LaSEWeb: Automating Search Strategies over Semi-Structured Web Data

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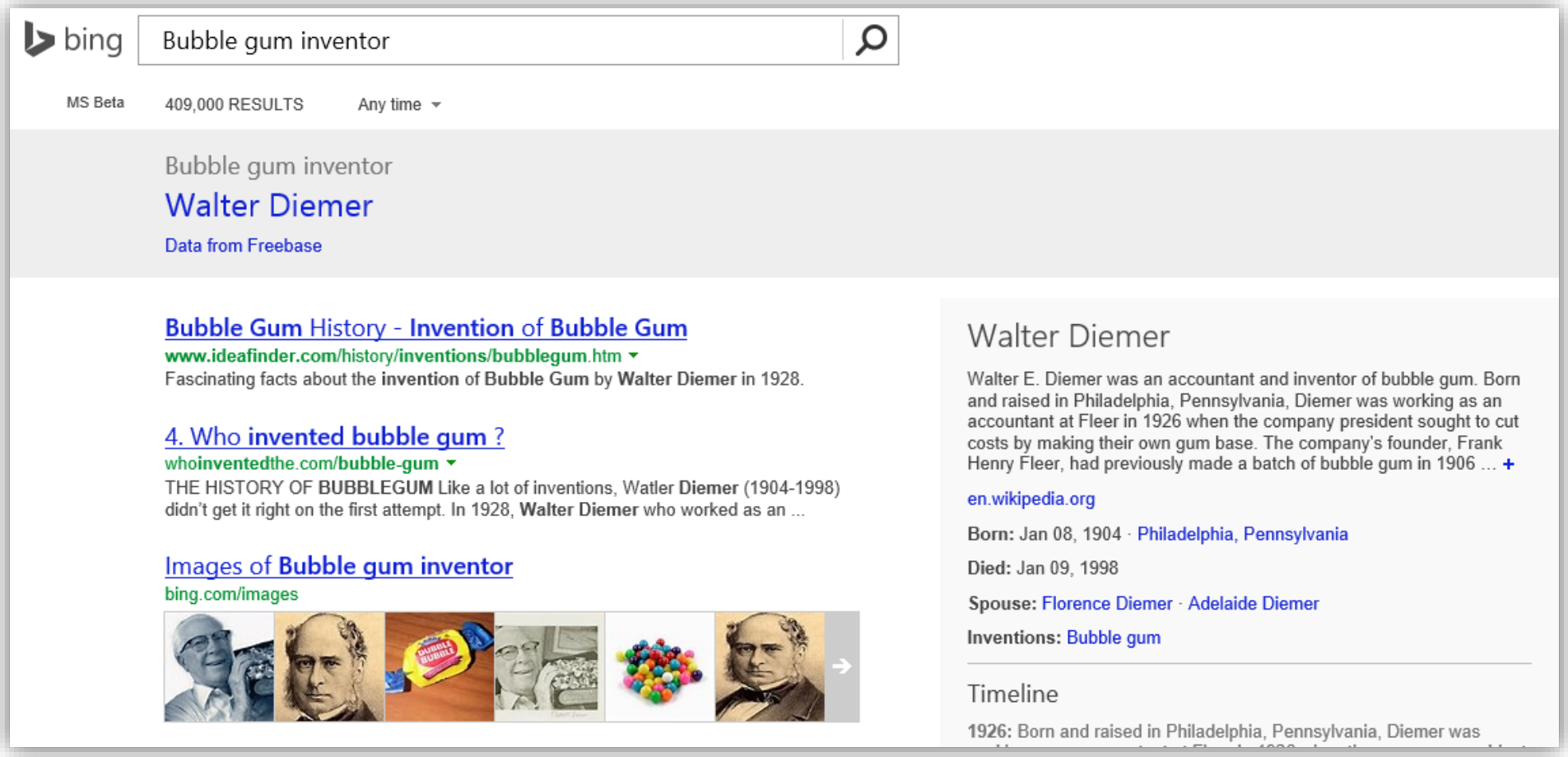
Motivation: search engine micro-segments



