

## Where Text Analytics is at Today

Robert Dale Centre for Language Technology www.clt.mq.edu.au

#### The Aim of This Talk

- To give you an idea of where the commercial activity is in text analytics
- To give you an idea of where current research is focussed in text analytics

#### The Problem: Too Much Information

- 80% of data is 'locked up in text'
- How big is the web?
  - A recent frequently cited answer: 155,583,825 sites
  - Google indexes in excess of 8 billion pages
- FAST's enterprise search solution handles up to 10 billion documents
- My hard disk contains 29.7Gb of work-related data in 106k documents
- My Outlook file is 800Mb with no attachments included

## A Solution: Text Analytics

- Text Analytics is
  - ... the process of automatically extracting ...
  - ... structured or semi-structured information
  - ... from unstructured machine-readable documents

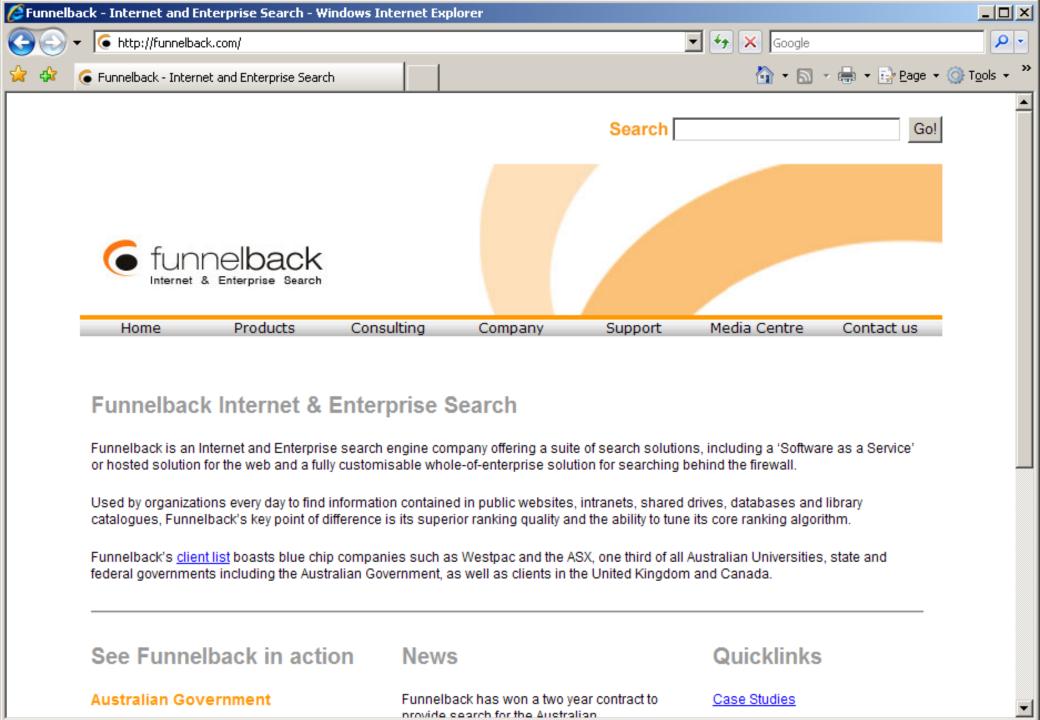
- Search
- Text Categorisation and Clustering
- Entity Recognition
- Cross-Document Name Matching
- Text Summarisation
- Event Recognition
- Sentiment Analysis
- Question Answering

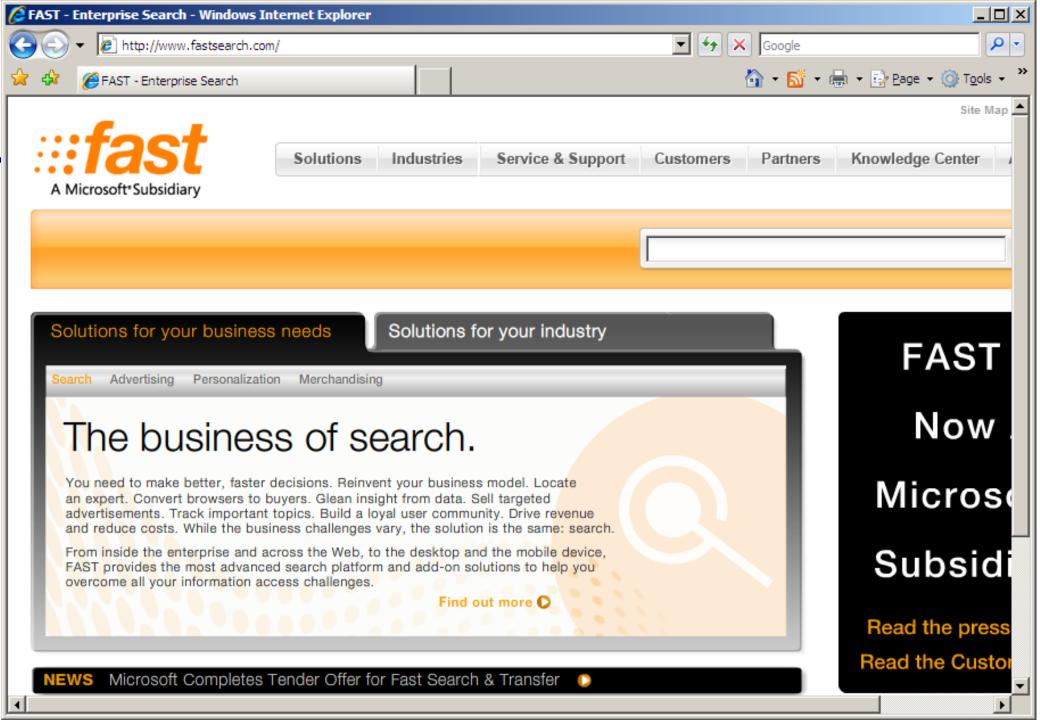
#### Search

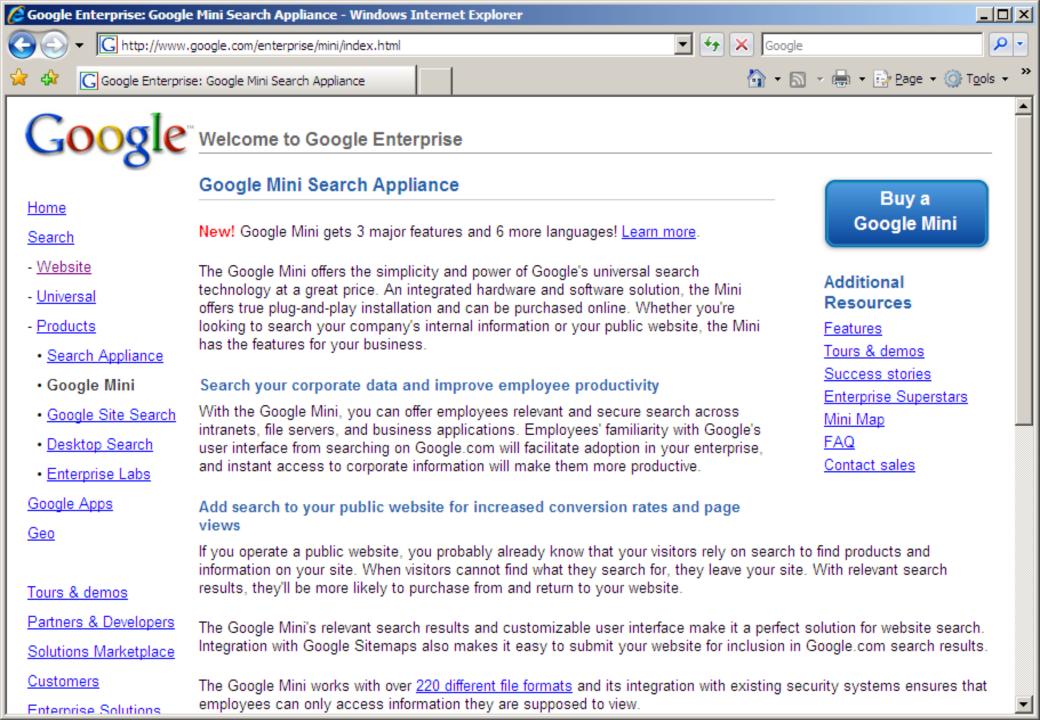
- ... aka Information Retrieval
- Basic techniques:
  - treat documents as bags of words, look for overlap with query
- Smarter ideas:
  - Page rank; link analysis; hubs and authorities
  - Using linguistic knowledge
- State of the art: Still really searching for words rather than searching for <u>concepts</u>

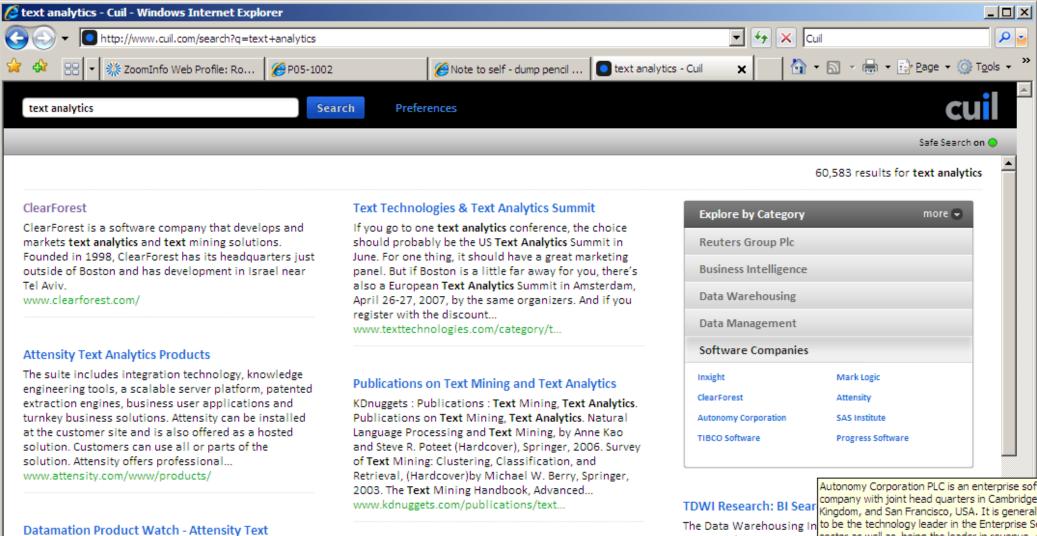
## Linguistic Knowledge in Search

- High frequency 'closed class' words are not very informative:
  - 'the', 'and', 'of'
- Automatic detection of multiword concepts:
  - New York City subway
- Stemming or <u>morphological analysis</u> can find pages otherwise missed:
  - 'apples'  $\rightarrow$  'apple', 'application'  $\rightarrow$  'apply'
- Query expansion via synonyms:
  - 'car'  $\rightarrow$  'automobile'









#### Analytics ...

- Attensity Text Search: The newest offering in the product suite; combining the ability to perform text searches of documents along with analytics of those documents. Text Search is driven by Brainware. -Attensity Classify: Supporting user-definition of document groups and the automatic assignment of documents to these groups. Attensity Classify is... products.datamation.com/dms/im/1159...

#### **Text Analytics Summit 2007**

The 3rd Annual Text Analytics Summit 2007 is taking place 12 - 13 June, 2007 in Boston. If you're a user of text analytics technology in any application or industry, this is an unmissable opportunity to learn from your peers and understand the bottom-line impact of the latest deployments. If you're a developer, this is your chance to meet a market focused... www.textanalyticsnews.com/usa/

survey in late 2006 as we sector as well as being the leader in revenue, management practitioner numbers, and for public companies in revenue vendors via an Internet-based survey. 370 respondents are the data sample for this report entitled, &BI and Text Analytics: New Additions to the BI Technology Stack.& The technology stack for business... www.dmreview.com/specialreports/200...

QL2 Software - Solutions - Enterprise Search,

2 Columns | 3 Columns

- Search
- Text Categorisation and Clustering
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### **Text Categorisation**

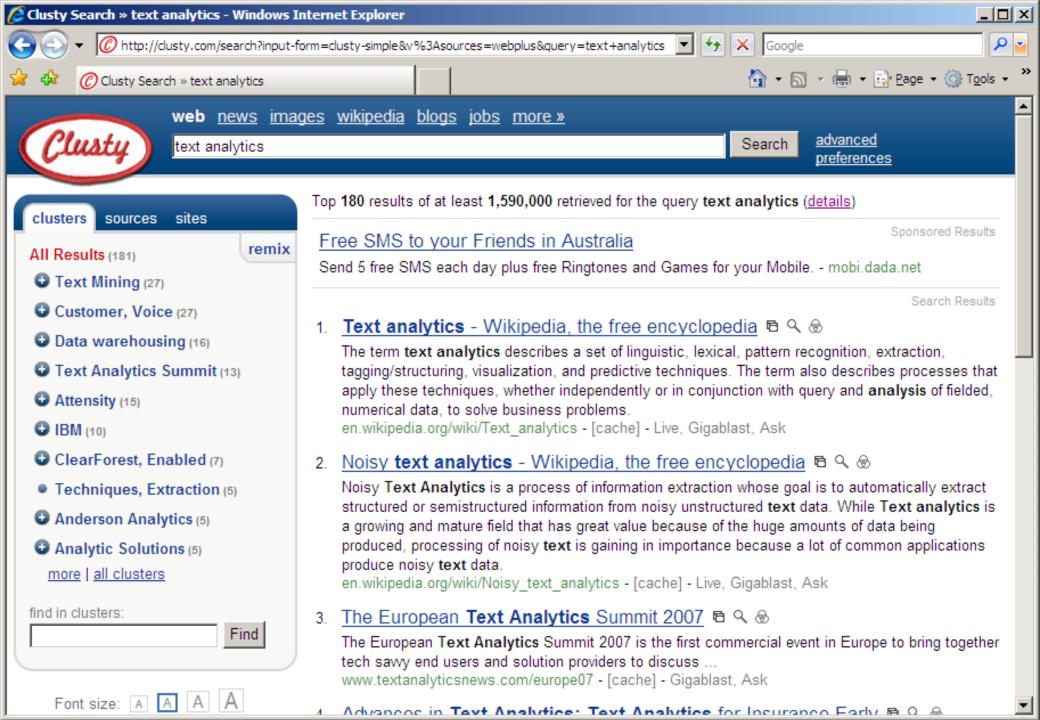
- Given a set of categories, automatically determine which category a new item belongs to
- Machine learning identifies the characteristics of existing documents that cause them to belong to their categories

