubles (RUB)
Time difference: UTC+3
Data from: The World Factbook

Related places

Saint Petersburg
Moscow Oblast
Republic of Karelia
Sakha Republic
Krasnoyarsk Krai
Application - Aggregation of Search Results

Yahoo!

how to fix a leaking faucet

Search

Web Images Video More Anytime

Also try: how to fix a leaking faucet kitchen

How to fix a leaking faucet?

From Yahoo Answers
The stuff that will fix this leak is packing string. It is a string like material that is wrapped around thses types of faucets and as they are tightened the packing puts pressure and steals around the stems of the faucets knobs. The knobs will become harder to turn because of the packing and pressure around the valve stem. And that should stop the leakings, if not try and replace... Full answer
answers.yahoo.com

More answers

How To Fix a Leaking Faucet - Video Results

How to Fix a Leaky Faucet
youtube.com

Repair Leaky Shower Faucet
youtube.com

How to fix a leaking kitchen faucet
youtube.com

How to Fix a Dripping Faucet
youtube.com

More How To Fix a Leaking Faucet videos
Application – Improved User Interface

Ads related to: best phone carriers usa

Best Cell Phone Service 2016 - Plans, Coverage and...
www.tomsguide.com › Wireless Carriers
When it comes to picking the best wireless carrier, the cost of cell phone plans and the quality of customer service are some of the other factors you should ...

List of United States wireless communications...
en.wikipedia.org/wiki/List_of_United_States..... ➤
Largest U.S. wireless providers. The top 5 wireless telecommunications facilities-based service providers by subscriber count in the United States are:

Top 10 Cell Phone Providers of 2016 | Top Ten...
www.toptenreviews.com › Mobile › Phones
Looking for the best cell phone providers? We have easy-to-read, expert unbiased reviews and feature comparisons of the best and cheapest services.

Top 5 Cell phone providers (USA) - Toried
www.toried.com/rank.php?pid=19 ➤
This is a ranking of the top 5 Cell phone providers (USA) in the world. Toried.com is a top 5 ranking and description website of the best brands, products and ...
Application – Improved User Interface

<table>
<thead>
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<td>4</td>
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Background

- Multi-click queries represent complex search tasks for which the user needs cannot be satisfied by a single web page.
Goals (and outline)

- Define
- Analyze
- Automatically detect

Multiple-Click Queries (MCQs)
Query Sessions

A Query Session (QS) includes a query, the ranked results and a set of clicks.

A Multi-Click Query Session (MCQS) is a QS that is associated with more than one click.

- MCQSs are defined in the context of a single QS.
- Considering the percentage of MCQSs associated with a query, we capture different behavior of users:
  - “toys r us coupons” - ~20% MCQSs
  - “free movie streaming sites” - ~67% MCQSs
Multi-Click Queries

- **Multi-Click Queries (MCQs)** are queries such that:
  - a substantial portion of QSs associated with the query are MCQs

A query \( q \) is considered as **MCQ** w.r.t. a portion \( p \) if

\[
\frac{|MCQS(q)|}{|QS(q)|} \geq p
\]

- \( p \) was optimized to \( 0.5 \)
  - a query is considered as MCQ if at least **half** of its associated QSs are MCQs

- The complementary set of MCQ is denoted as **Sparse-Click Queries (SCQ)**
Number of Clicks

- 92.9% of all QSs have zero or one clicks
- 92.6% of MCQ-sessions (QSs associated with MCQ) have multiple clicks
  - while some MCQ-sessions are associated with [0,1] clicks the majority of them are associated with MCQSs according to our definition
Outline

- Define
- Analyze
- Automatically detect

Multiple-Click Queries (MCQs)
Dataset

• (Sample of) Query Sessions from May 1\textsuperscript{st} to 21\textsuperscript{st}, 2015
  • 31.42M QSs
    • MCQ–6.5%, SCQ – 93.5%
    • For unique queries – MCQ - 11.4%
• Logged in users
• English only

• Properties of the data:
  • Query, # of clicks
  • Context: time, device, gender, age
  • Post-retrieval: URL, title, relevance score, # results...
  • Clicks: rank, domain
Analysis Conducted

• **Query**
  • syntax - **length**, questions, **POS distribution**
  • lexical – **distinctive terms**, query categories

• **Click** – position, domains

• **Contextual Properties** – temporal aspects, device type, user attributes

• **Post-Retrieval** – **scores**, # of domains, quick link
**Query Length**

- MCQs are substantially longer than SCQ in average
- Verbose queries (5+ words) often indicate complex information needs [Gupta and Bendersky]

Lexical Analysis

- Most distinctive terms by Kullback-Leibler (KL) divergence.
  - SCQs reflect *navigational* needs
  - MCQs reflect *complex* needs or *questions*
Users tend to express their need for multiple results by using plural rather than singular form
  - e.g., “senior people jokes” or “travel tips florence”
Queries that involve a proper noun have a more focused information need

