

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

Elad Kravi*, Ido Guy~, Avihai Mejer~, David Carmel~,
Yoelle Maarek~, Dan Pelleg~, Gilad Tsur~

*Technion ~ Yahoo Reseach
Research conducted during an internship at Yahoo Research

A Search in the web...

YAHOO!

RealClearPolitics - Election 2016 - General.

www.realclearpolitics.com/epolls/2016/president/us/

RealClearPolitics - Election 2016 - General Election: **Trump vs.**



2016 Election: Clinton vs. Trump - 270toWin

www.270towin.com/maps/clinton-trump-electoral-map

How the electoral map for 2016 is shaping up for a **Clinton vs. Trump** race, based on polling and/or 2012 actual results.

2016 General Election: Trump vs. Clinton - Polls - ...

elections.huffingtonpost.com/pollster/2016-general-election-trump-vs-clinton

Polls and chart for 2016 General Election: **Trump vs. Clinton**. Includes estimates and poll results at HuffPost Pollster.



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

www.dailywire.com/news/5361/can-trump-beat-hillary-here-are-...

3 days ago ... While that's certainly not welcome news for the **Trump** campaign, it is a 10-vote improvement from a week ago, where the polls showed **Clinton** ...

2016 Election Forecast | FiveThirtyEight

projects.fivethirtyeight.com/2016-election-forecast/

Nate Silver's predictions and polling data for the 2016 presidential election between Hillary **Clinton** and Donald **Trump**.

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

www.nytimes.com/2016/08/07/opinion/sunday/clinton-trump.html

Aug 7, 2016 ... ONE persistent narrative in American politics is that **Clinton** is a slippery, compulsive liar while Donald **Trump** is a gutsy truth-teller.



2016 Trump vs. Clinton Presidential Election Polls...

www.electionprojection.com/latest-polls/national-presidential-election-polls/

Click here for 2016 **Trump vs. Clinton** Presidential Election Polls. Check here often to see who is ahead in the national **Trump vs. Clinton** 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

Can we understand from the interaction whether the user has a complex information need?

Applications of Multi-Click Queries

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

An example – Hero Card

YAHOO!

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

[Feedback](#)

Application - Aggregation of Search Results

YAHOO!

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 these types of faucets and as they are tightened the packing puts pressure and seals 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