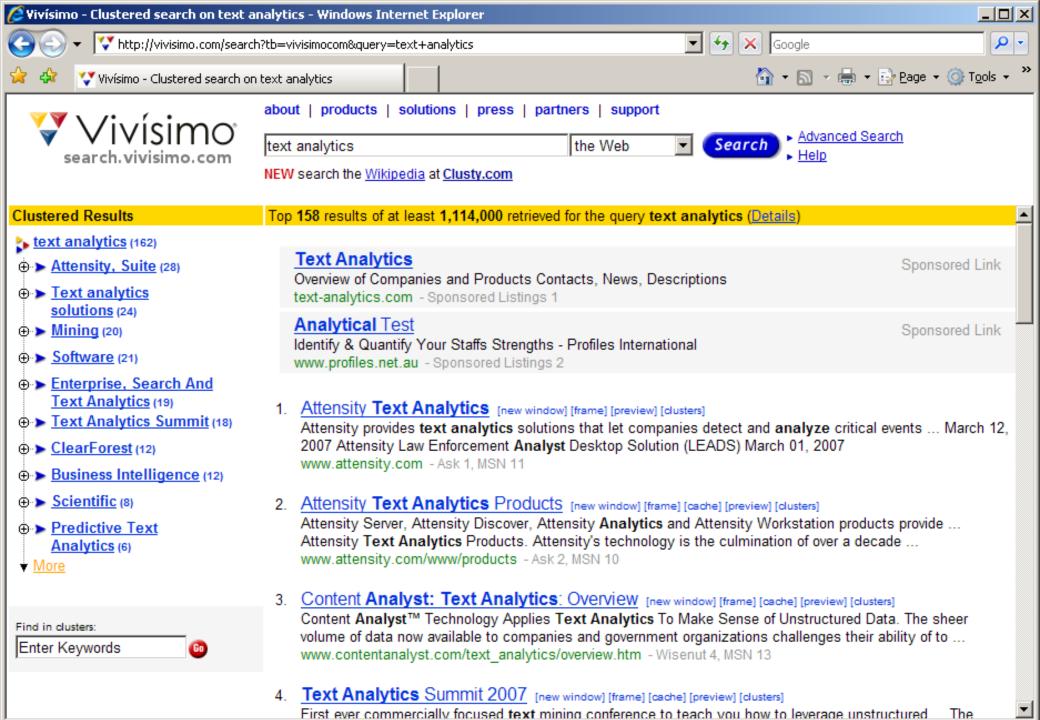
# **Uses of Text Categorisation**

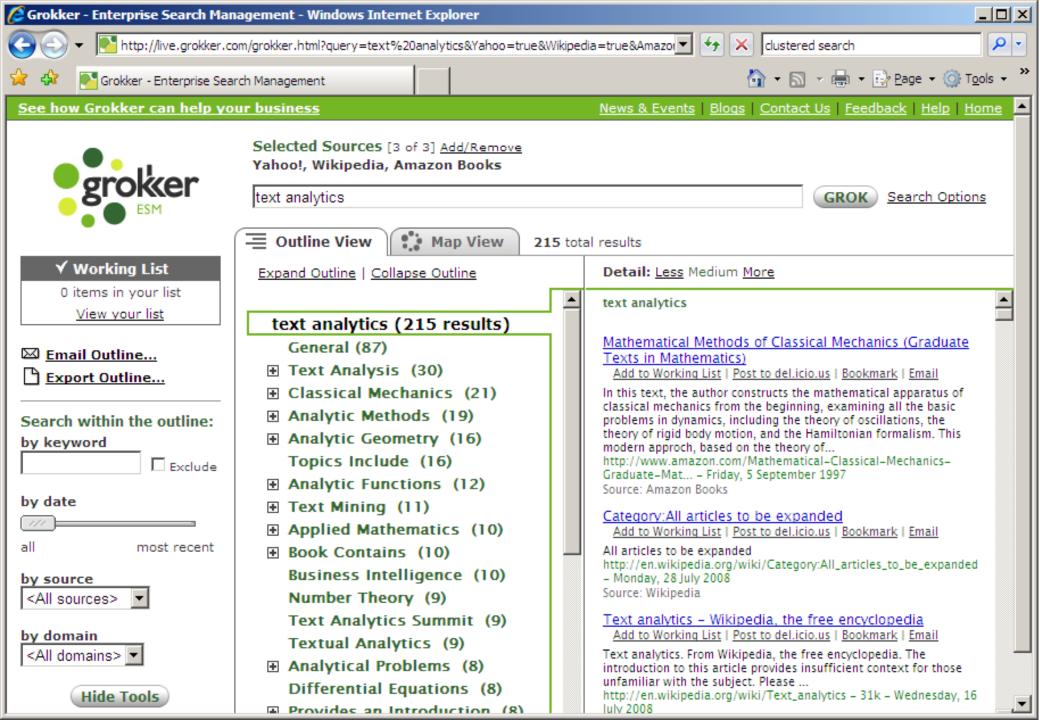
- Organising information into a structure
  - Email folders
  - Spam and junk mail detection
  - ASX company announcements around 150 distinct document types
- Text categorisation can be <u>rule-based</u> or <u>machine-learned</u>

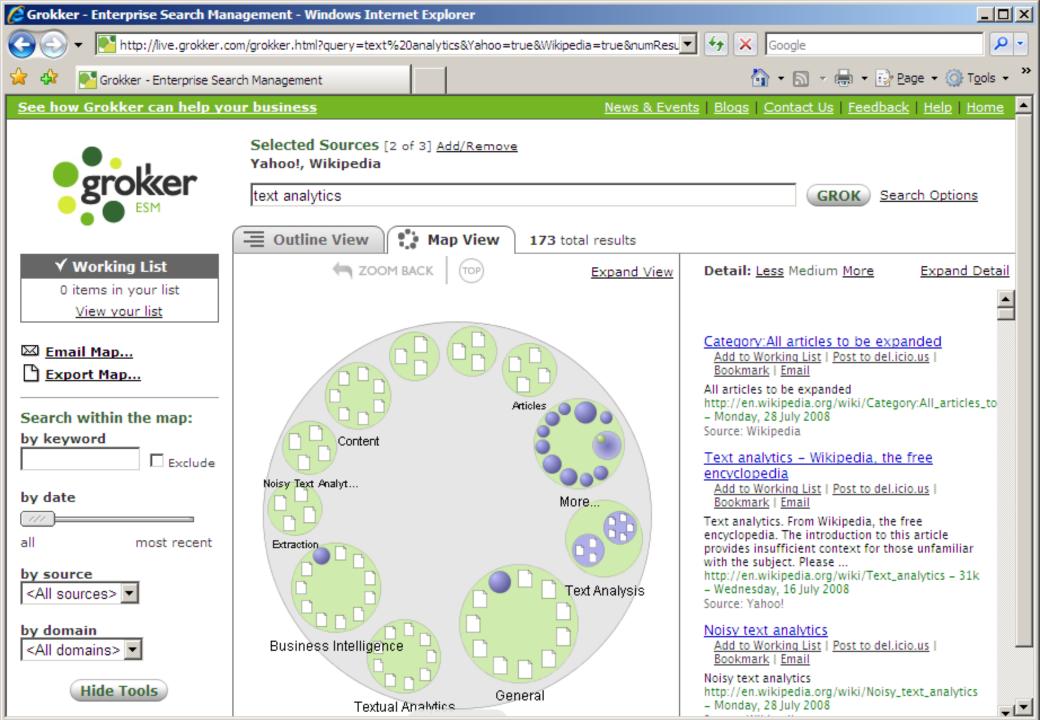
# **Text Clustering**

- From a given set of uncategorized items, determine the most natural data-driven groupings
- Machine learning identifies the similarites and differences between existing documents









# **Text Categorisation and Clustering**

- Categorisation:
  - Taxonomies are alive and well
  - Vendor claim: deploying taxonomies can reduce the amount of time it takes to find information by 50%
- Clustering:
  - Available in some second-tier search engines
  - Why hasn't Google prime-timed it?

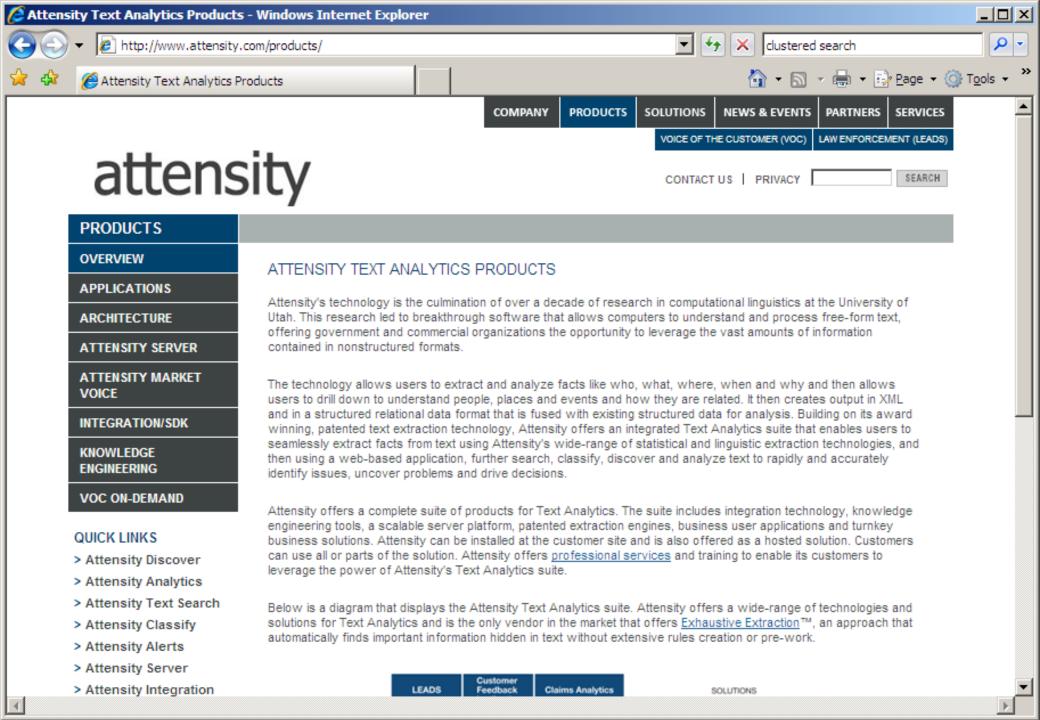
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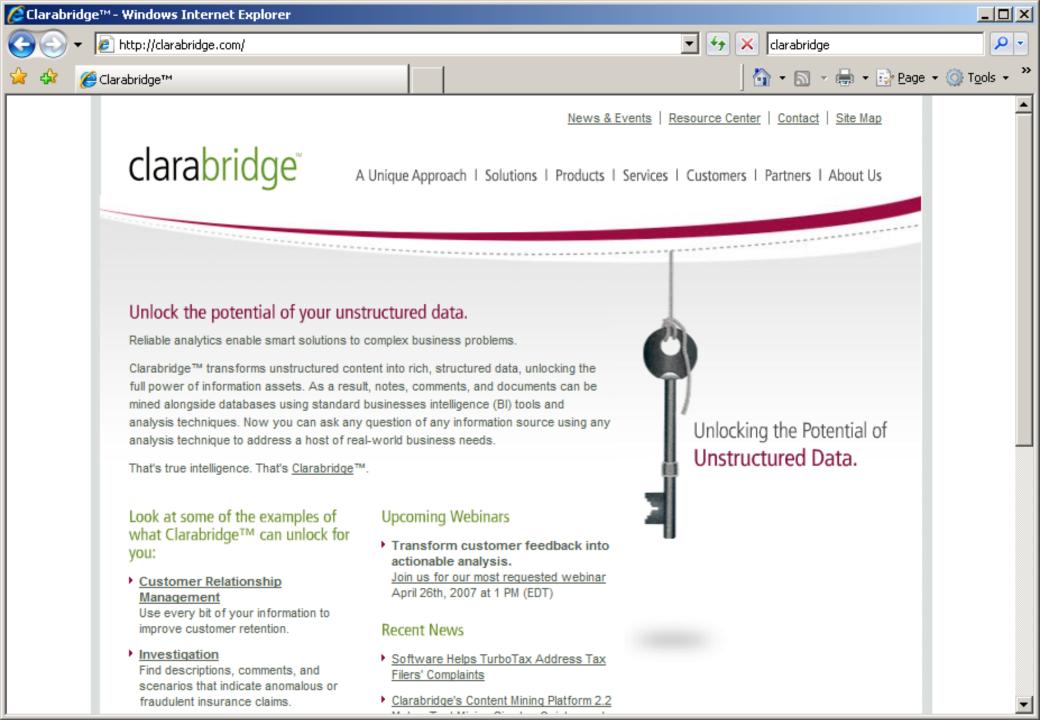
#### **Named Entities**

