Banco de Dados

Fundamentos

André Santanchè e Patrícia Cavoto
Instituto de Computação – UNICAMP

Agosto 2016

Fantasia à Constantinople por Felix Ziem

Prêmio de US$ 1 milhão

Exercício 1: Netflix Prize
Recomendar um Filme

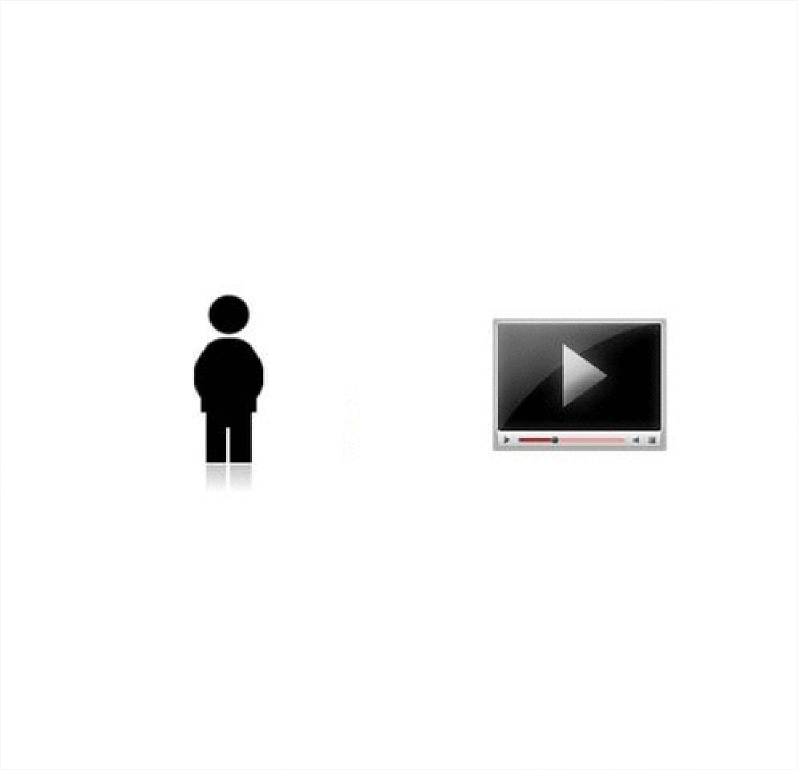
- Considerando que você vai recomendar filmes para usuários do Netflix, detalhe:
  - Que dados você levaria em consideração?
  - Que passos você seguiria para recomendar um filme para um usuário.

Filtragem Colaborativa

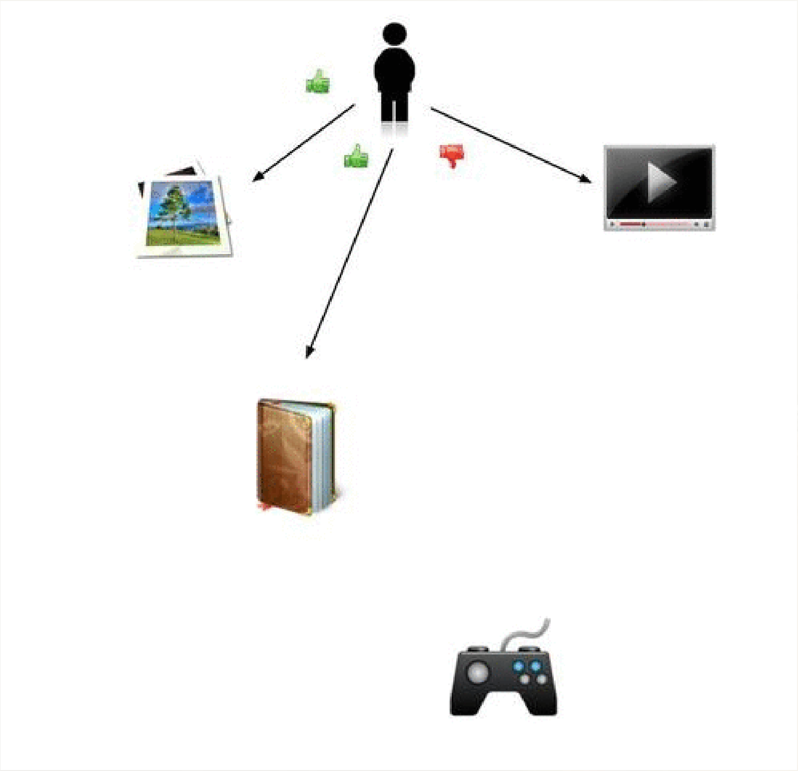
- Técnica de recomendação
- Exemplo baseado em https://en.wikipedia.org/wiki/Collaborative_filtering

