

A Framework for Pattern Analysis

Nello Cristianini

A Framework

- Establish
 - Notation
 - Terminology
 - Settings

Data: X

- **DATA** is any information that is **given** to us about the system / phenomenon / event / ... of interest
- It is the result of **OBSERVATIONS** (measurements) OF **SOME ASPECT OF NATURE**
- DATA can be
 - a sequence of nucleotides
 - a social network,
 - a set of networks,
 - a text, (or a set of documents)
 - a set of points on a map,
 - an image,
 - a set of images,
 - etc... etc...
- We denote our DATA by X

Patterns

- We choose to define patterns in a data-dependent way:
patterns are properties of data X
(not of distributions, or anything else)
- Here we define it in terms of a pattern function:
- Definition (**Pattern function**)
A pattern function is any real-valued function π of the data X.
- $\pi : X \rightarrow \mathbb{R}$
- $\pi : X \rightarrow \rho(X)$
- E.g.: the largest set of aligned points on a map of megalithic sites, the misfit of the pulsar signal, the frequency of Nile floods,...

Pattern and Pattern Strength

- Definition (**Pattern**):
A pattern is the equality of the pattern function with a certain number $\pi \in \mathbb{R}$
 $\pi(X) = \pi$
- Definition (**Pattern strength**)
- The value $\hat{\pi}$ is referred to as the pattern strength

(Typically, one defines pattern functions such that the larger strengths are more interesting.)

Patterns in data

- To speak about a pattern, we need to speak about
- Data X
- A pattern function: $\pi : X \rightarrow \mathbb{R}$
- The value of the pattern function on the data, which is the pattern strength

$$\pi(X) = \hat{\pi}$$

Task for you: can you identify these quantities for every method explained in this school ?

The Pattern Space

- It often makes sense to consider a space of pattern functions
with $\pi: X \rightarrow \mathbb{R}$

$$\pi \in \Pi$$

- For example: the set of pattern functions π_i counting the number of nucleotides G following position i in the DNA sequence
- ATGCGCGSTAGCGT
- **Definition (Pattern space Π)**
- Pattern functions π belong to a so-called pattern space Π , the set of all pattern functions

- WORK THROUGH LEYLINES EXAMPLES
- IDENTIFY ALL ELEMENTS OF PATTERN ANALYSIS
 - Data
 - Patterns
 - Null model
 - Search strategy
 - Matching vs. discovery

Tandem repeats in DNA

Example (Tandem repeats in .junk.-DNA)

Certain parts of the DNA show a considerable amount of variation.

E.g. the D7S820 genetic locus:

- aatthttgta ttttttag agacggggtt tcaccatggt ggtcaggctg
- actatggagt tattttaagg ttaatata taaagggtat gatagaacac
- ttgtcatagt ttagaacgaa ctaacgatag atagatagat agatagatag
- atagatagat agatagatag atagacagat tgatagttt ttttatctc
- actaaatagt ctatagtaaa catttaatta ccaatattg gtgcaattct
- gtcaatgagg ataaatgtgg aatcgttata attcttaaga atatatattc
- cctctgagtt ttgatacct cagatttaa ggcc

The length of this sequence is subject to large variation... due to varying numbers of repeats of .atag.(17 times here.)

Example

- Data: X is the DNA sequence of locus D7S820
- Pattern function: $\pi(X)$ is the frequency of the substring atag in X .
- Let's write $\pi_{\text{atag}}(X)$
- The pattern strength is here 17, i.e. $\pi_{\text{atag}}(X)=17$.

Example (Tandem repeats in 'junk'-DNA)

Certain parts of the DNA show a considerable amount of variation.
E.g. the D7S820 genetic locus:

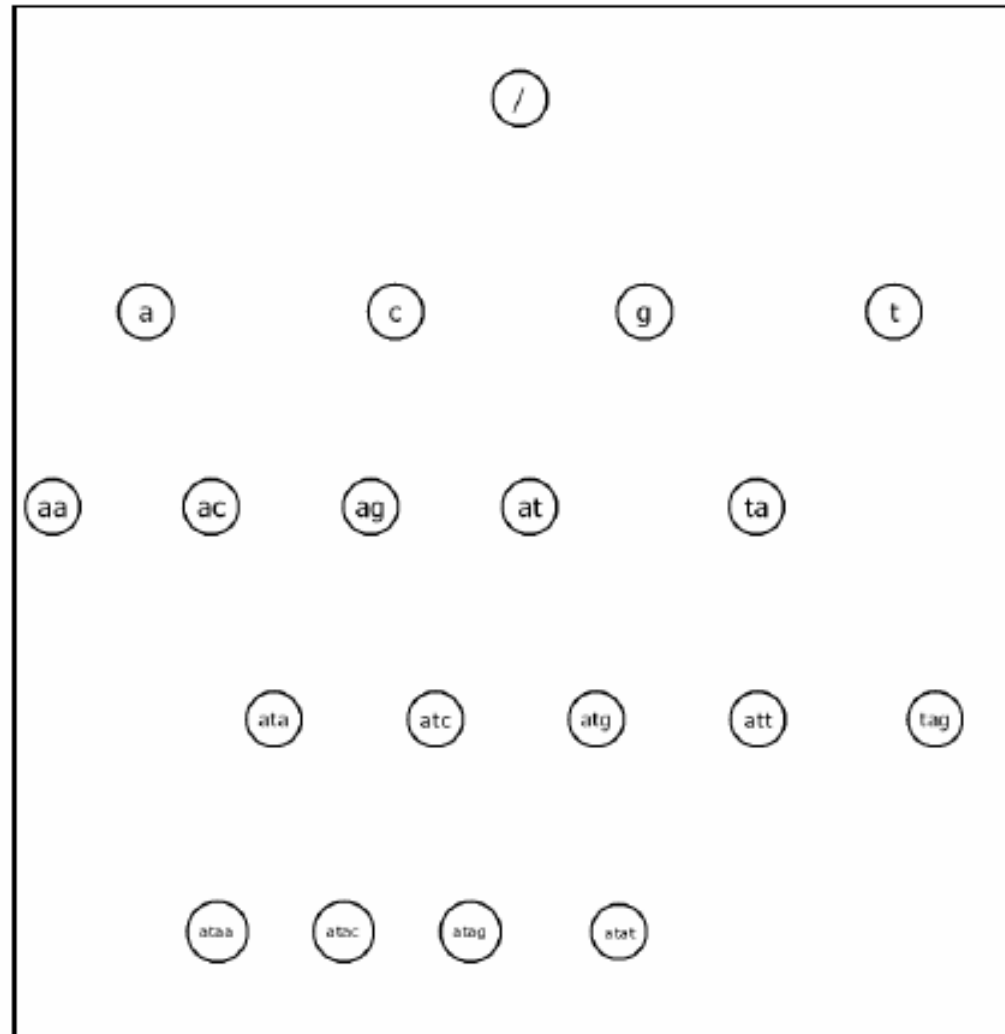
```
aatTTTTgta ttttttttag agacgggggtt tcaccatggtt ggtcaggctg  
actatggagt tattttaagg ttaatata taaagggtat gatagaacac  
ttgtcatagt ttagaacgaa ctaacgatag atagatagat agatagatag  
atagatagat agatagatag atagacagat tgatagtttt tttttatctc  
actaaatagt ctatagtaaa catttaatta ccaatatttg gtgcaattct  
gtcaatgagg ataaatgtgg aatcgttata attcttaaga atatataattc  
cctctgagtt tttgatacct cagattttaa ggcc
```

The length of this sequence is subject to large variation... due to varying numbers of repeats of 'atag' (17 times here.)

- Data: X is the DNA sequence of locus D7S820
- Pattern function: $\pi(X)$ is the frequency of the substring $atag$ in X . Let's write $\pi_{atag}(X)$
- The pattern strength is here 17, i.e. $\pi_{atag}(X) = 17$.

Tandem repeats in DNA

- Π contains functions counting a substring's frequency
- $\pi_{\text{substring}} \in \Pi$, *parameterised* by such substring
- Exploring the pattern space \Leftrightarrow exploring this substring/parameter space



Definition (Pattern Visualization)

The visual representation of a pattern $\pi(X) = \hat{\pi}$.

- Not a simple task – and a matter of taste
- Depends on what type of pattern to visualize
- Using graphs, networks, pictures, tables,...

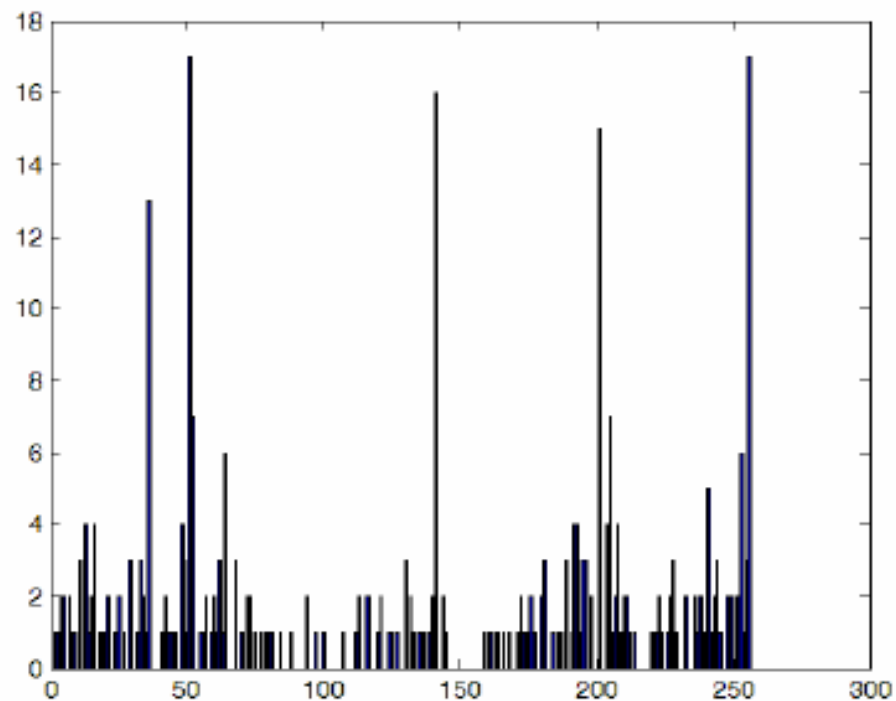
Example (Tandem repeats in 'junk'-DNA)

Visualization can be as simple as this:

```
aatTTTTgta ttttttttag agacgggggtt tcaccatggt ggTcaggctg
actatggagt tattttaagg ttaatata taaagggtat gatagaacac
ttgtcatagt ttagaacgaa ctaacgatag atagatagat agatagatag
atagatagat agatagatag atagacagat tgatagtttt tttttatctc
actaaatagt ctatagtaaa catttaatta ccaatatttg gtgcaattct
gtcaatgagg ataaatgtgg aatcgttata attcttaaga atatatatc
cctctgagtt tttgatacct cagattttaa ggcc
```

Example (Tandem repeats in 'junk'-DNA)

This is a different visualization:



Many more can be made up...

Pattern evaluation (pattern matching)

Definition (Pattern Evaluation)

Evaluating the pattern function π on the data X is the computation of $\pi(X)$

- In nearly all practical cases, pattern evaluation is easy
- In some cases, pattern evaluation can only be done approximately
- Very often identical to what is known as 'pattern matching'

Pattern evaluation (pattern matching)

Example (Tandem repeats in 'junk'-DNA)

- Here, pattern evaluation amounts to the counting of the occurrences of 'atag' in the given string X
- At the same time, the occurrences may be remembered e.g. for visualization purposes
- Exercise: can you devise an efficient way to evaluate this pattern function, i.e. counting the frequency of a given substring?

Pattern discovery

Definition (Pattern Discovery)

The discovery of an 'interesting' pattern from the pattern space

- The hardest task in practice
- The most interesting task as well...

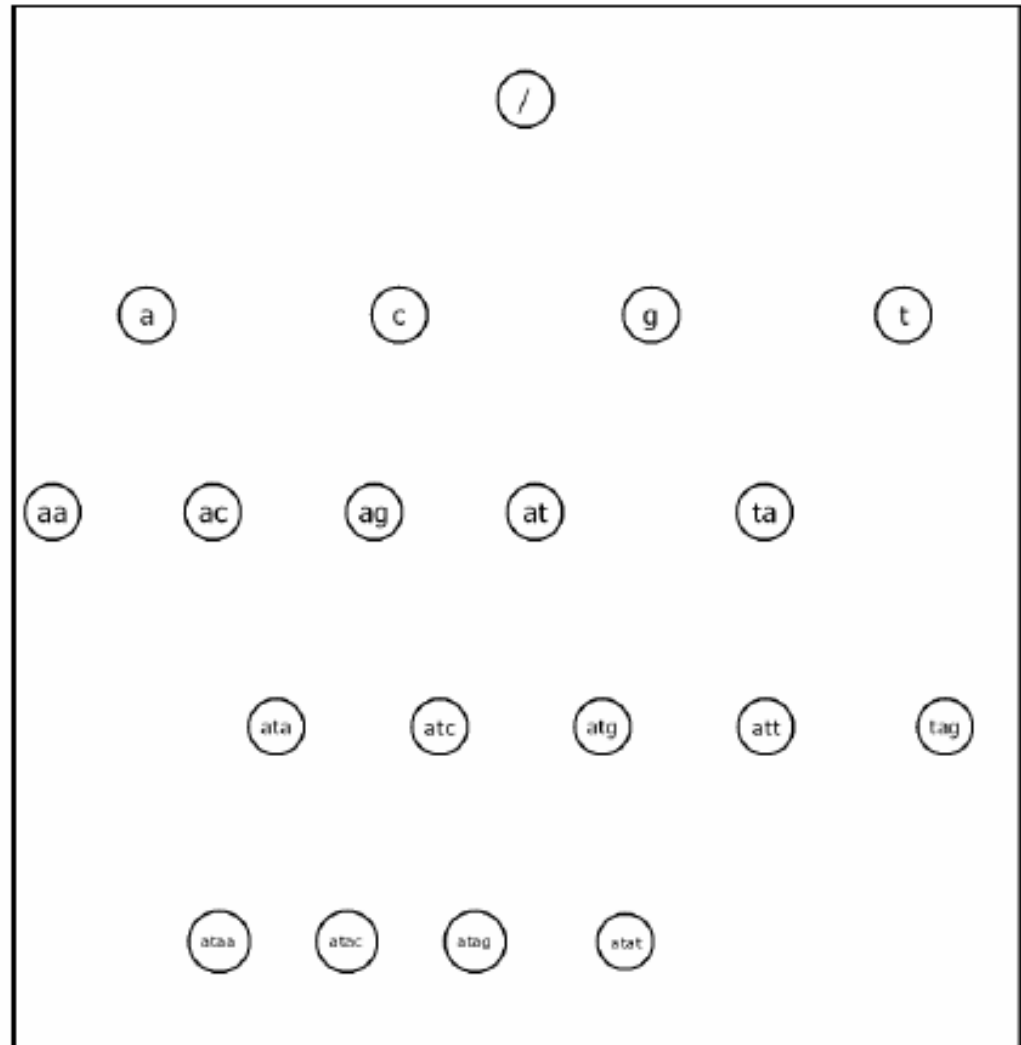
Pattern discovery

Example (Tandem repeats in 'junk'-DNA)

- What if the substring '*atag*' was not specified?
- How to come up with an interesting pattern?
- Explore the pattern space in search for one
- Or, equivalently, explore the parameter space, here the space of all substrings

Pattern discovery

- Now, what is 'interesting'?
- And do we really want to explore the complete pattern space?
- To answer these questions, let us consider our running example once more



A partial order between pattern functions

Example (Tandem repeats in 'junk'-DNA)

If 'atag' occurs 17 times, what can we say about 'ata'? And about 't'? In any case that they occur at least 17 times – and similarly, that 't' occurs more often than 'ata'.

- We can order the pattern functions according to the so-called natural partial order:

Definition (The Natural Partial Order)

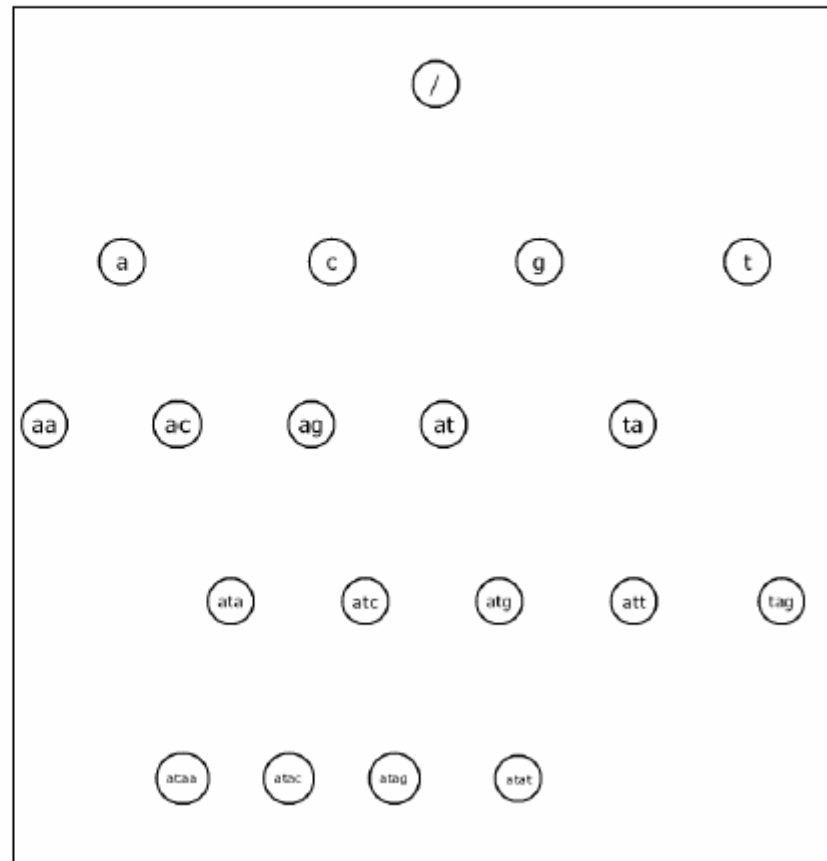
The natural partial order $>_n$ is defined by:

$$\pi_1 \geq_n \pi_2 \Leftrightarrow \pi_1(X) \geq \pi_2(X) \quad \forall X \in \mathcal{X}$$

- E.g., $\pi_{atag} \leq_n \pi_{ata} \leq_n \pi_t$
- $\pi_s \leq_n \pi_{s'}$ if s' is a substring of s (substring partial order)

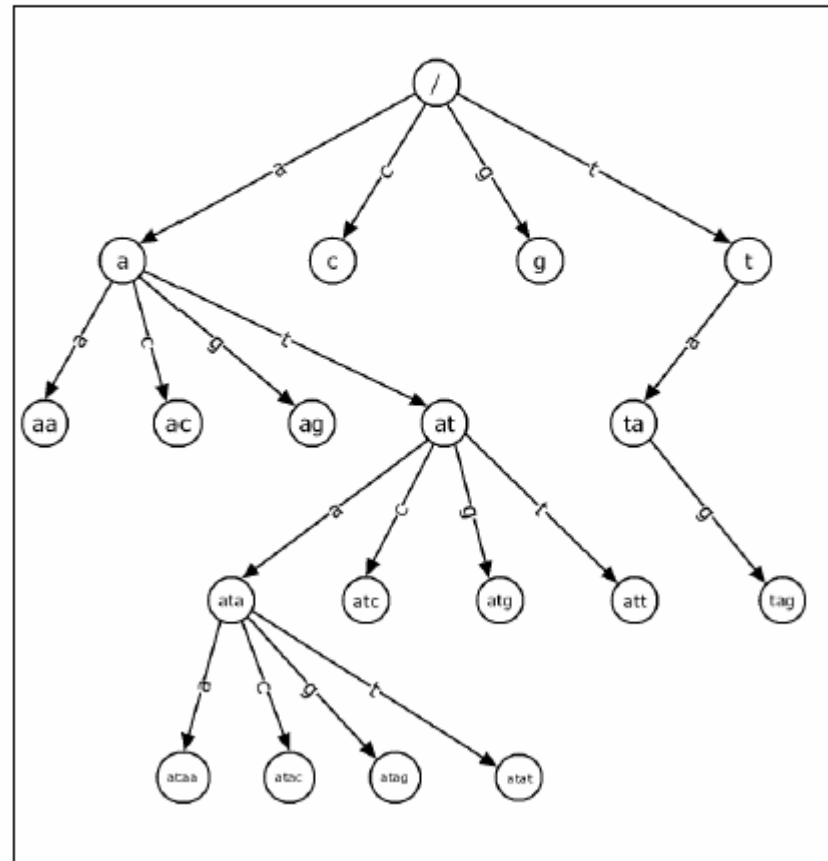
A partial order between pattern functions

- Unclear if a larger pattern strength for a naturally larger pattern function is of any interest...
- Only look at pattern functions of a certain depth in the natural partial order!