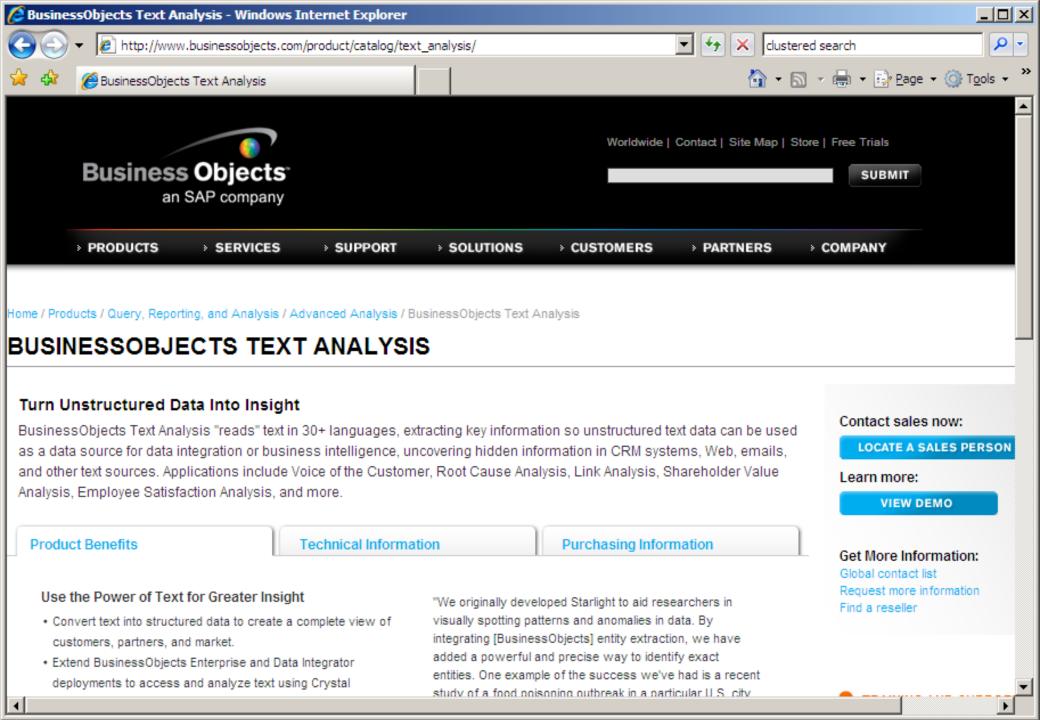
- The idea: <u>entities</u> are more important than words
- Traditionally:
  - People, organizations, geographical locations
  - Time expressions, currency amounts, weights and measures
- Now:
  - All of the above, plus key concepts or terms in any field

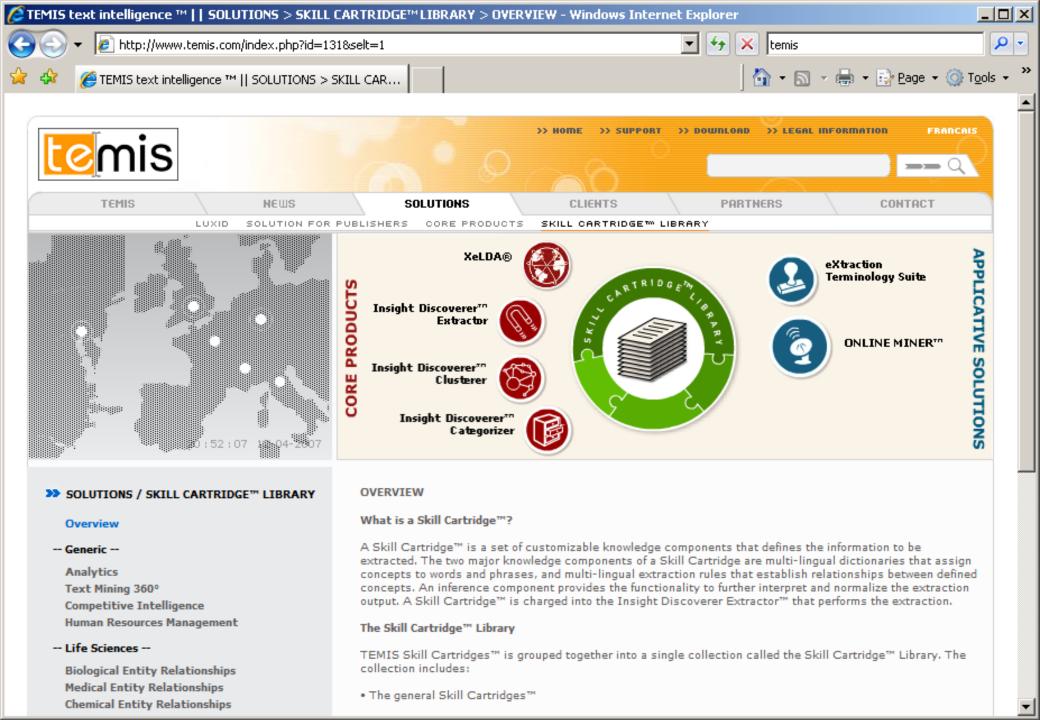
#### **Approaches**

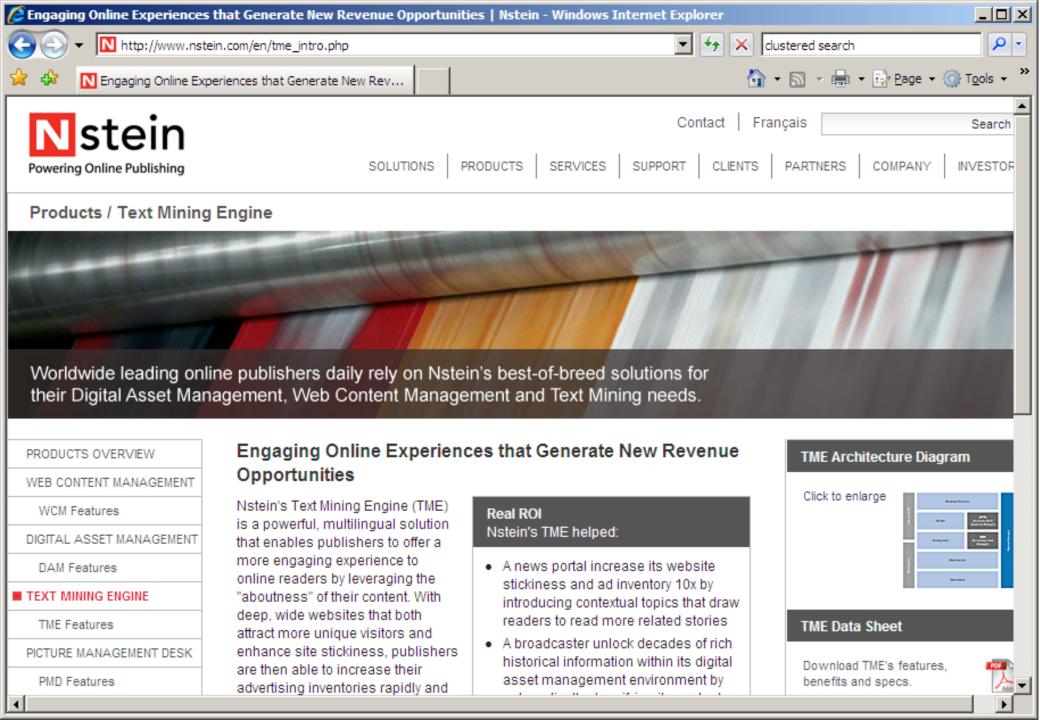
- Gazetteers:
  - large lists of names and variants
- Rule-based systems:
  - Eg, "any initcapped string with 'Ltd' at the end is a company"
- Machine learning:
  - Based on the words that precede and follow initcapped strings, determine if they are likely to be named entities of a specific type





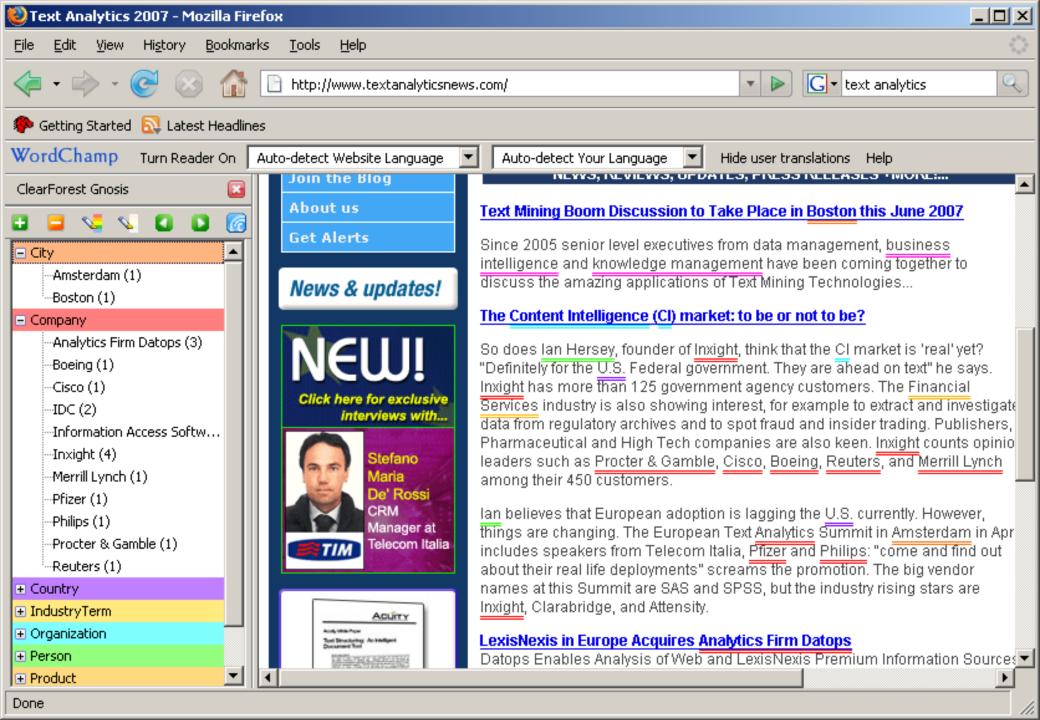


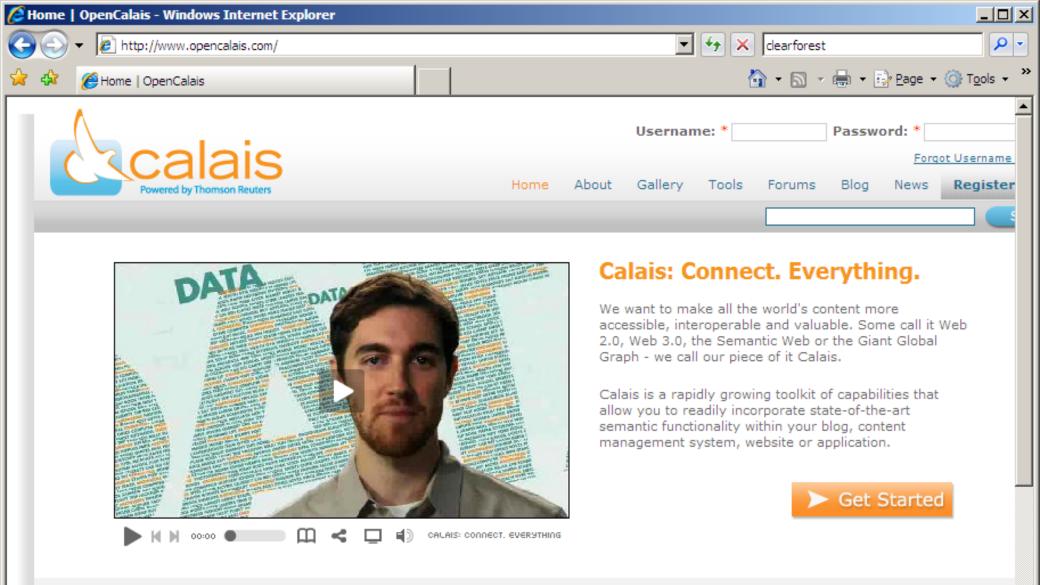












#### **Latest News**

#### Welcome to Calais 2.1!

This release includes many new features and tools to make Calais more usable, useful and accessible. Please take a

#### **Featured Application**

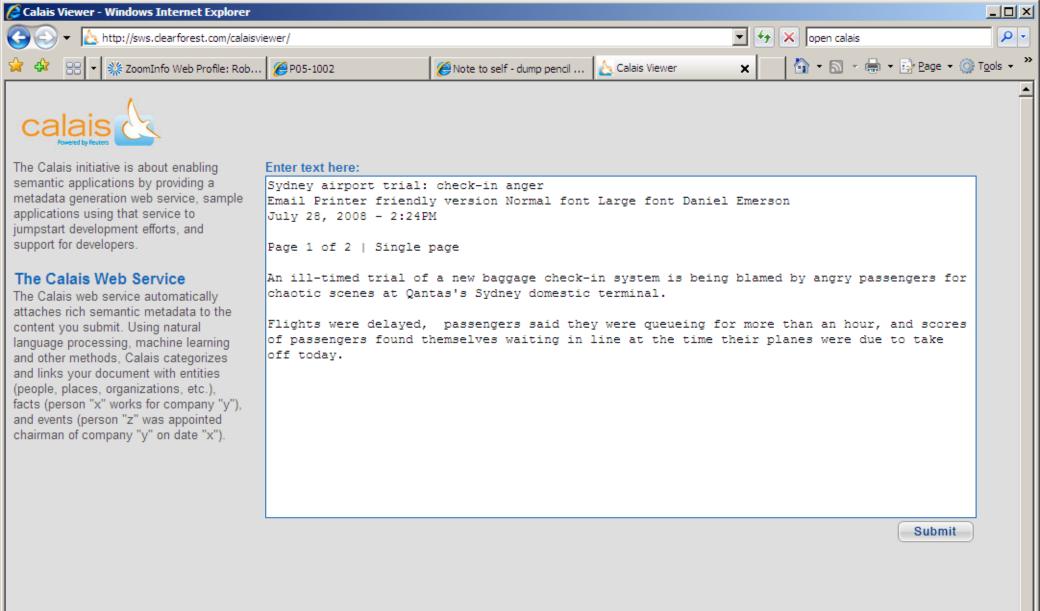
Meet Calais Tagaroo.