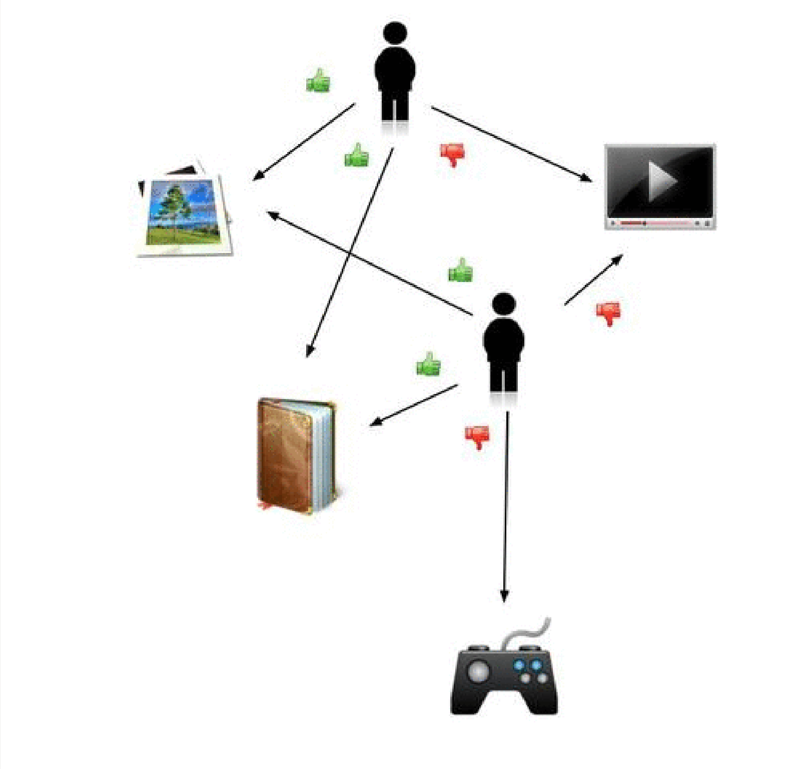
Itens candidatos a recomendação

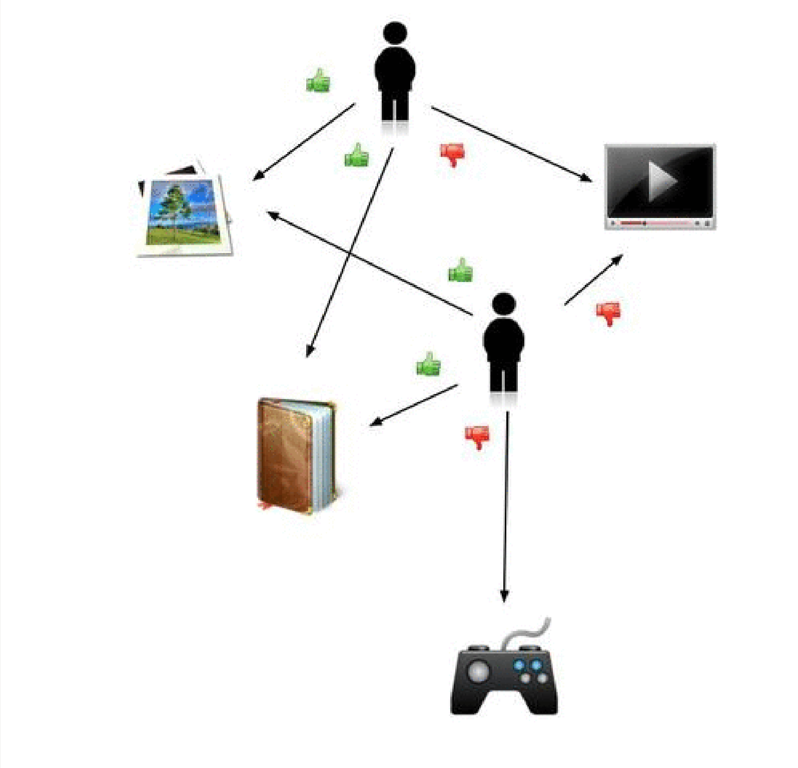
Devo recomendar para Asdrubal?