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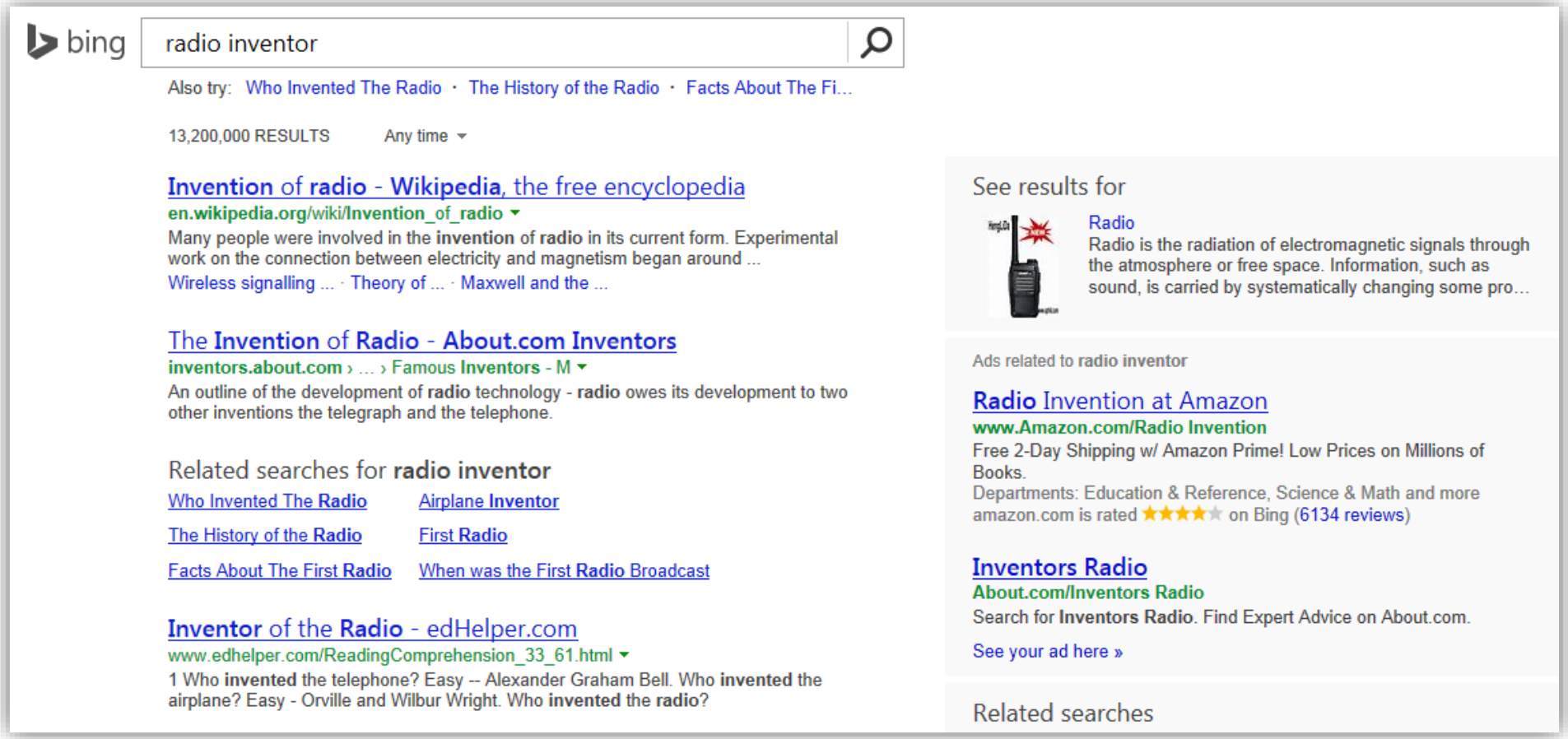

