Advanced Semantic Search: The Medical World as an Example

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Can Semantic Search answer this :-?)

“Hello, Bob? It’s your father again. I have another question about my new computer. Can I tape a movie from cable TV then fax it from my VCR to my CD-ROM then E-mail it to my brother’s cellular phone so he can make a copy on his neighbor’s camcorder?”
Can Semantic Search figure this :-?)}
Can Semantic Search understand this :-?)
Semantic Search Approaches

Approaches to semantic search

- Reasoning engines
- Contextual analysis
- Natural language understanding
- Ontology search/expansion

Address somewhat different problems
General SEs also Utilize Semantic Analysis

- For example, Google Search uses:
  - Freebase: incorporate signals from semantic DBs.
  - Google+: create a layer of people, places and things, and a network of their relationships.
  - "Something different" option: list of related searches that might be of interest.
  - Google Squared: automatically fetches and organizes facts from across the Internet.
What Makes Search a Semantic Search?

- Illustrates 10 points that define semantic search.
Side-by-Side Comparison on PubMed

New PubMed Search

Searching more than 20 million Pubmed Abstracts
Semantic Search service provided by hakia.com
Side-by-side comparison in PubMed

NewPubMed API for Developers
NewPubMed SSE vs. PubMed SE

Semantic search technology provided by hakia

Document Search DEMO (PM)

hakia’s Enterprise Search demo contains over 1 million documents (10 million articles) from Pubmed.org.

- Pubmed documents are content rich, which simulates a typical corporate or government environment.
- Pubmed articles mostly include medical content with some other scientific material, which is an ideal challenge for a search engine for complex queries.
- The response times in this demo include latency over the Internet connection, which will not be the case inside a corporate environment.
- The demo compares hakia’s performance to Pubmed’s own search engine, which sometimes fails to bring results that hakia finds. Use the examples for such comparisons that differentiate semantic search versus conventional index search.
- Compare the search results presentation to differentiate hakia’s transparency versus Pubmed’s cryptic presentation which is again a typical shortcoming of the indexing approach.
PubMed Search Engine
Document Search DEMO (PM)

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1. Handling Morphological Variations

• A SSE is expected to handle all morphological variations (like tenses, plurals, etc.) on a consistent basis.

• In other words, the results should not change whether you type "improve, improves, improving, improved, improvement, etc.".

• The example query “Improving quality of life" illustrates that hakia results contain morphological variations of the query.
Semantic search technology provided by hakia

Sort by: relevance date

**Does meeting needs improve quality of life?**
2004 May-Jun - Slade M, Lease M, Ruggeri M, Kuipers E, Tanella M, Thornicroft G
Health Services Research Department, Institute of Psychiatry, London, UK.
m.slade@icp.kcl.ac.uk

Psychiatry and psychosomatics
Apart from its baseline value, the only baseline predictor of follow-up QoL was
unmet need (B = -0.08, 95% CI -0.21 to -0.09), accounting for 58% of
the variance in follow-up quality of life. Graphical chain modelling confirmed this
association. CONCLUSIONS: The association between high numbers of unmet needs and
low subjective quality of life appears increasingly robust across several studies.
Future research will need to investigate whether changes in needs precede changes
in quality of life. This study provides further evidence that a policy of actively
assessing and addressing unmet needs may lead to improved quality of
life.
dopt=Abstract&list_uids=15031591

**Implant therapy to improve quality of life.**
2003 Sep - At W Stappert C
Department of Prosthodontics, Albert-Ludwigs-University, Freiburg, Germany.
attwael@zmi2.uk.uni-freiburg.de
Quintessence international (Berlin, Germany : 1985)

Excessive alveolar bone resorption often confines a conventional therapy with
complete dentures. Implant therapy has found a way to solve the problem through
enhanced stability and retention, thus increasing its functionality, leading to
improved patient satisfaction and a higher quality of life. This article describes an
implant-supported restoration of a patient with reduced oral health and high Oral
Health Impact Profile values (OHIP-14). Upon improvement of oral hygiene and the
compliance of the patient, the residual dentition was extracted and four implants
were inserted, both in the maxillary and the mandibular arches. After the healing
period was completed, two implant-supported prostheses with rigid bars for retention
were fabricated. The patient's aesthetics, phonetics and masticatory function were
properly restored at the time of delivery. A significant improvement in the patient's
quality of life was noticed.
dopt=Abstract&list_uids=14620207