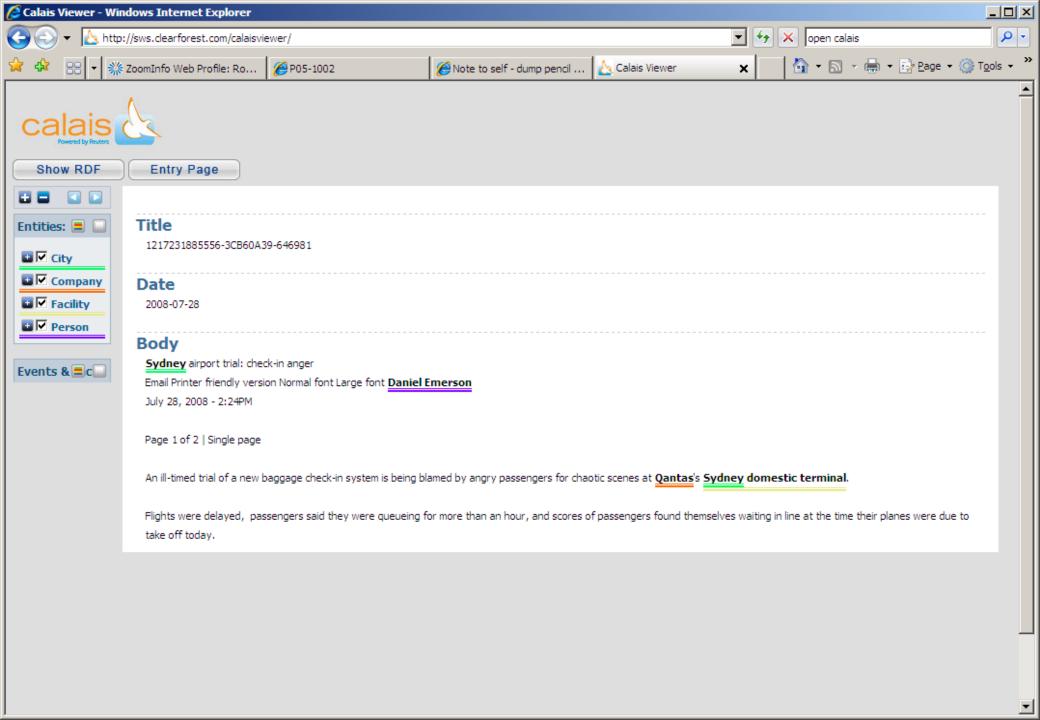
Tagaroo provides automated tag generation



#### Calais and You

Choose one of the user types below to see what you can do with Calais.

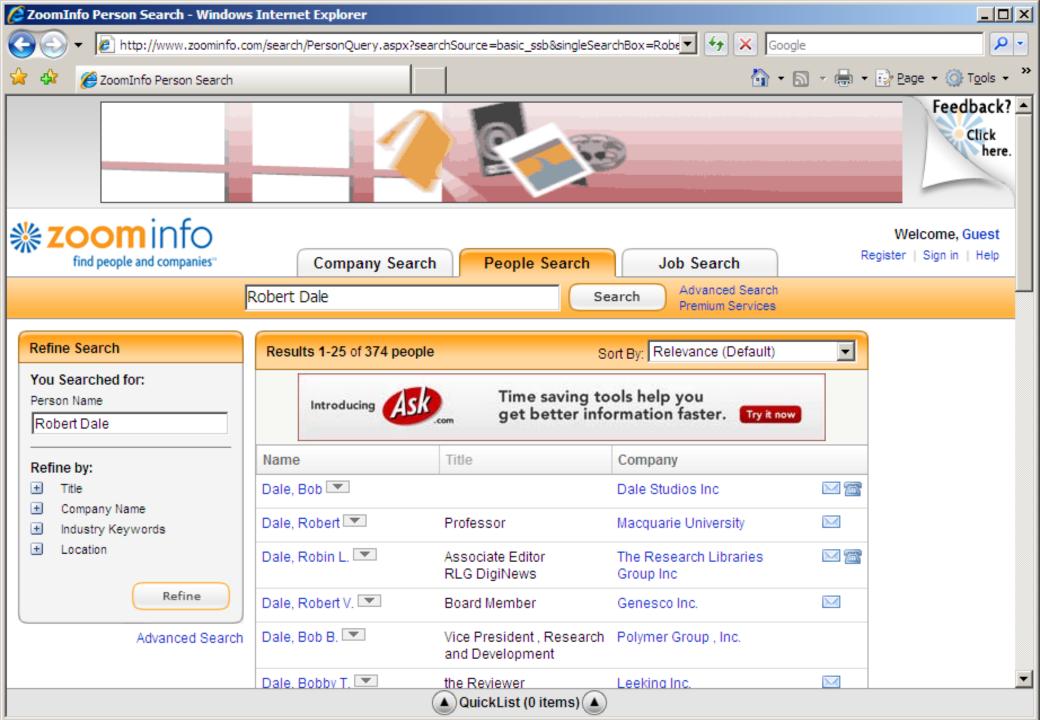


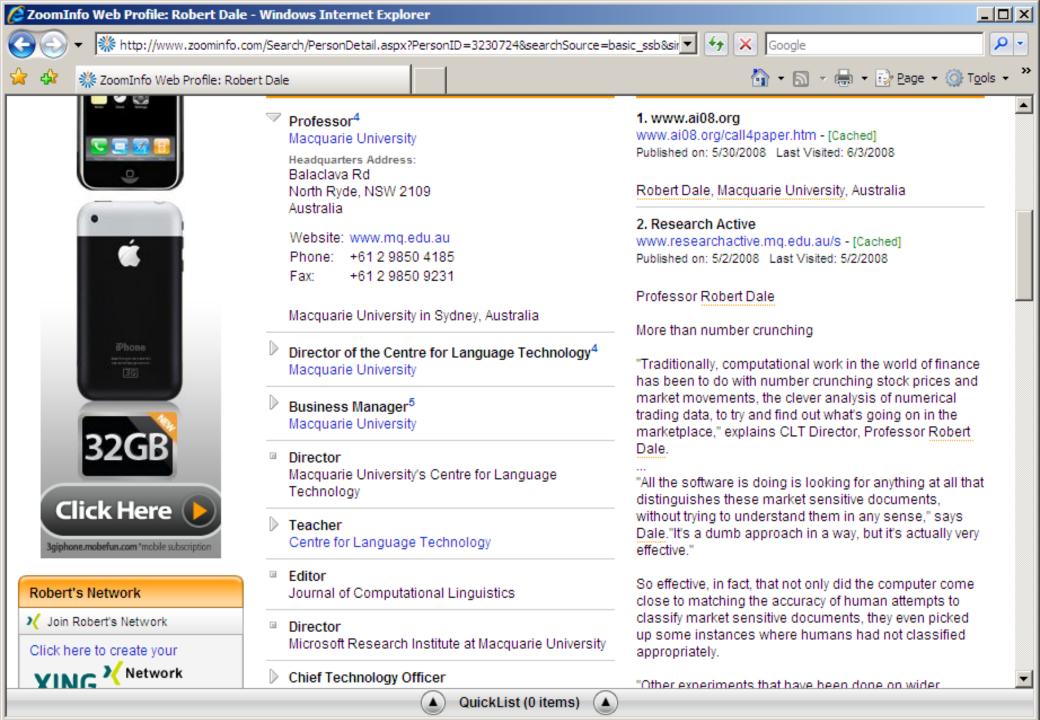


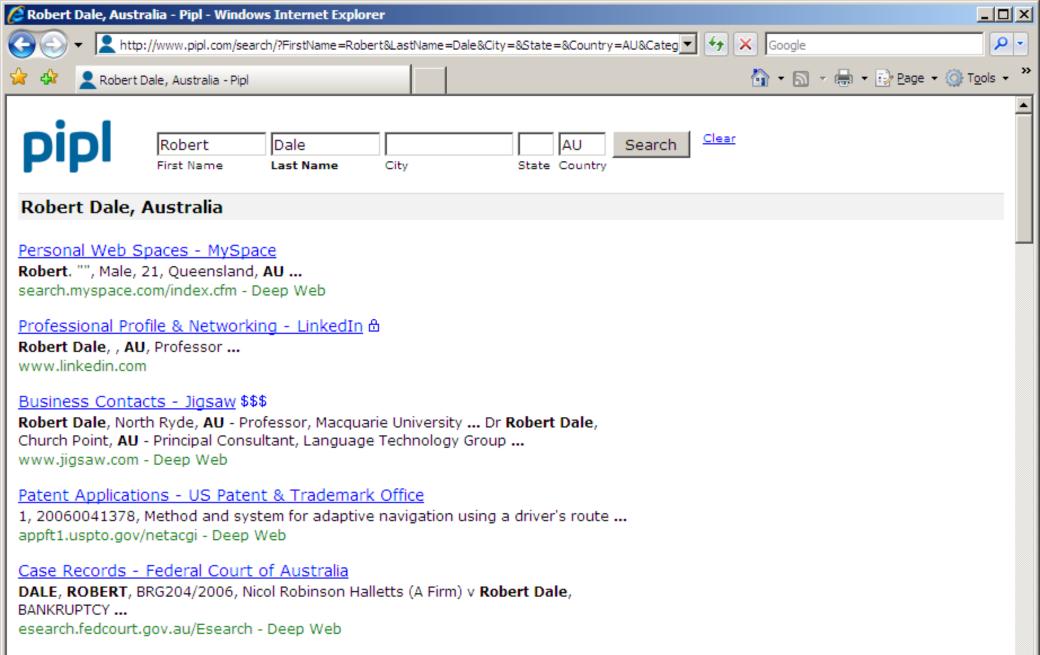
#### Issues

- Complex names:
  - John and Mary Smith
  - Proctor and Gamble
- Book and movie titles
- Not Every Initcapped String Is A Name

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## Nominal Rolls (10) DALE, ROBERT BARRY, NX6422, 21 Aug 1912, BOURKE, NSW, Army ... DALE, ROBERT ELMO FALIERE, PA34, 9 Aug 1910, BIRKENHEAD, SA, RAN ...

#### Issues

- Name variation:
  - Alexander Smith, Alex Smith, A Smith, Mr Smith
  - − IBM = Big Blue; Qantas = the Red Kangaroo
- Two sides to the coin:
  - -One name, many people
  - Many names, one person

#### **Text Analytics Components**

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# **Types of Summarisation**

- Informative vs Indicative
- Extractive vs Abstractive

#### Informative vs Indicative

- An <u>informative</u> summary represents or replaces the original document:
  - Needs to contain all the core information and omit ancillary information
- An <u>indicative</u> summary suggests the contents of the article without giving away detail on the actual content
  - Can serve to entice the user into retrieving the full form
  - Examples: book jackets, card catalog entries, movie trailers

#### **Extractive vs Abstractive**

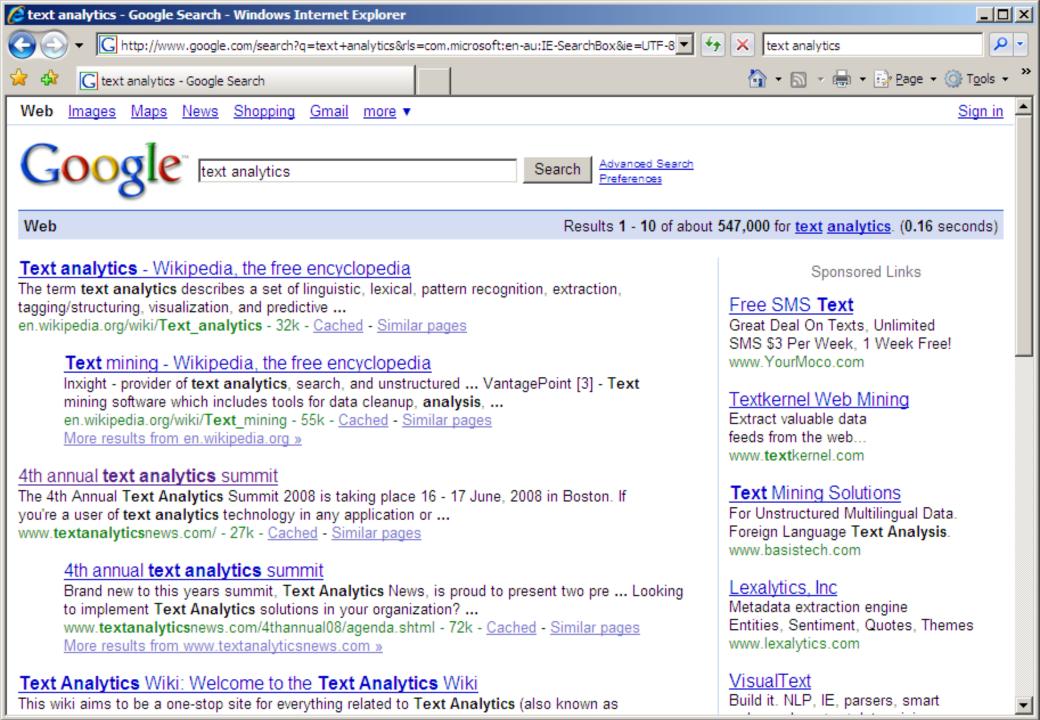
- Extractive summaries (extracts) are made up of fragments (whole sentences or phrases) of the source text.
- Abstractive summaries (abstracts) may contain content not directly present in the source — may require generalization or abstraction

#### **Techniques for Extractive Summarisation**

- Basic idea:
  - Extract key sentences
- Approaches:
  - Rule-based vs machine-learned
- Relevant features
  - Position of sentence in text; frequency of words appearing in sentence; density of named entities