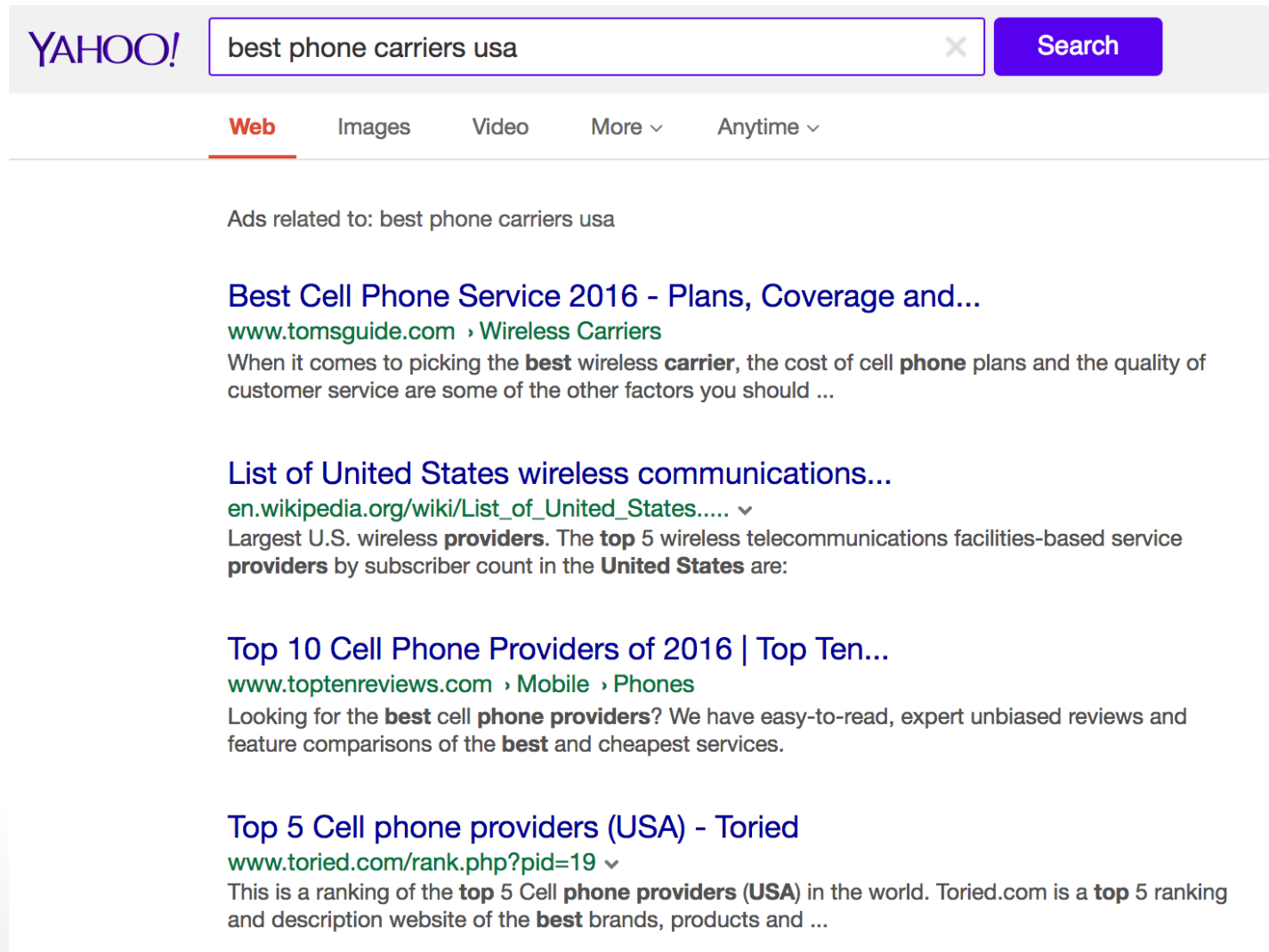
Repair Leaky Shower Faucet
youtube.com

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



The image shows a screenshot of a Yahoo! search results page. At the top left is the 'YAHOO!' logo. To its right is a search input field containing the text 'best phone carriers usa' and a small 'x' icon to clear the text. Further right is a blue 'Search' button. Below the search bar is a navigation menu with the following items: 'Web' (underlined in red), 'Images', 'Video', 'More' (with a dropdown arrow), and 'Anytime' (with a dropdown arrow). Below the navigation menu is a horizontal line. Underneath the line, the text 'Ads related to: best phone carriers usa' is displayed. There are four search results listed below:

- 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

YAHOO!