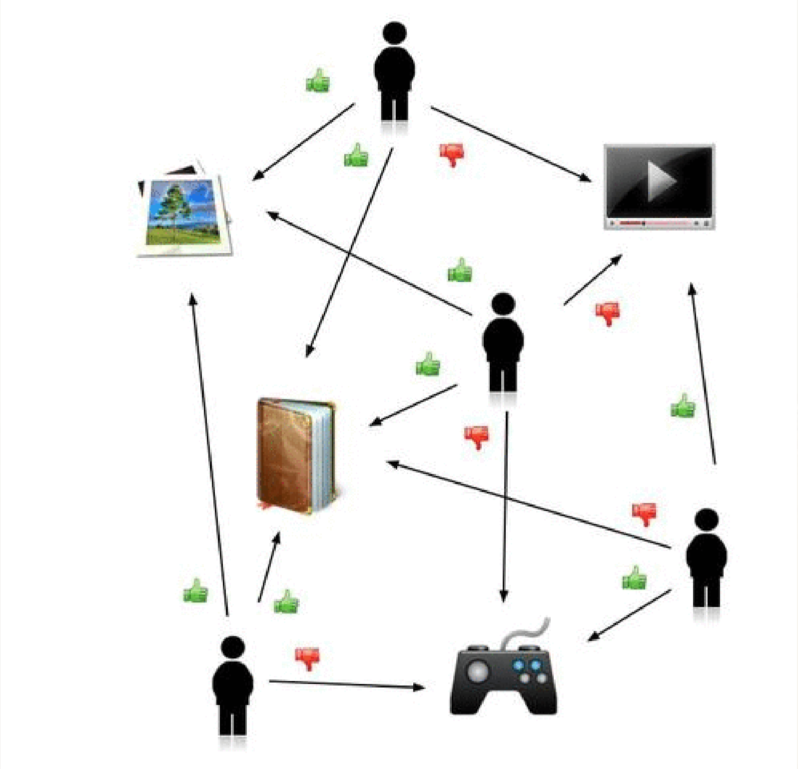


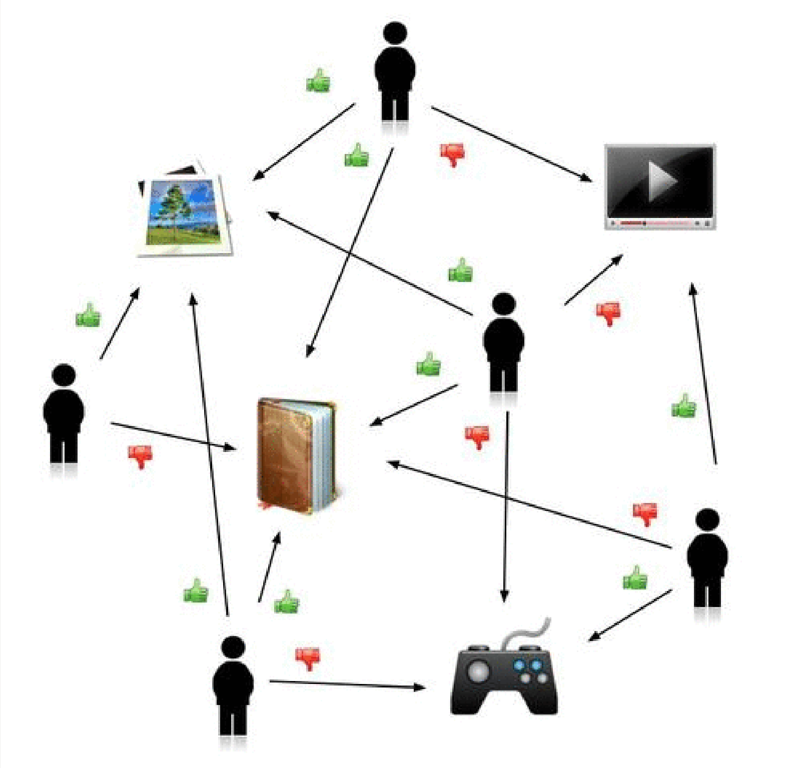
Usuários e suas avaliações

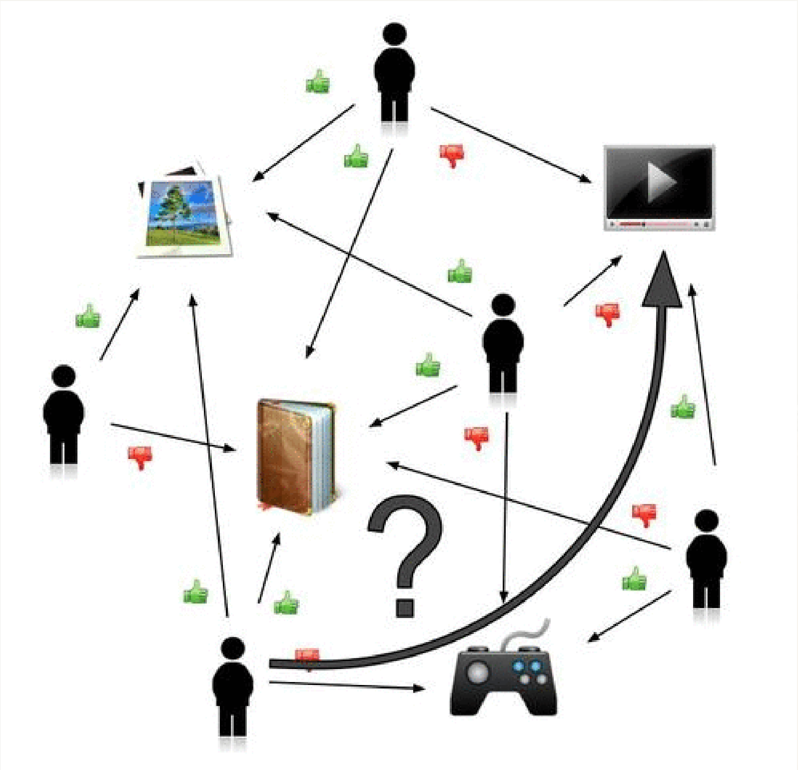




