Overview of Research

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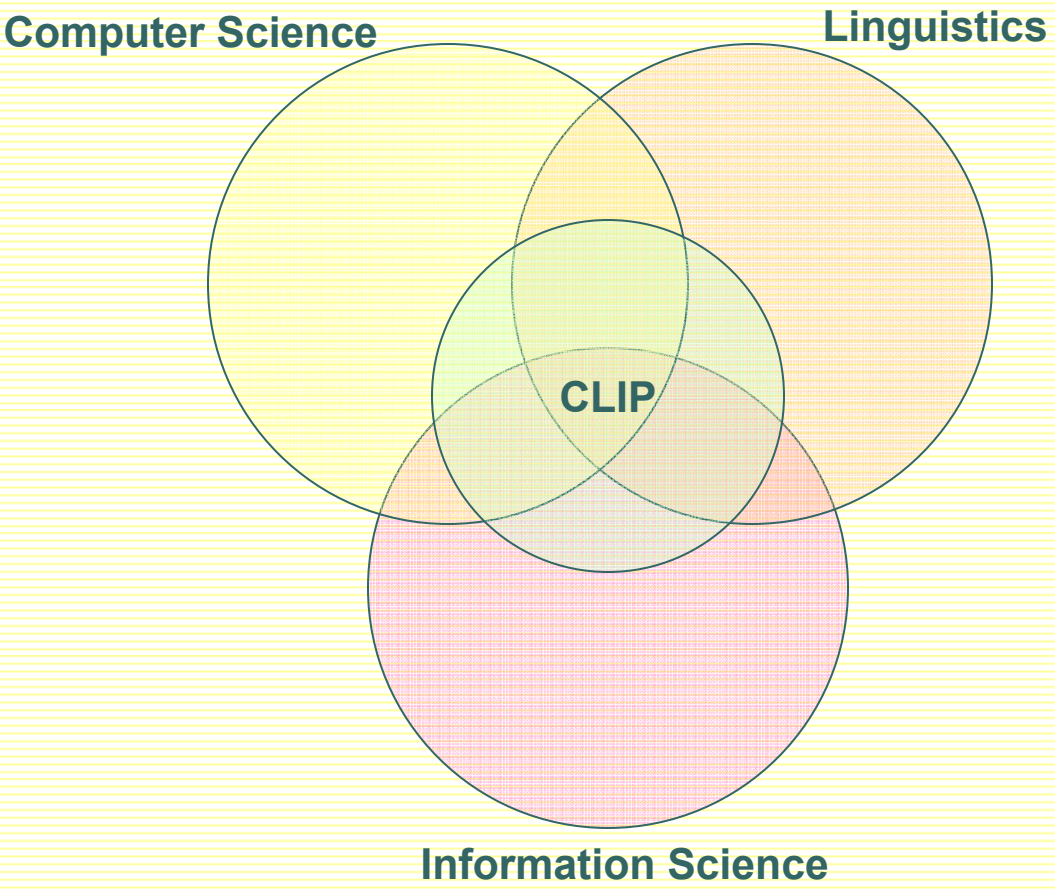
Tuesday, May 10, 2007

The CLIP Lab



Units on Campus

- Academic units:
  - Department of Computer Science
  - Department of Linguistics
  - College of Information Studies (CLIS)
- Different labs inside UMIACS:
  - CLIP (Computational Linguistics and Information Processing)
  - HCIL (Human-Computer Interaction Laboratory)
  - …