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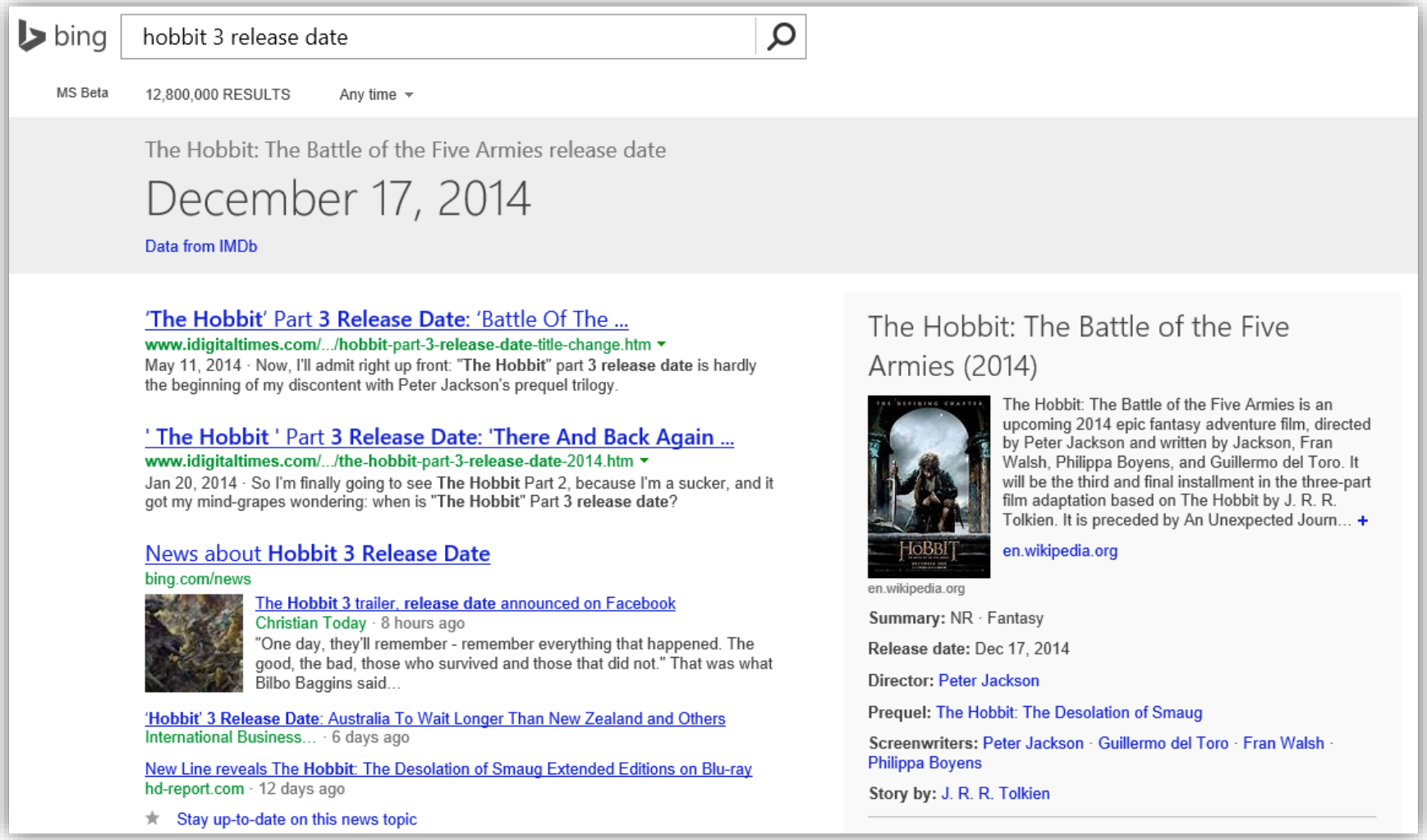

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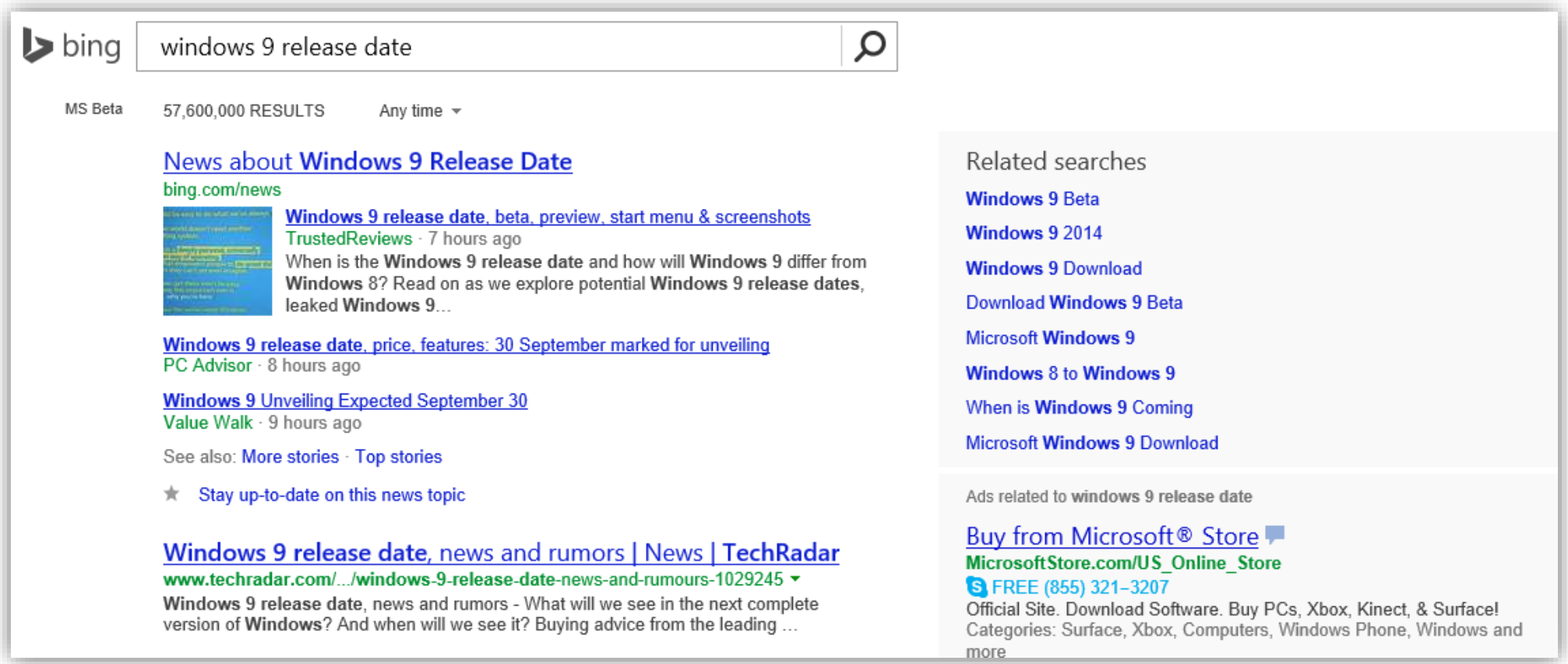