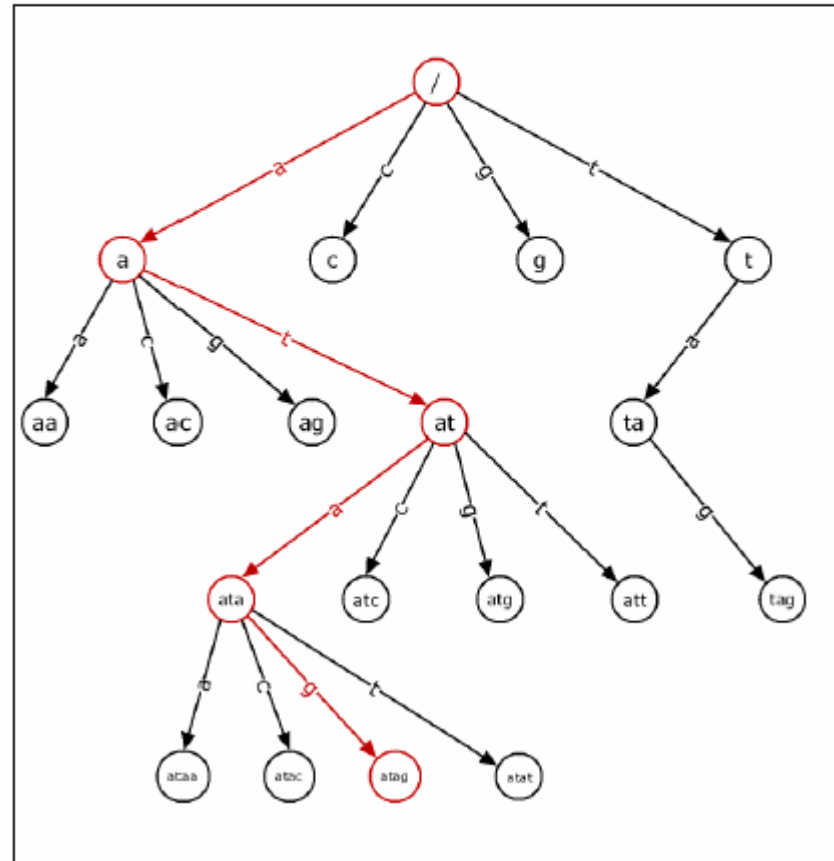
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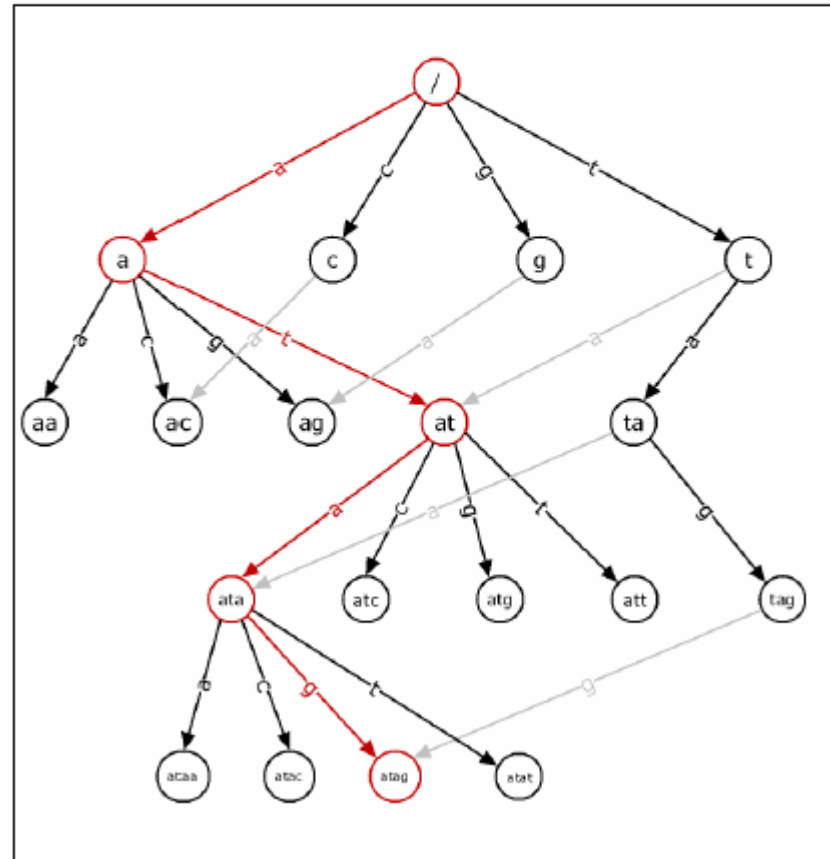
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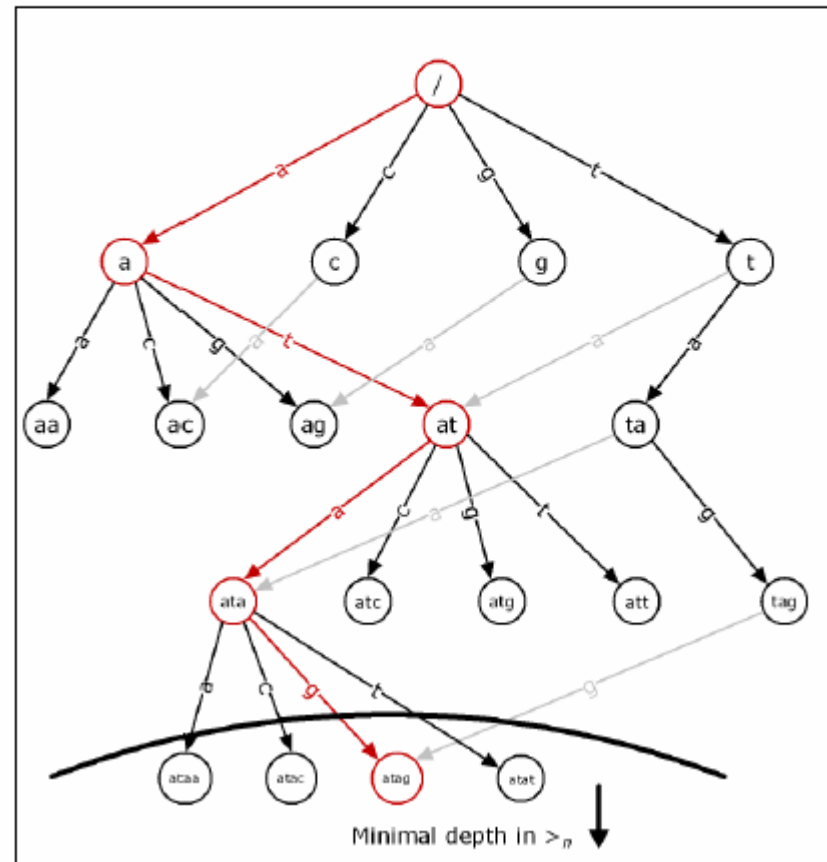
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A partial order between pattern functions

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- Only look at pattern functions of a certain depth in the natural partial order!



A partial order between pattern functions

- For convenience: define a functional that maps pattern functions to the reals
- In this example: minus the length of the substring counted
- $C(\pi_{atag}) = -4$

Definition (Capacity functional)

A capacity functional C is a functional that maps each pattern function $\pi \in \Pi$ to a real number:

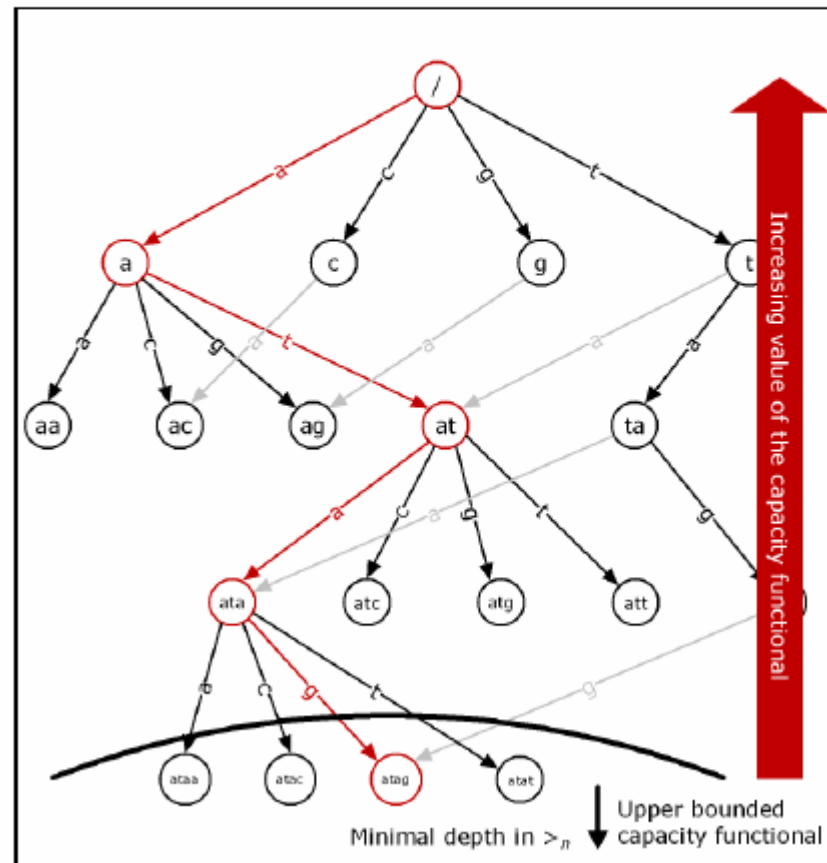
$$C : \Pi \rightarrow \mathfrak{R} : \pi \rightarrow C(\pi)$$

We choose it so that it is monotonically decreasing down the natural partial order:

$$\pi_1 \geq_n \pi_2 \Rightarrow C(\pi_1) \geq C(\pi_2)$$

A partial order between pattern functions

- For convenience: define a functional that maps pattern functions to the reals
- In this example: minus the length of the substring counted
- $C(\pi_{atag}) = -4$



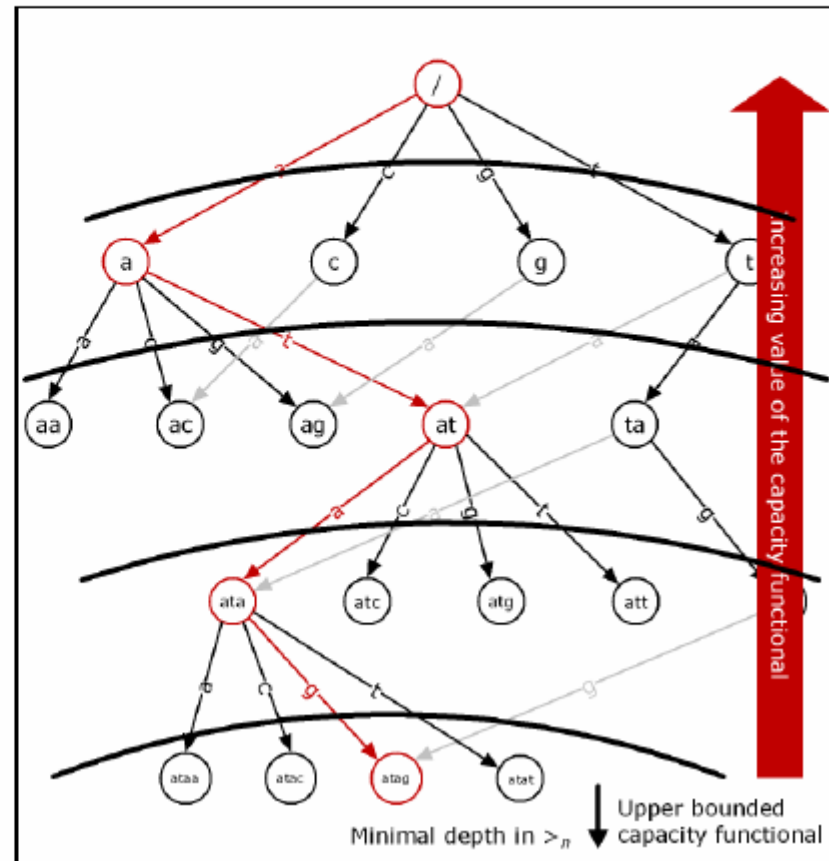
Stratification

Then we can stratify the pattern space in subspaces by defining

$$\Pi_c = \{\pi \in \Pi : C(\pi) < c\}$$

for which

$$\Pi_{c_1} \subseteq \Pi_{c_2} \Leftrightarrow c_1 \leq c_2$$



Pattern discovery: stratification formulation

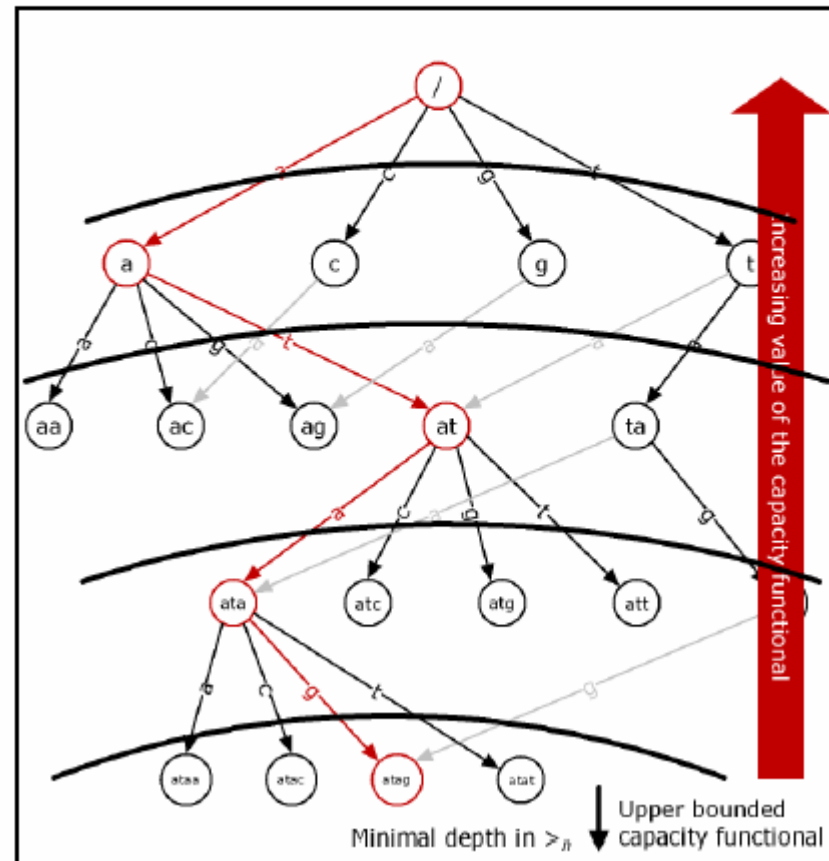
- Stratification:

$$\begin{aligned} \max_{\pi} \quad & \pi(X) \\ \text{s.t.} \quad & C(\pi) < c \end{aligned}$$

- Restrict pattern space to $\Pi_c = \{\pi : C(\pi) < c\}$

Example (Tandem repeats in 'junk'-DNA)

Find the most frequent substring of minimal length



Pattern discovery: regularisation formulation

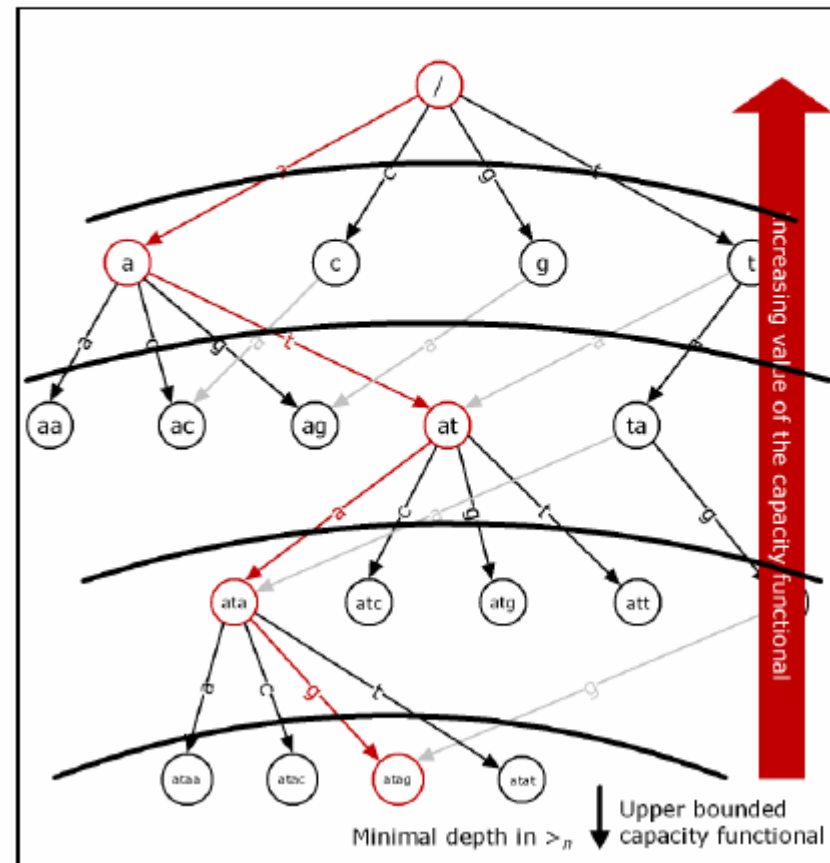
- Regularisation:

$$\begin{aligned} \min_{\pi} \quad & C(\pi) \\ \text{s.t.} \quad & \pi(X) > \hat{\pi} \end{aligned}$$

- Somehow equivalent...

