

Characterizing and Predicting Search Engine Switching Behavior

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What is Engine Switching?

- Voluntary transition from one search engine to another search engine
 - e.g., Query Google then query Yahoo! or Bing
- We study within-session switching in this paper
- Other variants include:
 - Between-session switching: switch for different tasks
 - Long-term switching: suddenly or gradually over time

Outline

- Motivation
- Methods
 - Log analysis
 - Large-scale survey
- Characterizing search engine switching
 - Overview of log and survey data
 - Pre-/post-switch behaviors
- Predicting search engine switching
- Conclusions

Motivation

- Engine switching is important to search engine users
 - Half of search engine users switch between engines
- Engine switching is important to search providers
 - Represents customers (+ revenue) lost and gained
- Little is known about:
 - Rationale behind switching
 - Switching behavior
 - Features most useful in predicting switching events
- We address these open questions in this paper

Methods

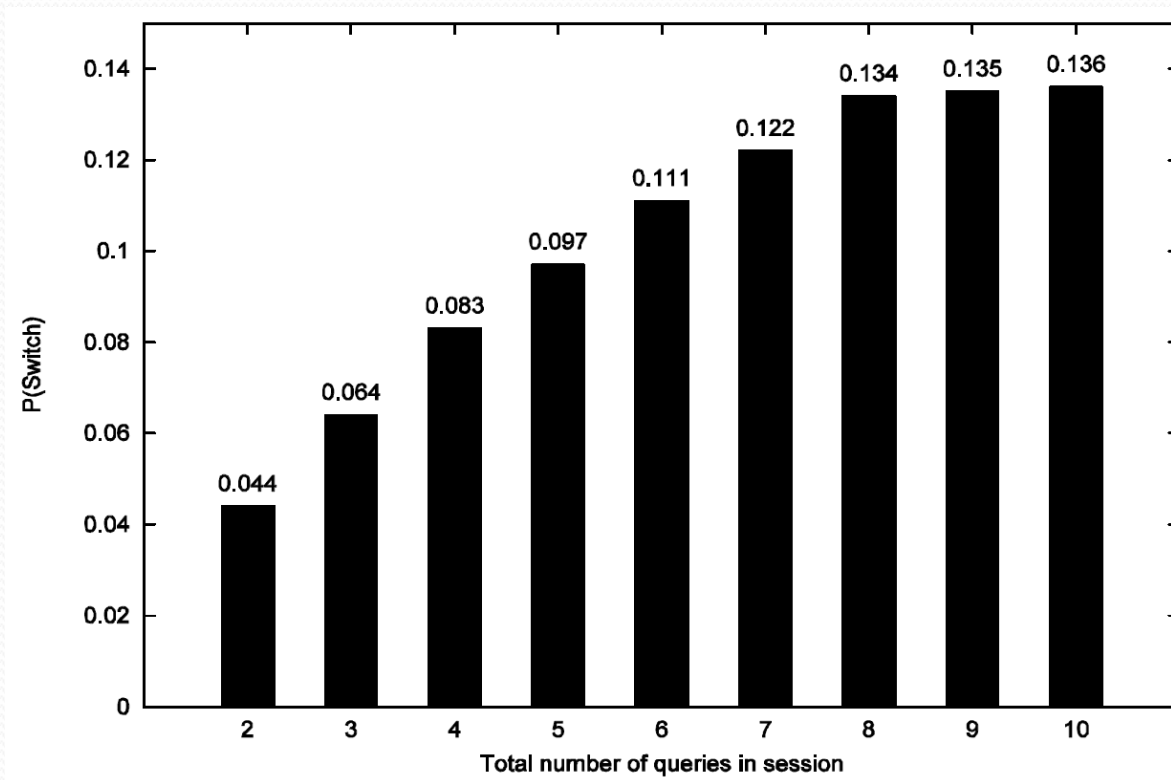
- Log analysis
 - 6 months of toolbar logs (Sep 08 – Feb 09)
 - Hundreds of thousands of consenting toolbar users
 - Search *sessions* extracted from logs
 - Start with query and end with 30-minute inactivity timeout
 - May contain queries to multiple engines
- Survey
 - 500 Microsoft employees
 - Targeted switching rationale (to complement log analysis)
 - Also asked about recent switching episodes and patterns of behavior prior to switching