Repetitive search tasks

Structured databases

- Precise, but limited in content
- No time-sensitive information
- Provide no context (sources)

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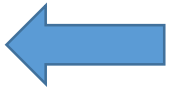

Web mining scripts

- Two extremes:
  - Powerful ML, which has to be re-learned for each micro-segment
  - Fragile HTML layout parser
- Inaccessible for end-users

LaSEWeb Query Language

- A semantic scripting language for semi-structural information extraction from the Web
- Models natural patterns from the humans' search strategies

LaSEWeb interpreter

- Explores multiple webpages, clusters different answer candidates, and provides context for each answer
- Makes use of state-of-the-art NLP/ML/PL algorithms

Example: phone number

Sumit Gulwani
Primary Affiliation: Senior Researcher @ Microsoft Research (Redmond Lab)
Other Affiliations: Adjunct Faculty @ IIT Kanpur
Affiliate Faculty @ Univ. of Washington

Address: Microsoft Corporation, One Microsoft Way, Redmond, WA, 98052
Email: sumitg at microsoft dot com
Phone: (425) 706-7709
Fax: (425) 936 7329 (attn: sumitg)

$\vec{v}$ = (“Sumit Gulwani”)

let $\eta_t = Emphasized(v_1)$ **in**
let $\eta_b = AttributeLookup(Syn(\text{"phone"}), \ell_a)$ **in**
$Union(\eta_t, \eta_b)$
where $Regex(\ell_a, \text{"(\d+)\W*\d+\W*\d+"})$
where $Layout(\eta_t, \eta_b, \text{Down})$ **and** $Nearby(\eta_t, \eta_b)$

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- Visual attributes
- Implicit table detection

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- Visual attributes
- Implicit table detection
- Linguistic patterns