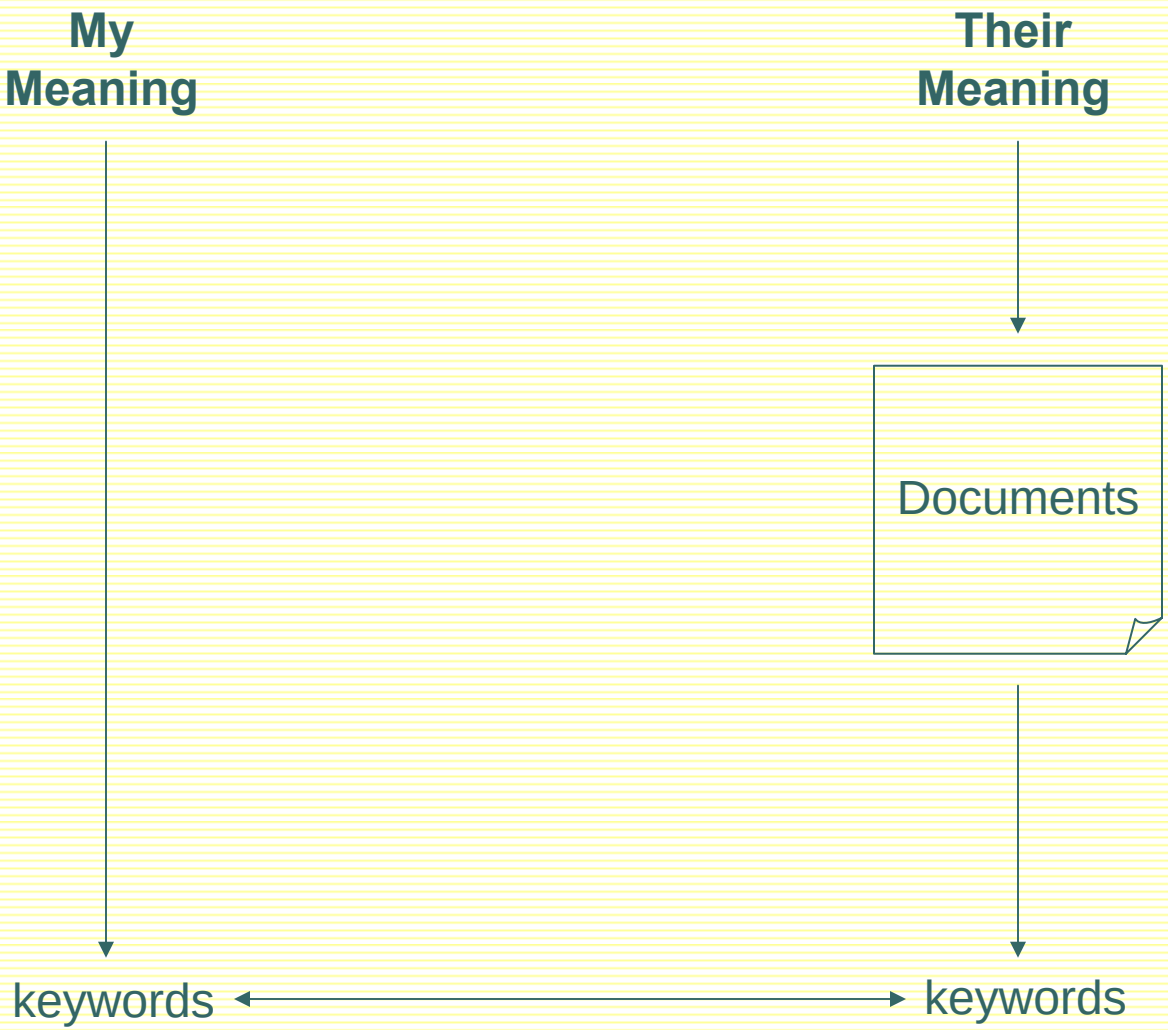
CLIP PI's

- Bonnie Dorr: Summarization, MT
- Mary Harper: ASR
- Judith Klavans: Summarization
- Jimmy Lin: QA, IR
- Doug Oard: IR
- Philip Resnik: MT
- Amy Weinberg: MT, psycholinguistics