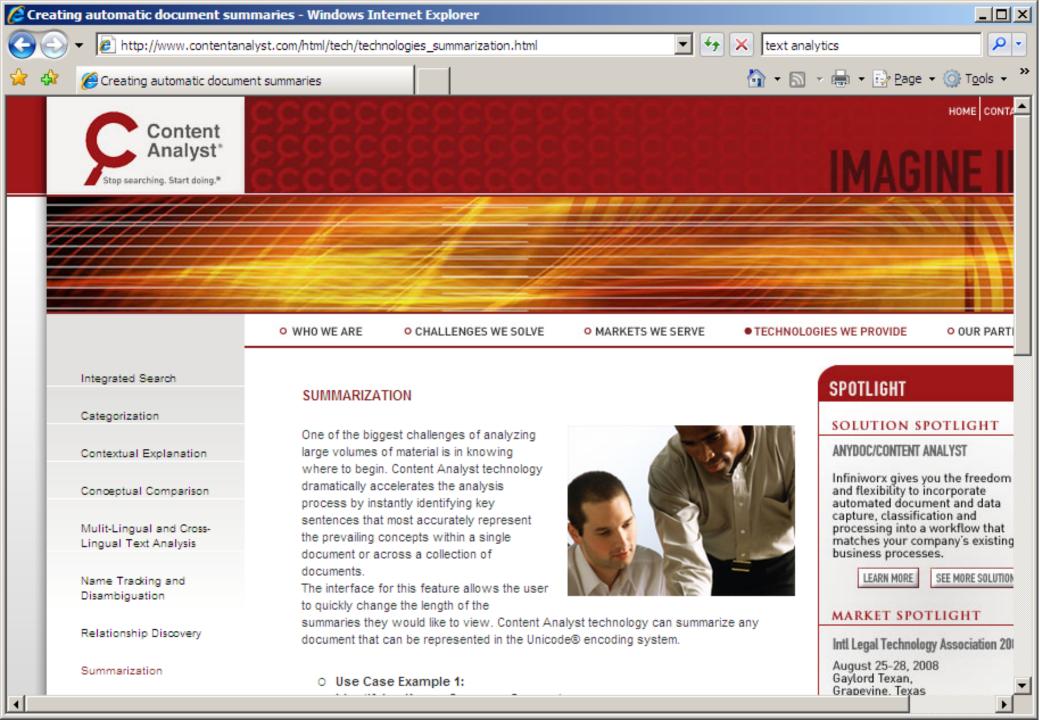
#### Related Techniques

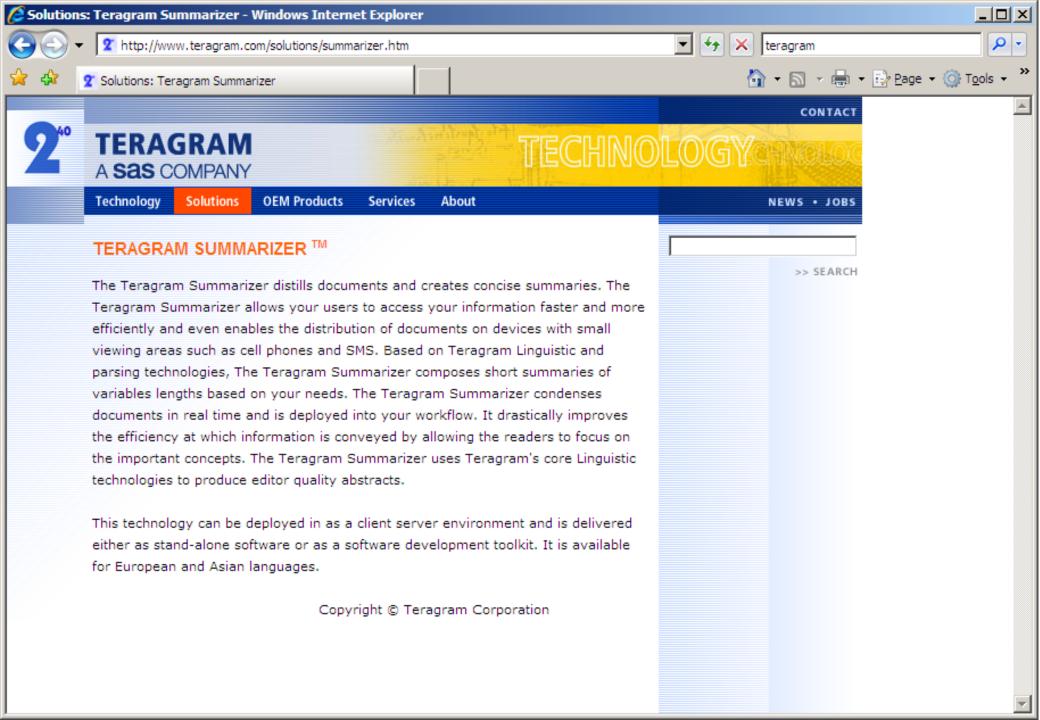
- Sentence compression
  - Geoff Dixon, CEO of <u>Qantas</u>, today announced that the company will sell off ...
  - $\rightarrow$  Qantas will sell off ...
- Microsoft's IntelliShrink
  - DrctDepositPymntsWllBAvlbleInYrAccntWthn3BsnssDysFrmPymntDteBlw
- 'Snippet' or 'teaser' extraction

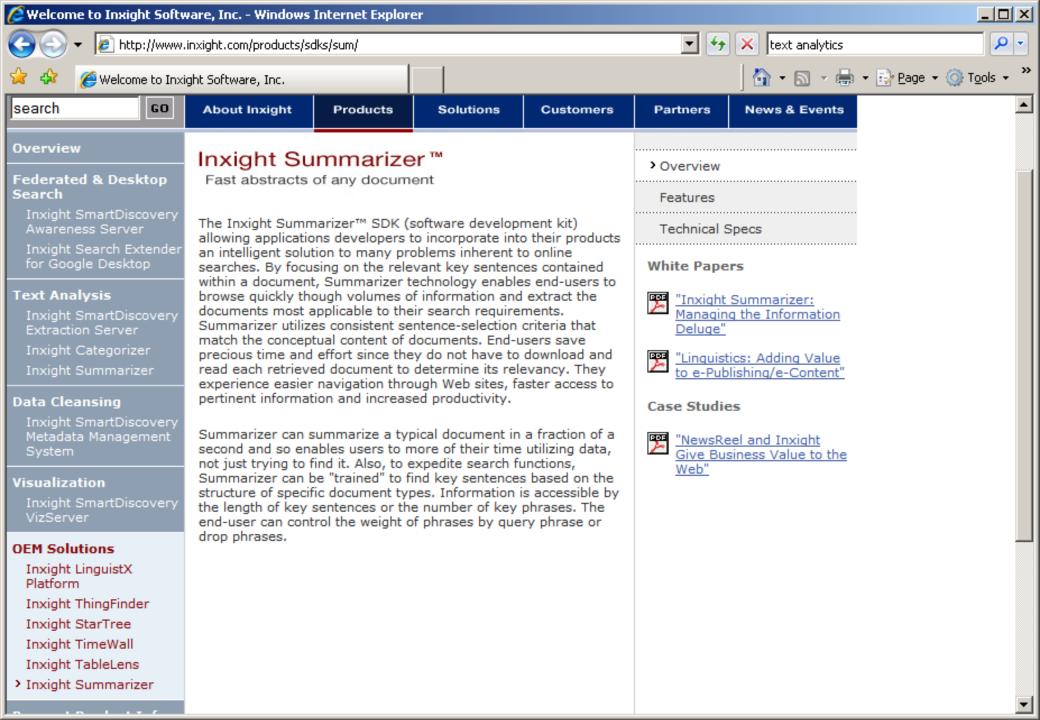


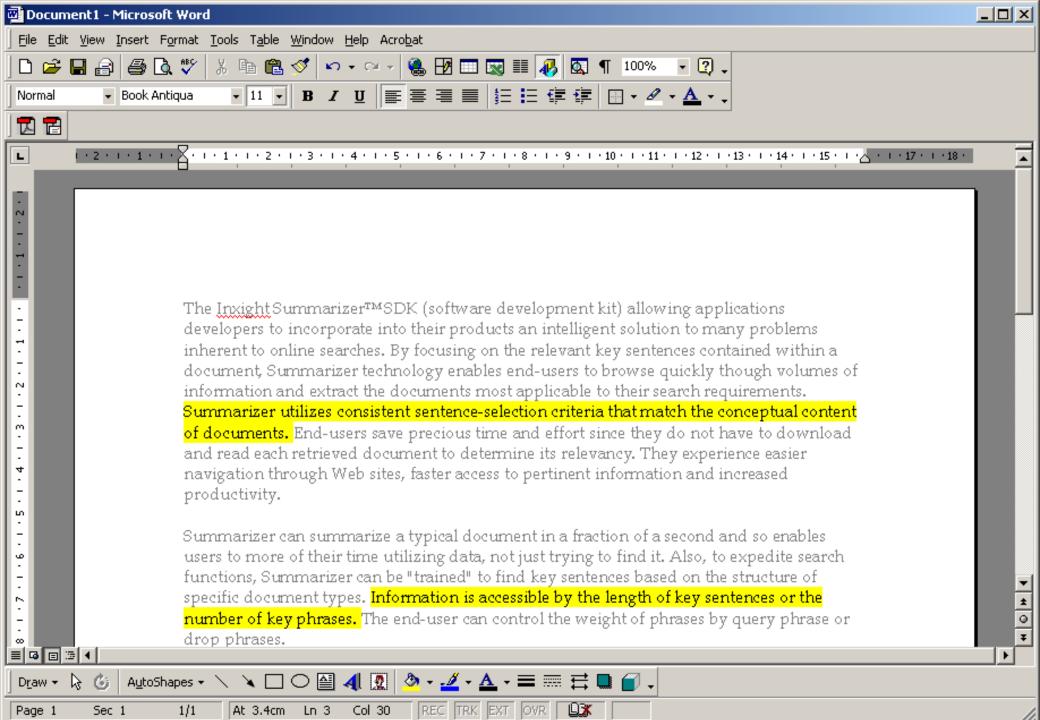
#### Issues Impacting on Performance

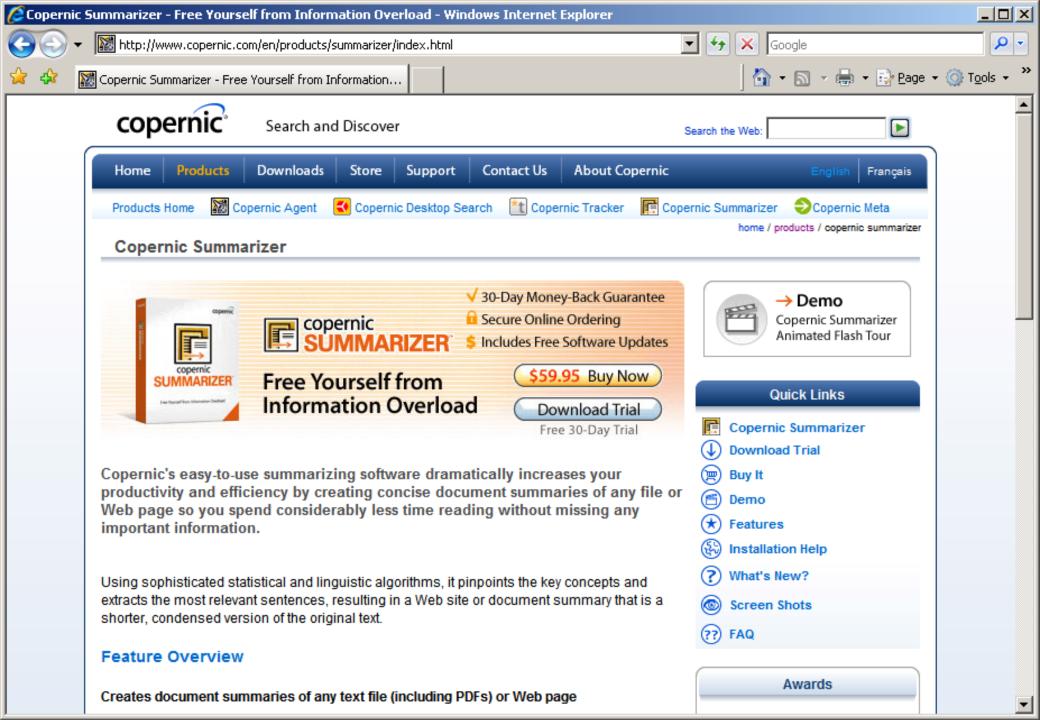
- Real summarisation requires real understanding
- Quality of 'knowledge-free' summarisation relies on aspects of the document other than content
- Problems with out-of-context or dangling references:
  - 'He said the price offered in the buyback scheme would be ...'











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## **Event Recognition**

- Working out who did what to whom and when
- Also known as 'Information Extraction'

# **Doing It Yourself**

- GATE, from the University of Sheffield
- IBM's UIMA

# **An Example Document**

elect Alfredo Cristiani co	9 (ACAN-EFE) [TEXT] Salvadora Indemned the terrorist killing of Att Alvarado and accused the Faraburat (FMLN) of the crime.	torney
•••	Incident: Date	19-Apr-89
Vice President-elect Fra	Incident: Location	El Salvador: San Salvador (CITY)
	Incident: Type	Bombing
	Perpetrator: Individual ID	urban guerrillas
	Perpetrator: Organization ID	FMLN
	Perpetrator: Confidence	Suspected or Accused by Authorities: FMLN
	Physical Target: Description	vehicle
	Physical Target: Effect	Some Damage: vehicle
	Human Target: Name	Roberto Garcia Alvarado
	Human Target: Description	attorney general: Roberto Garcia Alvarado
	Human Target: Effect	Death: Roberto Garcia Alvarado

#### **Techniques**

- Identify named entities (see earlier)
- Identify stated relationships between named entities:
  - Generally achieved via pattern matching
  - As pattern matching becomes more complex, it effectively becomes syntactic parsing