Example (Tandem repeats in 'junk'-DNA)

Find the longest substring of minimal frequency



Other formulations

- Other (intermediate) formulations exist, e.g.

$$\max_{\pi} \pi(X) - \gamma C(\pi)$$

Example (Tandem repeats in 'junk'-DNA)

Informally: find a substring that trades off length and frequency

- γ is commonly known as the *regularisation parameter*
- Take home message: (nearly) all pattern discovery problems can be written in terms of a *data independent* capacity functional and a *data dependent* pattern strength

Notes on the capacity functional

- Taking C to decrease monotonically down the natural partial order \geq_n ensure we exclude trivially large patterns
- Sometimes, it is hard to identify \geq_n , and a corresponding C
- However, C does not *have to* vary monotonically over \geq_n
- Any choice of C will reduce the choices, and the risks of finding a trivially large and meaningless solution
- We'll make this more rigorous later!

Conclusion

- We have set up a formal framework of pattern analysis
- It is very general (we think)
- In the next 2 weeks you will find out how pattern discovery is carried out, and before that how we can interpret the results (the discovered pattern) statistically
- Later weeks: applications of these ideas to specific problems

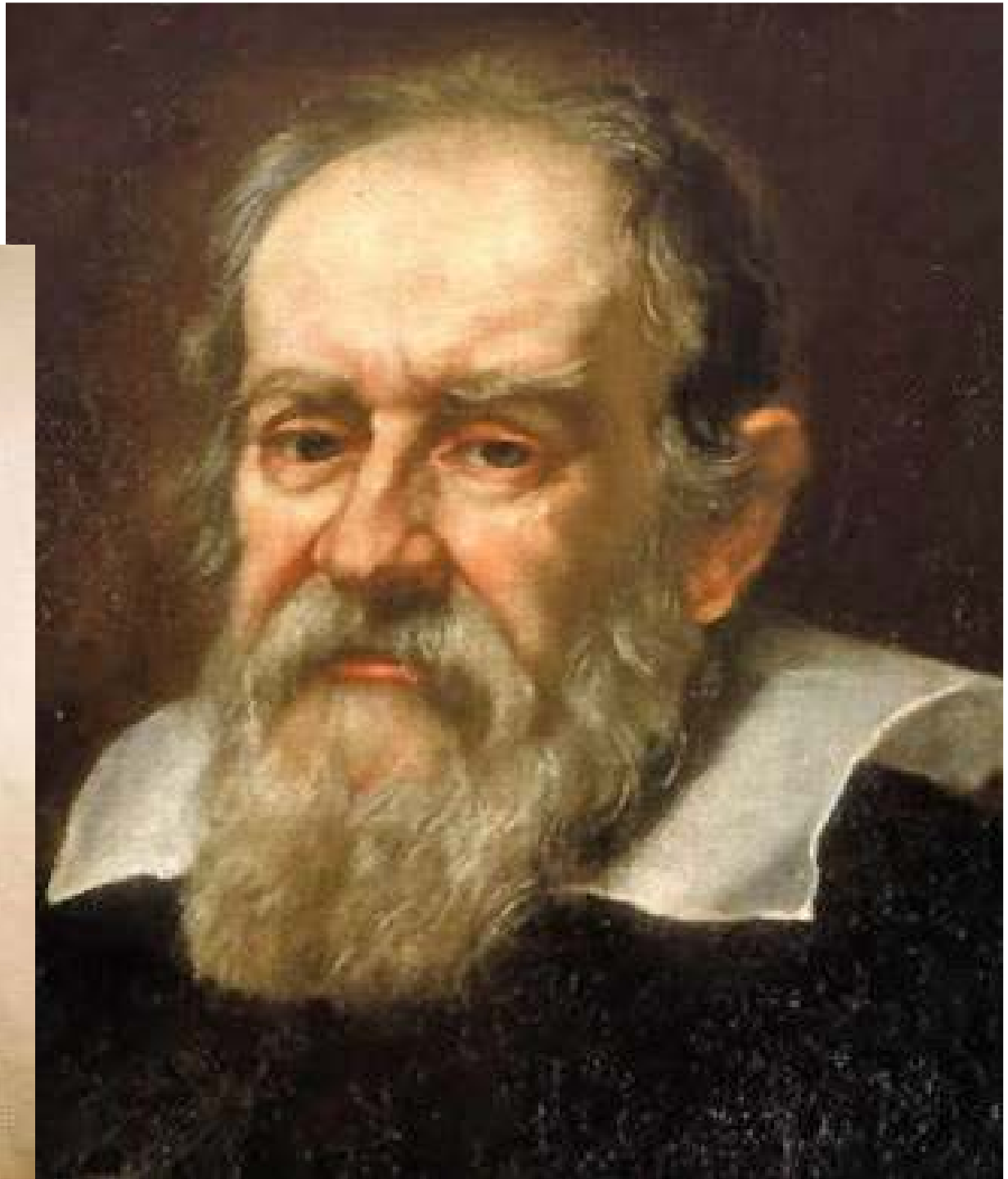


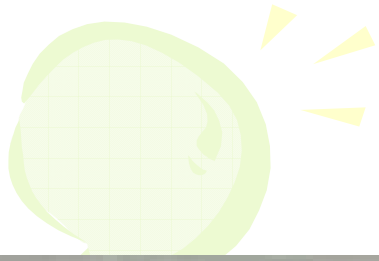
**Patterns in
Data**

and Scientific Method

**Nello Cristianini
University of Bristol**

Venice 1609

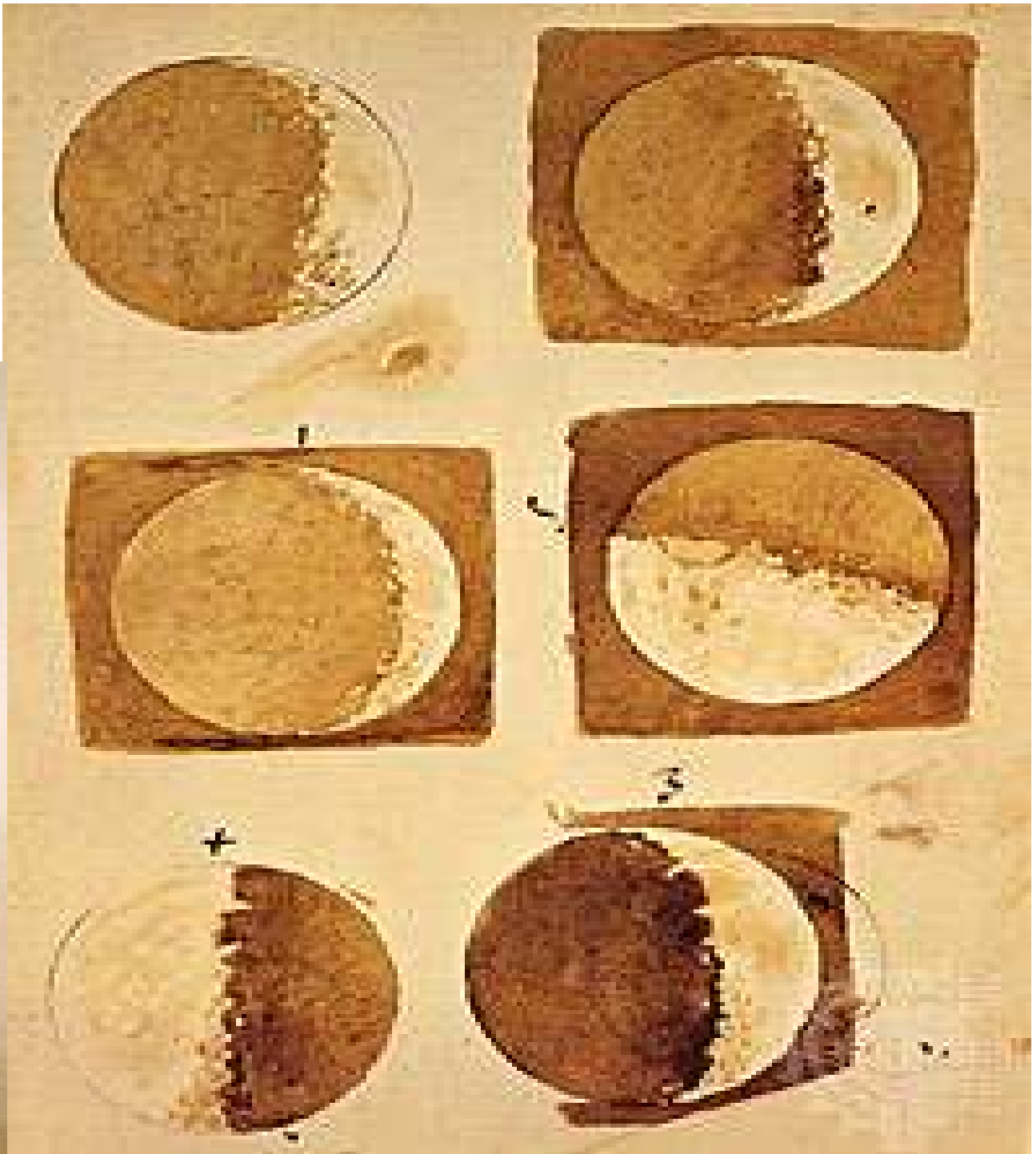
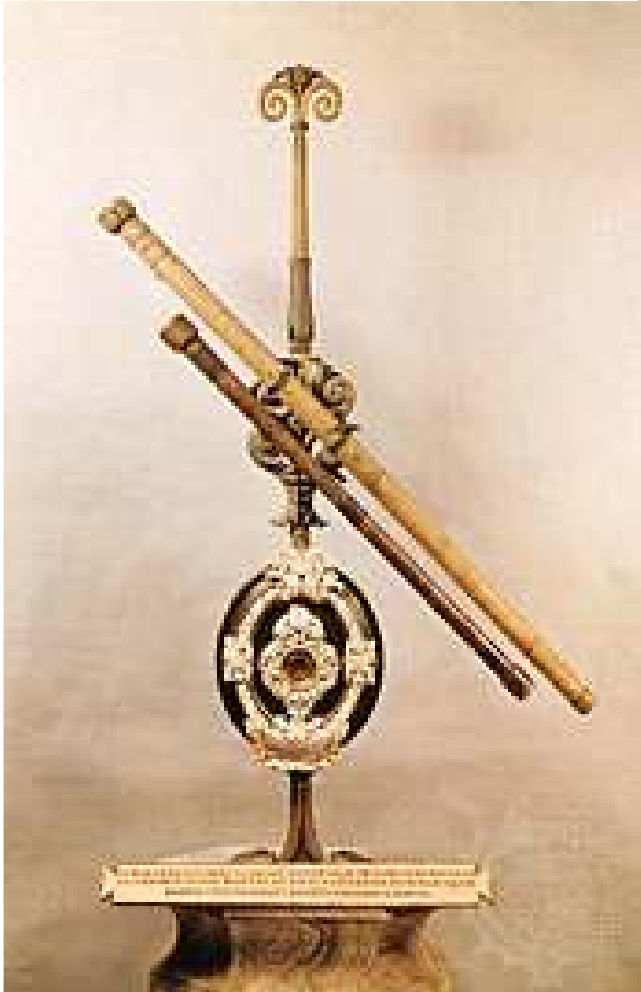




Venice, 1609



Discovery





The slide features three decorative lightbulb icons on the left side. The top one is green, the middle one is blue, and the bottom one is purple. Each lightbulb has a grid pattern on its surface and several yellow triangular rays emanating from the top, suggesting they are lit. The title 'Implications' is centered at the top in a large, bold, dark blue font.

Implications

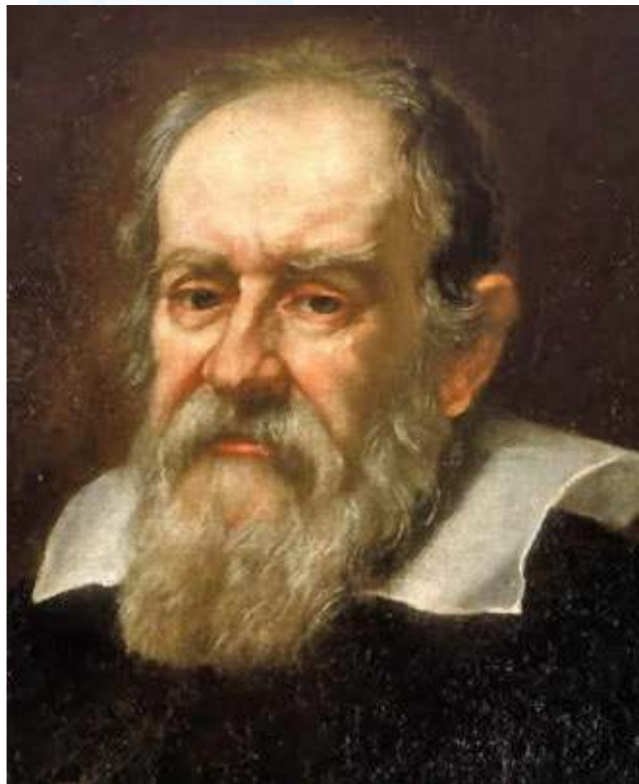
- The implications of these observations were not just for astronomy
- They were philosophical, theological, methodological



The Scientific Method

- Formalised, standardised, systematic process of knowledge acquisition
 - Various repeatability criteria for data generation
 - Experiment-hypothesis cycle is a standard technique for hypothesis generation
 - Usage of mathematics or other formal languages to express knowledge where possible
 - (other techniques we came up with: double blind, peer review, ...)
- 
- 

Publication



S I D E R E V S N V N C I V S

MAGNA, LONGEQVE ADMIRABILIA
Spectacula pandens, suspiciendaque proponens
vnicuique, præfertim verò

PHILOSOPHIS, atq; ASTRONOMIS, que à

G A L I L E O G A L I L E O P A T R I T I O F L O R E N T I N O

Patauini Gymnasij Publico Mathematico

P E R S P I C I L L I

*Nuper à se reperti beneficio sunt obseruata in LVNÆ FACIE, FIXIS IN-
NUMERIS, LACTEO CIRCVLO, STELLIS NEBVLOSIS,*

Apprime verò in

Q V A T V O R P L A N E T I S

*Circa IOVIS Stellam disparibus interuallis, atque periodis, celesti-
tate mirabili circumuolutis; quos, nemini in hanc vsque
diem cognitos, nouissimè Author depre-
hendit primus; atque*

M E D I C E A S I D E R A

N V N C V P A N D O S D E C R E V I T .


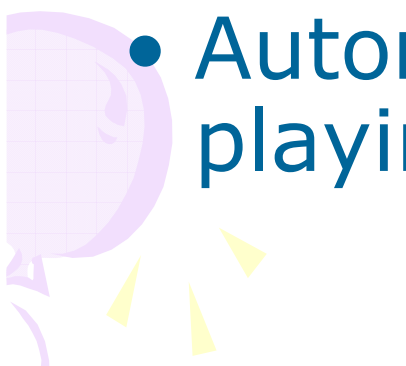


VENETIIS, Apud Thomam Baglionum. M D C X.

Superiorum Permissu, & Priuilegio.



A Revolution under way

- Things are changing under our eyes
 - Disruptive innovation is currently changing scientific method not in a quantitative – but in a qualitative – way
 - Automated Pattern Analysis is playing a central role in this
- 
- 

SEQUENCING

- Tera bytes

...



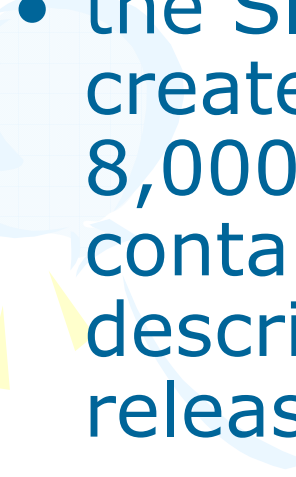
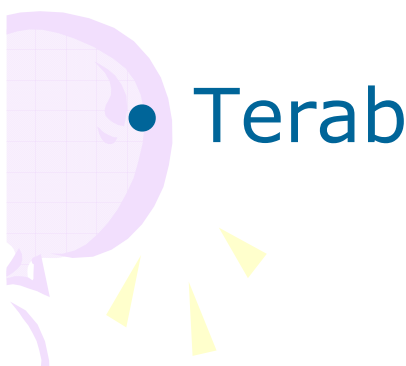
LHC

- 15 petabytes per year







Astronomy

- Automated Sky Surveys
 - the Sloan Digital Sky Survey (SDSS) created a 5-wavelength catalogue over 8,000 square degrees of the sky, containing about 200 million objects, described by hundreds of features (data released incrementally to the public).
 - Terabytes...
- 
- 



Chemistry

- Combinatorial Chemistry

- 
- Hundreds of thousands of compounds can be generated and tested, either by using robotics, or – increasingly - by computer simulations, in what is essentially a survey of entire regions of chemical space, hunting for compounds with a given set of properties.
- 

A Google DATACENTER


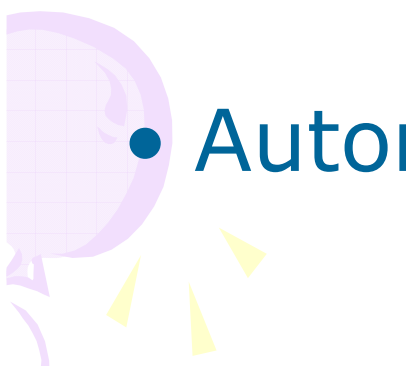


Many Google DATACENTERS





The “Industrial Revolution”

- High quality experimental information is **AUTOMATICALLY** produced on massive scale
 - Data is **AUTOMATICALLY** analysed by pattern discovery software, which can **GENERATE HYPOTHESES**
 - Automation of scientific process
- 
- 

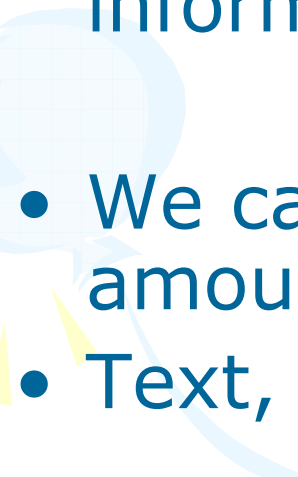
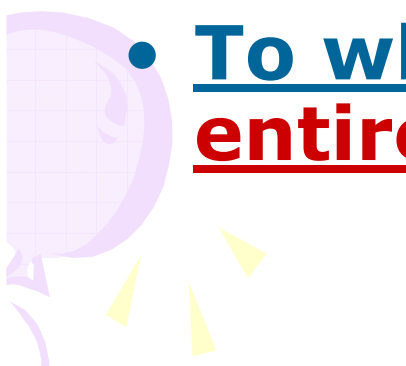


Implications

- The automated generation of data and hypotheses is today part of the scientific method
- The implications are philosophical



Pattern Analysis

- Various disciplines have contributed to this
 - Statistics, data mining, machine learning, information theory, ...
 - We can MANAGE and ANALYSE massive amounts of data, of any kind...
 - Text, DNA, graphs, images, times series, ...
 - **To what extent can we automate the entire process of scientific discovery?**
- 
- 

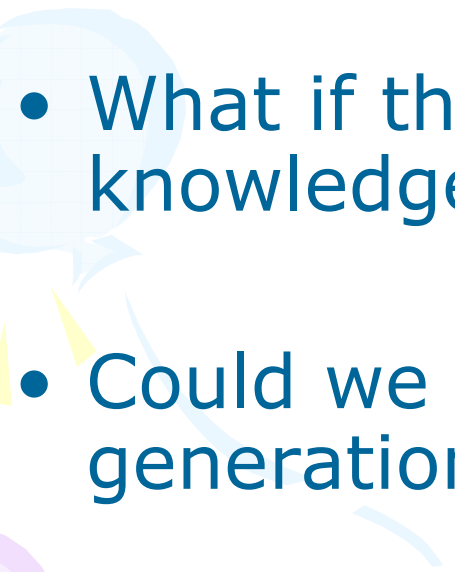



Closing the Loop

- This month in Science: two articles on the automated generation of scientific knowledge
- One of them included closed loop: automation of experimental design too...