Results: 1 to 20 of 9498

1. Fernandez JS, Miranzo S, Vamkoff H, Tavares DM, Santos CB.
PMID: 22576345 [PubMed - in process]
Related citations

2. Oezaz M, Juul Nielsen A, Rukjbinga A, Okels, Birk H, Krasnik A,
Hernandez-Quevedo C.
PMID: 22575681 [PubMed - in process]
Related citations

3. Improving maintenance of physical activity in older, knee
ostearthritis patients trial-pilot (IMPACT-P): Design and
methods.
Focht BC, Garver MJ, Devor ST, Dias J, Rose M, Lucas AR, Emery
CF, Hackshaw K, Rejeski WJ.
Contemp Clin Trials 2012 May 1. [Epub ahead of print]
PMID: 22576796 [PubMed - as supplied by publisher]
Expanded Google Query
"health-care improving quality of life"

Scholarly articles for health-care improving quality of life
The role of health care providers and significant others — Sprangers — Cited by 607
Quality of life measures in health care — Applications — Fitzpatrick — Cited by 540
Cross-cultural adaptation of health-related quality of life — Guillem — Cited by 1861

Improving Health Care Quality: Fact Sheet
www.ahrq.gov — News & Information — Fact Sheets
Improving the quality of health care and reducing medical errors are ... can alleviate pain and improve physical function and quality of life in patients with severe ...

Quality of life (healthcare) - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Quality_of_life_(healthcare)
1 Ascertain Health Related Quality of Life ... determine which treatment plan is the best option, thereby improving healthcare through an evolutionary process.

Remote healthcare improving quality of life for the chronically ill
www.timeshighereducation.co.uk/story.asp?storyCode=205572...
22 September 2006. Brussels, 21 Sep 2006. An EU-funded project has developed a series of tools to facilitate remote health monitoring of people with chronic ...

Improving the Quality of Life
Improving the Quality of Life ... assistance; delivery of health and social care, educational needs; medical treatment; ergonomics; modelling; health-care systems ...
2. Handling Synonyms with Correct Senses

- A SSE is expected to handle synonyms (cure, heal, treat,.. etc.) in right context with correct word senses.
- For example, the word "treat" can mean doing social favors as in "trick and treat" (customary Halloween tradition), which would not be correct in the medical sense.
- The level of sense disambiguation in a SSE is a sign of its progress.
- The example query “Is there a cure for ALS?” shows that hakia brings results with synonyms with the correct senses.
VEGF necessary to prevent motoneuron degeneration, sufficient to treat ALS?

2004 Jun - Lambrechts D, Storleer E, Carmeliet P
The Center for Transgene Technology and Gene Therapy, Flanders Interuniversity Institute for Biotechnology, Katholieke Universiteit Leuven, B-3000 Leuven, Belgium.
Trends in molecular medicine
Since Charcot recognized the devastating disorder amyotrophic lateral sclerosis (ALS) in 1874, many theories have been proposed to explain its pathogenesis, but it remains a deadly and incurable disease. Three years ago it was reported that reduced levels of vascular endothelial growth factor (VEGF) caused ALS-like motoneuron degeneration in mice. Recent evidence indicates that insufficient VEGF is also a risk factor for ALS in humans. Although VEGF was once considered to be only a specific angiogenic factor, emerging evidence indicates that it also displays important neuroprotective activity. These insights have primed widespread interest in developing VEGF-based therapies for (motor) neuron degenerative disorders, raising new hope for the treatment of ALS and other neurodegenerative diseases.

Heat shock protein 105 interacts with and suppresses aggregation of mutant Cu/Zn superoxide dismutase, clues to a possible strategy for treating ALS.