Overview of Switching - Logs

- 4% of all search sessions contained a switching event
- Switching events:
 - 58.6 million switching events in 6-month period
 - 1.4% of all Google / Yahoo! / Live queries followed by switch
 - 12.6% of all switching events involved same query
 - Two-thirds of switching events from browser search box
- Users:
 - 72.6% of users used multiple engines in 6-month period
 - 50% of users switched search engine within a session

Overview of Switching - Logs

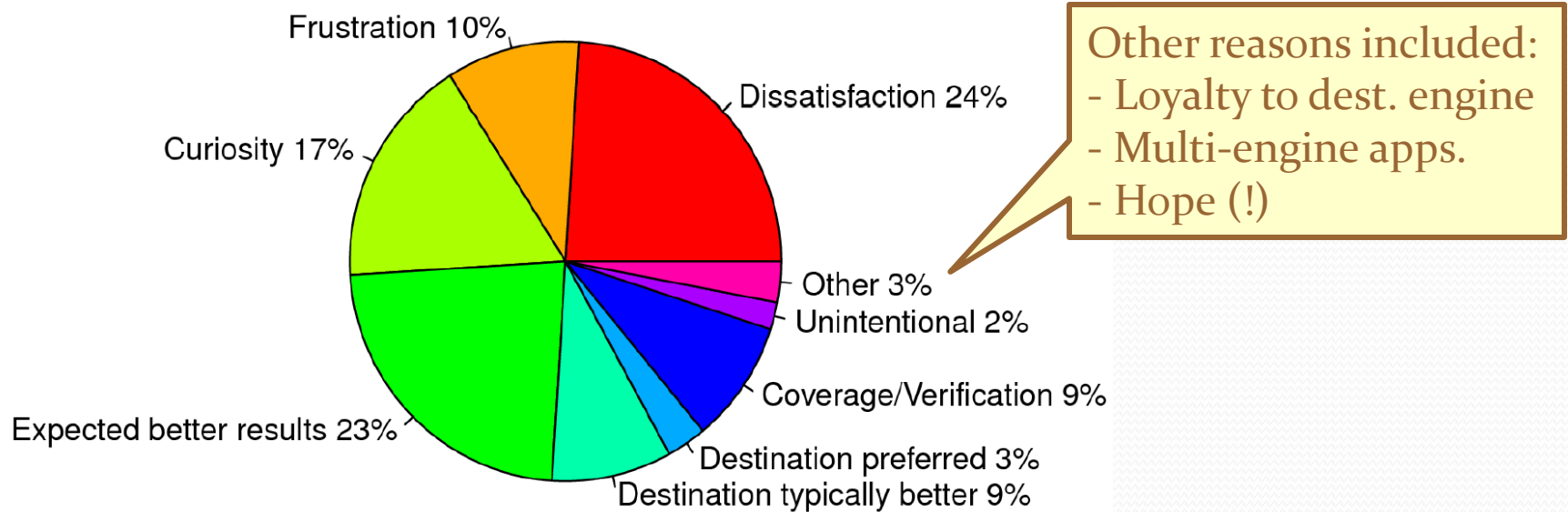
- Switching is more frequent in longer sessions




Overview of Switching - Survey

- 70.5% of survey respondents reported having switched
 - Remarkably similar to the 72.6% observed in logs
- Those who did not switch:
 - Were satisfied with current engine (57.8%)
 - Believed no other engine would perform better (24.0%)
 - Felt that it was too much effort to switch (6.8%)
 - Other reasons included brand loyalty, trust, privacy
- Within-session switching:
 - 24.4% of switching users did so “Often” or “Always”
 - 66.8% of switching users did so “Sometimes”

Reasons for Engine Switching



- Three types of reasons:
 - Dissatisfaction with original engine
 - Desire to verify or find additional information
 - User preference

