To Click or not to Click?

The Role of Contextualized and User-Centric Web Snippets

Nikos Zotos – Patras University
Paraskevi Tzekou – Patras University
George Tsatsaronis – Athens University
Lefteris Kozanidis – Patras University
Sofia Stamou – Patras University
Iraklis Varlamis – Athens University

Lost in Search Results

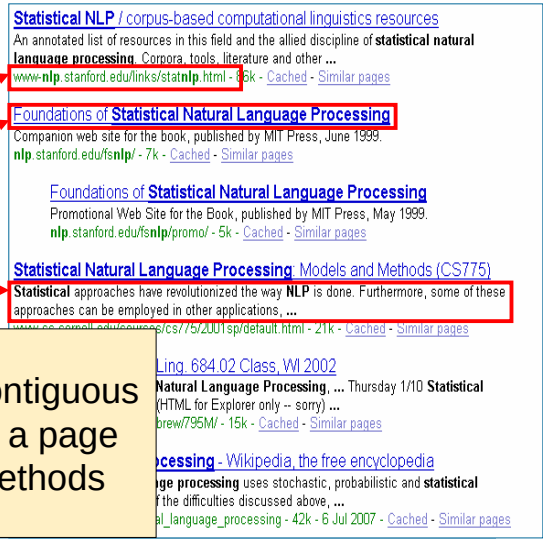
RESULTS

- Too many for a query
- Convey little information about their relevance to the query

Challenge: How do users choose the URLs to click on?

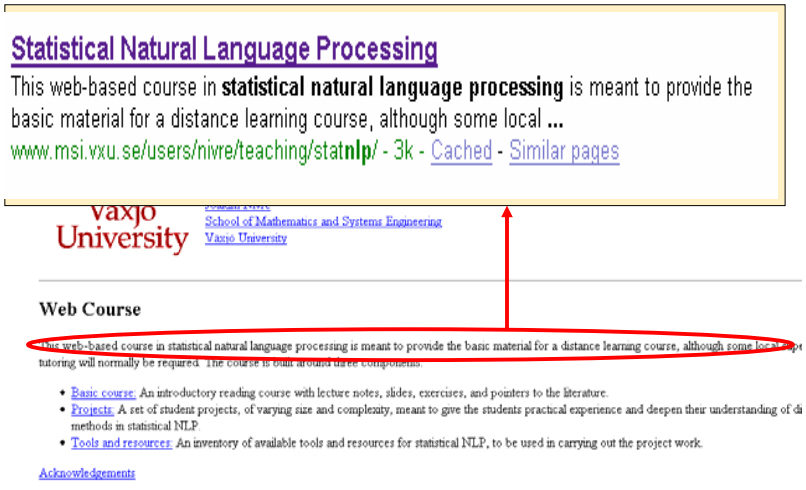
Clicking Decisions

- URLs might help
- Title represents the page contents
- Text fragments give a glimpse to the page's content



Snippet: A set of contiguous text extracted from a page using statistical methods

Snippet Selection

- 

The Role of Snippets

- Snippets do not really help the users decide on which URLs to click?

WHY NOT?

- Not obviously related to the query intention
- Marginally informative of the pages' content
- Lack coherence, incomplete text

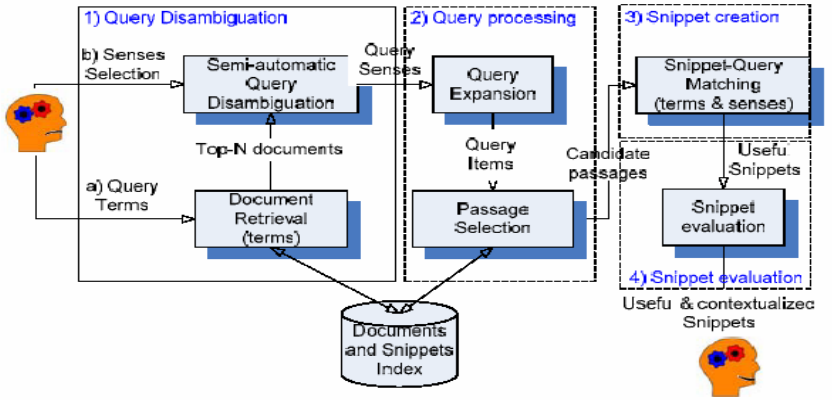
ANY IDEAS?

1. Select query-relevant snippets
2. Rely on text semantics
3. Examine coherence
4. Examine expressiveness
5. Ask users

Question: Can we **improve** the contribution of snippets in the **decision** making process?