Department of Neurology, Kyoto University Graduate School of Medicine, Kyoto, Japan.
Journal of neurochemistry
A dominant mutation in the gene for copper-zinc superoxide dismutase (SOD1) is the most frequent cause of the inherited form of amyotrophic lateral sclerosis. Mutant SOD1 protein accumulates in the cytoplasm and degrades the motor neurons. We identified a novel interaction between heat-shock protein 105 (Hsp105) and mutant SOD1. We detected this interaction both in spinal cord extracts of mutant SOD1(G34A) transgenic mice and in cultured neuroblastoma cells. Expression of Hsp105, which is found in mouse motor neurons, was decreased in the spinal cords of SOD1(G34A) mice as disease progressed, while levels of expression of two other heat-shock proteins, Hsp70 and Hsp27, were elevated. Moreover, Hsp105 suppressed the formation of mutant SOD1-containing aggregates in cultured cells. These results suggest that techniques that raise levels of Hsp105 might be promising tools for amelioration of the mutant SOD1 toxicity.
3. Handling Generalizations

- A SSE is expected to handle generalizations (disease = GERD, ALS, AIDS, etc.) where the user's query is expressed in generalized form and the result is expected to be specific.

- The example query “Which disease has the symptom of coughing?” brings a result set in hakia such that GERD is recognized by the SSE as the specific answer.
OBJECTIVES: To critically review and summarize the literature on cough and gastroesophageal reflux disease (GERD), and to make evidence-based recommendations regarding the diagnosis and treatment of chronic cough due to GERD.

METHOD: Ovid MEDLINE literature review (through March 2004) for all studies published in the English language and selected articles published in other languages such as French since 1963 using the medical subject heading terms "cough," "gastroesophageal reflux," and "gastroesophageal reflux disease." RESULTS: GERD, singly or in combination with other conditions, is one of the most common causes of chronic cough. In patients with normal chest radiographic findings, GERD most likely causes cough by stimulation of an esophageal-bronchial reflex. When GERD causes cough, there may be no GI symptoms up to 75% of the time. While 24-hour esophageal pH monitoring is the most sensitive and specific test in linking GERD and cough in a cause-effect relationship, it has its limitations.

Citic acid cough threshold in patients with gastroesophageal reflux disease rises after laparoscopic fundoplication.

BACKGROUND: It has been reported that antireflux surgery can diminish chronic cough due to gastroesophageal reflux disease (GERD) that is resistant to pharmacologic therapy. The aim of this study was the assessment of citric acid cough threshold (CACT) in patients with chronic cough due to GERD before and 3 months after laparoscopic Toupet fundoplication. METHODS: Thirty subjects (20 women and 10 men, median age, 45.3 years) with chronic cough due to GERD, and 15 healthy volunteers underwent cough challenge with doubling concentrations of citric acid. Twenty subjects with GERD, a group of 14 women and 6 men (mean age, 45.5 years) underwent the same protocol 3 months after laparoscopic fundoplication.
4. Handling Concept Matching

• Perhaps the most challenging functionality among all, a SSE is expected to recognize concepts and bring relevant results.

• Usually, the depth of this capability is increased in verticals of operation, and it would be unrealistic to expect coverage in all subjects under the sun.

• The example query "what treats headache" brings a result set in hakia including concept matching such that migraine belongs to the concept of headache in the medical sense.
TREATING HEADACHE RECURRENCE AFTER EMERGENCY DEPARTMENT DISCHARGE: A RANDOMIZED CONTROLLED TRIAL OF NAPROXEN VS. ASA

Department of Emergency Medicine, Albert Einstein College of Medicine, Bronx, NY 10467, USA. befried@montefiore.org
Annals of emergency medicine

STUDY OBJECTIVE: Multiple parenteral medications are used to treat migraine and other acute primary headaches in the emergency department (ED). Regardless of specific headache diagnosis, no medication eliminates the frequent recurrence of primary headache after ED discharge. It is uncertain in which medication primary headache patients should be given on discharge from an ED. The aim of this study is to compare the efficacy of oral sumatriptan with naproxen for treatment of post-ED recurrent primary headache. METHODS: This was a randomized, double-blind efficacy trial. We randomized patients to either naproxen 500 mg or sumatriptan 100 mg for headache recurrence after ED discharge. Patients were eligible if they received parenteral therapy for an acute exacerbation of a primary headache in the ED. Patients who met established criteria for migraine without aura were designated a priori as a homogenous subgroup of interest. We followed all patients by telephone 48 hours after ED discharge.