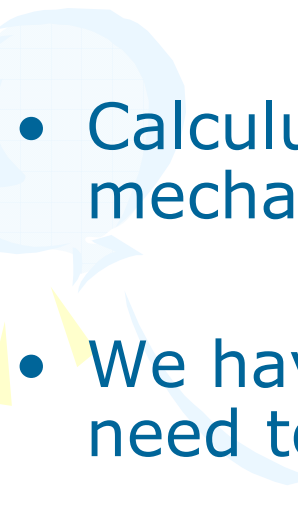



Closing the Loop

- Do we **need** scientific knowledge to be human-readable?
 - What if the main or sole consumers of that knowledge were **other machines**?
 - Could we be **cut out** of the knowledge generation loop (eventually)?
 - See [Amazon.com](https://www.amazon.com)...
- 
- 





Readability

- Galileo pioneered the use of mathematical expressions to summarise the results of his experiments
 - Calculus later emerged and co-evolved with mechanics
 - We have come to expect that scientific theories need to be expressed by mathematical equations
 - They do not need to be...
- 
- 



Pattern Analysis

- The set of principles behind most successful algorithms in PA is actually quite small
 - Efficient search and optimisation in vast pattern spaces
 - Effective control of multiple testing issues, by use of sharp statistical tools
 - Principles that unify all, from suffix trees to itemset mining, from graphical models to kernel methods
- 
- 





Science

- How can this vast toolbox, and this conceptual framework, help us to acquire more scientific knowledge?
- Improbable domain... the SOCIAL sciences...



Social Sciences

- Example: media content analysis
 - Professor + students + newspapers + VCR + various weeks of work = 'coding' of news-items
 - Important discoveries, all done by hand
 - Advanced text-mining can change that...
- 
- 

NewsPatterns - Saturday 21 June 2008

Monitoring 454 News Outlets and 6 Languages.
 Read more...



- Read (18,79)
- Barack Obama (12,290)
- Jamie Lynn Spears (18)
- Other (61,89)

- People Today**
- Read (73)
 - Barack Obama (45)
 - John McCain (23)
 - Bush (20)
 - Britney Spears (19)
 - Jamie Lynn Spears (18)**
 - Robert Mugabe (14)
 - Amy Winehouse (11)
 - Candoleezza Rice (10)
 - Tim Russert (8)

- Organisations Today**



Jamie Lynn Spears (18)

Jamie Lynn gives birth
 20 Jun 2008 04:16:27 GMT

It's a girl, y'all! Jamie Lynn Spears gave birth to Maddie Briann this morning at Mississippi Southwest Regional Medical Center in McComb, Miss. It's the first child for the 17-year old Zoey 101 star and her fiance, 19-year old
 Read more...

Jamie Lynn Spears Has a Baby Girl
 20 Jun 2008 04:16:14 GMT

There is a new baby in the Spears clan! Jamie Lynn Spears and her fiance Casey Aldridge welcomed a baby girl Thursday morning. PEOPLE confirms exclusively that the baby was named Maddie Briann. "Just the family was there," says a source about the birth around 9:30 a.m. at a hospital in Mississippi, near her Louisiana hometown. "Everyone
 Read more...

Report: Spears Gives Birth To Girl, Maddie
 20 Jun 2008 04:15:22 GMT

People magazine reports that Britney Spears' younger sister, Jamie Lynn Spears, has given birth.
 Read more...

Search Today's News

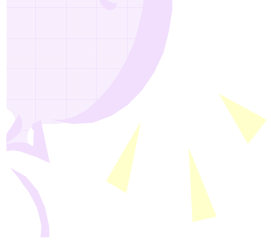
Locations Today

- U.S. (157)
- China (58)
- New York (27)
- Japan (27)
- Washington (26)
- London (24)
- United States (21)
- Iraq (20)
- India (20)
- Britain (26)
- More >

Sequence

- chung san sui fly (3)
- ile de france (4)
- nicolas Sarkozy (4)
- the treaty of lissabon (3)
- the heads of state (4)
- summit in brussels (3)
- of the european union (3)
- secretary of state for sports (2)
- the second round of G2
- around paris (3)
- More >

Sequence from Translated Spanish



NewsPatterns - Mozilla Firefox
 http://newspatterns.enn.bris.ac.uk/

NewsPatterns - Saturday 21 June 2008

Monitoring 454 News Outlets and 6 Languages.
[Map](#) [Timeline](#) [Social Network](#) [Bar Chart](#) [Text Only](#)

Jamie Lynn Spears Activity

Jamie Lynn Spears Share

People Today

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- Jamie Lynn Spears (18)
- Robert Muzsa (14)
- Ami Winehouse (11)
- Candoleezza Rice (10)
- Tim Russert (9)

Organisations Today

Jamie Lynn Spears (18)

Jamie Lynn gives birth

20 Jun 2008 04:18:57 GMT

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- secretary of state for sports Bernard Laporte (2)
- the second round of OS
- around paris (3)

Sequence from Translated Spanish

Transferring data from newspatterns.enn.bris.ac.uk...

NewsPatterns - Saturday 21 June 2008

Monitoring 454 News Outlets and 6 Languages.
Read more...

Map Timeline Social Network Bar Chart Text Only



Jamie Lynn Spears (18)

Jamie Lynn gives birth

20 Jun 2008 04:18:27 GMT

It's a girl, y'all! Jamie Lynn Spears gave birth to Maddie Briann this morning at Mississippi Southwest Regional Medical Center in McComb, Miss. It's the first child for the 17-year old Zoey 101 star and her fiance, 19-year old
[Read more...](#)

Jamie Lynn Spears Has a Baby Girl

20 Jun 2008 04:16:14 GMT

There is a new baby in the Spears clan! Jamie Lynn Spears and her fiancé Casey Aldridge welcomed a baby girl Thursday morning. PEOPLE confirms exclusively that the baby was named Maddie Briann. "Just the family was there," says a source about the birth around 9:30 a.m. at a hospital in Mississippi, near her Louisiana hometown. "Everyone
[Read more...](#)

Report: Spears Gives Birth To Girl, Maddie

20 Jun 2008 04:15:22 GMT

People magazine reports that Britney Spears' younger sister, Jamie Lynn Spears, has given birth.
[Read more...](#)

Search Today's News

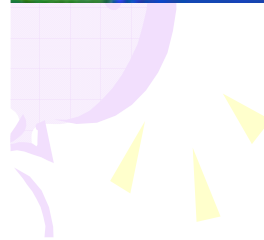
Locations Today

- U.S. (157)
- China (58)
- New York (27)
- Japan (37)
- Washington (26)
- London (24)
- United States (21)
- Iraq (20)
- India (20)
- Britain (26)
- More >

Sequence

- Jung can see fly (3)
- ile de france (4)
- nicolas Sarkozy (6)
- the treaty of Lisbon (3)
- the heads of state (4)
- summit in brussels (3)
- of the european union (3)
- secretary of state for sports Bernard Laporte (2)
- the second round of G8
- around paris (3)
- More >

Sequence from Translated Spanish



Election Watch'08

Election Watch automatically summarises news about the 2008 US Presidential race. [More](#)



Read Activity



Read Share



- Read (31.2%)
- Barack Obama (19.2%)
- John McCain (9.8%)
- Other (39.7%)



Heat Map Map Timeline Bar Chart Word Cloud Text Only



Search

Politicians

- Read (73)
- Barack Obama (45)
- John McCain (23)
- Bush (20)
- Robert Mugabe (14)
- Condoleezza Rice (10)
- Tim Russert (9)
- Gordon Brown (8)
- Ran (7)
- Michelle Obama (7)
- [More >](#)

Read (73)

China to raise fuel prices

20 Jun 2008 04:13:53 GMT

Read full story for latest details.
[Read more...](#)

Thailand braces for anti-government protests

20 Jun 2008 04:13:53 GMT

Read full story for latest details.
[Read more...](#)

French economy forecast to halt

20 Jun 2008 04:13:53 GMT

Read full story for latest details.
[Read more...](#)

Celebrity Watch - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Getting Started Latest Headlines INI laptop login


Celebrity Watch

Celebrity Watch summarises the World's hottest celebrity gossip news! [Read more...](#)

David Beckham Activity

0 1 2 3 4 5 6 7 8

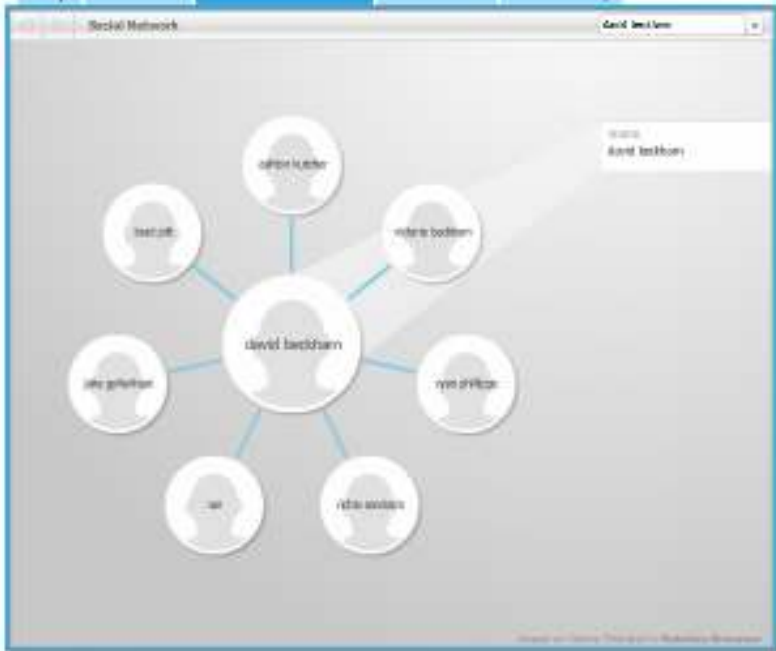
David Beckham Share



- Read (25.1%)
- Barack Obama (15.5%)
- David Beckham (7.5%)
- Other (51.5%)

PASCAL

Map Timeline **Social Network** Bar Chart Text Only



social network david beckham

Barack Obama
Michelle Obama
David Beckham
George Clooney
Brad Pitt
Aniston
Vince Carter
Chris Rock
Lindsay Lohan
Liam Neeson
Keanu Reeves
Mick Jagger
Tom Cruise
Halle Berry
Scarlett Johansson
Celine Dion
Sharon Stone
Nicolas Cage
Johnny Depp
Cameron Diaz
Lindsay Lohan
Liam Neeson
Keanu Reeves
Mick Jagger
Tom Cruise
Halle Berry
Scarlett Johansson
Celine Dion
Sharon Stone
Nicolas Cage
Johnny Depp
Cameron Diaz

David Beckham (8)

San Francisco crowd goes nuts as David Beckham takes it all off

20 Jun 2008 04:13:55 GMT

Don't miss this video of a San Francisco crowd shrieking and squealing with delight as a gigantic, almost-nude shot of David Beckham was revealed inch-by-inch at Macy's in Union Square yesterday. The huge billboard is an ad for Emporio Armani underwear, but the promoters kept it draped until showtime and then dropped the curtain slowly as the crowd went wild. It was better than a strip joint and you didn't have to stick any money in his drawers. [AddThis Button BEGIN addthis_pub = 'mizlzb'; AddThis Button END](#)

[Read more...](#)

David Beckham's hot manhood

20 Jun 2009 04:11:04 GMT

Search

Who's Hot

- < Less
- Read (73)
- Barack Obama (45)
- John McCain (23)
- Bush (20)
- Britney Spears (19)
- Jamie Lynn Spears (18)
- Amy Winehouse (11)
- Condoleezza Rice (10)
- Jamie Lynn (9)
- David Beckham (8)
- Gordon Brown (8)
- Charlie Sheen (8)
- Ran (7)
- Sienna Miller (7)
- Denise Richards (7)
- Laws (6)
- Steve Carell (6)
- Hugo Chavez (6)

Transferring data from celebratwch.ens.bris.ac.uk...

Found In Translation

FOUND
In Translation

Found in Translation monitors
news outlets in languages.
[More...](#)

Yr Hw
Fun Ce
Yr Hw
Fun Centre

EU Activity



EU Share



- ★ EU (51.9%)
- ★ Belgium (2.0%)
- ★ Cyprus (0.5%)
- ★ Other (45.6%)

Weather

- ★ EU (286)
- ★ Belgium (11)
- ★ Cyprus (3)
- ★ Czech Republic (35)
- ★ Denmark (7)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (8)
- ★ Greece (18)
- ★ Hungary (1)
- ★ Italy (50)
- ★ Lithuania (2)
- ★ Netherlands (12)
- ★ Portugal (17)
- ★ Romania (2)
- ★ Slovenia (11)
- ★ Spain (8)
- ★ Sweden (8)
- ★ United Kingdom (19)

Weather EU News Local News Text Only



EU (286)

EU aid to Bulgaria longer suspended

The European Union has frozen aid to EU Member Bulgaria because of fraud and corruption. The aid will total EUR 560 million and was intended for agriculture and infrastructure.

[Read more...](#)

Greenland votes on autonomy

In Greenland on Tuesday, the polls are open for a referendum on extending the autonomy of the capital island to Denmark.

[Read more...](#)

Yellow River is heavily polluted

A third of the Yellow River in China is so polluted by industrial waste water not only is inappropriate as drinking water, but also for the industry or agriculture.

[Read more...](#)

A woman washes up baby by toilets

A British woman to the judge said Monday that her new-born baby toilets have inadvertently by the year. The woman said she thought she had diarrhoea.

[Read more...](#)

Search

Local-News

- ★ EU (295)
- ★ Belgium (11)
- ★ Czech Republic (31)
- ★ Denmark (5)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (5)
- ★ Greece (21)
- ★ Hungary (1)
- ★ Italy (50)
- ★ Lithuania (2)
- ★ Netherlands (12)
- ★ Portugal (11)
- ★ Romania (2)
- ★ Slovenia (11)
- ★ Spain (8)
- ★ Sweden (23)
- ★ United Kingdom (19)

EU-News

- ★ EU (298)
- ★ Belgium (11)
- ★ Czech Republic (31)
- ★ Denmark (5)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (8)
- ★ Greece (21)
- ★ Hungary (1)
- ★ Italy (50)
- ★ Lithuania (2)
- ★ Netherlands (12)
- ★ Portugal (11)

SMART

Found In Translation

FOUND
In Translation

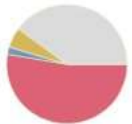
Found in Translation monitors
news outlets in languages.
[More...](#)

Yr Hw
Fun Ce.
Yr Hw
Fun Centre

Belgium Activity



Belgium Share



- ★ EU (52.7%)
- ★ Belgium (2.0%)
- ★ Czech Republic (5.5%)
- ★ Other (39.8%)

Weather

- ★ EU (286)
- ★ Belgium (11)
- ★ Cyprus (3)
- ★ Czech Republic (35)
- ★ Denmark (7)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (8)
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- ★ Lithuania (2)
- ★ Netherlands (12)
- ★ Portugal (17)
- ★ Romania (2)
- ★ Slovenia (11)
- ★ Spain (8)
- ★ Sweden (8)
- ★ United Kingdom (19)

Weather | EU News | Local News | Text Only



Belgium (11)

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[Read more...](#)

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A British woman to the judge said Monday that her new-born baby toilets have inadvertently by the year. The woman said she thought she had diarrhoea.

[Read more...](#)

Search

Local-News

- ★ EU (295)
- ★ Belgium (11)
- ★ Czech Republic (31)
- ★ Denmark (5)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (5)
- ★ Greece (21)
- ★ Hungary (1)
- ★ Italy (50)
- ★ Lithuania (2)
- ★ Netherlands (12)
- ★ Portugal (11)
- ★ Romania (2)
- ★ Slovenia (11)
- ★ Spain (8)
- ★ Sweden (23)
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EU-News

- ★ EU (298)
- ★ Belgium (11)
- ★ Czech Republic (31)
- ★ Denmark (5)
- ★ Estonia (3)
- ★ France (50)
- ★ Germany (8)
- ★ Greece (21)
- ★ Hungary (1)
- ★ Italy (50)
- ★ Lithuania (2)
- ★ Netherlands (12)

File Edit View History Bookmarks Tools Help

http://memewatch.enm.bris.ac.uk/index.php?clusterRank=2&date=2008-09-10 ranking correlation

Getting Started Latest Headlines INI laptop login Intelligent Systems @... System Watch Web focuses : Nature University of Bristol - ...

YouTube - The Next Fifty Years of Sci... MemeWatch Google Mail - ECML paper - nello.cristi... "lipstick on a pig" - Google Search

Mem^e Watch

What's on our minds?