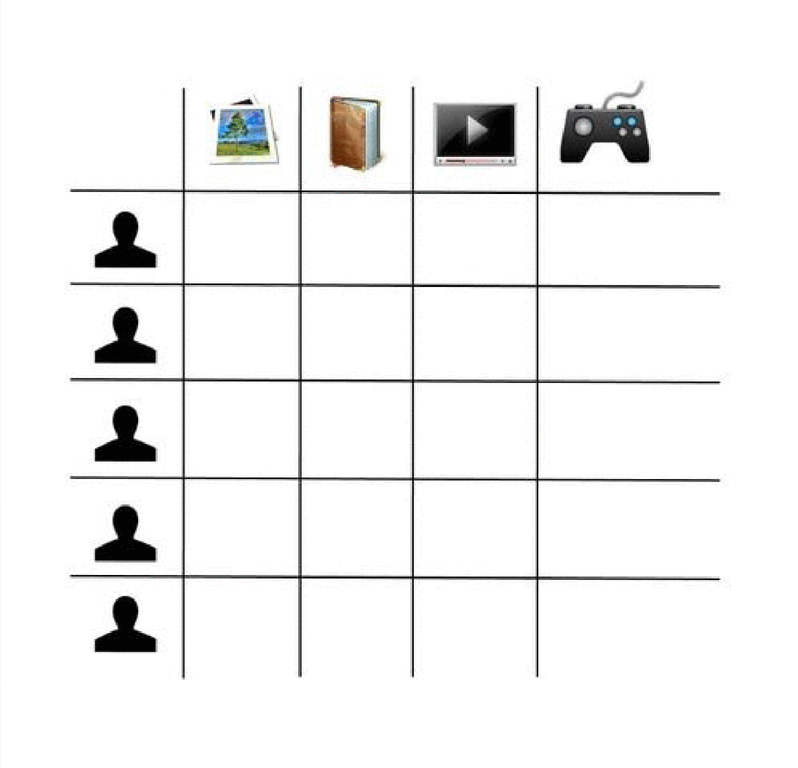




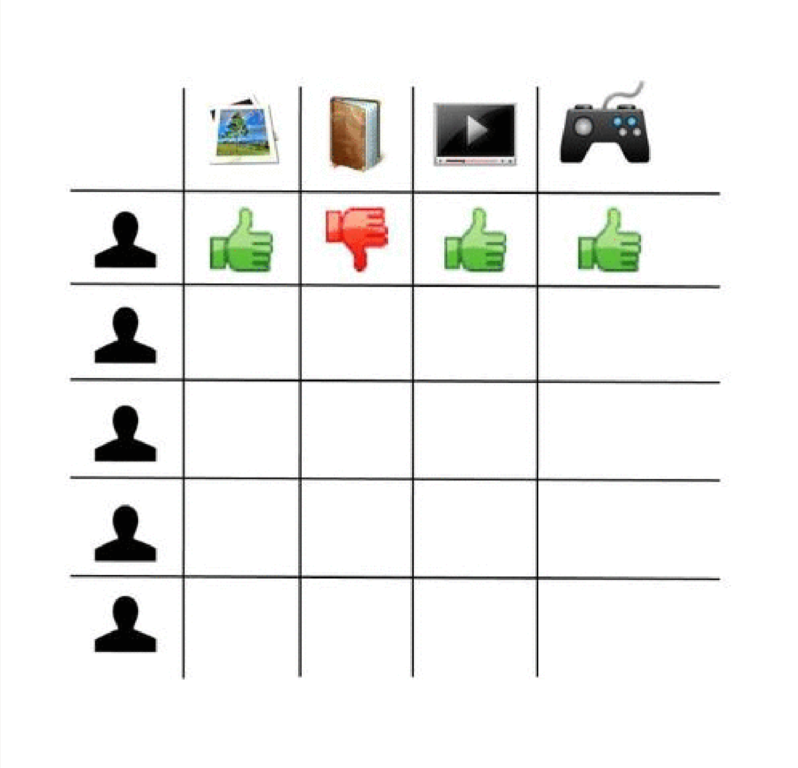


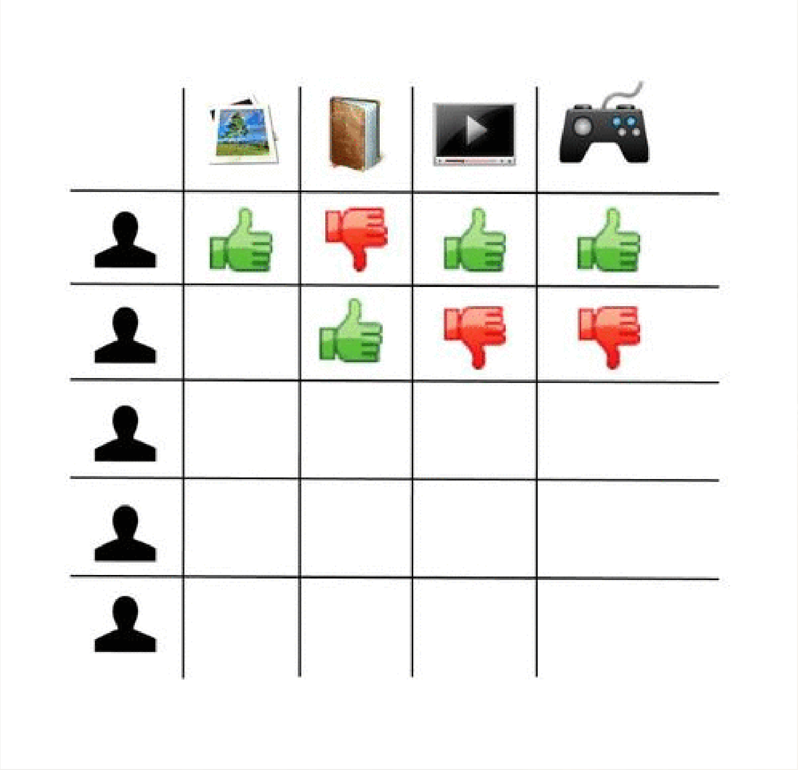