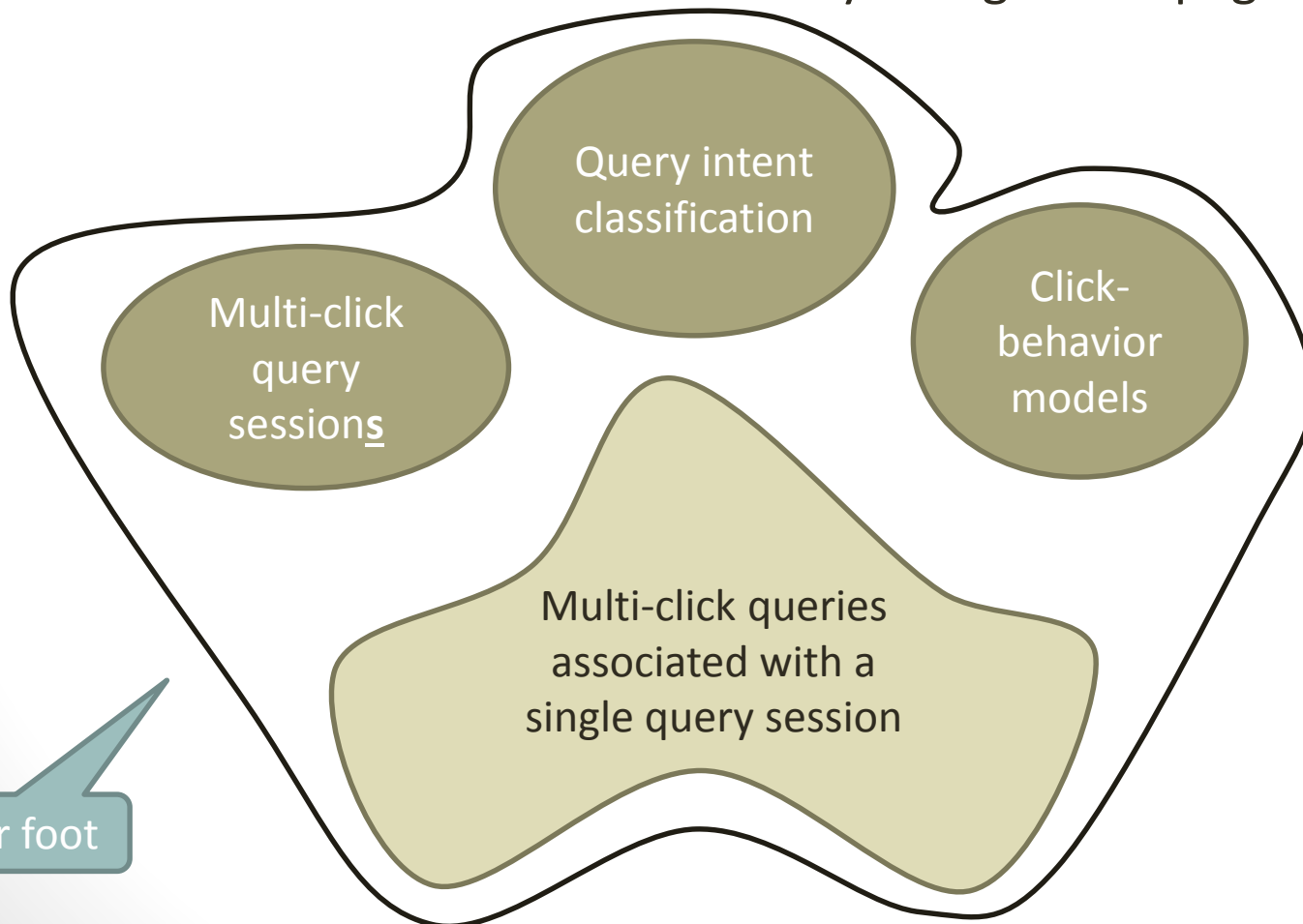
Web Images Video More ▾ Anytime ▾

tom's guide
Wireless Carrier
Grades 2015

	PERFORMANCE 50 pts	PLANS 20 pts	CUSTOMER SUPPORT 15 pts	PHONE SELECTION 10 pts	SPECIAL FEATURES 5 pts	OVERALL 100 pts	
T-Mobile	46	19	13	8	5	91	1 ST
verizon	48	17	13	8	3	89	2 ND
at&t	45	14	14	10	2	85	3 RD
Sprint	38	15	13	7	4	77	4 TH
boost mobile	37	12	12	5	3	69	5 TH
metroPCS	43	14	9	2	1	69	5 TH
Virgin mobile	37	11	11	1	1	61	7 TH
Straight Talk	32	9	11	3	2	57	8 TH
cricket	25	13	12	4	1	55	9 TH