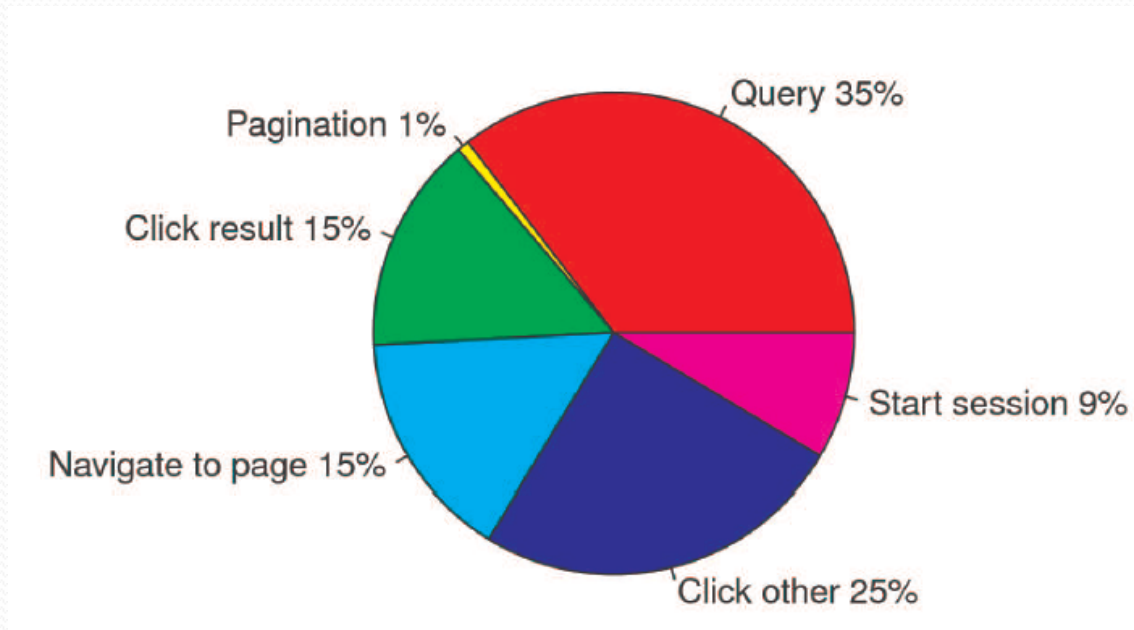


How do users behave
before and after switching?

Pre-switch Behavior

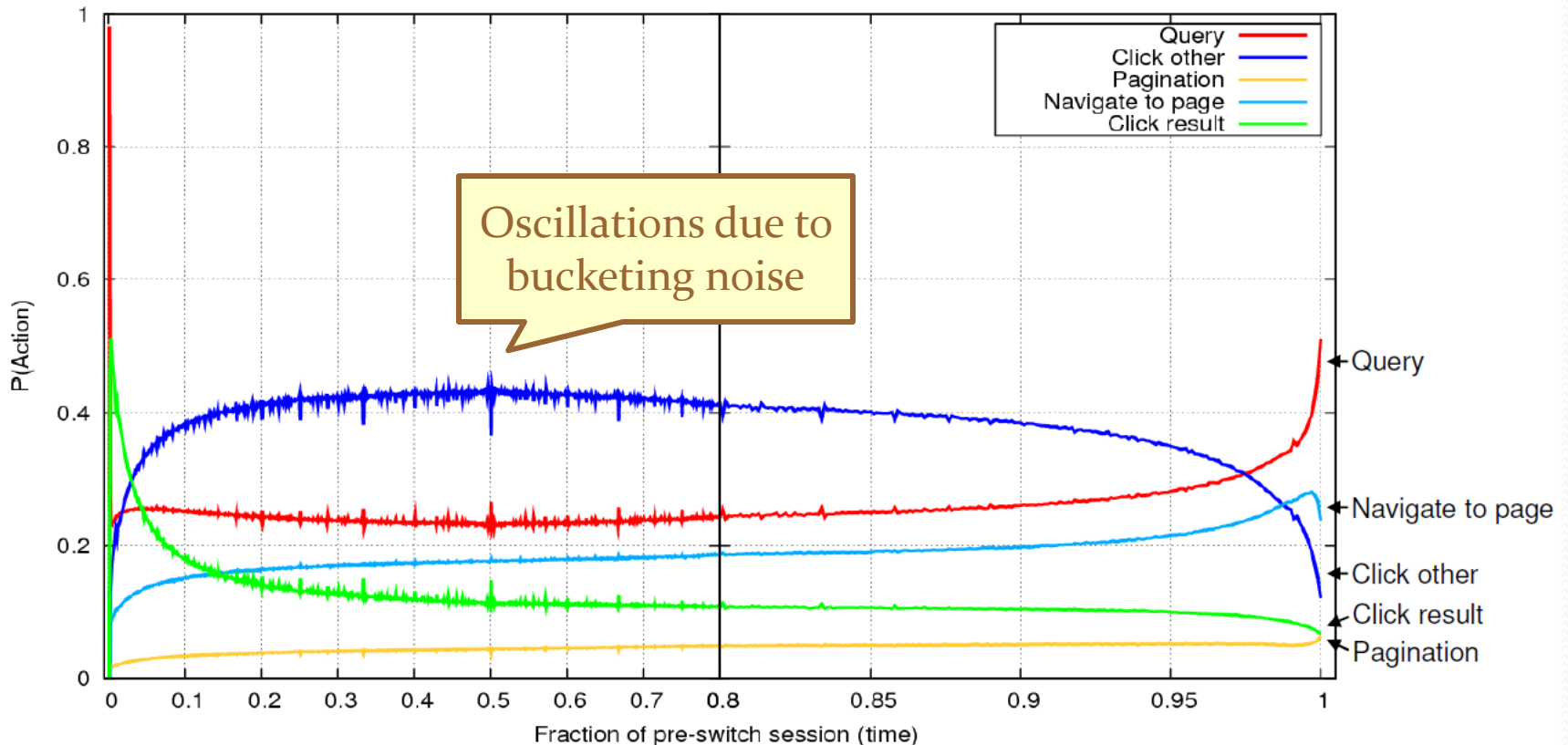
- Analyzed switching events in the logs **to determine the frequency of pre-switch actions**
- Consider six actions:
 - Query
 - Pagination (request next result page)
 - Click result (SERP)
 - Click other (non-SERP)
 - Navigate to page without click (e.g., address bar)
 - Start session