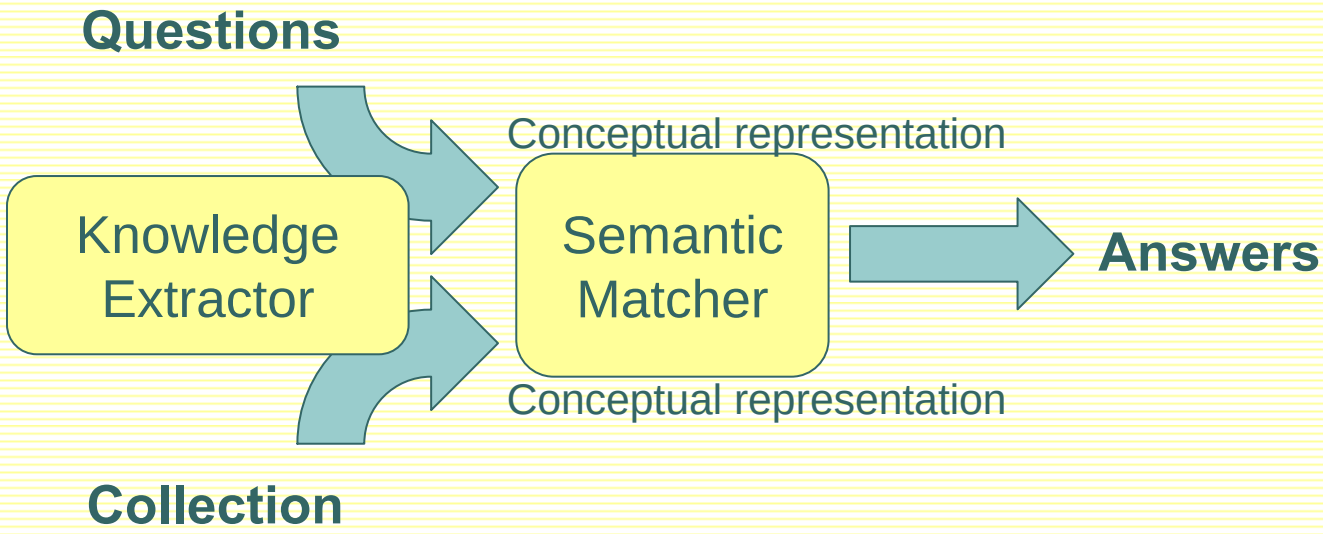
Various Projects

- Factoid question answering
  - “Who shot Abraham Lincoln?”
  - Different approaches: Web, semi-structured databases
- Question answering on videos
- Interactive IR
- Summarization (w/ Bonnie Dorr)
- Evaluation methodologies
- Search visualization
- Models for “conceptual retrieval”

What's wrong with IR?



“Conceptual Retrieval”



A Different Approach

- Previous work focuses on the general domain
  - Broad but (relatively) shallow
  - Hampered by commonsense problem
  - Difficult to acquire large amounts of knowledge
- Our approach:
  - Develop a general framework
  - Instantiate in domain-specific applications
  - Leverage lessons learned to refine the framework

Why the Medical Domain?

- Evidence-Based Medicine
  - = A paradigm of medical practice that emphasizes decision-support from high-quality clinical research
- Need for retrieval systems is well documented

K_1: Problem Structure

- EBM identifies four components of a question
  - Originally developed as a clinical tool
  - Can serve as a knowledge representation

"In children with an acute febrile illness, what is the efficacy of single-medication therapy with acetaminophen or ibuprofen in reducing fever?"

Population/ **P**roblem	children/ acute febrile illness
Intervention	acetaminophen
Comparison	ibuprofen
Outcome	reducing fever