<table>
<thead>
<tr>
<th>Query length</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>SCQ</td>
<td>12.5</td>
<td>53.2</td>
<td>66.8</td>
<td>70.1</td>
<td>74.5</td>
<td>78.7</td>
<td>83.3</td>
<td>86.5</td>
<td>89.6</td>
<td>93.5</td>
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<td>66.8</td>
<td>71.9</td>
<td>76.4</td>
<td>81.1</td>
<td>84.9</td>
<td>88.4</td>
<td>91.0</td>
<td>94.9</td>
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<td><strong>%NNS</strong></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>SCQ</td>
<td>14.4</td>
<td>25.2</td>
<td>32.5</td>
<td>37.6</td>
<td>39.6</td>
<td>40.2</td>
<td>41.4</td>
<td>40.5</td>
<td>47.6</td>
<td></td>
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<tr>
<td>MCQ</td>
<td>14.4</td>
<td>25.2</td>
<td>32.5</td>
<td>37.6</td>
<td>39.6</td>
<td>40.2</td>
<td>41.4</td>
<td>40.5</td>
<td>47.6</td>
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<td>SCQ</td>
<td>13.1</td>
<td>54.5</td>
<td>49.4</td>
<td>54.3</td>
<td>52.8</td>
<td>50.7</td>
<td>46.5</td>
<td>45.4</td>
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<td>46.9</td>
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<td>52.8</td>
<td>46.3</td>
<td>43.1</td>
<td>41.3</td>
<td>38.1</td>
<td></td>
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</tbody>
</table>

MCQs have higher portion of plurals

A consistent difference in favor of SCQs
Post Retrieval

<table>
<thead>
<tr>
<th>Average (Stdev)</th>
<th>SCQ</th>
<th>MCQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st result score</td>
<td>16.54 (16.78)</td>
<td>7.76 (14.45)</td>
</tr>
<tr>
<td>Avg result score</td>
<td>1.47 (10.43)</td>
<td>-1.83 (10.15)</td>
</tr>
<tr>
<td>NQC</td>
<td>4.44 (3.28)</td>
<td>2.65 (2.29)</td>
</tr>
</tbody>
</table>

• Score are substantially lower for MCQs
• NQC – a common measure of Query Performance Prediction

\[ NQC(q) \equiv \sqrt{\frac{1}{k} \sum_{d \in D_q} (\text{Score}(d) - \mu)^2} \]

• lower NQC coincides with more difficult queries

Outline

- Define
- Analyze
- Automatically detect

Multiple-Click Queries (MCQs)
Automatic Detection of MCQ

- MCQ include 6.5% of the query sessions
  - Imbalance data was not our focus
- Balanced dataset:

<table>
<thead>
<tr>
<th></th>
<th>Train</th>
<th>Test</th>
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<tbody>
<tr>
<td>Month</td>
<td>May. 1\textsuperscript{st} - 14\textsuperscript{th}</td>
<td>May. 15\textsuperscript{th} - 21\textsuperscript{st}</td>
</tr>
<tr>
<td>Quantity</td>
<td>1M QSs</td>
<td>1M QSs</td>
</tr>
<tr>
<td>Distribution</td>
<td>50:50 MCQ/SCQ</td>
<td>50:50 MCQ/SCQ</td>
</tr>
</tbody>
</table>

Goal: examine which of the MCQ properties are useful for prediction

- Features (1446 overall):
  - Query – surface descriptors, POS tags, language model
  - Context – time, user
  - SERP – scores, textual similarity, unique domains, quick link
## Classification results & Ablation test

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Accuracy</th>
<th>MCQ Precision</th>
<th>MCQ Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>AROW</td>
<td>75.2%</td>
<td>72.4%</td>
<td>81.2%</td>
</tr>
<tr>
<td>Logistic Regression</td>
<td>70.8%</td>
<td>71.0%</td>
<td>70.2%</td>
</tr>
<tr>
<td>Random Forest</td>
<td>74.8%</td>
<td>70.3%</td>
<td>86.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
<th>Accuracy</th>
<th>Ablation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query - All</td>
<td>1,376</td>
<td>67.1%</td>
<td>72.7%</td>
</tr>
<tr>
<td>POS tags</td>
<td>1,352</td>
<td>67.4%</td>
<td>74.6%</td>
</tr>
<tr>
<td>Surface</td>
<td>17</td>
<td>66.8%</td>
<td>74.1%</td>
</tr>
<tr>
<td>Language model</td>
<td>7</td>
<td>64.1%</td>
<td>74.3%</td>
</tr>
<tr>
<td>Context - All</td>
<td>37</td>
<td>54.7%</td>
<td>75.1%</td>
</tr>
<tr>
<td>User</td>
<td>22</td>
<td>54.2%</td>
<td>75.2%</td>
</tr>
<tr>
<td>Time</td>
<td>15</td>
<td>51.0%</td>
<td>75.0%</td>
</tr>
<tr>
<td>SERP - All</td>
<td>33</td>
<td>72.5%</td>
<td>68.6%</td>
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<tr>
<td>Result scores</td>
<td>16</td>
<td>64.8%</td>
<td>73.2%</td>
</tr>
<tr>
<td>Number of domains</td>
<td>6</td>
<td>62.0%</td>
<td>74.3%</td>
</tr>
<tr>
<td>Quick link</td>
<td>1</td>
<td>60.9%</td>
<td>74.2%</td>
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<tr>
<td>Textual similarity</td>
<td>10</td>
<td>55.4%</td>
<td>74.6%</td>
</tr>
</tbody>
</table>
Summary of Main Findings

• **MCQs are longer**
  - In an average of ~1 word
  - Associated with complex information needs and with questions

• **POS tags analysis differs MCQs from SCQs**
  - MCQs consists of *richer language*, with less proper nouns and more adjectives and plurals

• **MCQs have weaker Post-Retrieval signals**
  - NQC analysis supports them as difficult queries
Summary & Conclusions

**Conclusions**
- MCQs are an important class of queries, that have not been formally studied in the past
- We formally defined the class, and characterized it
- An initial classification over a balanced dataset was presented

**Implications** - potential improvement of user experience and ad matching

**Future Work**
- Additional signals may be considered (hero cards, dwell time,...)
- Classification over imbalanced dataset
A MCQ:
Which lectures should one attend in CIKM 2016?
;

Thank you for listening