[Acute headaches -- when to treat immediately, when to wait] 2007 May 21 - Pollmann W, Förderer S
Marianne-Steuers Klinik, Berg, walter.pollmann@me-klinik.info
MMW Fortschr der Medizin

Headaches are among the most frequently named symptoms in general practice. About 90% of the patients suffer from idiopathic headaches, for example, migraine or tension headaches, which are treated according to guidelines. An acute headache can however also be a symptom of a serious primary disease, such as subarachnoid haemorrhage, arterio dissectio, cerebral infarction, cerebral venous thrombosis or acute glaucoma. Patients with suspected symptomatic headaches must be immediately referred to a specialist or hospital for further diagnosis and therapy.

5. Handling Knowledge Matching

• Very similar to the previous item, a SSE is expected to have embedded knowledge and use it to bring relevant results (swine flu = H1N1, flu=influenza.)

• Knowledge match and concept match are similar in principle, yet different in practice in the way the capability is acquired.

• The example query "swine flu virus" brings a result set in hakia where these kinds of matches are visible.
Swine influenza A (H1N1) virus infection in infants


Division of Neonatology, Department of Pediatrics, Dr. Sami Uus Maternity and Children’s Hospital, Ankara, Turkey.

European journal of pediatrics

There are few reports on pandemic swine influenza A (H1N1) virus infection in very young infants. We aimed to discuss the clinical characteristics and management of the H1N1 influenza infection in very young infants. Clinical characteristics of ten infants diagnosed with H1N1 influenza virus infection during the 2009 outbreak season in a tertiary neonatal intensive care unit were evaluated. The diagnosis was confirmed by testing of respiratory samples with pandemic H1N1 influenza-specific real-time PCR assay. Of the 46 patients with fever or respiratory problems, ten (22%) were diagnosed with H1N1 influenza virus infection during the 2009 (October-December) peak outbreak season. All infants including the preterms were admitted from home, seven (70%) were full-term and three (30%) were preterm. Median age of the patients at admission was 24.5 days. Fever and cough were the most common symptoms. Apea was the initial symptoms in three patient.


The new influenza A H1N1 virus: balancing on the interface of humans and animals

2010 Jan - van der Meer FJ, Oreel K, Barlema HW

Department of Comparative Biology and Experimental Medicine, Faculty of Veterinary Medicine, University of Calgary, Calgary, Alberta T2N 4N1.
frank.vandermeer@ucalgary.ca

The Canadian veterinary journal. La revue vétérinaire canadienne

In the spring of 2009, a new human influenza A H1N1 virus emerged in Mexico and the United States. The strain was referred to as “swine flu” as it has strong similarities with currently circulating swine influenza viruses, although the first outbreak on a swine farm was recorded more than 2 mo following the first human reports. This new strain, designated as pandemic (H1N1) 2009, has shown the ability to spread among the human population and can be found on all continents. The way influenza viruses and specifically this influenza A pandemic (H1N1) 2009 virus evolve is described in this manuscript.

6. Handling Natural Language Queries

- A SSE is expected to respond sensibly when the query is in a question form (what, where, how, why, etc.).
- Note that a SE is different than a "question answering" system since SE's main task is to rank search results in the most logical and relevant manner whereas a question answering system may produce a single extracted entity.
- The example query "how fast is swine flu spreading?" brings a result set in hakia to shed light on this capability.
Preparing for swine flu: 10 questions that all nurses need to ask themselves
2009 Sep 1-7 - Robinson S., Sutherland H., Spooner D.
Emergency Department, Addenbrooke's Hospital, Cambridge.

Nursing times
Human swine flu is spreading rapidly and it is timely to reflect on how well we as individuals are prepared for a pandemic. Being prepared includes nurses not only being confident they have a mask that fits but also being prepared at putting on and removing personal protective equipment safely. It also involves being familiar with the latest guidance from the Department of Health, having an understanding of the processes in their workplace and an appreciation of some of the ethical challenges if numbers of affected patients overwhelm the health system's resources. This article suggests staff ask themselves 10 questions to assess their level of preparedness.