Motivation for our Study

Design a sound model for snippet selection based on semantics



Our Contribution

Hypothesis

- Semantic processing of both the query and the query-relevant pages will give better snippets
- Semantically-selected snippets will help the users make clicking decisions

Our contribution:
Designed a method that selects **Expressive** and **Coherent** snippets by accounting for their **Usefulness** to the query intention

Towards Useful Snippets

Procedure

Given a query and a set of relevant pages

(1) disambiguate the query intention

(2) select candidate snippets based on their semantic similarity to the query

(3) keep query-useful snippets

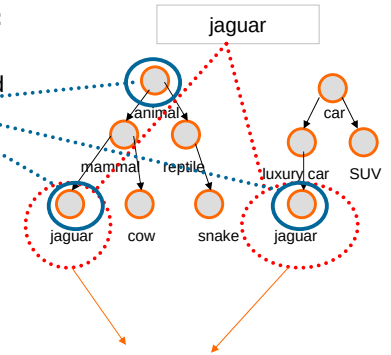
(4) evaluate snippets' coherence and expressiveness

(5) return best-matching snippet

Identifying the Query Intention

Semi-automatic Query Sense Disambiguation:

- Map query keywords to WordNet
- Process the top N (N=20) returned pages and map their content terms to WordNet
- Take query matching-senses that have a semantic relation to the pages' content terms senses
  - Display them to the user
- Ask the user select the query sense that best describes the query intention



S_1: Vehicle brand of which The 1932-1940 SS models except 4-cyl. Are classic cars.

S_2: A large spotted feline of tropical America similar to the leopard, in some classifications considered a member of the genus Felis

Towards Query-Relevant Snippets

Query and Page semantic processing:

- Expand query terms with their WordNet synonyms
- Find all appearances of query terms in the page's text
- Define windo… query items
- Compute Te… Semantic Correlation between query and candidate snippet terms

$$\text{Relevance}(q, p) = \frac{\sum_{j=1}^{k} qr \bullet \text{Tf / IDF}(t_j, p)}{qs \bullet \sum_{i=1}^{n} \text{Tf / IDF}(t_i, p)}$$

k: terms in snippet *p* that relate to at least one term in *q*
n: total number of terms in *p*
qr: number of *q* terms to which the snippet term t_j relates (query relevant terms)
qs: number of terms in the query (query size)
Tf/IDF(t_x, p) importance of term t_x in *p* as determined by their cosine similarity VSM

$$\text{Similarity}(q_i, S_k) = \frac{2 * \text{depth}(\text{LCS}(i,k))}{\text{depth}(i) + \text{depth}(k)}$$

Based on the Wu and Palmer similarity metric

Least Common Subsumer

Selecting Query-Useful Snippets

Query-snippet semantic correlation values weighted by the score of relation type (r) quantifies the quality of the selected passage

$$\text{Quality}(S, q) = \frac{1}{n \times m} \sum_{j=1}^{m} \{ \sum_{k=1}^{n} [\text{Similarity}(q_j, S_k) \bullet \text{RelationWeight}(r)] \}$$

Based on the findings of Song et al., 2004 (CICLing)

Synonymy: 1, Hyper/Hyponymy: 0.5, Mero/Holonymy: 0.4

Combining **Relevance** and **Quality** between snippet and query terms derives the snippet's **Usefulness** to the query intention

$$\text{Usefulness}(S, q) = \text{Relevance}(q, S) \bullet \text{Quality}(S, q)$$

Terminological Overlap

Avg. semantic similarity

Evaluating Selected Snippet

- Task I: Measuring Coherence
- Task II: Measuring Expressiveness

Coherence: indicates the degree of **in-snippet semantic** correlation and is useful in **selecting** the URLs to click on

Expressiveness: indicates the degree of semantic correlation between **snippet and remaining text** terms and is useful in **focusing** retrieval to useful text fragments

Evaluating Selected Snippet (2)

Semantic Coherence: semantic similarity that snippet terms exhibit to each other, as determined in WordNet

$$\text{Coherence}(S_1) = \frac{1}{n}\sum_{i,j=1}^{n} \arg\max_{w_j} \text{similarity}(w_i, w_j)$$

Wu and Palmer metric

Expressiveness: semantic similarity that snippet and remaining text terms exhibit to each other

$$\text{Expressiveness}\left(S_1, (D - S_1)\right) = \text{Usefulness}\left(S_1, (D - S_1)\right)$$

Product of: (i) Terminological Overlap (**Relevance**) between snippet terms and terms in the remaining document (D-S_1) and (ii) Avg. **Semantic Correlation** between snippet and remaining document terms, weighted by the Relation(r) type.