[Home](#) [About](#) [People](#)

Top memes (2008-09-10)

< > >> <<

- [Large Hadron Collider \(LHC\)](#)
- ["lipstick on a pig"](#)
- [Korean leader Kim Jong](#)
- [beam of protons](#)
- [the Large](#)

Wed 10 September 2008

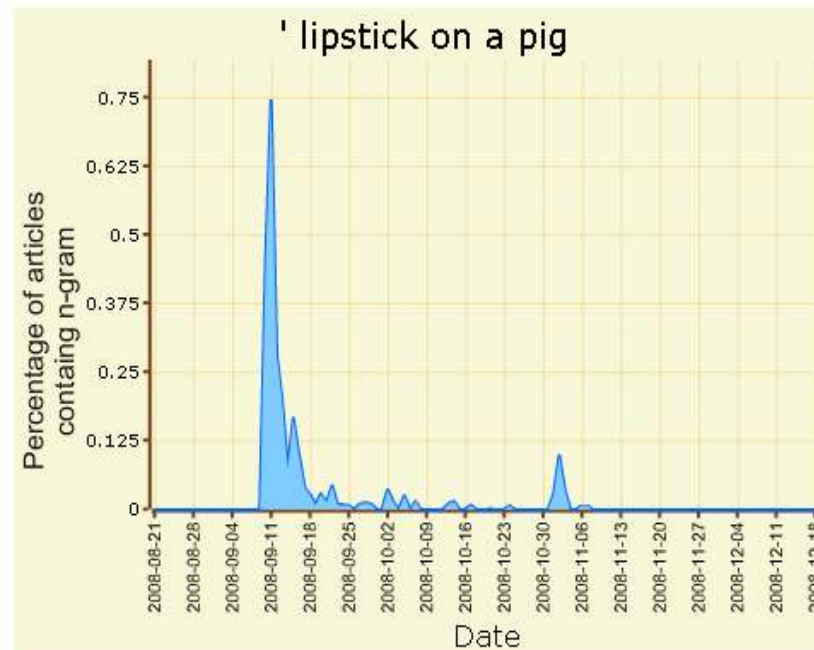
In the news

[Obama's 'lipstick on a pig' comment sparks war of words](#)

[2008-09-10 05:00:52] Accusations of sexism and dishonesty went through the U.S. presidential race...

[McCain on change like lipstick on a](#)

Meme timelines



Transferring data from memewatch.enm.bris.ac.uk...

start | final_salford_article_... | Patterns_Data_Salfor... | MemeWatch - Mozilla ... | Downloads | ecml09_v6b.pdf - Ad... | MyPresentations

Detecting Changes

Election Watch'08

Election Watch monitors 595 outlets for news concerning the 2008 US Presidential election. [More](#)



John McCain Activity

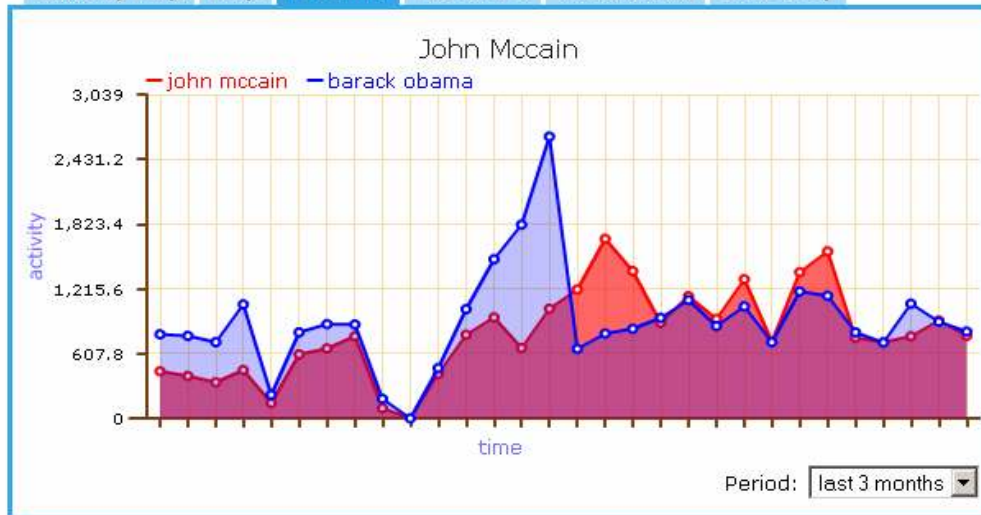


John McCain Share



- ★ [John McCain \(27.3%\)](#)
- ★ [Barack Obama \(25.5%\)](#)
- ★ [Sarah Palin \(9.8%\)](#)
- ★ [Other \(37.3%\)](#)

Activity Map Map Timeline Bar Chart Word Cloud Text Only



Search

Politicians

- ★ [John McCain \(153\)](#)
- ★ [Barack Obama \(143\)](#)
- ★ [Sarah Palin \(55\)](#)
- ★ [Gordon Brown \(28\)](#)
- ★ [Bill \(23\)](#)
- ★ [Joe Biden \(23\)](#)
- ★ [David Letterman \(21\)](#)
- ★ [Clinton \(21\)](#)
- ★ [Brown \(20\)](#)
- ★ [Al Maliki \(20\)](#)



John McCain (153)



The politics of hate

13 Oct 2008 04:25:26 GMT

The ugly desperation of the McCain campaign rampages further out of control: Media Bubble, Oct. 8 -- John McCain's bid for the Oval Office suffered another stunning blow yesterday when

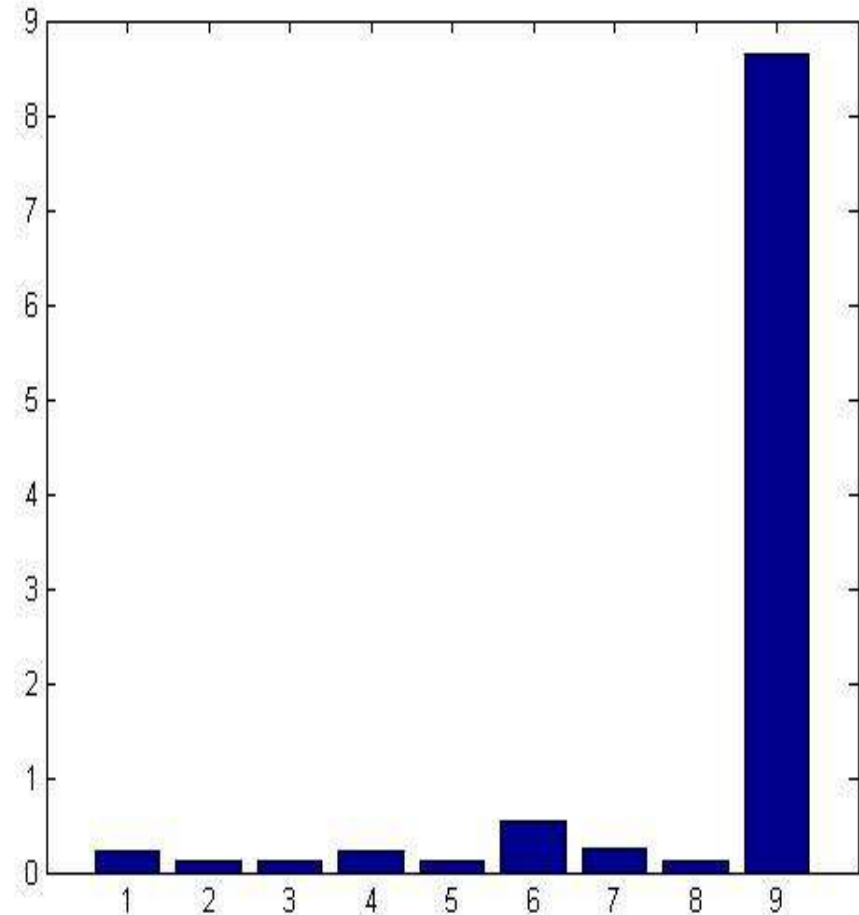


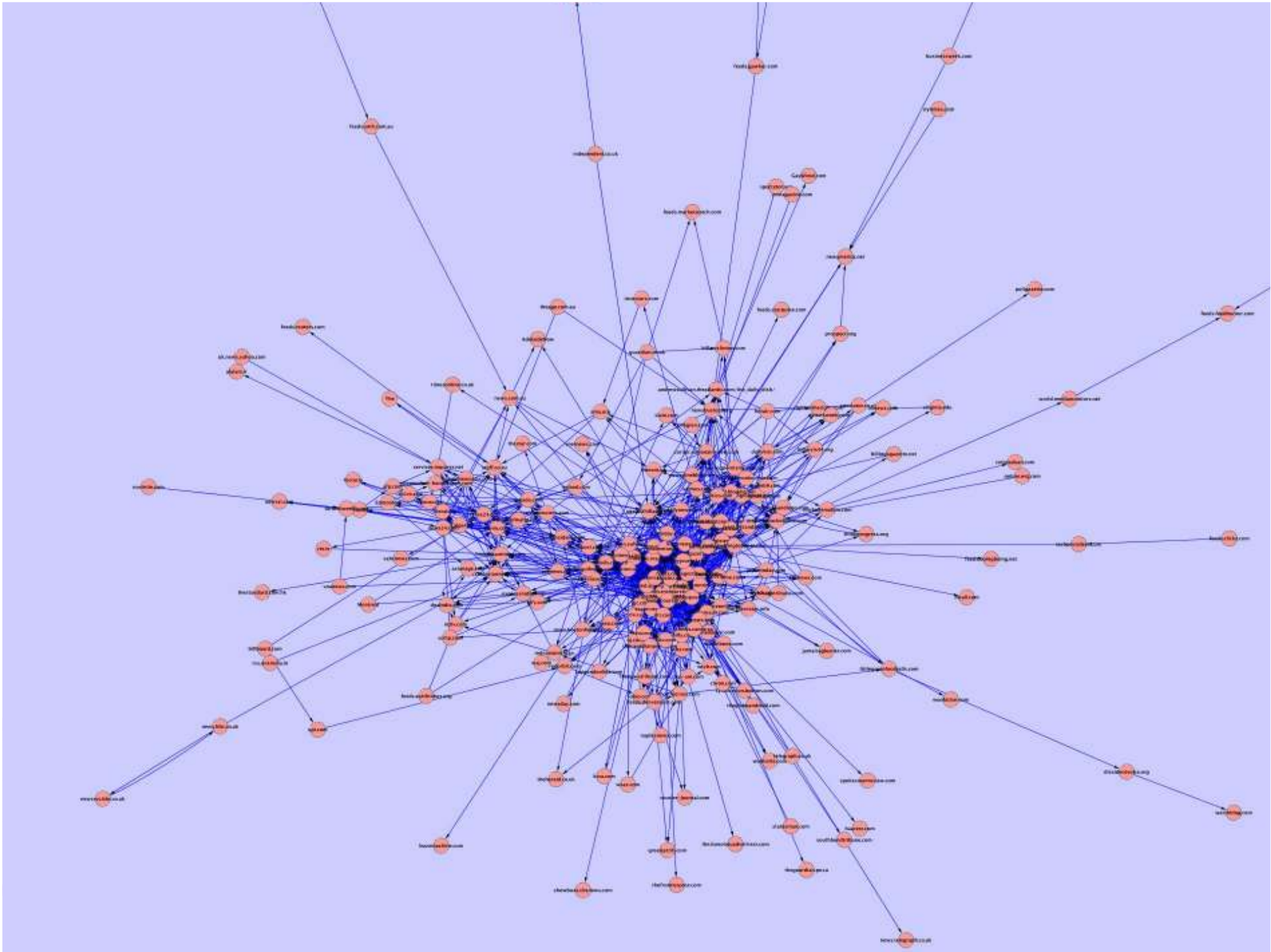
Pope-ularity

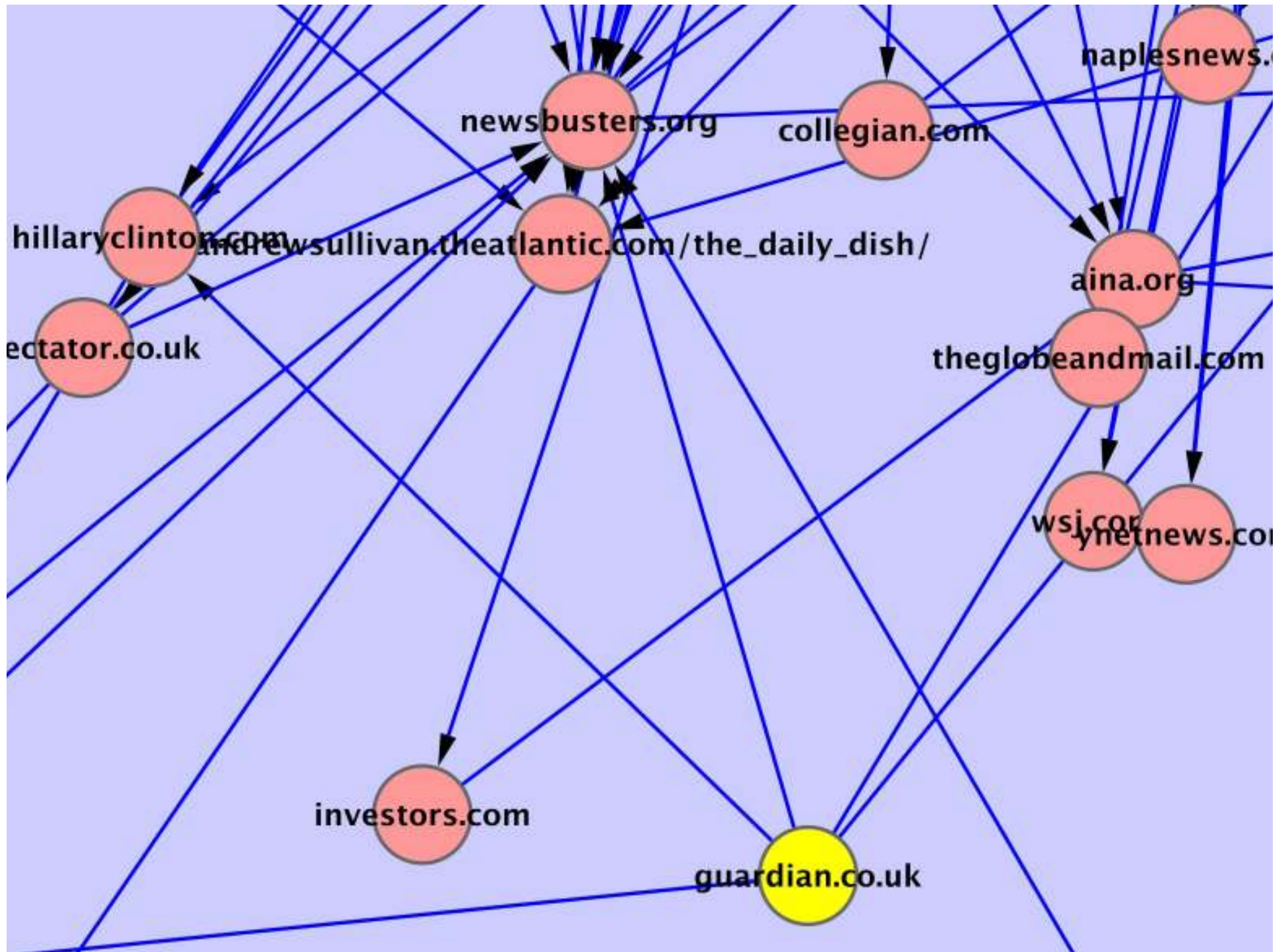
- In the US outlets, in the period april to november 2008, we measured the fraction of newsitems mentioning the Pope (in Content? Just in title-description?)
 - The fraction is
 - 0.102% for english speaking outlets
 - 0.377% for spanish speaking outlets
- 
- 

Pope-ularity

1. 'AFRICA'
2. 'UNITED KINGDOM'
3. 'ASIA'
4. 'CANADA'
5. 'UNITED STATES'
6. 'ITALY'
7. 'FRANCE'
8. 'GERMANY'
9. 'VATICAN'







The background features several large, overlapping, curved shapes in shades of green, purple, and blue. Interspersed among these are several small, yellow, triangular shapes pointing in various directions, creating a dynamic and abstract visual effect.

Data Driven Artificial Intelligence

**Creating Intelligent Behaviour
by Exploiting Patterns in Data**

**Nello Cristianini
University of Bristol**

Shop All Departments

Search All Departments slovenia

GO

Basket

Welcome

International

Gift Certificates

Sell Your Stuff

Deals Of The Week

Harry Potter

Disney

Department

Any Department

- Books (12,448)
- Music (31)
- MP3 Downloads (177)
- Kitchen & Home (173)
- Toys & Games (114)
- Classical Music (13)
- DVD (12)

+ See All 12 Departments

Shipping Option (What's this?)

Any Shipping Option

- ✓ Prime Eligible
- Free Super Saver Delivery

Listmania!



Essential Slovenia: A list by "dizzy068"



"slovenia"

Related Searches: [croatia](#), [slovenia map](#).

Select Results from All Departments

Choose a Department to enable sorting

1.



Slovenia (Lonely Planet Country Guide) by Steve Fallon (Paperback - 1 May 2007)

Buy new: ~~£12.99~~ **£7.79** 28 Used & new from £5.00

Get it by **Wednesday, Aug 19** if you order in the next **7 hours** and choose express delivery.

Eligible for **FREE** Super Saver Delivery.

★★★★☆ (7)

Excerpt - page 61: " ... camp. Ljubljana became the capital of the Socialist Republic of **Slovenia** within Yugoslavia in 1945 and remained the capital after **Slovenia's** independence in 1991. Today, Ljubljana is the nation's ... "

Books: See all 12,448 items

2.



The Rough Guide to Slovenia - Edition 2 by Darren (Norm) Longley and Rough Guides (Paperback - 25 Jan 2007)

Buy new: ~~£12.99~~ **£9.99** 27 Used & new from £6.04

Get it by **Wednesday, Aug 19** if you order in the next **7 hours** and choose express delivery.

Eligible for **FREE** Super Saver Delivery.

★★★★☆ (1)

Excerpt - page 17: "Getting there Flying is the easiest way to reach **Slovenia**, with several airlines now flying direct from airports in the UK. Flying from Ireland ... "

Books: See all 12,448 items

3.



Slovenia (Bradt Travel Guide Slovenia) (Bradt Travel Guides) by Robin McKelvie and

Done



lake bled

Search

Advanced Search Preferences

Web Show options...