Lessons from the swine flu: pandemic, panic and/or pandemonium?
2010 Nov - Isaac D.
Department of Infectious Disease and Microbiology, Children's Hospital at Westmead, Westmead and University of Sydney, Sydney, New South Wales, Australia.
david@chw.edu.au

Journal of paediatrics and child health
The 2009 pandemic of swine-origin A/H1N1 influenza (swine flu) spread rapidly in Australia and there was a prolonged winter outbreak lasting 18 weeks. For Australian children, the case fatality rate of swine flu was no higher than for seasonal influenza. Because of the high number of children infected with swine flu, however, there were more children admitted to hospital than usual and more children died. Health-care services (emergency departments, medical wards and intensive care units) were stretched. The introduction of special influenza clinics helped services cope. Pregnant women were at high risk of severe swine flu and seven pregnant women and seven of their babies died. Future pandemic planning should consider severity of influenza, in addition to rapidity of spread, as a criterion for escalating interventions.


Bavagnoli L., Maga G.
Institute of Molecular Genetics, IGBCNR, via Abbiategrasso 207, I-27100 Pavia, Italy.

Abstract
The influenza A virus is the main circulating influenza virus in the human population. It can cause disease also in birds and other mammals and is responsible for annual epidemics and occasional pandemics. The most known and deadly pandemic was the "Spanish flu" (influenza type A/H1N1), which struck the human population between 1918 and 1919, with probably the heaviest toll ever recorded in terms of human lives. The most recent flu pandemic, caused in 2009 by the swine-origin reassortant virus (H1N1), has raised several critical issues in terms of our preparedness in responding fast to new pandemic influenza strains. Probably the most instructive lesson that has been learned from the 2009 pandemic, was that the speed of manufacturing and distributing an effective vaccine will not be able to keep up with the pace of a rapidly spreading pandemic virus, failing to grant accessibility to the vaccine for a significant percentage of the susceptible population, before the onset of the pandemic peak. Thus, our first and most effective line of defense against a pandemic influenza virus, particularly in the early phases, are the antiviral drugs. Here we analyze our current understanding of the influenza pandemic viruses in general, and the pH1N1 in particular, along with the most recent approaches being pursued to design new anti-influenza drugs.
7. Ability to point to uninterrupted paragraph and the most relevant sentence

- Unlike conventional SEs where a query points to documents, A SSE is expected to do much better.
- A query must point not only to documents but also to relevant sections of them, so as to eliminate further search where the user is supposed to open the documents to find the relevant sections.
- The previous example query "how fast is swine flu spreading?" shows this capability as displayed in next slide.
Preventing swine flu: 10 questions that all nurses need to ask themselves.

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cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=19788108
8. Ability to Customize and Organic Progress

• Every search application tied to a specific business objective will have some specifics not applicable to general search mentality.

• The conventional approach of "one size fits all" limits the performance due to lack of options for progress.

• Semantic search allows customization in various stages by the owners of the system as well as the user of the system (i.e., such as semantic tagging) where search becomes a part of a social network formed around a business.
9. Ability to operate without relying on statistics, user behavior, and other artificial means

• A SSE is expected to bring relevant results by analyzing the content of a page, its source, authors, and the credibility of the results in response to a query.

• Relying on link referrals, user behavior/tagging, and other artificial means may produce good results when such data is available, but are outside the realm of semantic search.

• By not relying on artificial input, semantic search technology is more universal, applicable to any situation especially to enterprise documents and real-time content where such data does not exist.
Web 3.0? Semantic Web?

What’s the difference between Web 2.0 and Web 3.0?

It is that easy.
10. Ability to Detect its Own Performance

- When there is no semantic content analysis in a search algorithm, relevancy scores refer to artificial measurements, like how popular the page is.
- A SSE is expected to produce a relevancy score that reflects the degree of meaning match.
- This capability provides flexibility for the developers to apply meaning thresholds.
- Accordingly, the SSE can understand its poor performance to automatically flag areas of improvement that is needed.
Summary: Advantages of Semantic Search
Summary: Why Semantic Search?

- **Accuracy**: Improves accuracy of search results exponentially.
- **Focus**: Transforms search function from pointing a document to pointing a direct answer.
- **Engagement**: Allows flexibility to use natural language queries, thus increases user engagement.
- **Intelligence**: Enables semantic understanding of the user behavior via search analytics.
- **Control**: Prevents manipulations of content providers and users.
- **Independence**: Does not rely on external inputs (i.e., popularity) for base performance.
- **Progress**: Allows customization, user input, organic improvement.
So go for Advanced Semantic Search :-?)