Experimental Study: Goals

- Examine performance of our semantically-driven snippet selection model

Compared the performance of our model to the performance of the **Alicante** statistical passage retrieval algorithm

- Examine influence of semantically-derived snippets on user decisions

Carried out a **blind user study with 15 participants** who were asked to make click decisions based on a number of different snippets offered for the same queries and pages

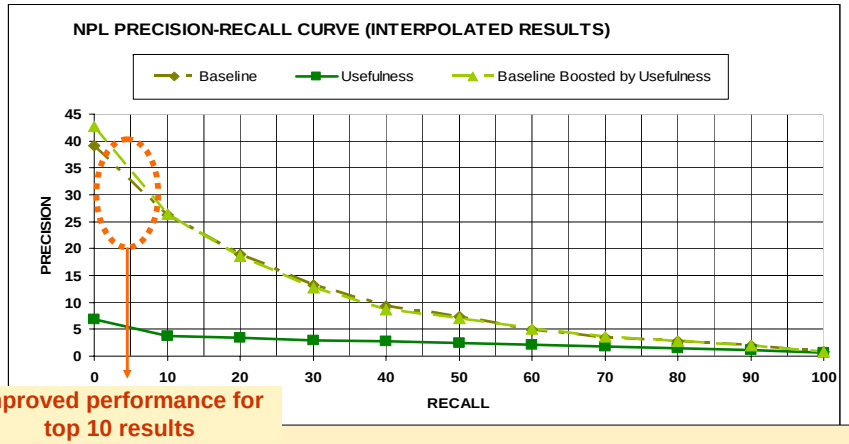
Experimental Setup

- Dataset: NPL collection
  - 30 experimental queries
  - 10,737 query-relevant documents
  - Every NPL document approximates the snippet size (~23 terms)
  - NPL queries vary in size between 2 and 9 words
- Getting Started
  - Semi-automatic annotation of queries with an appropriate WordNet sense
  - Semantic annotation of all document content terms
  - Computation of semantic similarity values between query and document terms

Experimental Setup (2)

- Merge NPL documents into a single text (virtual document)
- Issue queries and select snippets
- Comparison of snippets selected by the TF/IDF statistical model to the snippets selected by our semantically-driven model and the snippets selected by their combination
- Evaluation metric: interpolated 11-point Precision-Recall curves

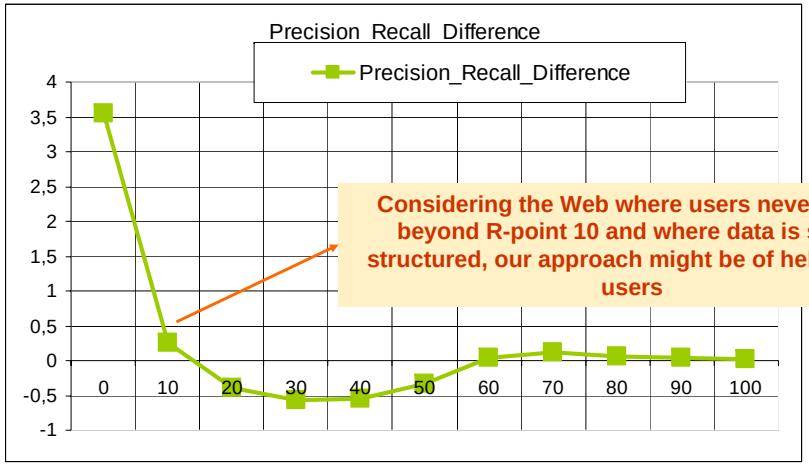
Experimental results



Improved performance for top 10 results

The combination of statistical and semantic criteria for snippet selection yields a 3.5% improvement

Experimental Results (2)



Considering the Web where users never reach beyond R-point 10 and where data is semi-structured, our approach might be of help to the users

Improvement is non-negligible considering that NPL is a well-structured, balanced and small data collection

Human Survey

Recruited 15 users and used the NPL dataset to select snippets based on:

- Baseline Alicante algorithm
- Usefulness metric
- Semantic Coherence metric
- Expressiveness metric

USER	Baseline	Query Usefulness	Semantic Coherence	Text-Expressiveness
1	5	12	9	8
2	9	17	8	5
3	6	7	7	10
4	8	17	9	10
5	8	13	7	5
6	11	15	5	6
7	3	15	7	6
8	14	14	4	3
9	9	9	10	7
10	11	15	5	6
11	4	11	9	6
12	7	15	11	8
13	5	10	11	9
14	9	18	6	8
15	6	12	7	5

Which of the displayed snippets do you think will direct you to a document that can successfully answer the query intention?

Queries were disambiguated and their selected senses were displayed

Users prefer Query-Relevant Snippets

Semantically-derived snippets are valued higher

Semantics-driven passage retrieval can assist the users focus on retrieved results

Conclusions

- **New approach** for query-centric snippet selection
- Evaluation models for measuring snippet **coherence** and **expressiveness**
- Extensive **experimentation** will help us define the contribution of every metric in the snippet selection process
- A novel technique towards **personalized passage retrieval algorithms**

Thank You☺

QUESTIONS?