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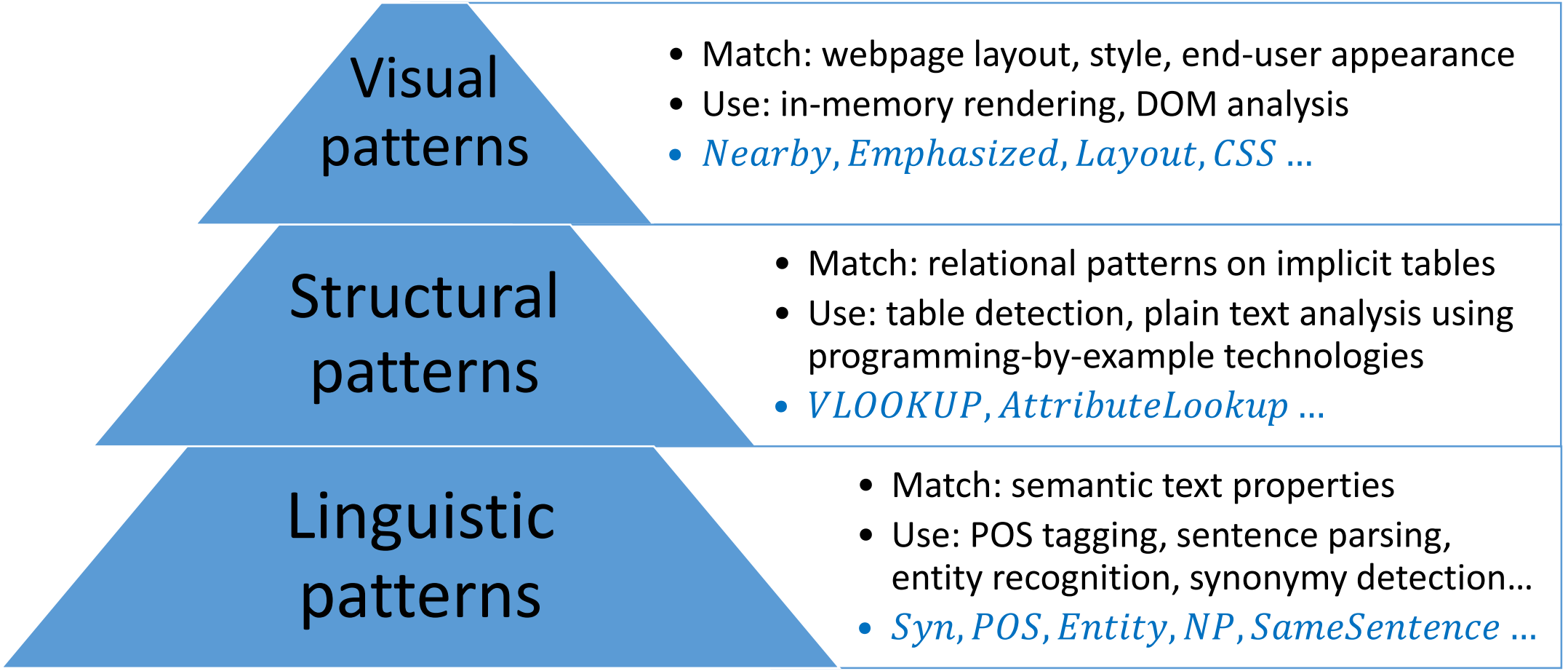
- Visual attributes
- Implicit table detection
- Linguistic patterns
- Clustering across webpages

Language Structure



[1] J. R. Finkel, T. Grenager, and C. Manning. Incorporating non-local information into information extraction systems by Gibbs sampling. In ACL, 2005.
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[3] K. Toutanova, D. Klein, C. D. Manning, and Y. Singer. Feature-rich part-of-speech tagging with a cyclic dependency network. In HLT-NAACL, 2003.
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Program interpreter: “user emulation” algorithm

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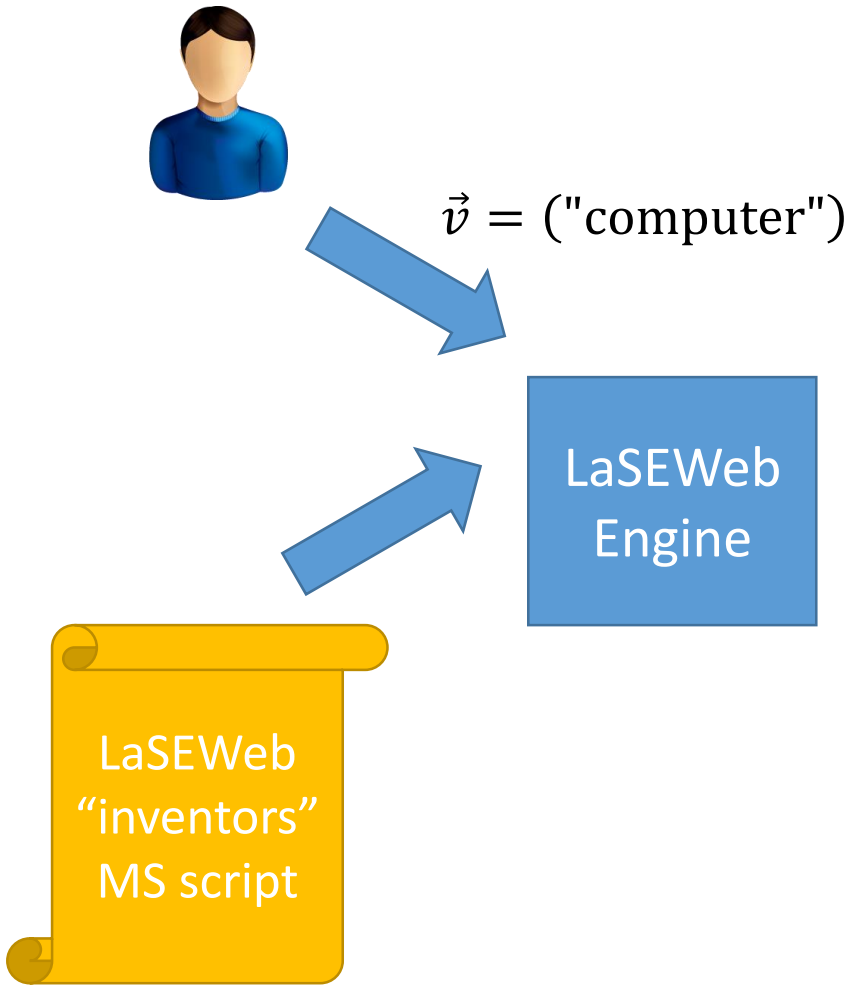