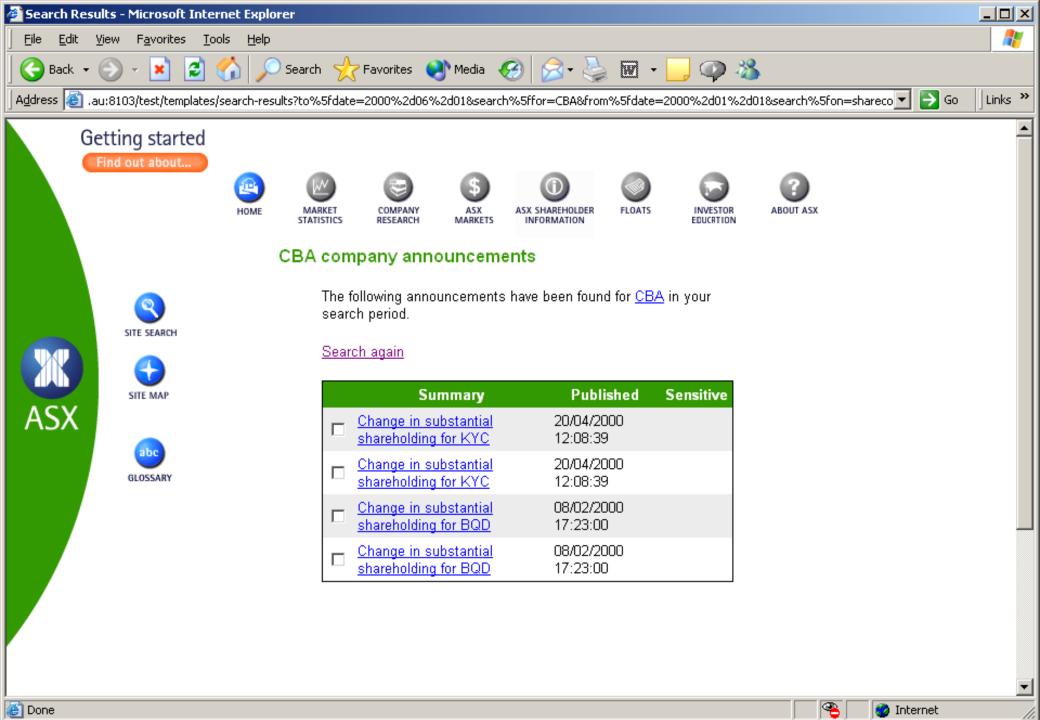
## **Example: GainSpring**

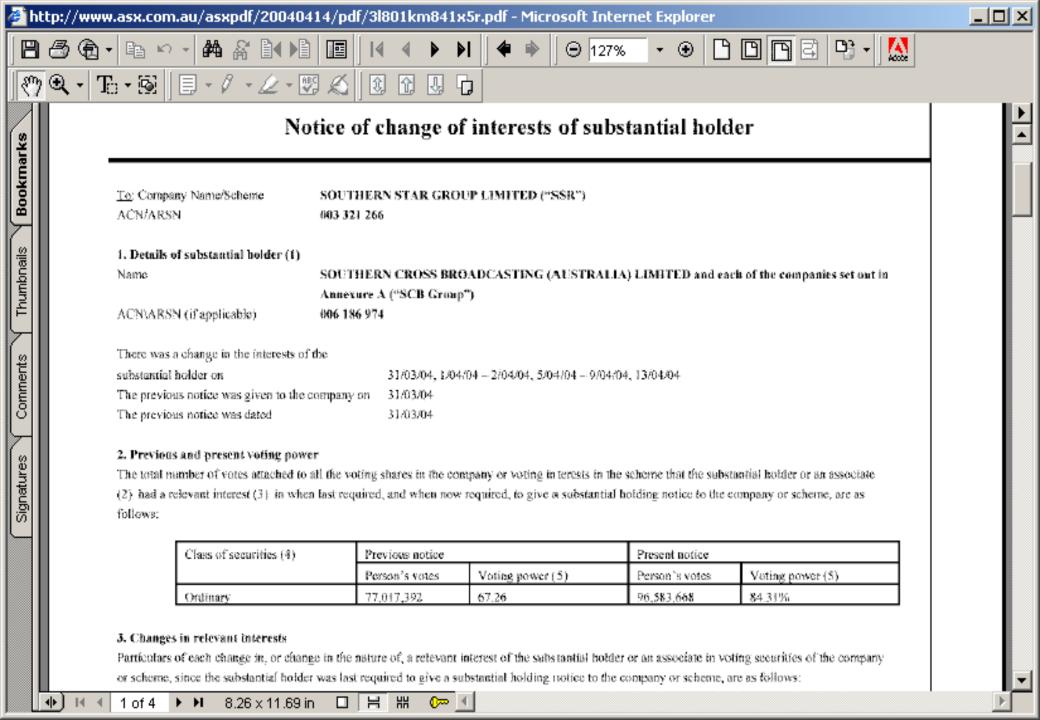
#### • Problem:

 100k+ company announcements per year issued through the Australian Stock Exchange

#### Goal:

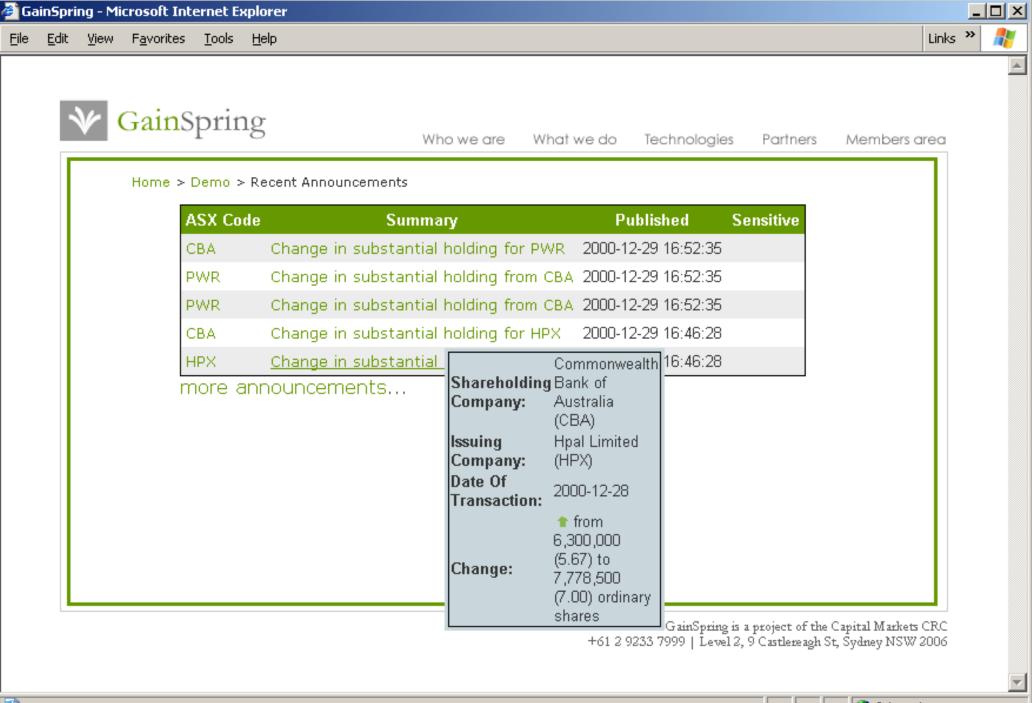
 Extracting key facts from documents automatically and deliver them via different mechanisms — web page, email alerts, SMS, synthesized voice





# Example Template Fill: Becoming a Substantial Holder

<u>Element</u>	Example Contents
DocumentCategory	02001
AcquiringPartyASX	TCN
AcquiringParty	TCNZ Australia Investments Pty Ltd
AcquiredPartyASX	AAP
AcquiredParty	AAPT Limited
DateOfTransaction	4/07/1999
NumberOfShares	243,756,813
ShareType	ordinary shares
PercentageOfShares	79.90%





#### A JAPE Rule from GATE

#### Issues Impacting on Performance

- Difficult to achieve high recall and precision because of variations in language
- Success depends on the predictability of document content
- High performance really requires full natural language processing

## **Text Analytics Components**

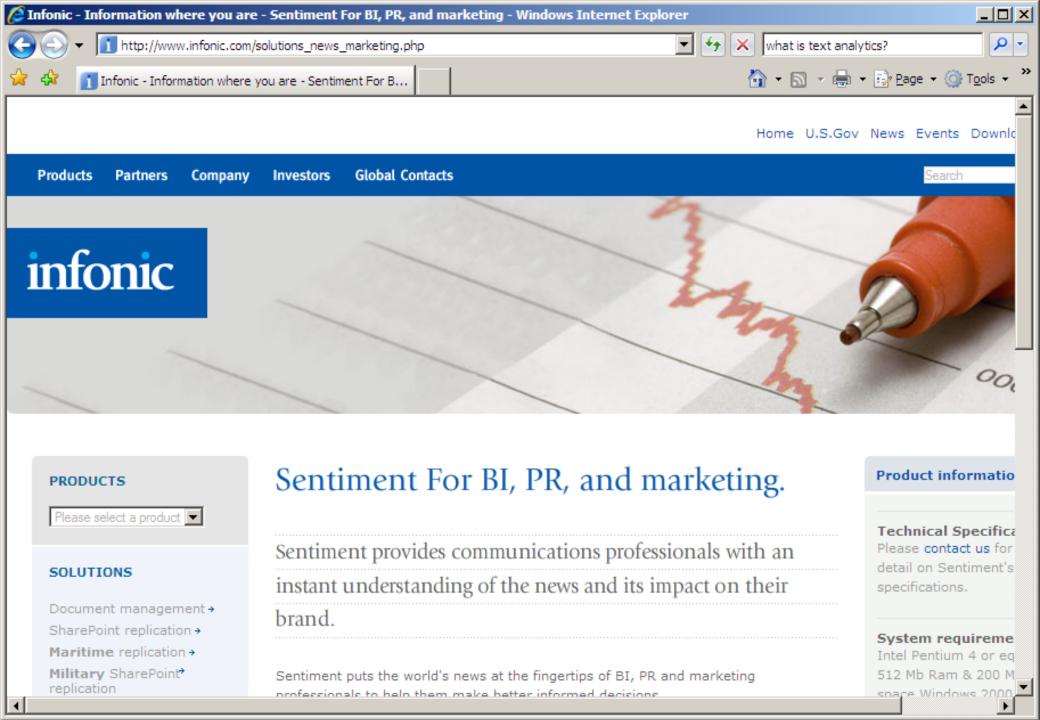
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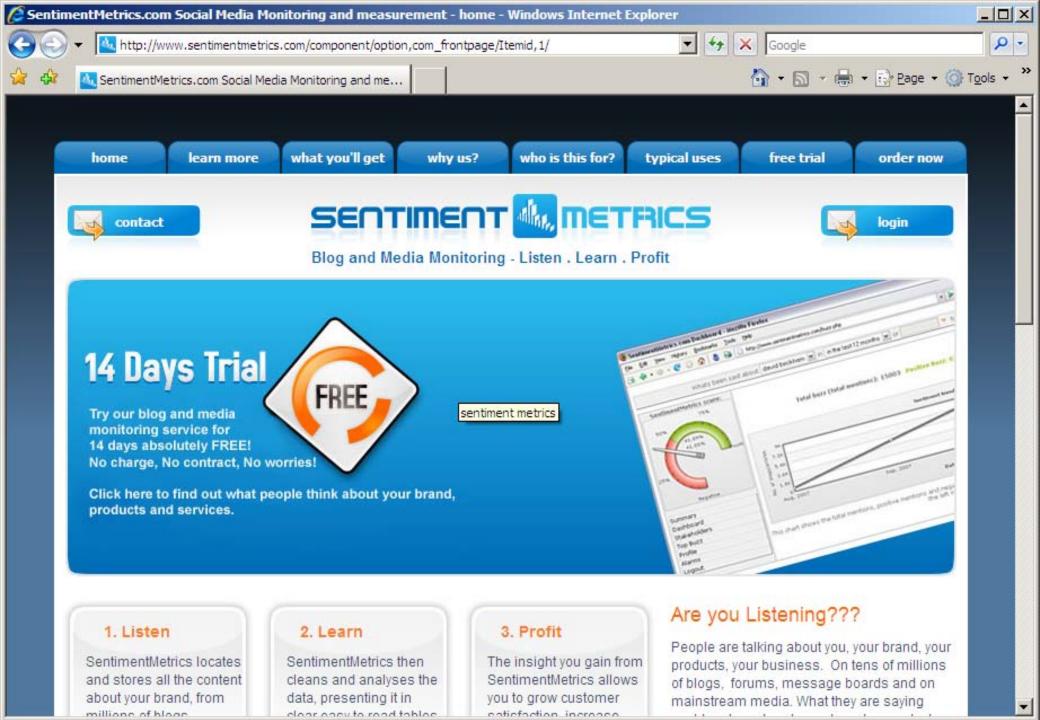
#### **Sentiment Analysis**

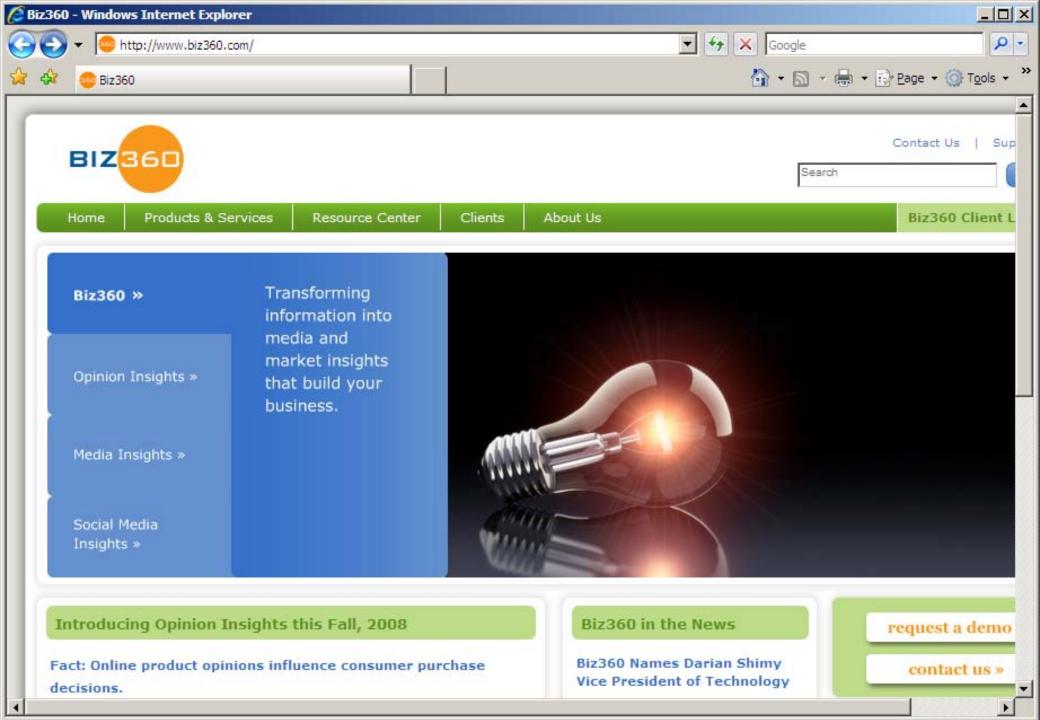
- Goal:
  - To automatically determine the polarity of sentiment expressed towards a company, product or individual
- Increasingly seen as important because of the blogosphere
- This year's hot topic, aka 'Voice of the Customer'