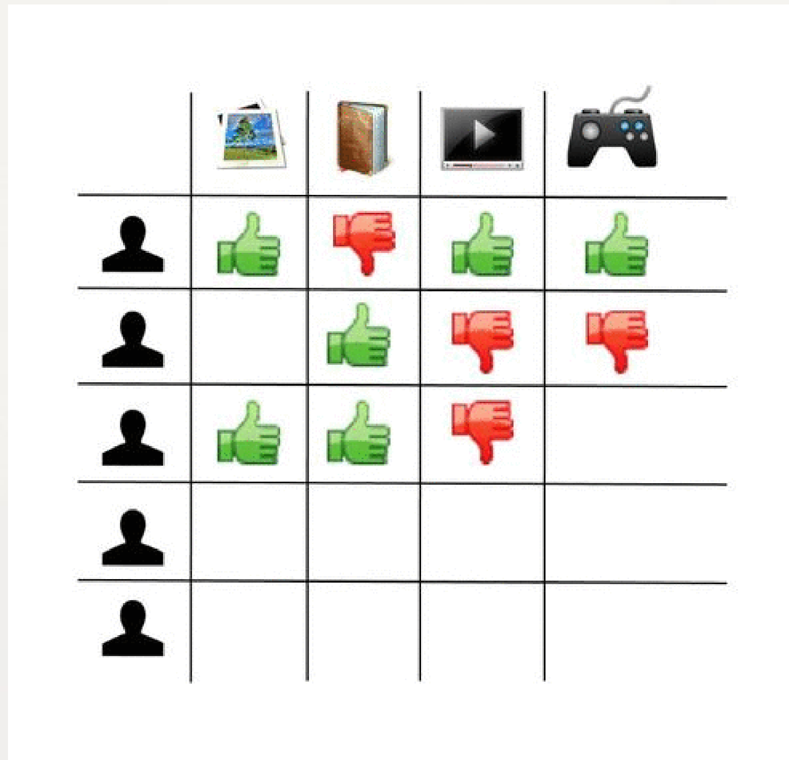
Vendo sob outra perspectiva

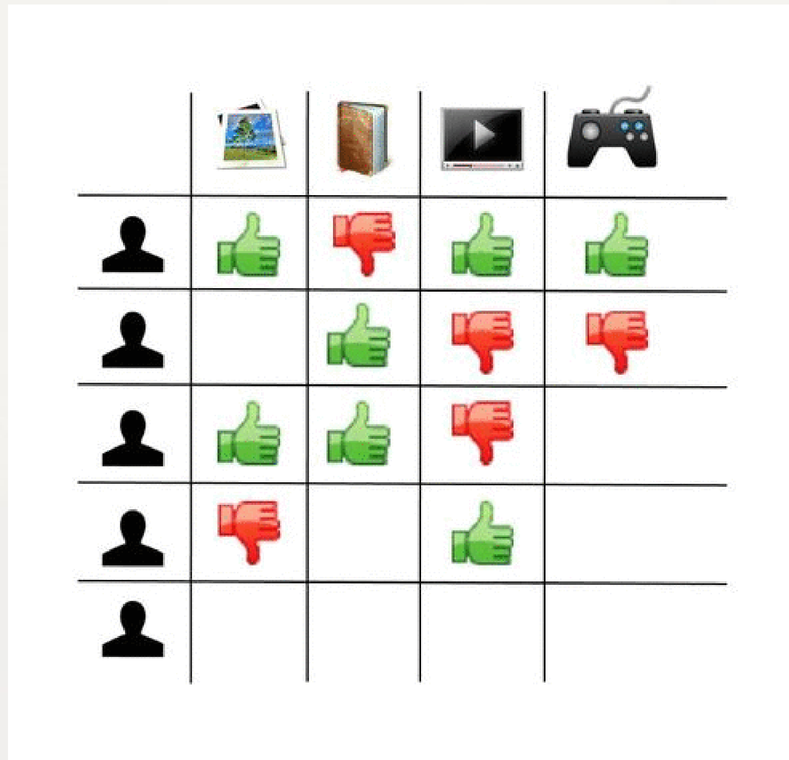


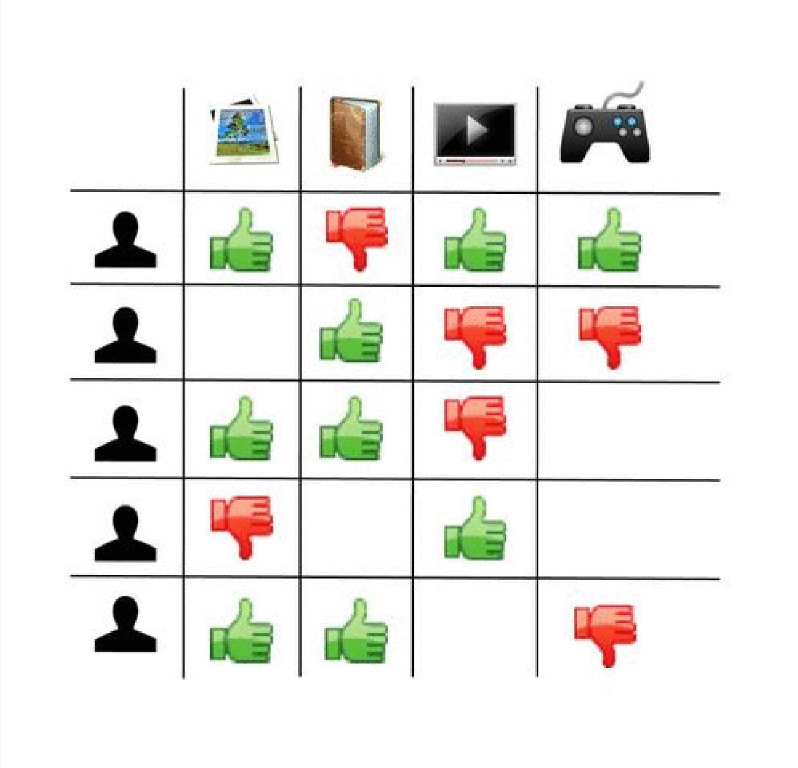