Results 1 - 10 of about 208,000 for lake bled. (0.32 seconds)

BLED

Tourist information and services in **Bled** and surroundings.

www.bled.si/en/ - [Cached](#) - [Similar](#) - [Share](#) [Print](#) [Close](#)

- [Accommodation](#)
- [How to get there](#)
- [Photogallery](#)
- [The sights](#)
- [Sighseeinh](#)
- [About bled](#)
- [Useful information](#)
- [Sports and recreation](#)

[More results from bled.si »](#)

Bled - The sights

The **Bled lake** with an island. The **lake** was formed after the recession of the Bohinj glacier. It is up to 2120 m long and up to 1380 m wide, ...

www.bled.si/en/?id=463 - [Cached](#) - [Similar](#) - [Share](#) [Print](#) [Close](#)

Lake Bled - Wikipedia, the free encyclopedia

22 Apr 2009 ... **Lake Bled** (Slovene: Blejsko jezero; German: Veldeser See) is a glacial **lake** in the Julian Alps in northwestern Slovenia, where it adjoins ...

en.wikipedia.org/wiki/Lake_Bled - [Cached](#) - [Similar](#) - [Share](#) [Print](#) [Close](#)

Image results for lake bled - Report images



Bled travel guide - Wikitravel

Bled [1] is a town in Slovenia, on the east side of **Lake Bled**. ... **Bled** Jezero, local

Sponsored Links

Lake Bled Hotels

Stay Near **Lake Bled Bled** Slovenia
Compare Photos, Hotel Info & Rates.
www.europe-hotelrooms.com

Lake Bled Hotels

Hotels near **Lake Bled Bled** Slovenia
Pay at check-in. No booking fees.
www.priceline-europe.com

Lake Bled

Hotels in Europe (Save 50%)
Book Online and Save Even More
OfficialEuropeHotels.com

Done

Translate text, webpage, or document

Enter text or a webpage URL, or [upload a document](#).

Do you have more cevapcici?
Can I have another beer, please?
Please, give the bill to John...

English



Slovenian



[swap](#)

Translate

Translation: English » Slovenian

Ali imate več Čevapčiči?

Lahko dobim še eno pivo, prosim?

Prosimo, da račun za John ...

Selecting Ads for Web

The screenshot shows a Mozilla Firefox browser window displaying the Amazon.co.uk DVD page. The address bar shows the URL <http://www.amazon.co.uk/dvds-used-boxed-sets/b?ie=UTF8&node=283926>. The page header includes the Amazon.co.uk logo, a sign-in prompt, and navigation links like "Your Amazon.co.uk", "Deals of the Week", and "Gift Certificates". A search bar contains the text "DVD". Below the search bar, there are tabs for "Advanced Search", "Browse Genres", "New & Future Releases", "Blu-ray", "Bestsellers", "TV", "Essential DVDs", "Bargains", "Sell Your DVDs", and "Your Rental List". A prominent banner for "Hot Blu-ray Releases this month" features images of "LUST" and "THE GODFATHER".

The main content area is titled "DVD" and includes a "Browse" sidebar on the left with categories like "Blu-ray Store", "Hi-Def: Learn & Shop", "HD DVDs", and "Browse by Genre". The main content features a "DVD Up to 40% off bestsellers" section with a description: "Browse Amazon.co.uk's DVD shop to find great discounts on tens of thousands of top DVDs--new releases, hot pre-orders, box sets, Blu-ray and much more." Below this is a "What's Hot in DVD" section with product listings for "SEX AND THE CITY", "Jungle Book", "Mamma Mia!", "HULK", and "CLOVERFIELD". A "3 for £10" promotion is also visible.

On the right side, there is a "Shop now" button above a large "KUNG FU PANDA" movie poster. Below the poster is a "SHARE" button. At the bottom right, there is an "Amazon.co.uk Exclusive" section featuring "IRON MAN" products with "50% off" and "40% off" discounts.

The Windows taskbar at the bottom shows the "start" button and several open applications: "AIMA-slides", "Wireless Network...", "to_do_list.txt - N...", "Amazon.co.uk DV...", "Downloads", "Microsoft PowerP...", and "Apple Software U...". The system clock shows "12:41".

Selecting Ads



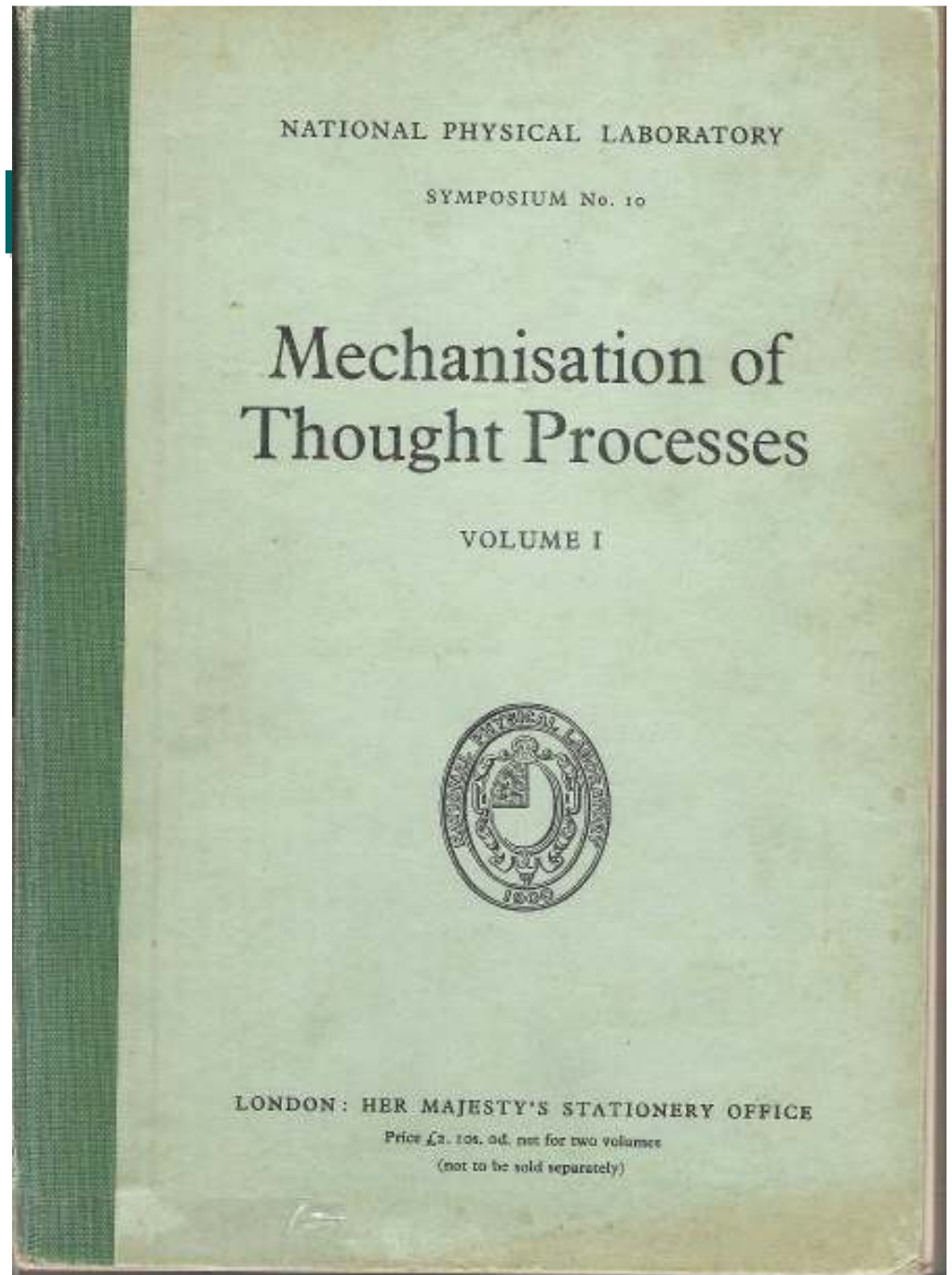
The image shows four customized banner ads for Canon. The first is a red banner with the text "Canon Improve your image. Four times over!" and a small image of a printer. The second is a black banner for the "Canon BJC-8200 Color Bubble Jet Printer" with the slogan "The Photo Printer You'd Expect From Canon." The third is a blue and white banner for "Brilliant color every time." with the website "www.ccsi.canon.com". The fourth is a red banner for "Canon e-Store" with the text "The online store for printers, scanners, multifunction and more!!" and a "Click Here!" button.



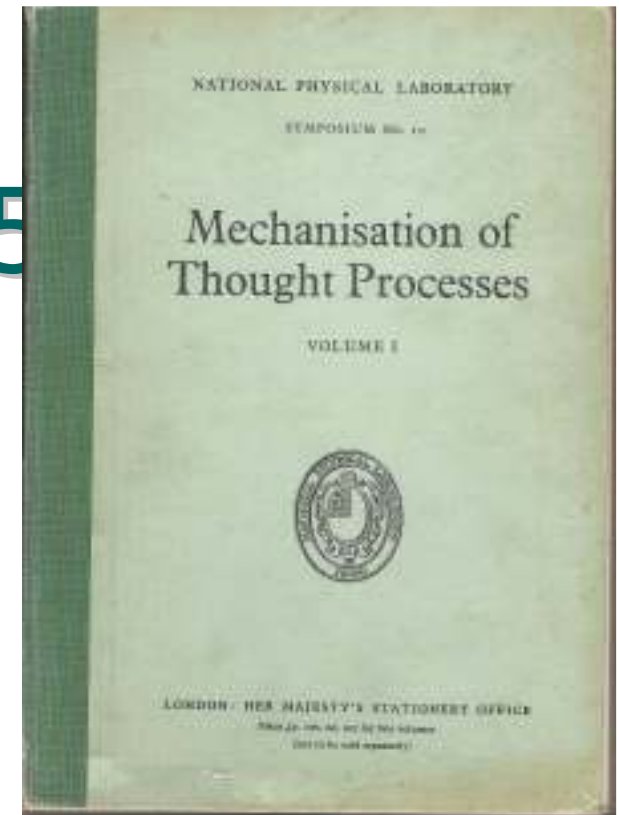
The image shows a vertical stack of ten different banner ads. From top to bottom: 1. "THE MASTER NETWORKER" featuring Gene Hildbrand, a phone number 210-481-2555, and a website. 2. "J.A.M.CO. ENTERPRISES" for Beauty, Health, and Fitness, with the slogan "We Remove Confusion from Internet Shopping!" and phone number 210-637-0450. 3. "Piano Lessons" for ages 4-104, with a highly experienced teacher and phone number 210-690-2188. 4. "KIM'S ACADEMY of Tae Kwon Do" with the slogan "Get Your Mind, Body, & Spirit In Shape" and phone number 653-2700. 5. "GUERRERO • CPA" for "Bridging Accounting & Technology Together" with phone number 210-764-7040. 6. "HOME ~ LIFE ~ AUTO" insurance services by "Jim Davis Agency" with phone number 210-495-1700. 7. "FOS" for "Digital Studio" with phone number 210-967-7400. 8. "Polo's Photography" with phone number 210-212-9177. 9. "LDH" Law Office of Laura D. Heard, P.C. with phone number 210-655-9090. 10. "Founding & Sales Inc." for "Providing Construction & Consultation for New Home Designs" with phone number 210-523-0155.

Either customised versions of same banner
Or choose different products and services...

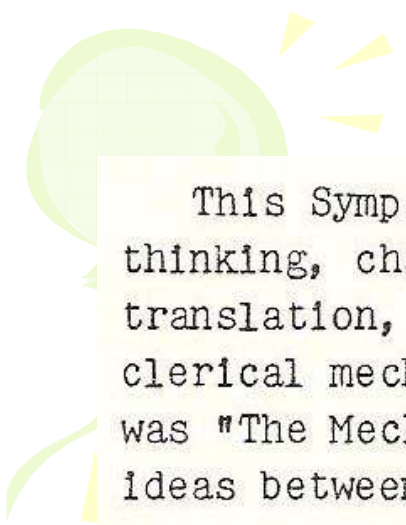
Noveml



November 195



This Symposium was held to bring together scientists studying artificial thinking, character and pattern recognition, learning, mechanical language translation, biology, automatic programming, industrial planning and clerical mechanization. It was felt that a common theme in all these fields was "The Mechanization of Thought Processes" and that an interchange of ideas between these specialists would be very valuable.



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1958

A research community in machine-intelligence had emerged from WWII.

Alan Turing had died in 1954, leaving a powerful legacy of ideas.

The cybernetic movement was already 10 years old (Wiener's book=1948).

Macy conferences had ended and Ratio Club had stopped meeting.

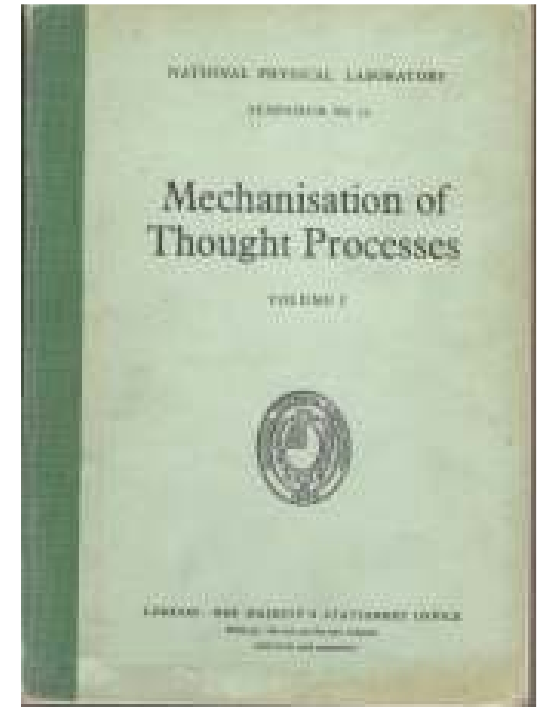
A new emphasis was coming from the new "Artificial Intelligence" community.



In this meeting the various strands met.

Contents

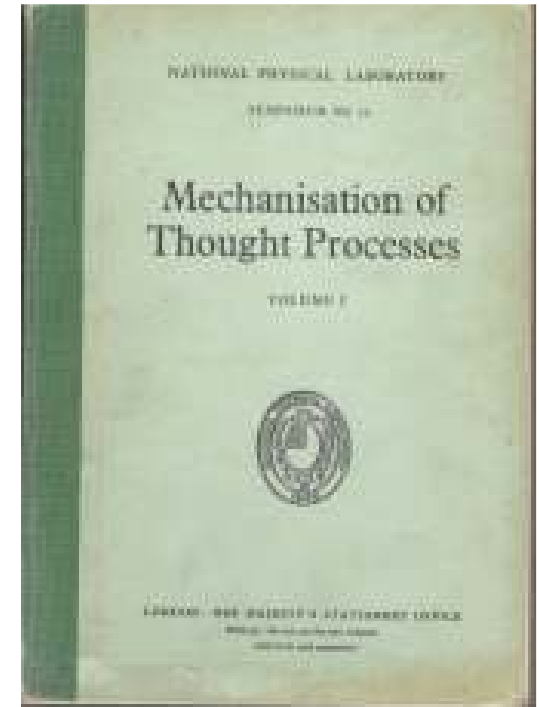
- The Symposium was organised into Sessions:
 - **General Principles**
 - **Automatic Programming**
 - **Mechanical Language Translation**
 - **Speech Recognition**
 - **Learning in Machines**
 - **Implications for Biology**
 - **Implications for Industry**



They are all VERY familiar today...

Participants

- The programme included both members of the cybernetics movement and of the newly growing AI movement, as well as people who did not directly relate to either.
- Programmable machines were now commercially available (IBM 704).
- This was perhaps just before optimism turned into the hype of the 1960s.
- The list of participants included ...:
 - F. Rosenblatt
 - A. Samuel
 - M. Minsky
 - O. Selfridge
 - J. McCarthy
 - D. MacKay
 - G. Walter
 - W. McCulloch
 - Ross Ashby
 - ...



GENERAL PRINCIPLES

Chairman: DR. A. M. UTILEY, NPL

Some methods of artificial intelligence and heuristic programming

DR. M. L. MINSKY, MIT, USA

Discussion on paper 1

Chairman: Dr. W. S. McCULLOCH, MIT, USA

Operational aspects of intellect

DR. D. M. MACKAY, King's College, London

Discussion on paper 2

Programs with common sense

DR. J. McCARTHY, MIT, USA

Discussion on paper 3

The mechanism of habituation

DR. W. ROSS ASHBY, Barnwood House Hospital, Gloucester

Discussion on paper 4

Conditional probability computing in a nervous system

DR. A. M. UTILEY, CME Division, NPL

Discussion on paper 5

First session: an idea of the general tone and of the efforts made to cover all the different approaches.

Some methods of artificial intelligence and heuristic programming

Marvin Minsky

Operational Aspects of Intellect

Donald MacKay

Programs with Common Sense

John McCarthy

The mechanism of habituation

Ross Ashby

Conditional probability computing in a nervous system

Albert Uttley

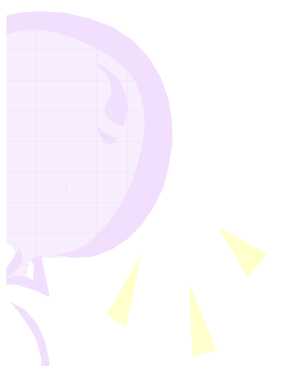


Methods of Artificial Intelligence and Heuristic Programming

- *"Machines to work on problems for which the designer does not have in advance practical methods of solution".*
- *"Particular attention is given to processes involving pattern recognition, learning, planning ahead, and the use of analogies or models".*
- *"...a machine might improve itself by adding to its collection of problem-solving methods" [Minsky's Talk]*

Symbolic AI. A discussion of planning problems, or problem solving , and how heuristic search can be used to find solutions.

Learning and induction presented as ways for the machine to improve by experience (comparing Solomonoff's induction to 'network machines' to distributed architectures...





Example Speech Recognition

and laboratory work

The principal problems that we intend to investigate by the use of computers are the following:

Collecting trigram frequencies;

Collecting n -gram frequencies;

Comparison of such data obtained from the dictionary and from current speech;

Collection of word transition probabilities for different types of material;

Collection of acoustic pattern data for words;

Comparison of the effect of using trigram and digram frequencies;



The session on **Speech Recognition** showed surprisingly modern ideas, including that of using statistical modelling of n -grams frequencies to reduce errors

LEARNING IN MACHINES

Chairman: MR. J. F. COALES,
Cambridge University

No theorems of statistical separability in the Perceptron
DR. F. ROSENBLATT, Cornell Aeronautical Lab., USA

Discussion on paper 4

Learning machines

DR. A. M. ANDREW, CME Division, NPL

Discussion on paper 5

Pandemonium: A paradigm for learning

DR. O. G. SELFRIDGE, MIT, USA

Discussion on paper 6

Frank Rosenblatt presented his new Perceptron algorithm, and some new variations on the theme.

Oliver Selfridge presented the Pandemonium system: an architecture very related to modern agents and evolutionary computation.

The running example was character recognition.