= PICO frame

K_2: User Tasks

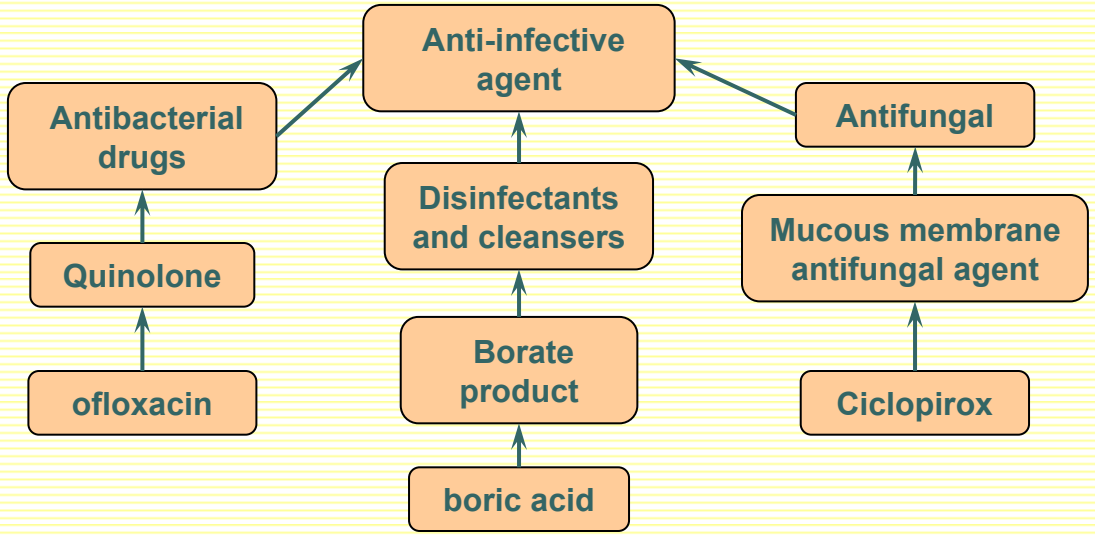
- Clinical tasks

Therapy	Selecting effective treatments, taking into account other factors such as risk and cost
Diagnosis	Selecting and interpreting diagnostic tests, while considering factors such as precision and safety
Prognosis	Estimating the patient's likely course over time and anticipating likely complications
Etiology	Identifying risk factors and the causes for a patient's disease

- Considerations for strength of evidence
  - Strength of Recommendations Taxonomy (SORT): three evidence grades

K_3: Domain

- The Unified Medical Language System (UMLS)
  - 2004 version: 1+ million biomedical concepts, > 5 million concept names
- Software for leveraging this resource:
  - MetaMap, SemRep for identifying concepts, relations



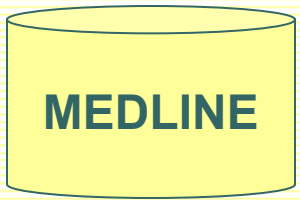
Conceptual Retrieval

Question:
In children with an acute febrile illness, what is the efficacy of single-medication therapy with acetaminophen or ibuprofen in reducing fever?

Task therapy
P children/acute febrile illness
I acetaminophen
C ibuprofen
O reducing fever

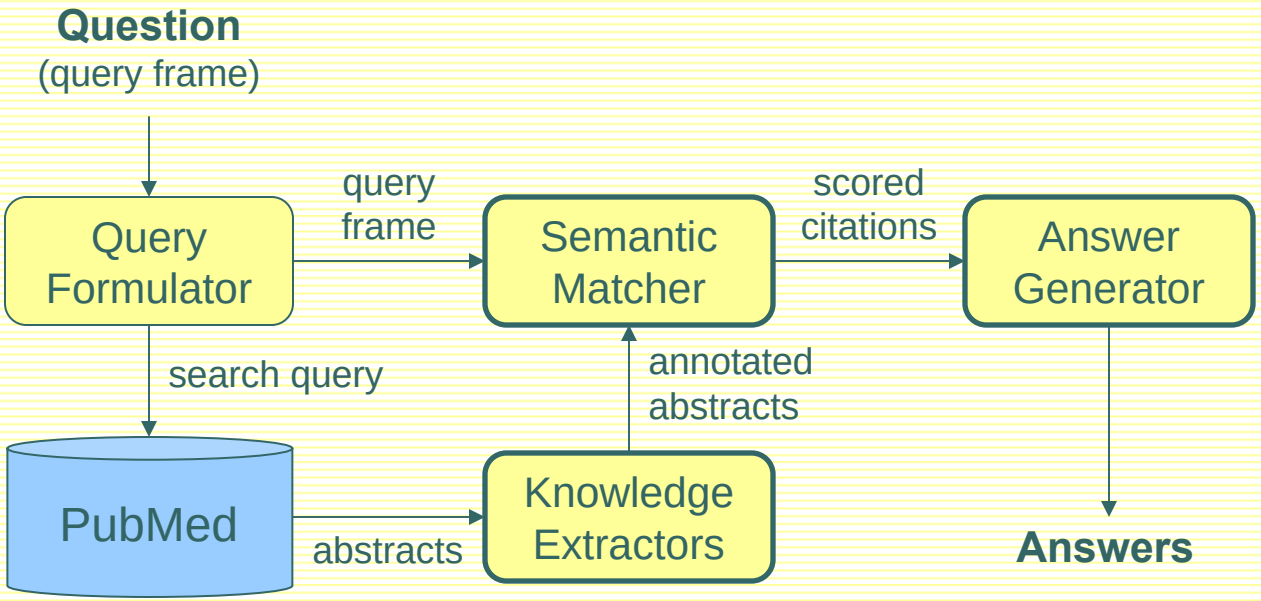
Answer:
Ibuprofen provided greater temperature decrement and longer duration of antipyresis than acetaminophen when the two drugs were administered in approximately equal doses.