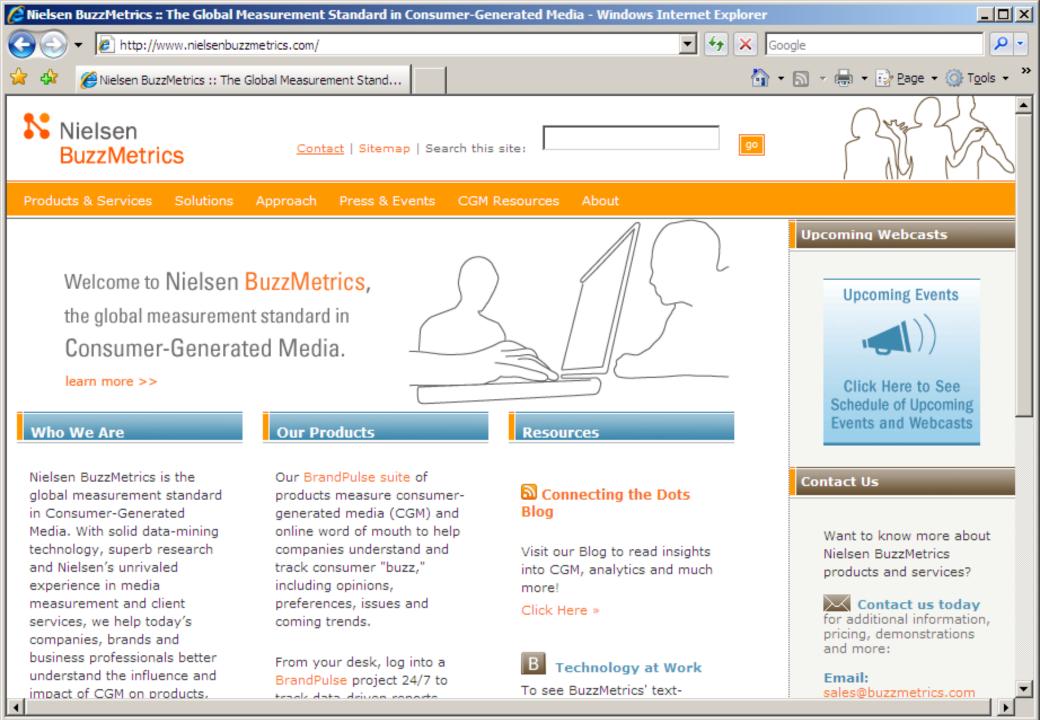
#### Approaches to Sentiment Analysis

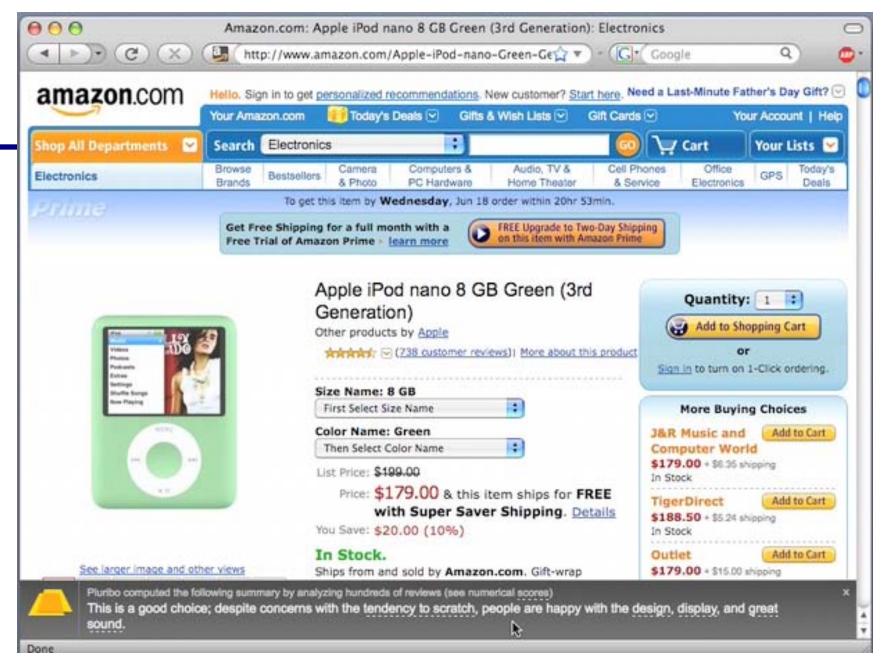
- Identify specific key words that are indicative: The General Inquirer
  - Positives (1914 words) eg: decent, ardent, wholesome, triumph,
  - Negatives (2293 words) eg: allege, despicable, harmful, worry, terrorize, . . .















### Why Sentiment Analysis is Hard

- This laptop is <u>a great deal</u>.
- A great deal of media attention surrounded the release of the new laptop.
- This laptop is <u>a great deal</u> ... and I've got a nice bridge you might be interested in.

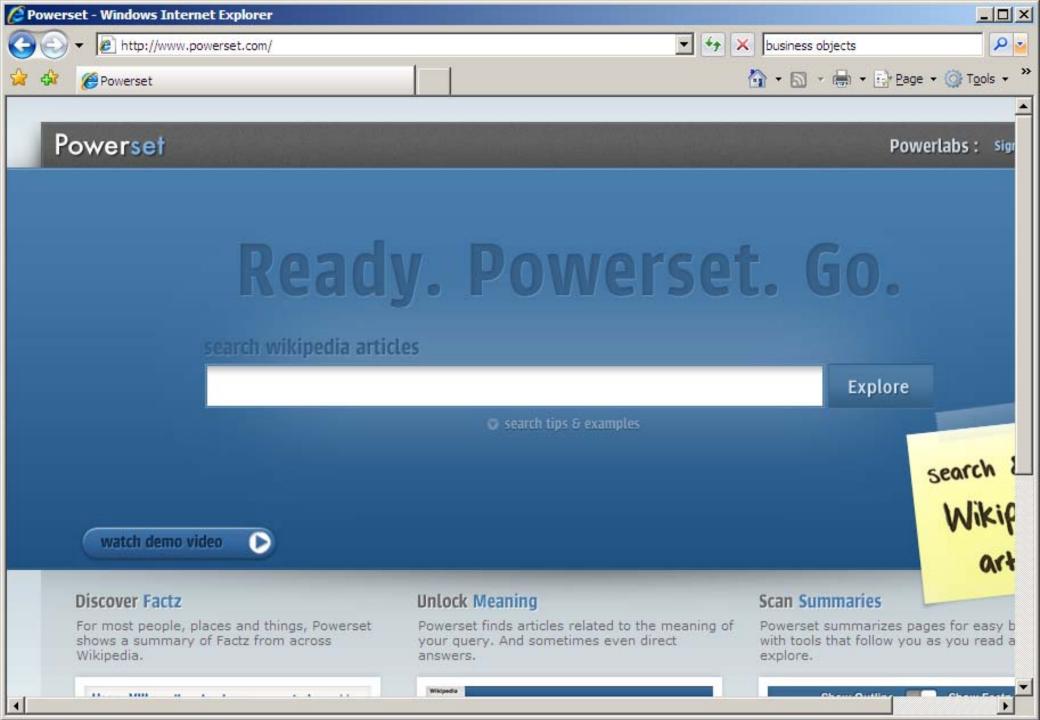
#### [Example from Lilian Lee]

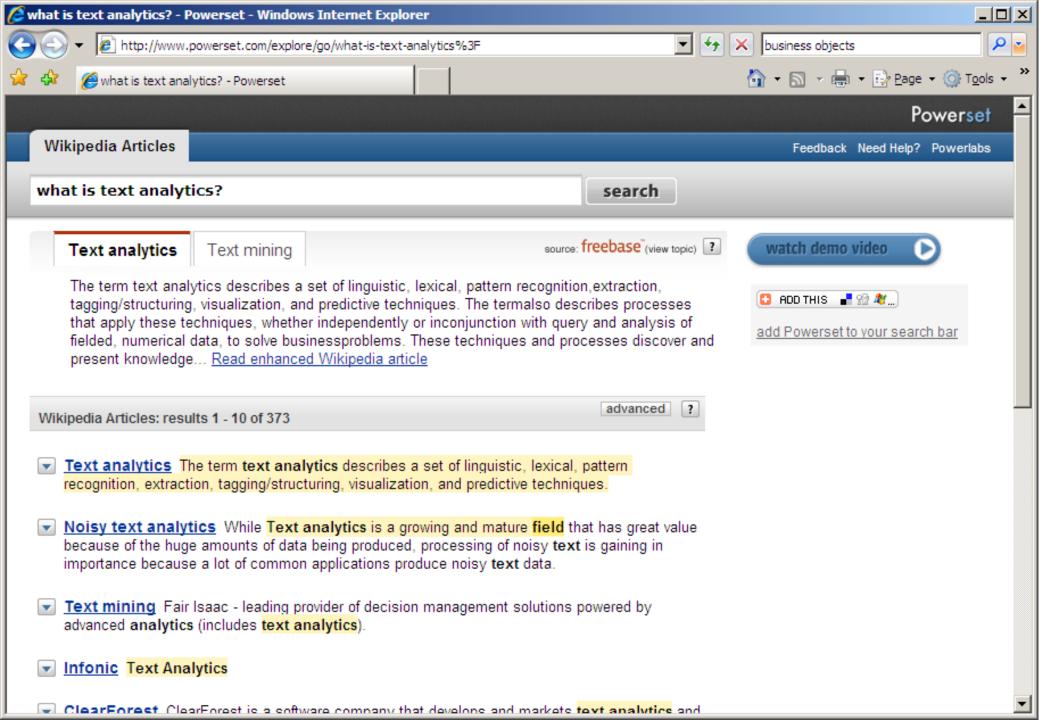
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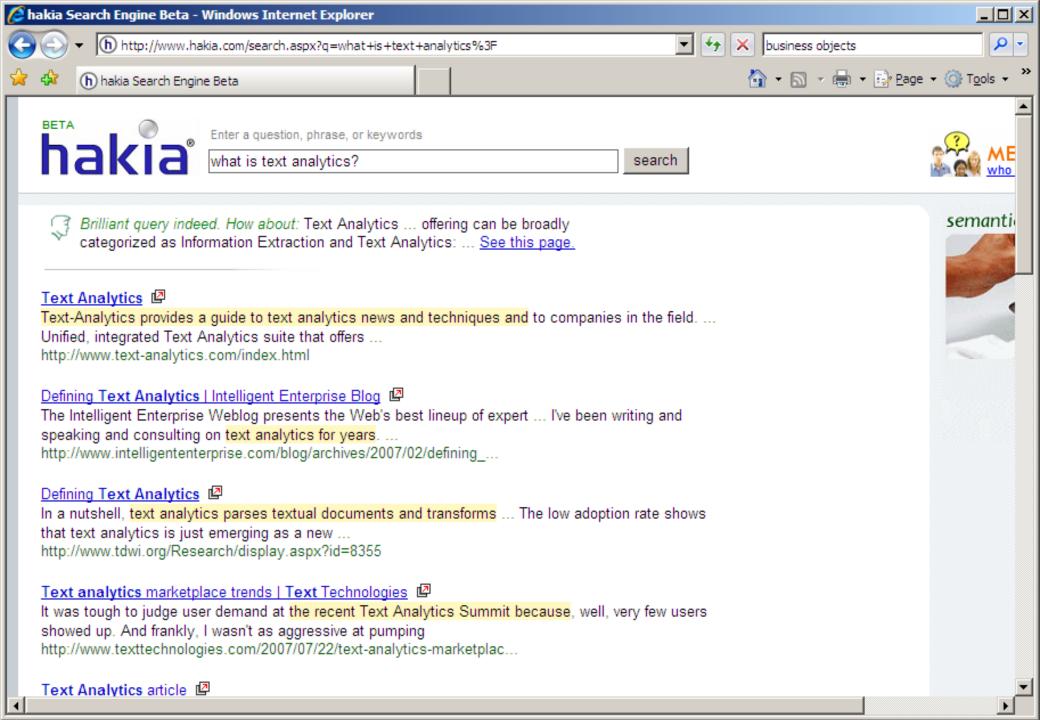
## **Question Answering**

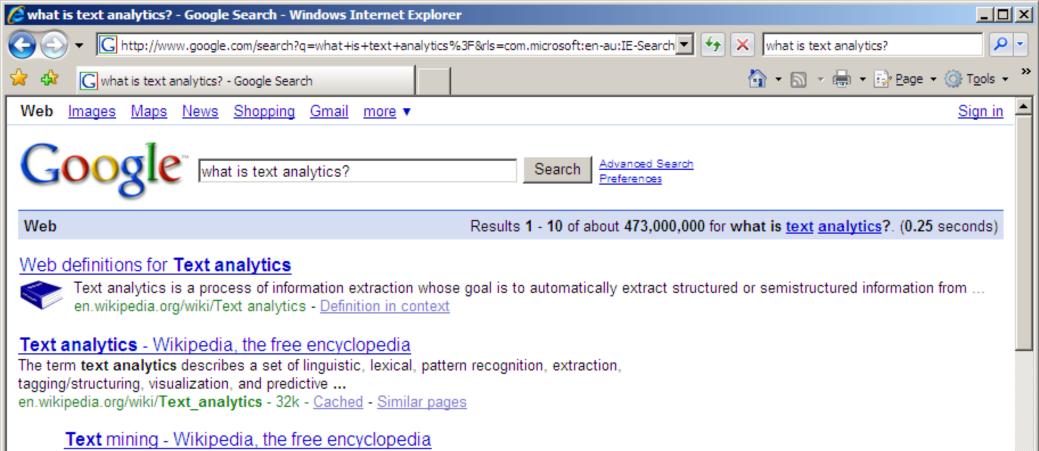
- Current paradigm:
  - Type in a query, get back a list of documents
- Future paradigm:
  - Type in a question, get back an answer











This Overall Analysis System for Intelligence Support (OASIS) integrates among the most advanced text analytics and text mining technologies available on ... en.wikipedia.org/wiki/Text mining - 55k - Cached - Similar pages More results from en.wikipedia.org »