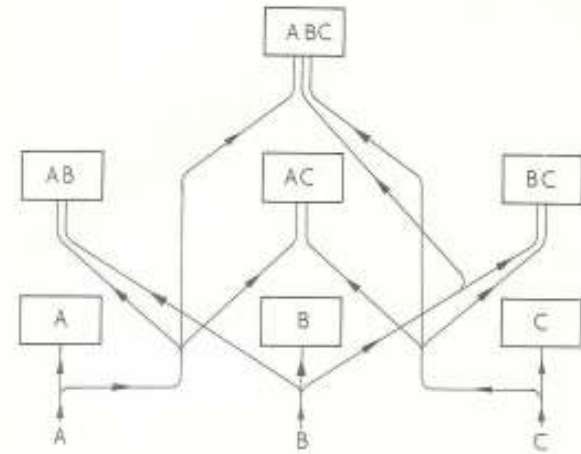
Alexander Andrew discussed the application of learning machines – based on statistical principles – to process control.

Ideas from control theory are discussed, and also its conditional-probability machine detected what we now call “association rules” in data mining.

Example

Learning Machine

Conditional Probability Machine



Suppose, for instance, that the A and B channels are active. Then the conditional probability of activity in C is given by:-

Probability of C , given A and B =

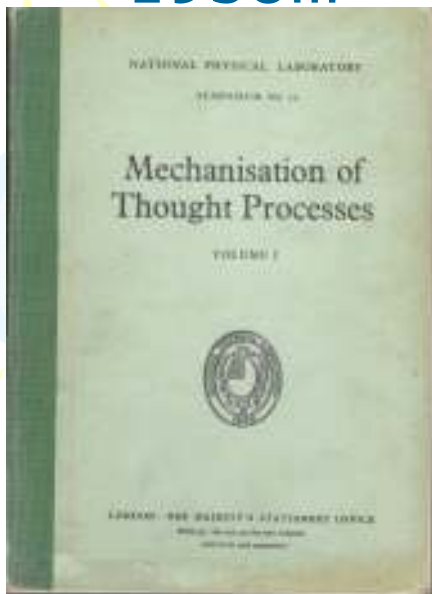
$$p_{AB}(C) = \frac{\text{count stored in } (ABC) \text{ unit}}{\text{count stored in } (AB) \text{ unit}} \quad (1)$$

Whenever the j and k inputs of the computer are activated simultaneously, it computes the quantities $p_{jk}(l)$, $p_{jk}(m)$ and $p_{jk}(n)$. If any of these exceeds a predetermined threshold value, an inference is made of activity in the l , m or n channel. The operation is similar when other groups of input channels are activated.

Hardware equivalent to finding association rules by Apriori...

Machine Intelligence, AD 1958

- Many ideas from 2008 Proceedings can be found in 1958...



Pattern recognition
Heuristic programming
Common sense
Conditional probability machines

Statistical separability
Inductive inference
Information Retrieval
Nervous Nets
Reinforcement

Perceptrons
Learning machines

- Many of them are still present in this conference



How Much Have We Progressed?

- Spontaneous questions...

- Are we any closer to building intelligent machines?

- What are the key achievements, and the key failures, of the past 50 years of research in this direction?

- What would we report, if we could – in some way – deliver a “keynote speech from 2009” at that Conference?





Machine Intelligence, AD 2009

- The 1958 conference would certainly be interested in hearing that today we can...
 - Retrieve relevant documents
 - Translate and summarise them
 - Recommend books and movies
 - Transcribe speech, recognize handwriting
- All this was on their wish list, and is



...

Shop All Departments

Search All Departments slovenia

GO

Basket

Welcome

International

Gift Certificates

Sell Your Stuff

Deals Of The Week

Harry Potter

Disney

Department

Any Department

- Books (12,448)
- Music (31)
- MP3 Downloads (177)
- Kitchen & Home (173)
- Toys & Games (114)
- Classical Music (13)
- DVD (12)

+ See All 12 Departments

Shipping Option (What's this?)

Any Shipping Option

- Prime Eligible
- Free Super Saver Delivery

Listmania!



Essential Slovenia: A list by "dizzy068"



"slovenia"

Related Searches: croatia, slovenia map.

Select Results from All Departments

Choose a Department to enable sorting

1.



Slovenia (Lonely Planet Country Guide) by Steve Fallon (Paperback - 1 May 2007)

Buy new: £12.99 **£7.79** 28 Used & new from £5.00

Get it by **Wednesday, Aug 19** if you order in the next **7 hours** and choose express delivery.

Eligible for **FREE** Super Saver Delivery.

★★★★★ (7)

Excerpt - page 61: " ... camp. Ljubljana became the capital of the Socialist Republic of **Slovenia** within Yugoslavia in 1945 and remained the capital after **Slovenia's** independence in 1991. Today, Ljubljana is the nation's ... "

Books: See all 12,448 items

2.



The Rough Guide to Slovenia - Edition 2 by Darren (Norm) Longley and Rough Guides (Paperback - 25 Jan 2007)

Buy new: £12.99 **£9.99** 27 Used & new from £6.04

Get it by **Wednesday, Aug 19** if you order in the next **7 hours** and choose express delivery.

Eligible for **FREE** Super Saver Delivery.

★★★★★ (1)

Excerpt - page 17: "Getting there Flying is the easiest way to reach **Slovenia**, with several airlines now flying direct from airports in the UK. Flying from Ireland ... "

Books: See all 12,448 items

3.



Slovenia (Bradt Travel Guide Slovenia) (Bradt Travel Guides) by Robin McKelvie and

Done



lake bled

Search

Advanced Search Preferences

Web Show options...

Results 1 - 10 of about 208,000 for lake bled. (0.32 seconds)

BLED

Tourist information and services in **Bled** and surroundings.

www.bled.si/en/ - [Cached](#) - [Similar](#) - [Share](#) - [Close](#)

- [Accommodation](#)
- [How to get there](#)
- [Photogallery](#)
- [The sights](#)
- [Sighseeinh](#)
- [About bled](#)
- [Useful information](#)
- [Sports and recreation](#)

[More results from bled.si »](#)

Bled - The sights

The **Bled lake** with an island. The **lake** was formed after the recession of the Bohinj glacier. It is up to 2120 m long and up to 1380 m wide, ...

www.bled.si/en/?id=463 - [Cached](#) - [Similar](#) - [Share](#) - [Close](#)

Lake Bled - Wikipedia, the free encyclopedia

22 Apr 2009 ... **Lake Bled** (Slovene: Blejsko jezero; German: Veldeser See) is a glacial **lake** in the Julian Alps in northwestern Slovenia, where it adjoins ...

en.wikipedia.org/wiki/Lake_Bled - [Cached](#) - [Similar](#) - [Share](#) - [Close](#)

Image results for **lake bled** - [Report images](#)



Bled travel guide - Wikitravel

Bled [1] is a town in Slovenia, on the east side of **Lake Bled**. ... **Bled** Jezero, local

Sponsored Links

Lake Bled Hotels

Stay Near **Lake Bled Bled** Slovenia
Compare Photos, Hotel Info & Rates.
www.europe-hotelrooms.com

Lake Bled Hotels

Hotels near **Lake Bled Bled** Slovenia
Pay at check-in. No booking fees.
www.priceline-europe.com

Lake Bled

Hotels in Europe (Save 50%)
Book Online and Save Even More
OfficialEuropeHotels.com

Done

Translate text, webpage, or document

Enter text or a webpage URL, or [upload a document](#).

Do you have more cevapcici?
Can I have another beer, please?
Please, give the bill to John...

English



Slovenian



[swap](#)

Translate

Translation: English » Slovenian

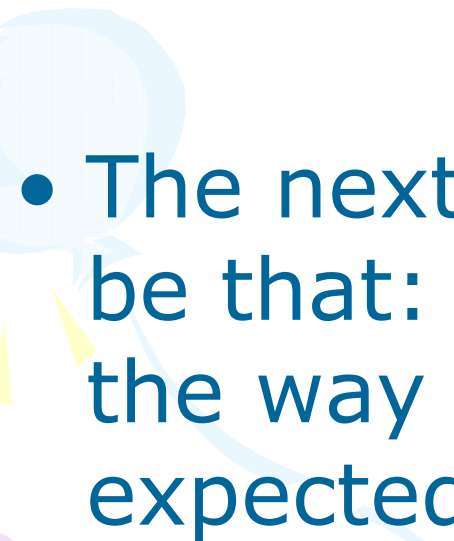
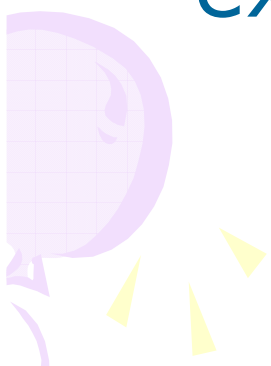
Ali imate več Čevapčiči?

Lahko dobim še eno pivo, prosim?

Prosimo, da račun za John ...


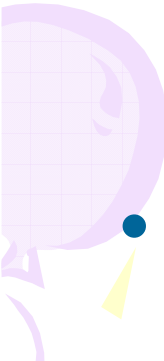


An invited talk from the future

- The main message should be that many goals have been achieved
 - The next message should probably be that: things did not go quite in the way that most AI Pioneers expected...
- 
- 

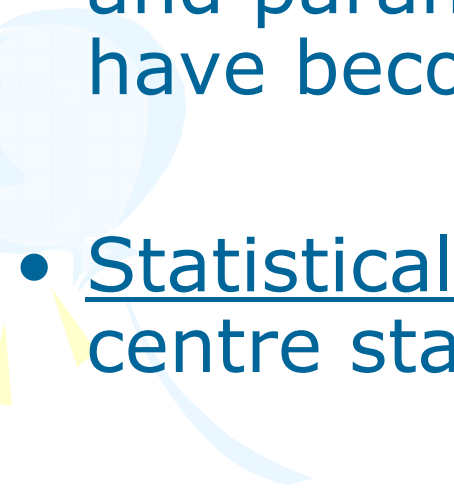



Data-Driven Artificial Intelligence

- We did not get computers to do all these things by understanding how humans do them, and then implementing that into a computer
 - We do not really know how humans understand a document. Our computers also do not understand the content of a document.
 - We did not obtain the intended behaviour by solving the problem of intelligence, but rather by a series of statistical hacks...
 - Large amounts of data, and rather simple algorithms for statistical pattern analysis
- 
- 

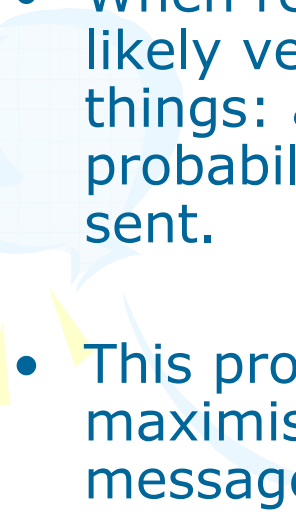
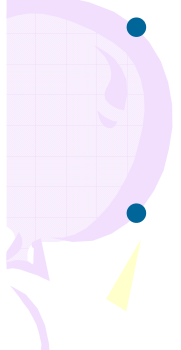


Low Level Processing

- Humble activities such as indexing, clustering and parameter estimation have become the enabling factors
 - Statistical pattern analysis has taken centre stage in AI (Data-Driven AI)
 - As just one example of this general trend, think of **the astonishing trajectory and impact of the Viterbi algorithm** for decoding
- 
- 



Example: Viterbi Algorithm

- Introduced in the 1960s as part of information theory and signal processing, in the context of communication via a noisy channel.
 - When receiving a corrupted message, we can infer the most likely version of the original message, if we know two things: a model of the noise in the channel, and the probability with which each given message could have been sent.
 - This process is often known as **decoding**, and involves maximising a functional over the space of all possible messages that could have been sent.
 - Viterbi's algorithm performs the decoding very efficiently, IF the original messages can be modelled by Markov chains.
 - Its method is the same as the problem of finding a shortest path in a graph (1959), a classical example of dynamic programming.
- 
- 

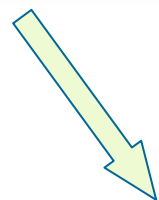
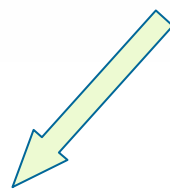
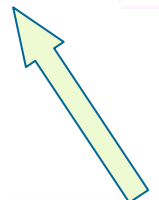
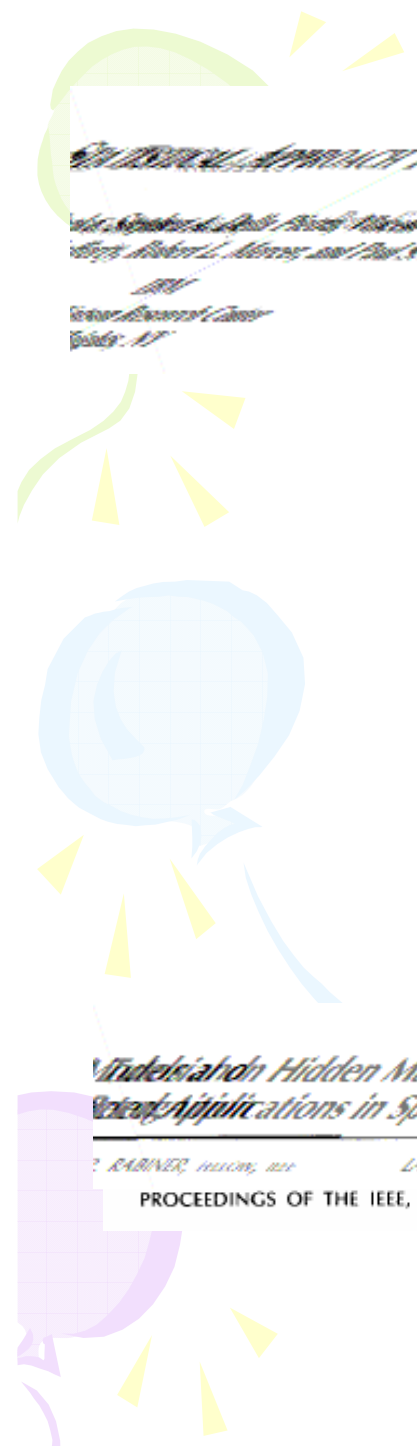
~~that finds genes in E. coli DNA that finds genes in E. coli DNA~~
~~and Hausler? Anders Krogh, I Saira Mian? and David Hausler? Anders Krogh, I Saira Mian? and David Hausler? Anders Krogh, I Saira Mian? and David Hausler?~~
~~Department of Computer Science, University of California, Santa Cruz, CA 95064, USA~~
~~Department of Computer Science, University of California, Santa Cruz, CA 95064, USA~~

Error Bounds for Convolutional Codes and an Asymptotically Optimum Decoding Algorithm

ANDREW J. VITERBI, SENIOR MEMBER, IEEE

~~Hidden Markov Models and Applications in Speech Recognition~~
~~Hidden Markov Models and Applications in Speech Recognition~~


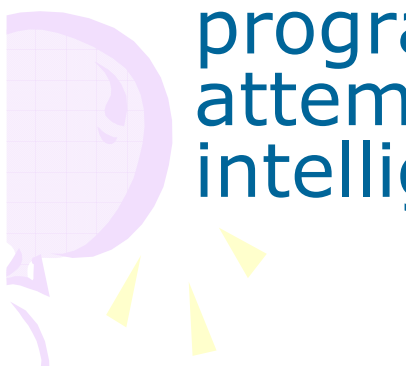
Belief Networks and PGMs
(junction tree)





Impact

Has humble **decoding algorithm** been more influential than celebrated theorem proving algorithms?

- 
- Probably **more central than** automated theorem proving, deep language analysis, neural network inference, evolutionary programming, and many other promising attempts at solving the problem of intelligence
- 





“Statistical Hacks”

- A series of simple statistical hacks, together with optimisation technology, and vast amounts of data, delivered much of the intelligent behaviour we use today



Optimisation and Statistics

- Optimisation and Statistics are the language behind algorithms such as Viterbi's
 - Similar ideas are also behind methods like
 - Support Vector Machines (used today for handwriting recognition, text categorization, etc),
 - Probabilistic Graphical Models...
 - Association Mining (used for recommendation systems)
 - Because of the centrality of Machine
- 
- 

The background features several large, overlapping, curved shapes in shades of purple, green, and blue. Interspersed among these are numerous small, yellow, triangular shapes pointing in various directions, creating a dynamic and abstract visual effect.

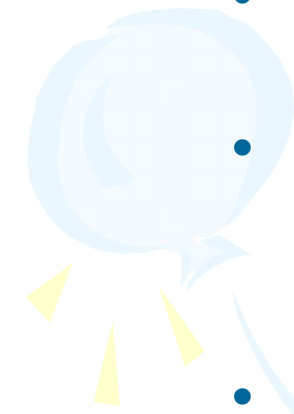
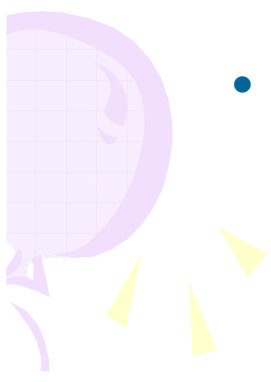
Patterns in Personal Data

Nello Cristianini
**Professor of Artificial
Intelligence**
University of Bristol



The Privacy Delusion


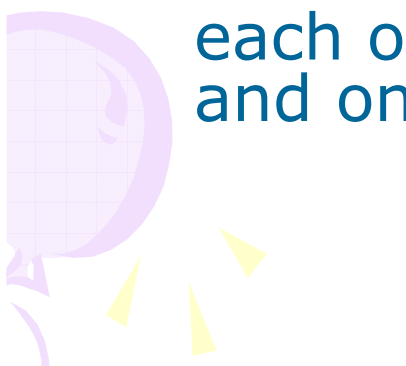


- 
- 
- When we read a newspaper article, we do not expect to receive a phone call that evening, advertising related items...
 - When we look at the window of a travel agent, we do not expect to receive their leaflets in the mail
 - When we play chess with a friend, we do not expect our intelligence to be profiled, and the information sold to employment or dating agencies
 - Our expectations are based on what is reasonably possible in the physical world, and on the fact that we hide in the crowd...
 - Many of these expectations may be violated in the new, information-driven society



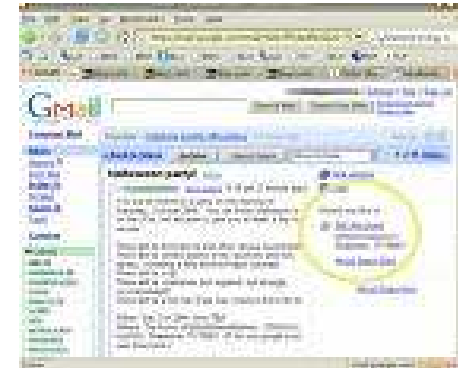
Information Society



- In order to be useful, information needs
 - Gathered
 - Stored / transmitted
 - Processed / analysed / interpreted
 - Acted upon
 - We expect these processes to be performed by humans, at least in part, and this shapes our expectations...
 - But EACH of these steps has been automated in recent years, and now computers can do each of these things cheaply, fast, effectively and on a VERY large scale
- 
- 



A Trail in Transaction Space

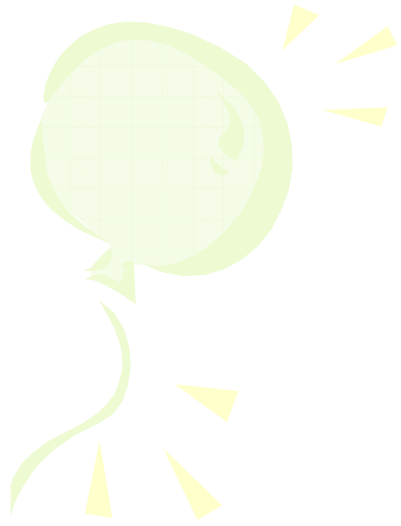
We leave a permanent digital trail of *personal* data behind us





Web Logs

- 121.179.178.143 - - [26/Oct/2008:13:31:53 +0000]
"GET /case_studies/iceman_demo_05.png HTTP/1.1"
304 - "http://www.computational-genomics.net/case_studies/iceman_demo.html"
"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 2.0.50727; .NET CLR 1.1.4322; InfoPath.1)"
 - 121.179.178.143 - - [26/Oct/2008:13:32:15 +0000]
"GET /images/code_input.gif HTTP/1.1" 304 -
"http://www.computational-genomics.net/case_studies/sabertooth_demo.html"
"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 2.0.50727; .NET CLR 1.1.4322; InfoPath.1)"
- 
- 



The AOL Case



• On August 4, 2006, AOL Research labs released a file on one of its websites containing the **search log** for over 650,000 users over a 3-month period, intended for research purposes.