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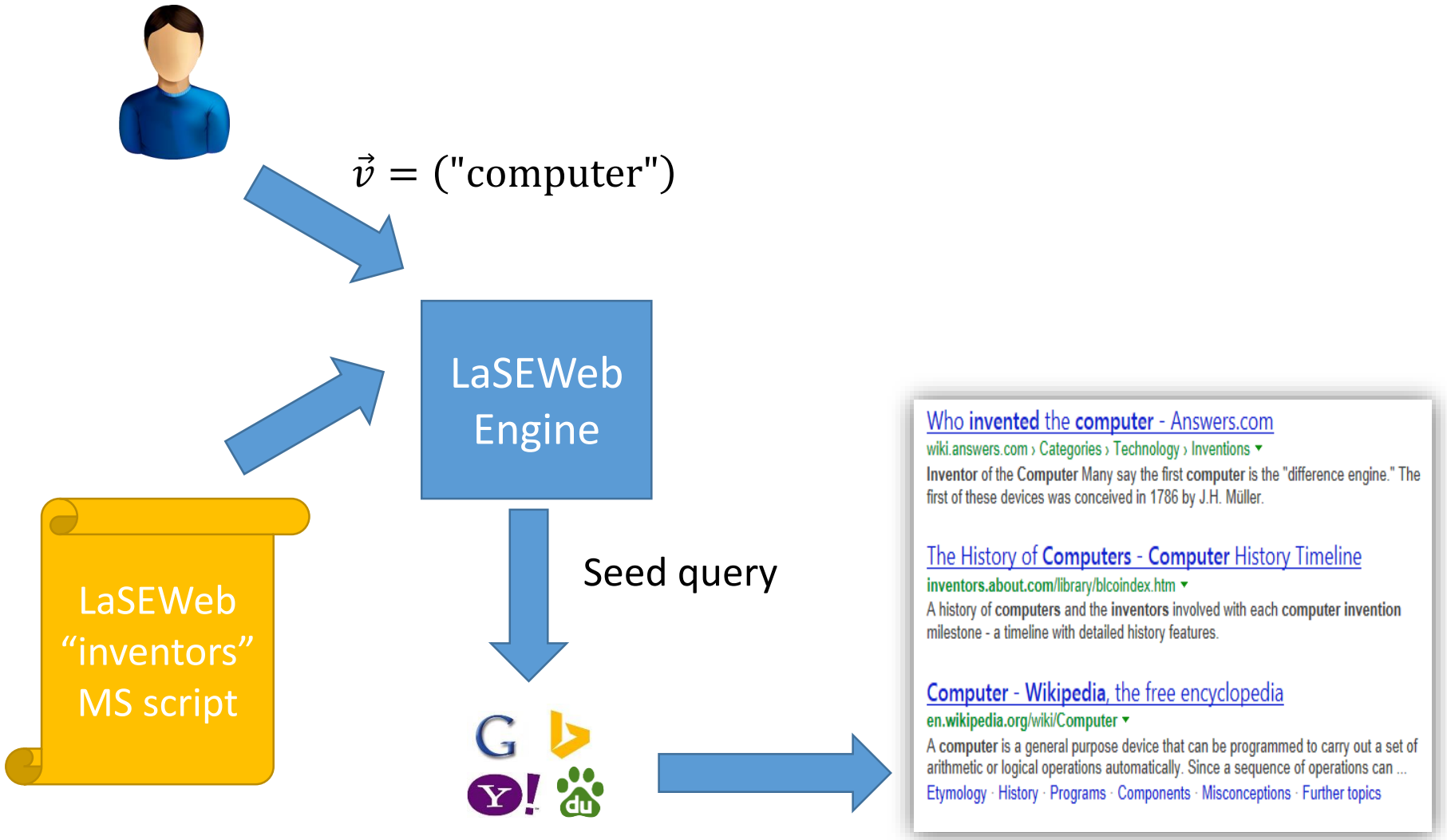