P children/acute febrile illness
I acetaminophen
C ibuprofen
O reducing fever



NLM's authoritative repository of 15 million+ abstracts

System Architecture



Is it better?

- Performance on held-out blind test set:

	Therapy	Diagnosis	Prognosis	Etiology	All
Precision at 10 (P10)					
PubMed	.350 (–39%)	.150 (–70%)	.200 (–46%)	.320 (–20%)	**.281 (–44%)**
Indri	.575	.500	.367	.400	**.500**
EBM	.783 (+36%)	.583 (+17%)	.467 (+27%)	.660 (+65%)	**.677 (+35%)**
Mean Average Precision (MAP)					
PubMed	.421 (–29%)	.279 (–48%)	.235 (–56%)	.364 (–17%)	**.356 (–35%)**
Indri	.595	.534	.533	.439	**.544**
EBM	.765 (+29%)	.637 (+19%)	.722 (+35%)	.701 (+60%)	**.718 (+32%)**

Results are statistically significant

Evidence Synthesis

- Integrate findings from multiple citations

Question: What is the best treatment for chronic prostatitis?

► **anti-microbial**

[temafloxacin] Treatment of chronic bacterial prostatitis with temafloxacin. Temafloxacin 400 mg b.i.d. administered orally for 28 days represents a safe and effective treatment for chronic bacterial prostatitis.

[ofloxacin] Ofloxacin in the management of complicated urinary tract infections, including prostatitis. In chronic bacterial prostatitis, results to date suggest that ofloxacin may be more effective clinically and as effective microbiologically as carbenicillin.

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► **Alpha-adrenergic blocking agent**

[terazosine] Terazosin therapy for chronic prostatitis/chronic pelvic pain syndrome: a randomized, placebo controlled trial. CONCLUSIONS: Terazosin proved superior to placebo for patients with chronic prostatitis/chronic pelvic pain syndrome who had not received alpha-blockers previously.

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Other Complex Questions

- Retrieval in the biomedical domain

Information describing the role(s) of a [gene] involved in a [disease].
gene: Interferon-beta
disease: Multiple Sclerosis

Information describing the role of a [gene] in a specific [biological process].
gene: nucleoside diphosphate kinase (NM23)
biological process: tumor progression

- Complex question answering

What evidence is there for transport of [art looted by the Nazis in WWII] from [Germany] to [France]?

What [familial ties] exist between [Neanderthals] and [humans]?

What [common interests] exist between [Network Solutions] and [the Internet Corporation for Assigned Names and Numbers (ICANN)]?

References

Dina Demner-Fushman and Jimmy Lin. Answering Clinical Questions with Knowledge-Based and Statistical Techniques. Computational Linguistics, 33(1):63-103, 2007.

Jimmy Lin and Dina Demner-Fushman. The Role of Knowledge in Conceptual Retrieval: A Study in the Domain of Clinical Medicine. Proceedings of SIGIR 2006, pages 99-106.

Dina Demner-Fushman and Jimmy Lin. Answer Extraction, Semantic Clustering, and Extractive Summarization for Clinical Question Answering. Proceedings of COLING/ACL 2006, pages 841-848.