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

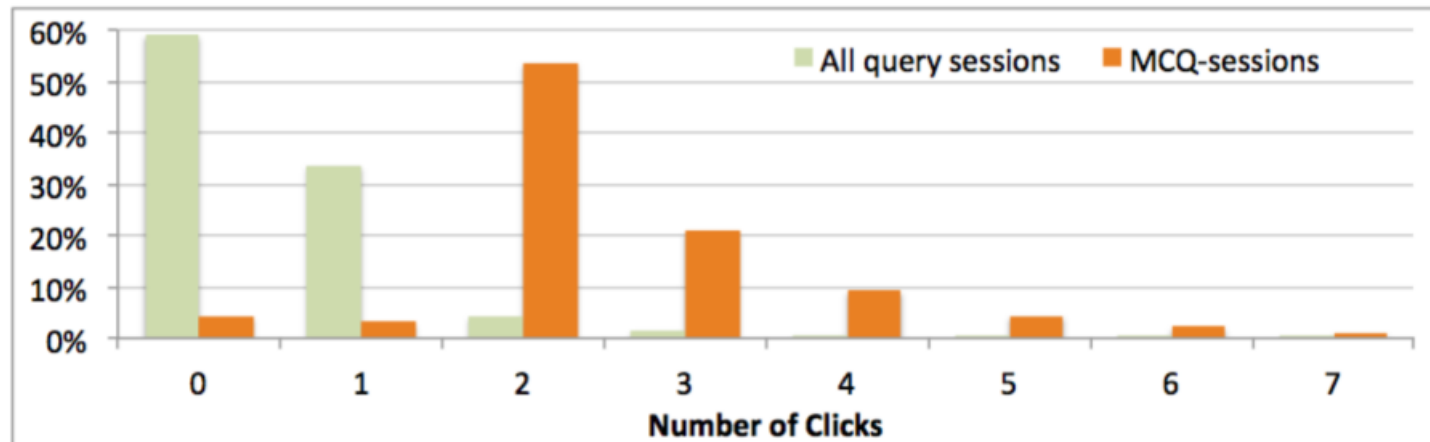
Multi-Click Queries

- **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 Qs have zero or one clicks
- 92.6% of MCQ-sessions (Qs associated with MCQ) have multiple clicks
 - while some MCQ-sessions are associated with [0,1] clicks the majority of them are associated with MCQs according to our definition

Outline

- Define
- Analyze
- Automatically detect

Multiple-Click Queries (MCQs)

Dataset

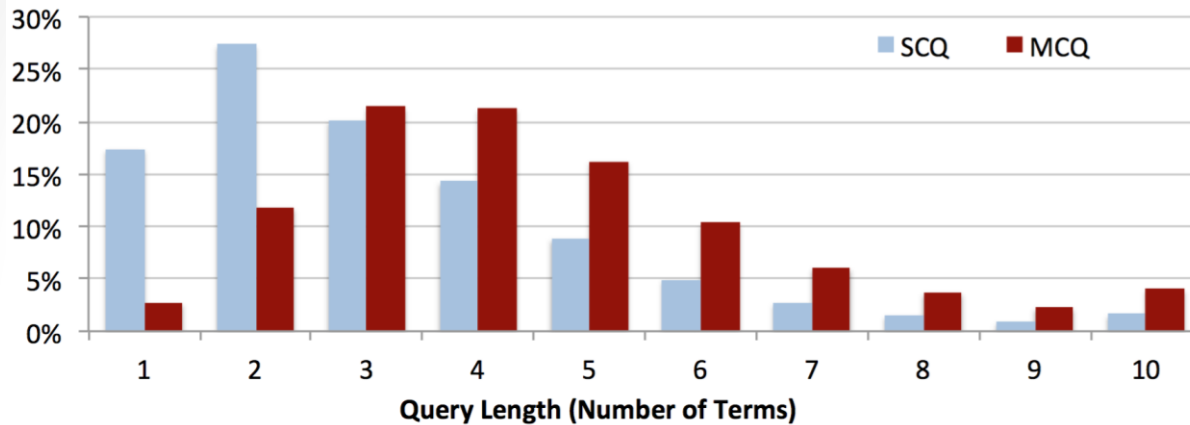
- (Sample of) Query Sessions from May 1st to 21st, 2015
 - 31.42M Qs
 - MCQ–6.5%, SCQ – 93.5%
 - For unique queries – MCQ - 11.4%
- Logged in users
- English only