Pre-switch Behavior



- Most common are queries and non-SERP clicks
- This is the action immediately before the switch
- What about pre-switch activity across the session?

Pre-switch Behavior



- Re-visitation also increases rapidly just before a switch
- Also represent behavior as sequence motifs ($qRcP^*qR$)

Pre-switch Behavior (Survey)

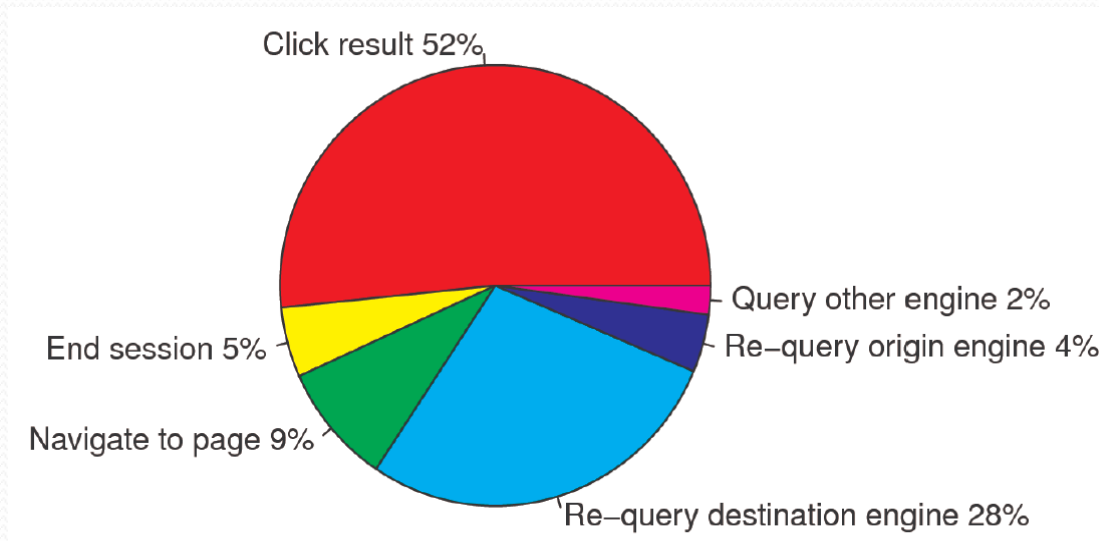
“Is there anything about your search behavior immediately preceding a switch that may indicate to an observer that you are about to switch engines?”