Usuários e suas avaliações



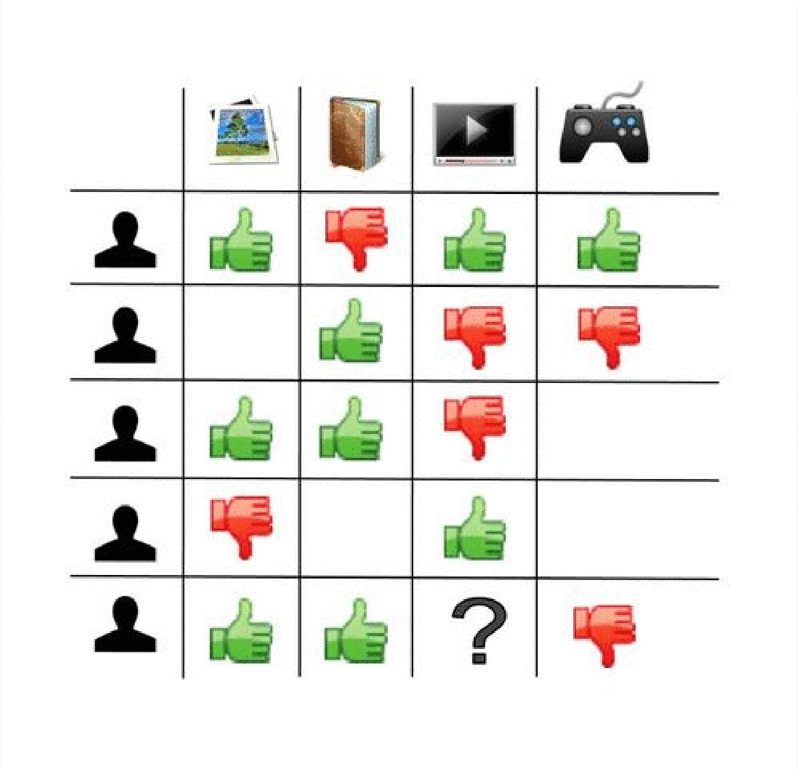




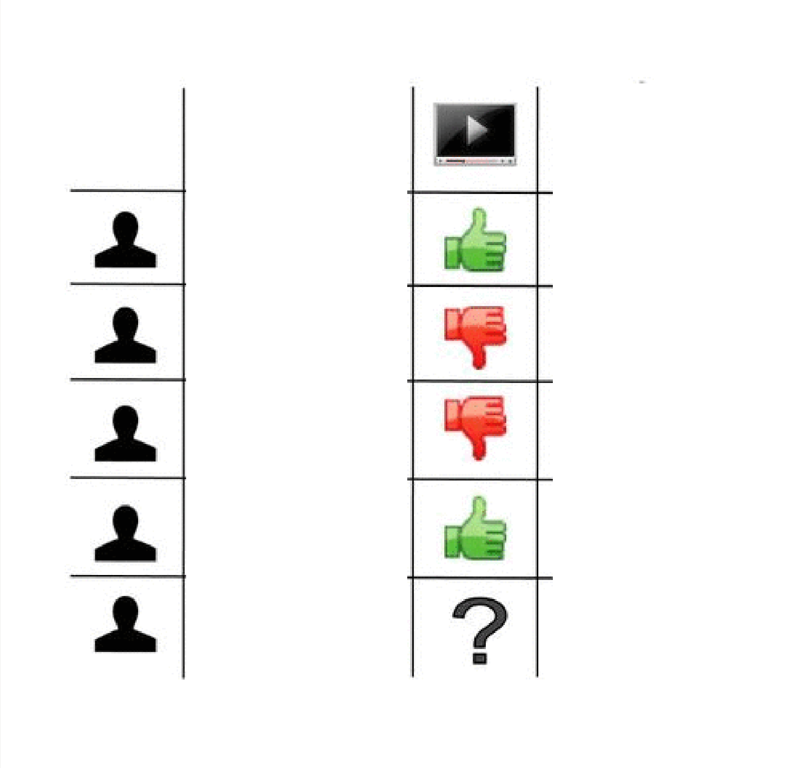