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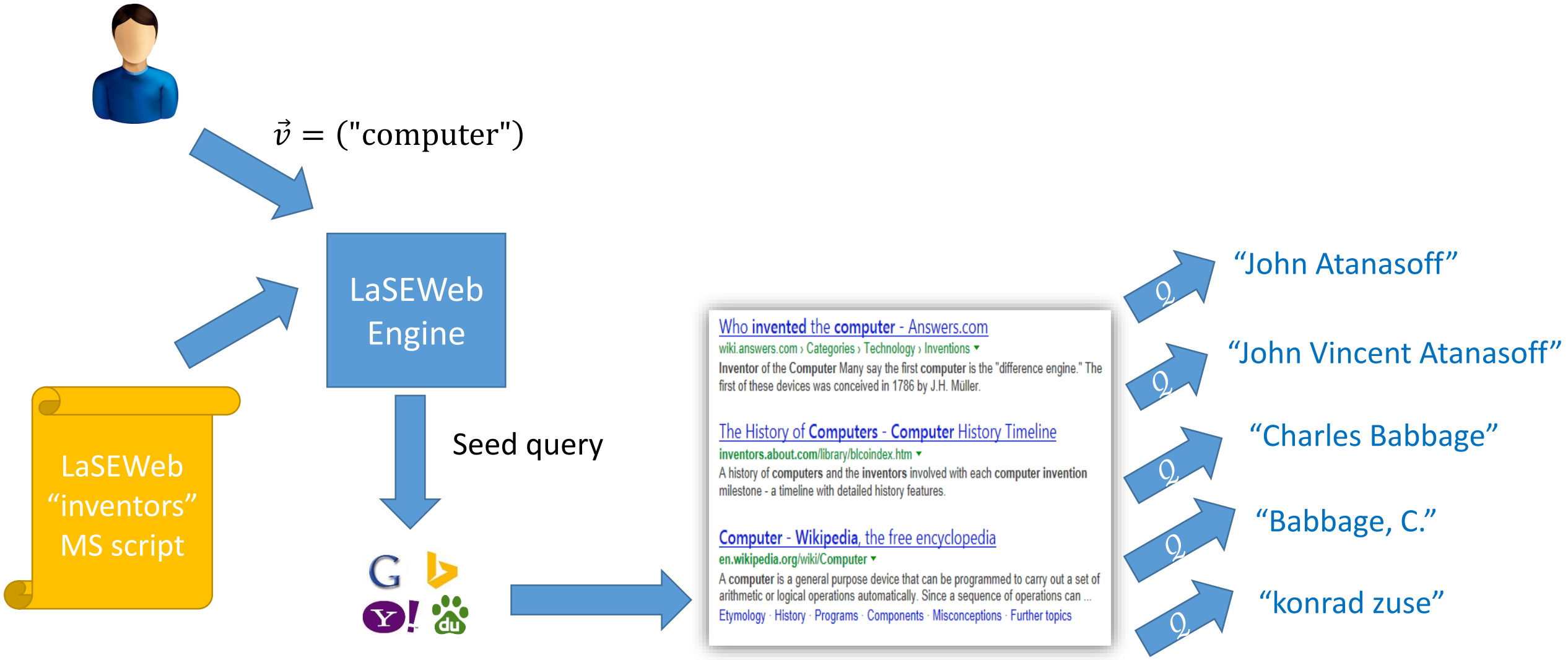