- Common answers:
 - Try several small query changes in pretty quick succession
 - Go to more than the first page of results, again often in quick succession and often without clicks
 - Go back and forth from SERP to individual results, without spending much time on any
 - Click on lots of links, then switch engine for additional info
 - Do not immediately click on something

Post-switch Behavior

- Analyzed switching events in the logs **to determine the frequency of post-switch actions**
- Consider six actions:
 - Click result (SERP)
 - Navigate to page without click (e.g., address bar)
 - Re-query destination engine
 - Re-query origin engine (switch back)
 - Query on other engine (switch to a third engine)
 - End session

Post-switch Behavior




- Extending the analysis beyond next action:
 - 20% of switches eventually lead to return to origin engine
 - 6% of switches eventually lead to use of third engine
- > 50% led to a result click. Are users satisfied?

Post-Switch Satisfaction

- Measures of user effort / activity (# Queries, # Actions)
- Measure of the quality of the interaction
 - % queries with No Clicks, # Actions to SAT (>30sec dwell)

Activity	# Queries		# Actions	
	Origin	Destination	Origin	Destination
All Queries	3.14	3.70	9.85	11.62
Same Queries	3.08	3.73	9.03	10.25
Success	% NoClicks		# Actions to SatAction	
	Origin	Destination	Origin	Destination
All Queries	49.7	52.7	3.81	4.71
Same Queries	54.5	59.7	3.67	4.61

- Users issue more queries/actions; seem less satisfied (higher %NoClicks and more actions to SAT)
- Switching queries may be challenging for search engines



Can we predict switching?
What features are important?

Predicting Switching - Overview

- Task: Predict whether next action in session is switch
- Learning model using logistic regression
- Feature classes:
 - Query – the last query issued in current session
 - Session – the current session
 - User – the current user
- Aim of experiment not to optimize model
 - Determine predictive value of query/session/user features
 - Model held constant, features combinations varied

Query features

abandonmentRate: Fraction of times query has no SERP click
avgClickPos: Average SERP click position (starts at zero)
avgNumClicks: Average number of SERP clicks
avgNumAds: Average number of advertisements shown
avgNumQuerySuggestions: Average number of query suggestions
avgNumResults: Average number total search results
avgTokenLength: Average length of query tokens
followOnRatio: Fraction of times query leads to another query
frequencyCount: Total query frequency
hasAlteration: True if alteration applied (e.g., remove plurals)
hasOperators: True if query has operators (e.g., site:)
hasQuotes: True if query contains quotation marks
hasSpellCorrection: True if spell correction fires
paginationRate: Fraction of times request next page of results
queryLength: Query length in characters
queryTokens: Query length in tokens

Session features

avgTimeBetweenQueries: Average time between queries

currentEngine: Current search engine name

currentSequenceAdvanced: Advanced string representation of session so far

currentSequenceBasic: Basic string representation of session so far

hasMotifAdvanced: True if currentSequenceAdvanced has seq. motif

hasMotifBasic: True if currentSequenceBasic has sequence motif

numBacks: Number of revisits in the session so far

numPaginations: Number of paginations in session so far

queriesInSession: Number of queries in the session so far

ratioQueriesWithNoClicks: Fraction of queries with no clicks

ratioQueriesWithOneClick: Fraction of queries with one click

ratioQueriesWithMultipleClicks: Fraction of queries with many clicks

timeInSession: Time in the session so far (in seconds)