O que recomendar para Asdrúbal?



Olhar a avaliação dos demais?



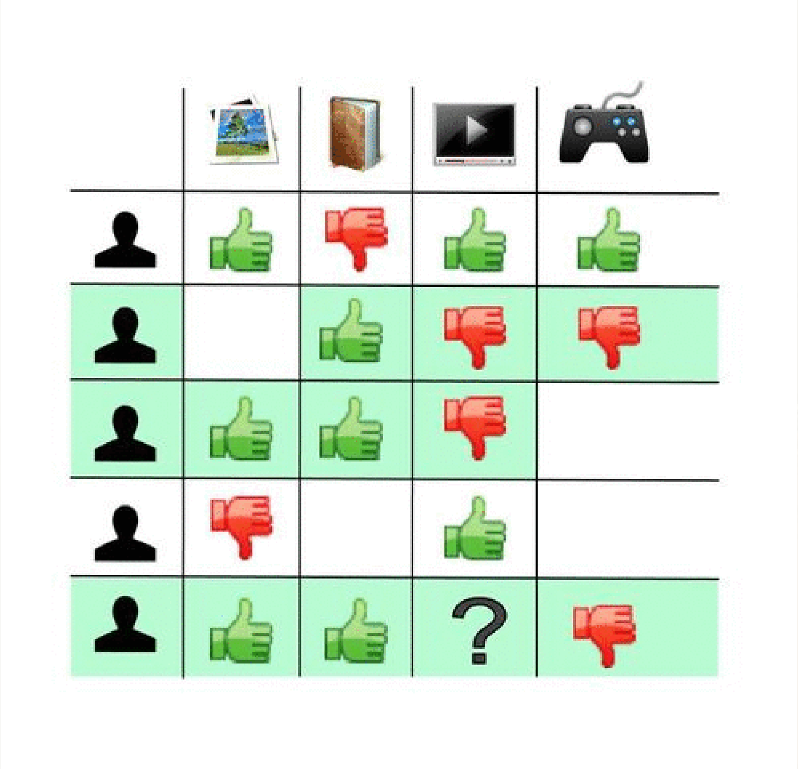
E se os demais não pensarem como Asdrúbal?