Program interpreter: “user emulation” algorithm

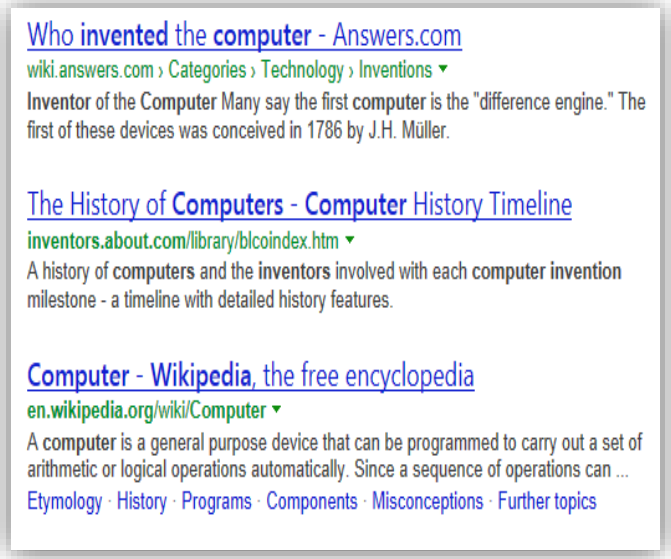
$\vec{v} = (\text{"computer"})$

$$score(C_i) = \frac{1}{|U|}\sum_{j=1}^{|U|}\sum_{s\in C_i}\frac{c(s,u_j)}{c(u_j)}$$

LaSEWeb Engine

LaSEWeb “inventors” MS script

Seed query



Q_1 “John Atanasoff”

Q_2 “John Vincent Atanasoff”

Q_3 “Charles Babbage”

Q_4 “Babbage, C.”

Q_5 “konrad zuse”

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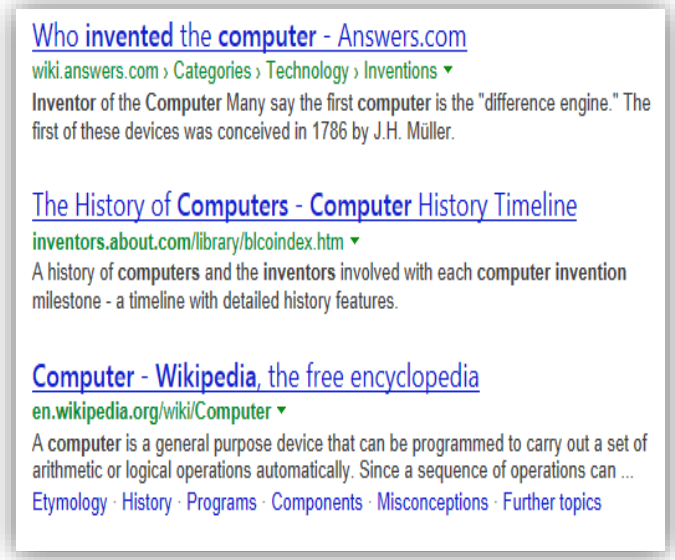

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John Atanasoff (14.5%)
http://www.computerhope.com
http://www.ehow.com
http://inventors.about.com

Charles Babbage (10.5%)
http://www.buzzle.com
http://www.ask.com

…

$$score(C_i) = \frac{1}{|U|}\sum_{j=1}^{|U|}\sum_{s\in C_i}\frac{c(s,u_j)}{c(u_j)}$$

Experiments

Micro-segment	# queries	Recall	Bing recall
ASCII code of a symbol	1,551	32.88%	0%
Calories in a food	9,207	71.80%	0%
Inventor of a product	8,994	75.91%	16.01%
Lyrics of a song	48,995	24.36%	0%
Phone number of a company	6,881	95.49%	0%
Population of a place	18,151	92.53%	57.58%
Release date of a product	12,339	97.24%	12.60%

Search task	Recall	Precision
Phone #	29/37	21/29
Affiliation	34/37	22/34
PhD institution	21/37	13/21
General chair	21/28	17/21
Invited talks	13/28	11/13
Average	**71%**	**73%**

- ~95% precision and 71% recall on factoid micro-segments
  - For micro-segments: Precision measured by random sampling, based on top-3 results
  - For end-user repetitive search tasks: Precision/recall measured manually
- Average execution time: ~5 sec/webpage
  - Depends on the rendering settings
- Current setting: offline deployment / database population

Summary & Future work

- Typical patterns of human search strategies in a scripting language for IE
  - Match semi-structured Web content
  - Existing cross-disciplinary technologies used as building blocks
  - Exploit information redundancy across multiple webpages
- Applications:
  1. Micro-segments of factoid questions in search engines
  2. Repeatable batch data extraction tasks for end-users
  3. Structured database population from free Web text
  4. English language comprehension problem generation
- Future work:
  - Automatic query execution plans in the language
  - Integration with “natural language → logic” engines

Summary & Future work

1. The principal characterized his pupils as _____ because they were pampered and spoiled by their indulgent parents.
2. The commentator characterized the electorate as _____ because it was unpredictable and given to constantly shifting moods.

(a) cosseted (b) disingenuous (c) corrosive (d) laconic (e) mercurial

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Thanks for listening!

Questions?