URLsInSession: Number of URLs in session so far

User features

avgSessionLengthQueries: Average session length in queries

avgSessionLengthTime: Average session length in time

avgSessionLengthURLs: Average session length in URLs

avgQueryLength: Average query length in characters

avgQueryTokens: Average query length in tokens

propPreferredEngine: Fraction queries issued to preferred engine

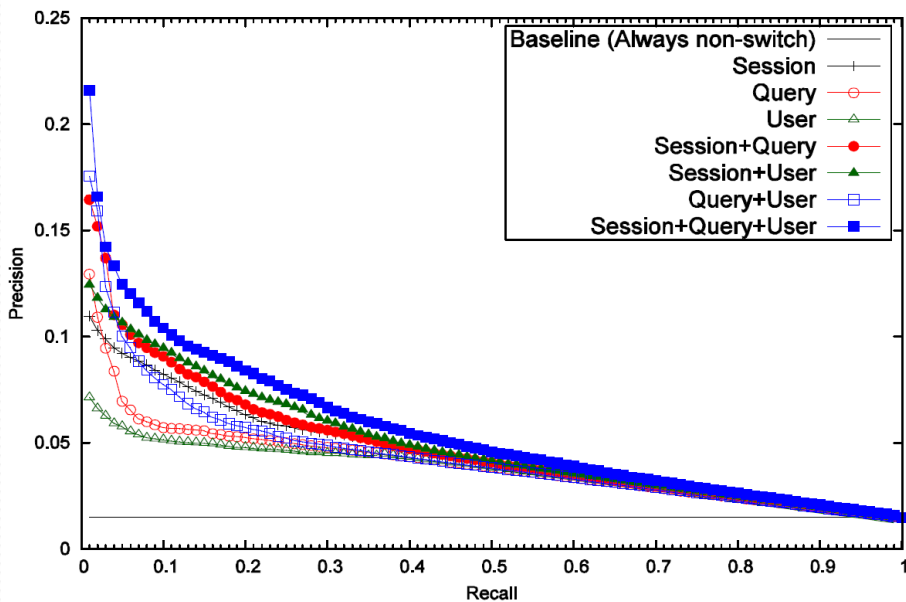
sessionCount: Total number of sessions

Predicting Switching - Method

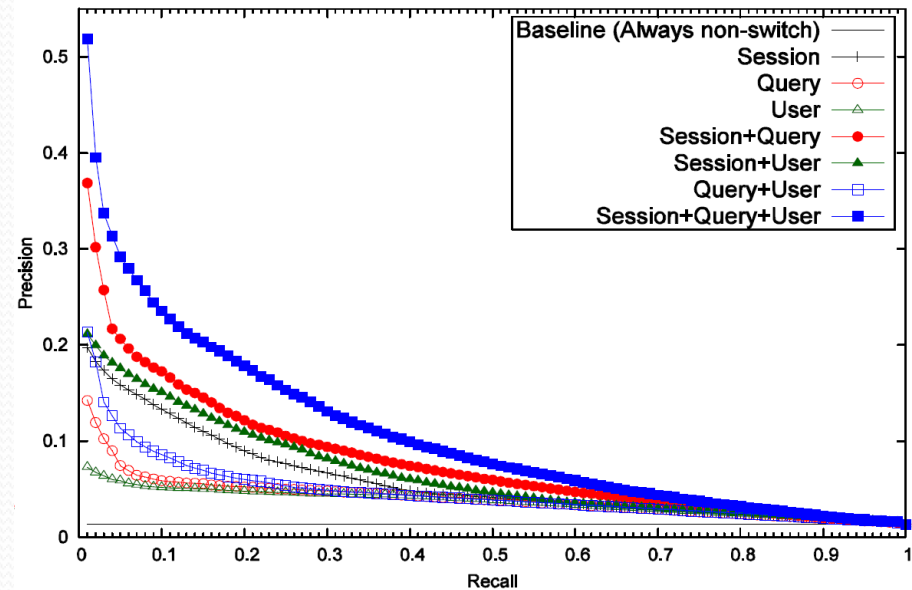
- Task: Predict if next session action is engine switch
- Used session *states*, where state =
 - Observed interaction in a session to a given point
 - Also includes most recent query and user id (to get history)
- Trained on 100K states randomly sampled from logs
 - Ratio during sampling 1 : 99 (switch : no-switch)
 - Artificially re-balanced the training data and used bagging
- Tested on 100 x 10K random samples from unseen logs
- Precision and recall computed over 100 samples

Predicting Switching - Results

All sessions



All sessions with 3 or more queries so far



- Models trained on all features best; Session best class
- Performance improves for longer sessions
 - More session information available

Predicting Switching - Usage

- Switch predictions seem useable, especially at low recall
- What can we do with switch predictions?
- *Origin engine* – predict switch away from them
 - Offer additional query suggestions, reduce number of ads
 - Enhance UI with richer support for sorting or filtering
 - Devote more computational resources to ranking
- *Destination engine* – predict switch to them (via toolbar)
 - Pre-fetch search results in anticipation of incoming user

Conclusions

- Characterized switching behavior using logs and survey
- Showed that:
 - Switching is important and increases for long sessions
 - Switching mainly associated with dissatisfaction
 - Also related to coverage/verification, user preferences
 - Important patterns exist in pre-switch behavior
 - Switching does not improve search success
 - Features of query, session, and user can predict switching
 - Session features are most useful
 - Sufficient signal to provide some search support
- Future: improve predictions, study long-term switching