#### TAPoR @ UAlberta - What is Text Analysis?

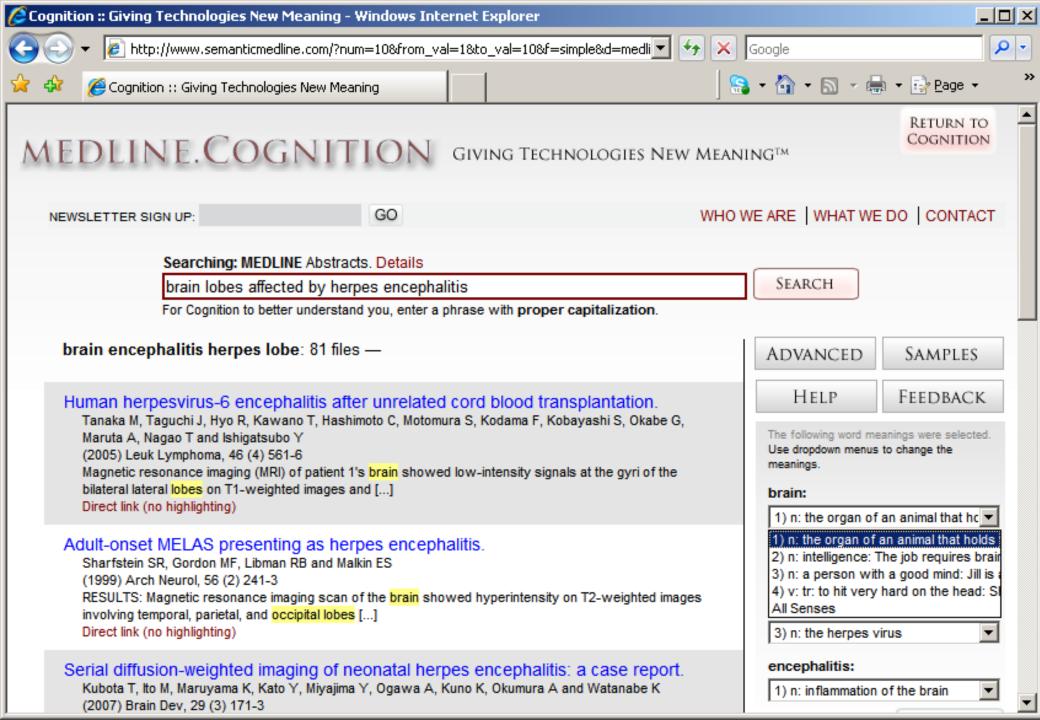
tapor.ualberta.ca/Resources/TAIntro/ - 55k - Cached - Similar pages

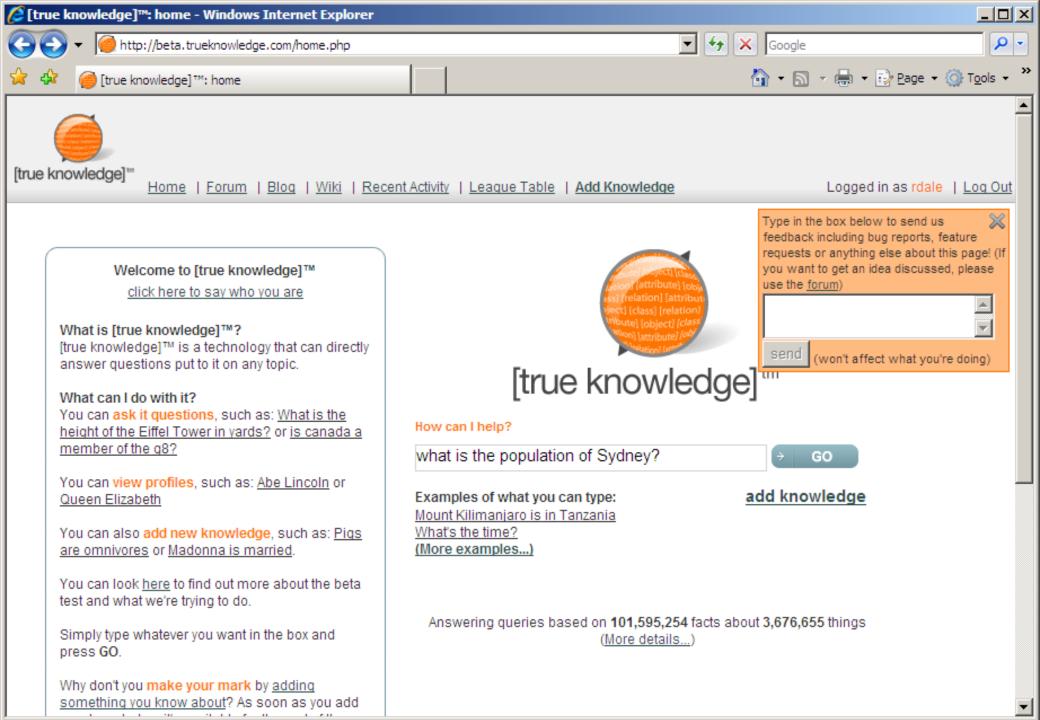
electronic text collections, and journals in the field of digital arts. ...

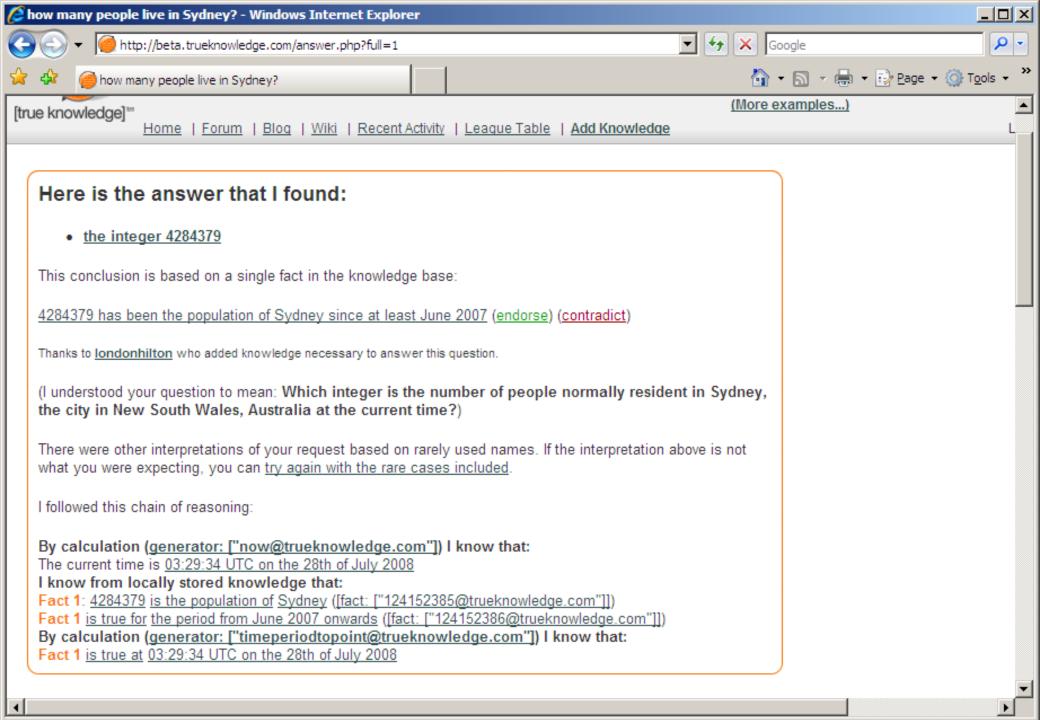
#### Text Analytics Wiki: Welcome to the Text Analytics Wiki

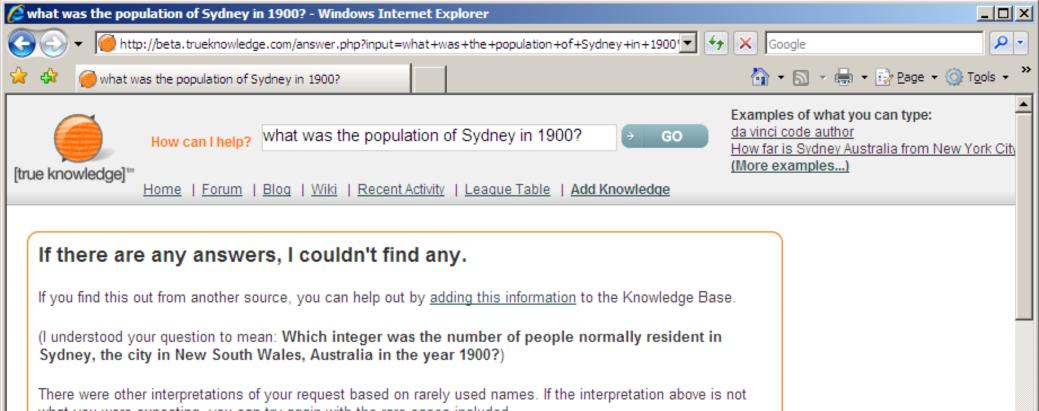
A range of resources including information about text analysis, the TAPoR workshop,

This wiki aims to be a one-stop site for everything related to Text Analytics (also known as Text Mining or Information Extraction). ... textanalytics.wikidot.com/ - 20k - Cached - Similar pages









what you were expecting, you can try again with the rare cases included.

External web pages (using standard web search):

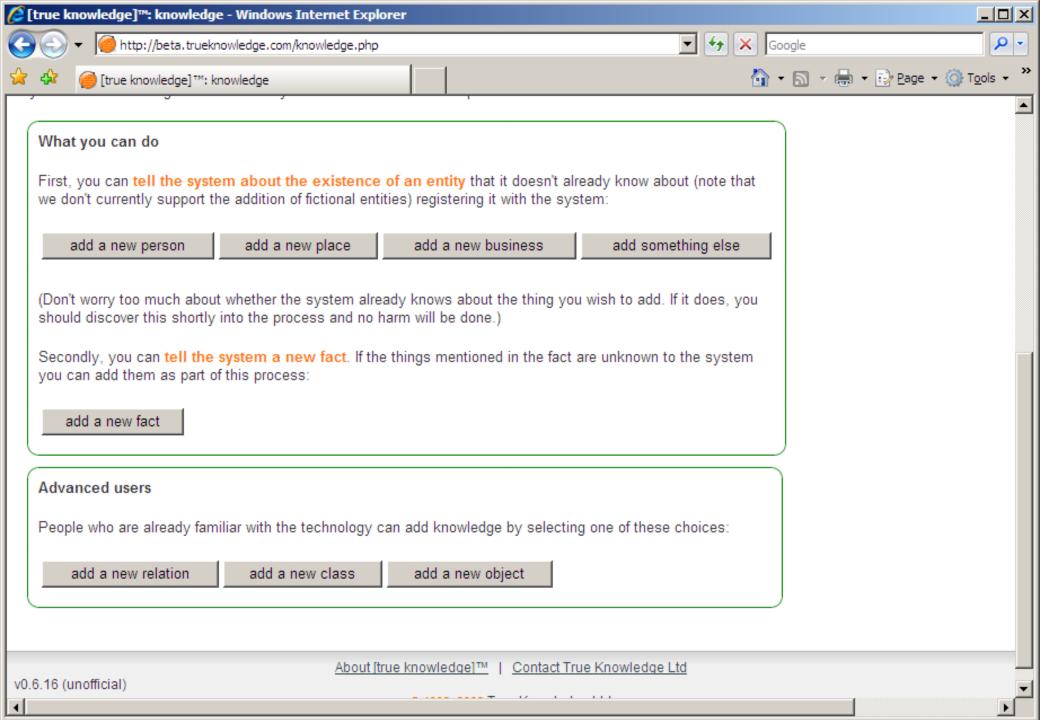
#### 1900 - Wikipedia, the free encyclopedia

1900 From Wikipedia, the free encyclopedia Jump to: navigation , ... 1930s Years : 1897 1898 1899 - 1900 - 1901 1902 1903 1900 by topic

http://en.wikipedia.org/wiki/1900

#### <u>DEMOGRAPHIA: Demographics Development Impacts Market Research & Urban ...</u>

... Louis St. Petersburg Stockholm Sydney Tianjin Tokyo-Yokohama Toronto Vancouver ... USA Metro Areas: USA Metros 1900: USA Smart Growth: Brief USA Cities 2000 USA ... http://www.demographia.com/



# **Issues Affecting Performance**

- Hard to break the 2.3-word-query habit:
  - In our four year 'Just Ask!' experiment, <u>less than 10%</u> of invited questions were actually questions
- 'Deictic' and other context-specific questions:
  - are my phys149 results available?
  - are practicals on this week?

# Other Related Areas Worth Watching

- Machine Translation
- Audio Search and Audio Mining

#### Where We're At

- <u>Search</u> provides 80% of the value of text analytics but this decreasing as document datasets get bigger and bigger
- <u>Text categorisation</u> provides value if implemented appropriately
- <u>Text clustering</u> can help if 100% accuracy is not required
- Text summarisation needs to be tailored to document sets
- Named entity recognition already improves on basic search
- Event recognition is hampered by low accuracy
- Sentiment analysis is this year's hot topic

## What's Coming

- Fact extraction and aggregation: 'open' information extraction
- Cross-document entity tracking
- Multi-document summarisation

## Finding Out More: Industry

- Check out the companies mentioned in this presentation
- Go to the Text Analytics Summit
- Type 'text analytics' into any search engine ...
- Read my 'Industry Watch' column
  - http://www.ics.mq.edu.au/~rdale/publications/industrywatch/

### Finding Out More: Research

- Conferences:
  - The Association for Computational Linguistics
  - Empirical Methods in Natural Language Processing
  - COLING
- Journals:
  - Computational Linguistics
  - Natural Language Engineering
- The ACL Anthology: http://aclweb.org/anthology-new/

#### Finding Out More: Do a PhD!

- Current topics being pursued at the Centre for Language Technology include:
  - Extracting tabular information from documents
  - Identifying requests and commitments from emails
  - Tracking entities across documents
  - Automatic agenda construction from UN documents
- High-value PhD scholarships available via the Capital Markets Cooperative Research Centre

# **Questions?**