• It contained about 20 million search keywords. All the transactions were anonymous, but each user was identified by a unique ID number.

• Few days later, acknowledging this was an error, AOL removed the file from public access, but the data are still available at various internet locations, for all of us to explore. Those responsible were later fired.



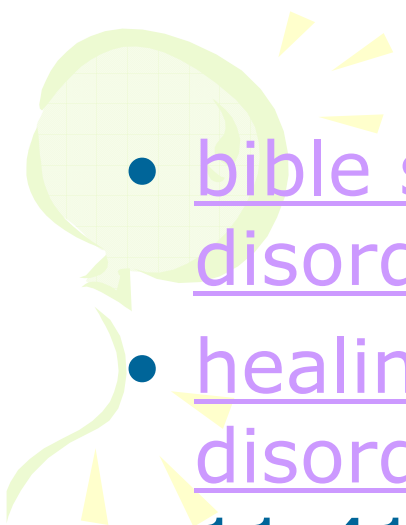
THE AOL CASE STUDY == Search activity of User 98280

- [ovulation calculator \[!\]](#)2006-03-03 12:37:21<http://www.babycenter.com>
- [premier cinema \[!\]](#)2006-03-03 17:43:23<http://www.pccmovies.com>
- [fine black girls \[!\]](#)2006-03-03 17:46:120
- [shoes \[!\]](#)2006-03-03 17:46:340
- [pregnancy calculator \[!\]](#)2006-03-07 11:23:41<http://pregnancy.about.com>
- [pregnancy calculator \[!\]](#)2006-03-07 11:23:41<http://parenting.ivillage.com>
- [pregnancy calculator and pictures of fetus \[!\]](#)2006-03-07 18:17:19<http://www.paternityangel.com>1
- [pregnancy calendar and fetus growth pictures \[!\]](#)2006-03-08 13:25:49<http://www.pregnancy.org>
- [pregnancy calendar and fetus growth pictures \[!\]](#)2006-03-08 13:25:49[http://www.hom .. ilynetwork.com](http://www.hom..ilynetwork.com)
- [pregnancy calculator \[!\]](#)2006-03-08 13:28:58<http://pregnancy.about.com>
- [first trimester of pregnancy \[!\]](#)2006-03-09 16:15:58<http://www.4woman.gov>
- [http www. click2houston.com \[!\]](#)2006-03-13 12:38:000
- [click2houston \[!\]](#)2006-03-13 12:38:10<http://www.click2houston.com>
- [a drug with slang name of ice \[!\]](#)2006-03-13 18:40:58<http://www.kci.org>
- [information on methamphetamines \[!\]](#)2006-03-13 18:42:20[http://www.the .. bilitation.com](http://www.the..bilitation.com)

- 
- [symptoms of cocaine addiction \[!\]](http://www.drugabuse.gov)2006-03-17 16:59:42<http://www.drugabuse.gov>
 - [affects of cocaine use if you are diabetic \[!\]](http://www.drugabuse.gov)2006-03-17 17:23:390
 - [diabetic's use of cocaine \[!\]](http://www.drugabuse.gov)2006-03-17 17:24:000
 - [i am diabetic and use cocaine \[!\]](http://www.realitycheck.org.au)2006-03-17 17:24:29<http://www.realitycheck.org.au>
 - [i am diabetic and use cocaine \[!\]](http://forums.dentdoctor.net)2006-03-17 17:24:29[http://forums. .. dentdoctor.net](http://forums.dentdoctor.net)
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.focusas.com)2006-03-17 17:31:48<http://www.focusas.com>
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.jrsm.org)2006-03-17 17:31:48<http://www.jrsm.org>
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.rochester.edu)2006-03-17 17:31:48<http://www.rochester.edu>
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.ncbi.nlm.nih.gov)2006-03-17 17:31:48<http://www.ncbi.nlm.nih.gov>
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.goa.e.columbia.edu)2006-03-17 17:31:48<http://www.goa .. e.columbia.edu>
 - [gastrointestinal problems associated with cocaine use \[!\]](http://www.drug-rehab.com)2006-03-17 17:31:48<http://www.drug-rehab.com>10

- [is bipolar disorder hereditary \[!\]2006-03-20 14:56:56http://www.bipolar.com](http://www.bipolar.com)
- [are people with bipolar disorder prone to use drugs and alcohol \[!\]2006-03-20 15:39:41http://www.nimh.nih.gov](http://www.nimh.nih.gov)
- [are people with bipolar disorder prone to use drugs and alcohol \[!\]2006-03-20 15:39:41http://concernedcounseling.com](http://concernedcounseling.com)
- [are people with bipolar disorder prone to use drugs and alcohol \[!\]2006-03-20 15:39:41http://www.aamft.org](http://www.aamft.org)
- [are people with bipolar disorder prone to use drugs and alcohol \[!\]2006-03-20 15:39:41http://www.dbsalliance.org](http://www.dbsalliance.org)
- [pregnancy calculator \[!\]2006-03-20 17:45:44http://pregnancy.about.com](http://pregnancy.about.com)
- [continental airlines \[!\]2006-03-21 10:43:36http://www.continental.com](http://www.continental.com)
- [crosby tx real estate for sale \[!\]2006-03-21 12:16:49http://www.homes.com](http://www.homes.com)
- [acreage for sale in crosby tx \[!\]2006-03-21 12:27:25http://bonniebutler.homes.com](http://bonniebutler.homes.com)
- [eva mendez information \[!\]2006-03-21 12:42:05http://www.celebritywonder.com](http://www.celebritywonder.com)
- [is there an illness disorder associated with a person wanting to have numerous pets \[!\]2006-03-22 14:06:020](#)
- [disorders with people owning numerous dogs \[!\]2006-03-22 14:10:190](#)
- [is it a disorder to want to own violent dogs \[!\]2006-03-22](#)

- 
- [dealing with abuse from a spouse with mental disorder \[!\]2006-03-22 15:56:19http://incestabuse.about.com](#)
 - [dealing with abuse from a spouse with mental disorder \[!\]2006-03-22 15:56:19http://pages.zdnet.com](#)
 - [dealing with spouse that has bipolar disorder \[!\]2006-03-22 16:18:42http://christi .. hristianet.com](#)
 - [dealing with spouse that has bipolar disorder \[!\]2006-03-22 16:18:42http://www.bipolarworld.net](#)
 - [dealing with spouse that has bipolar disorder \[!\]2006-03-22 16:28:440](#)
 - [spouse is cruel to everyone in family including animals \[!\]2006-03-22 16:29:250](#)
 - [coping with abusive spouses \[!\]2006-03-22 16:30:56http://divorce .. port.about.com](#)
 - [dealing with abusive spouse \[!\]2006-03-22 17:49:53http://www.covenantkeepers.org](#)
 - [spouse is cruel to everyone in family including animals \[!\]2006-03-22 18:01:110](#)
 - [dealing with verbally abusive spouse \[!\]2006-03-22 18:04:02http://www.drirene.com](#)



- [bible scriptures for healing from mental disorders \[!\]](#)2006-04-07 11:40:450

- [healing prayers for people with bipolar disorder \[!\]](#)2006-04-07
11:41:36<http://www.beliefnet.com>



- [prayers for relationship problems \[!\]](#)2006-04-09
16:35:37<http://www.divorcehope.com>

- [how does a male's cocaine use affect a fetus \[!\]](#)2006-04-10
15:42:14[https://my.ino .. search/content](https://my.ino..search/content)



- [birth defects caused by father's cocaine use \[!\]](#)2006-04-10
15:45:16<http://otispregnancy.org>

Google, and data integration

combining queries, position, email content, background information

- Google (for example) has access to multiple types of personal information

- Search log
- Position
- Videos (youtube)
- Email
- Calendar
- News preferences
- ...





- Similar considerations apply to Amazon, Expedia, etc. etc.
- What information can be obtained from the *integration* of all this data?



Inferences: prediction by segmentation

(double-click, post-code, credit scoring, ...)

- I can know a lot about you, if I know "others like you"
 - Defining "others like you" involves *segmenting* the population into small homogeneous groups (geographically, demographically, etc)
 - One way is using the PostCode
- 
- 





BS1 5TX

- If we check the preferences of people living near the Watershed Cinema of Bristol, where this talk is taking place, by using upmystreet.com, we find that “many of the people who live in this sort of postcode [BS1 5TX] will be cosmopolitan sharers or students living in flats”.
- We also find that they are likely to have a high interest in current affairs, and they tend to be young single people renting small one or two bedroom flats.
- While news may be followed online, they are also readers of The Guardian, Observer, Independent and The Times

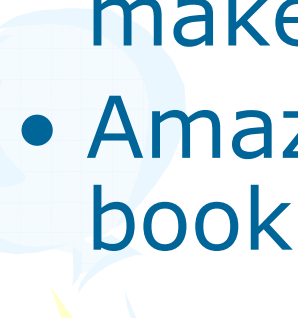



Behavioural Segmentation

- You can be segmented based on demography, or geography...
 - But what is possible today is to segment population by *past behaviour*
 - “People who have bought a pizza and rented a video, may buy a beer next....”
- 
- 

A lightbulb icon with a green grid pattern and yellow rays emanating from it, positioned in the top left corner of the slide.

Inference

- Information is typically integrated to achieve better segmentations, and make better predictions
 - Amazon: “people who bought this book also bought...”
 - Marketers and Political Campaigners love this information... and they pay for it!
- 
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- A lightbulb icon with a purple grid pattern and yellow rays emanating from it, positioned in the bottom left of the slide.

Consumer Response

Targeting precisely the right consumers for your campaign means having access to a database that not only offers the volume of records you need, but also provides the selection flexibility that allows you to dictate exactly your target group.

ConsumerResponse encompasses all of the UK and consists of over:

- ◆ 40 Million Individuals
- ◆ 22 Million Households

The way we process the data, the attention to detail we employ and the procedures the data is subjected to, all go to ensure that we achieve the level of accuracy you demand. All records are verified against:

- ◆ Electoral Role
- ◆ Movers File
- ◆ Goneaway File

A host of selection opportunities allows you to specify precisely the right contacts for your campaign, these include:

- ◆ Telephone Numbers
- ◆ Gender
- ◆ Age
- ◆ Income
- ◆ Occupation
- ◆ Nationality
- ◆ Home owner
- ◆ Tenant
- ◆ Length of residency
- ◆ Household composition

Geographic options are:

- ◆ Region
- ◆ County
- ◆ Town
- ◆ Postcode

The base data consists of:

- ◆ Salutation
- ◆ Initial
- ◆ Surname
- ◆ Address
- ◆ Postcode

If it's lifestyle data you require, a wide range of categories are available to choose from, use the sample below as a starting point:

- | | |
|-------------------------------|---------------------------|
| Alcohol drinkers | Gardeners |
| Arts | Health / Beauty |
| Car owners | Hobbies / Crafts |
| Charitable donators | Holidays / Travel |
| Cinema / Theatre goers | Insurance |
| Collectors | Mail order buyers |
| Computer users (home) | Mobile phone users |
| Dining out | Music |
| DIY / Home improvement | Outdoor interests |
| Finance / Investments | Pet owners |
| Food / Drink | Photography |
| Frequent Flyers | Shareholders |

Pricing	per thousand
Base rental	£170.00
Lease 12 months	£335.00
Telephone numbers	£80.00
Outright purchase	£580.00

SPECIAL COVERAGE



Political Profiling

- Political campaigning is now using the same tools as direct marketing: careful profiling of voters, followed by delivery of customised message
- The idea: merge voter information (electoral lists) with consumer information (purchased from direct marketing organisations), to obtain high quality portraits of each voter
- Called Micro-Targeting, it has been used in last 2 US Presidential elections
- Example: "Voters-vault" ...

HOW WE CAST OUR BALLOTS



Married, age 45 to 54, uses absentee ballot, no children, recently purchased a luxury car = leans Republican



White, under 40, college educated, relies heavily on the Internet for news, lives in an urban area = leans Democrat



Hispanic, over 60, border-swing-state resident, lives in an urban area, feels strongly about immigration = leans Republican



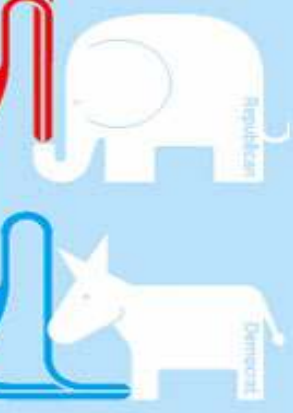
White, over 60, high school educated, union member, financially stressed = leans Democrat



Male, high school educated, lives in a swing state, reads *Guns & Ammo*, voted in 2006 = leans Republican


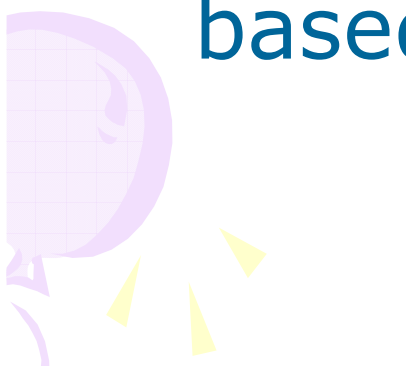


Single, age 20 to 29, lives in an urban area, has student loans, owns own home = leans Democrat





Computer Voyeur

- Is it any better if it is computers – not people – that read our mail, or listen to our conversations?
 - Automation affects also the *usage* of this information.
 - Google makes recommendations based *on the content* of my emails ...
- 
- 



Automating Usage

★ ● **Nello Cristianini**

PATTERNS IN PERSONAL DATA- Nello Cristianini

The Privacy Delusion

When we play online computer-chess we do not expect our intelligence to be measured, and compared with our school records, to be sold to recruitment agencies.

As we shop for holidays, or extravagant shoes, we do not expect this information to be given to debt collection agencies, or credit scoring organisations.

After all, our everyday world does not work like that. When we buy a newspaper, no one knows what articles we end up reading. Certain information is just for ourselves. There are things that we keep for ourselves, like the name of a girl we liked at school or our passion for Abba music. Whether we exchange emails to organise a surprise party, or we search for information about a skin condition that is worrying us, or we just take a walk on the beach, we do not expect our activities to be monitored. Should we?

What we expect today is the result of thousands of years of collective experience. We expect a certain part of our life to be kept private, if for no other reason - because there are so many of us that we cannot imagine anyone making the effort to gather information about all of those things for every person. We literally hide in the crowd, relying on numbers - if not decency of the others - to protect a little part of our personal sphere. These expectations might be misleading today or tomorrow, as the world is changing fast.

In order to be useful, information needs to be gathered, stored or transmitted, then processed and finally acted upon. Every step of this chain has undergone major transformations in the past decades, and can now be done automatically, cheaply, and very efficiently, by machines. Taken together, these technological advances have enabled a revolution in our society, but at the same time can pose a threat to the privacy of our personal sphere. What information can be automatically gathered today (we discuss on technical aspects here), and how much about our

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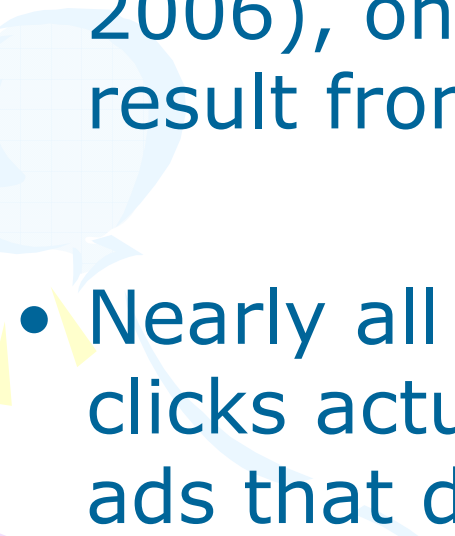
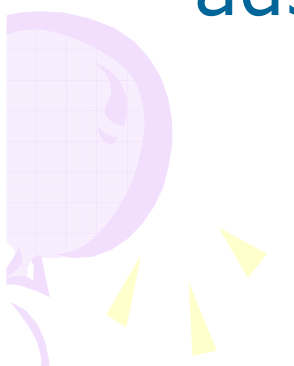
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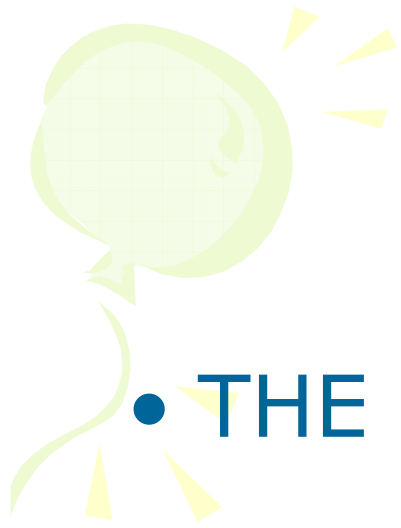
Automatic Targeting

- Amazon.com says 35 percent of product sales result from recommendations (in 2006), one wonders how many votes result from micro-targeting.
 - Nearly all Google's revenue is based on clicks actually made by their customers on ads that depend on the user's behaviour...
- 
- 



Tomorrow's World

- We are creating a new type of society, where the notion of privacy is very different.
 - Current laws are based on concepts that may no longer apply to the current situation on the ground.
 - As we sleep-walk irreversibly into this new world, we should develop concepts, laws, values, to help us exploit all that information technology has to offer us, without creating a nightmare for our children.
 - It is our job to understand the implications of what we are doing, and it is our job to explain where our work can lead us to the public and to the law makers.
- 
- 



• THE END