- 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



	MCQ	SCQ
average	4.8	3.3
stdev	1.8	1.4
median	4	3

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

* M. Gupta and M. Bendersky. Information retrieval with verbose queries. Foundations and Trends in Information Retrieval, 9(3-4):209–354, 2015.

Lexical Analysis

Unigrams		Bigrams	
SCQ	MCQ	SCQ	MCQ
facebook	how	yahoo mail	for sale
yahoo	sale	facebook login	how to
google	what	facebook com	in the
login	sex	yahoo com	for a
mail	can	google com	sale in
youtube	is	facebook sign	can you
craigslist	does	google maps	how much
gmail	do	wells fargo	how long
bank	i	sign up	of the
amazon	free	com login	is the
ebay	best	bank of	on a
airlines	women	www facebook	do i

- Most distinctive terms by Kullback-Leibler (KL) divergence.
 - SCQs reflect navigational needs
 - MCQs reflect complex needs or questions

Linguistic Analysis

Query length		1	2	3	4	5	6	7	8	9	10+
%NN	SCQ	42.5	53.2	66.8	70.1	74.5	78.7	83.3	86.5	89.6	93.5
	MCQ	35.6	55.2	66.8	71.9	76.4	81.1	84.9	88.4	91.0	94.9
%NNS	SCQ	7.2	16.4	27.1	33.1	36.8	39.6	40.2	41.4	40.5	47.6
	MCQ	14.4	25.2	32.5	37.6	40.7	42.9	44.4	44.8	44.9	48.2
%NNP	SCQ	43.1	54.5	49.4	54.3	54.8	52.8	50.7	46.5	45.4	42.5
	MCQ	33.0	46.9	46.6	49.6	50.4	48.9	46.3	43.1	41.3	38.1

MCQs have higher portion of plurals

a consistent difference in favor of SCQs

- 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

Post Retrieval

	Average (Stdev)	
	SCQ	MCQ
1st result score	16.54 (16.78)	7.76 (14.45)
Avg result score	1.47 (10.43)	-1.83 (10.15)
NQC	4.44 (3.28)	2.65 (2.29)

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

$$NQC(q) \equiv \frac{\sqrt{\frac{1}{k} \sum_{d \in D_q^k} (\text{Score}(d) - \mu)^2}}{|\text{Score}(D)|} \quad [\text{Shtok et al., Cummins et al.}]$$

- lower NQC coincides with more **difficult queries**

(*) A. Shtok, O. Kurland, D. Carmel, F. Raiber, and G. Markovits. Predicting query performance by query-drift estimation. *ACM Trans. Inf. Syst.*, 30(2):11:1–11:35, May 2012.

(*) Cummins, Ronan, Joemon Jose, and Colm O'Riordan. "Improved query performance prediction using standard deviation." *Proceedings of the 34th international ACM SIGIR conference on Research and development in Information Retrieval*. ACM, 2011.

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:

<u>Train</u>	<u>Test</u>
May. 1 st -14 th	May. 15 th -21 st
1M QSs	1M QSs
50:50 MCQ/SCQ	50:50 MCQ/SCQ

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

Classifier	Accuracy	MCQ Precision	MCQ Recall
AROW	75.2%	72.4%	81.2%
Logistic Regression	70.8%	71.0%	70.2%
Random Forest	74.8%	70.3%	86.0%

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

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