Exercício 2: Netflix Prize
Refinando a Recomendação

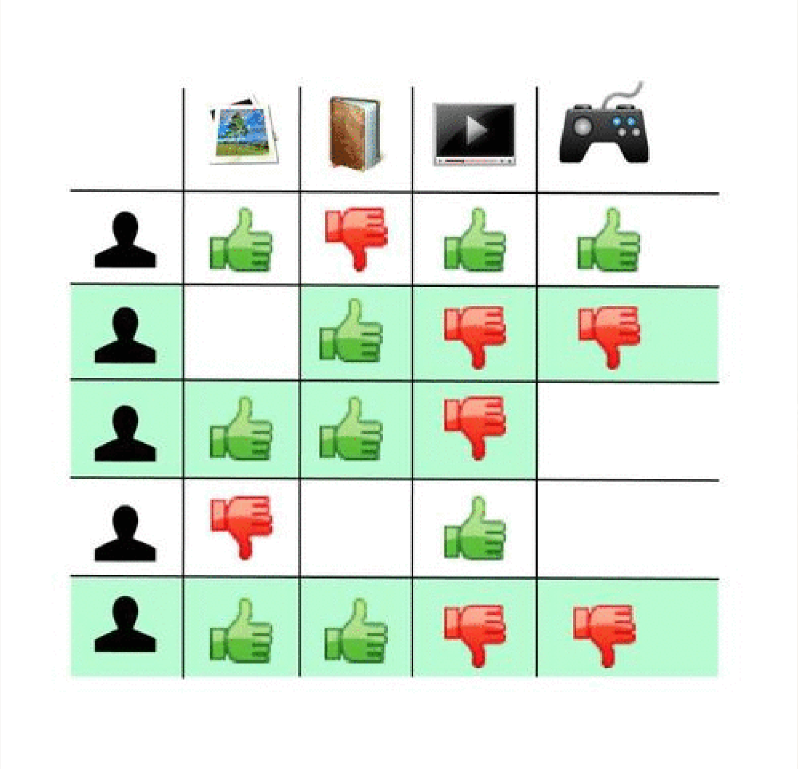
- Refine a recomendação para:
  - Que dados você levaria em consideração?
  - Que passos você seguiria para recomendar um filme para um usuário.

Selecionando Usuários Similares

Filtragem Colaborativa

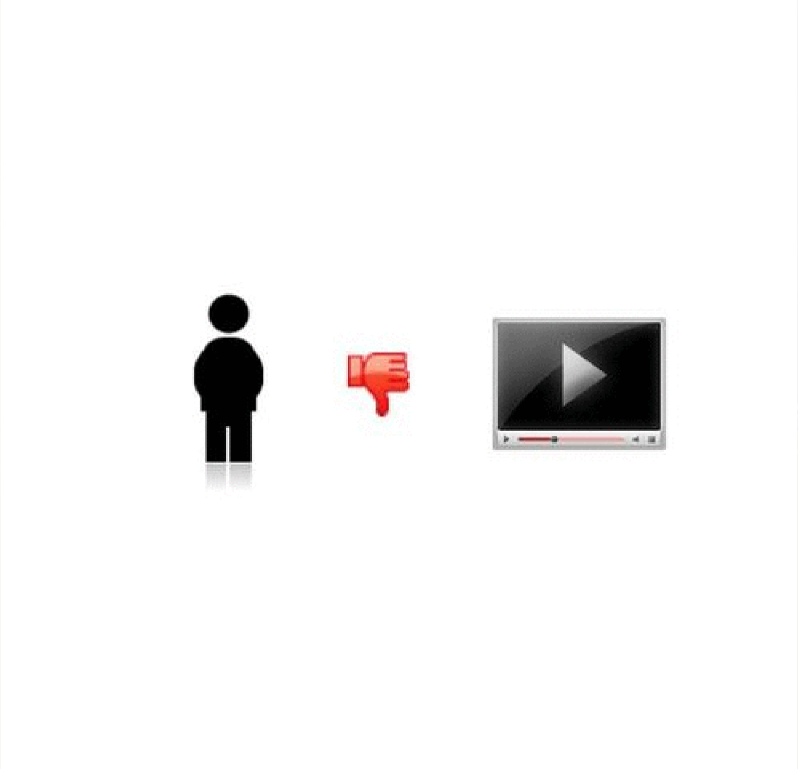


Indicando a partir dos similares
Filtragem Colaborativa



Indicando a partir dos similares

Filtragem Colaborativa



Começando com Banco de Dados

Motivação

- Aplicações computacionais de todos os portes trabalham com grandes volumes de dados
  - Gerenciamento de uma rede de farmácias
  - Sistema bancário
  - Sequenciamento do Genoma Humano
  - Redes Sociais

Motivação

- Grandes volumes de dados e suas relações complexas justificam a criação de estratégias específicas para gerenciá-los

Motivação

- Grandes volumes de dados e suas relações complexas justificam a criação de estratégias específicas para gerenciá-los

Bancos de Dados

Aplicações Tradicionais

- Bancos de dados numéricos e tradicionais
- Exemplos:
  - Gerenciamento de uma farmácia
  - Sistema bibliotecário
  - Sistema bancário

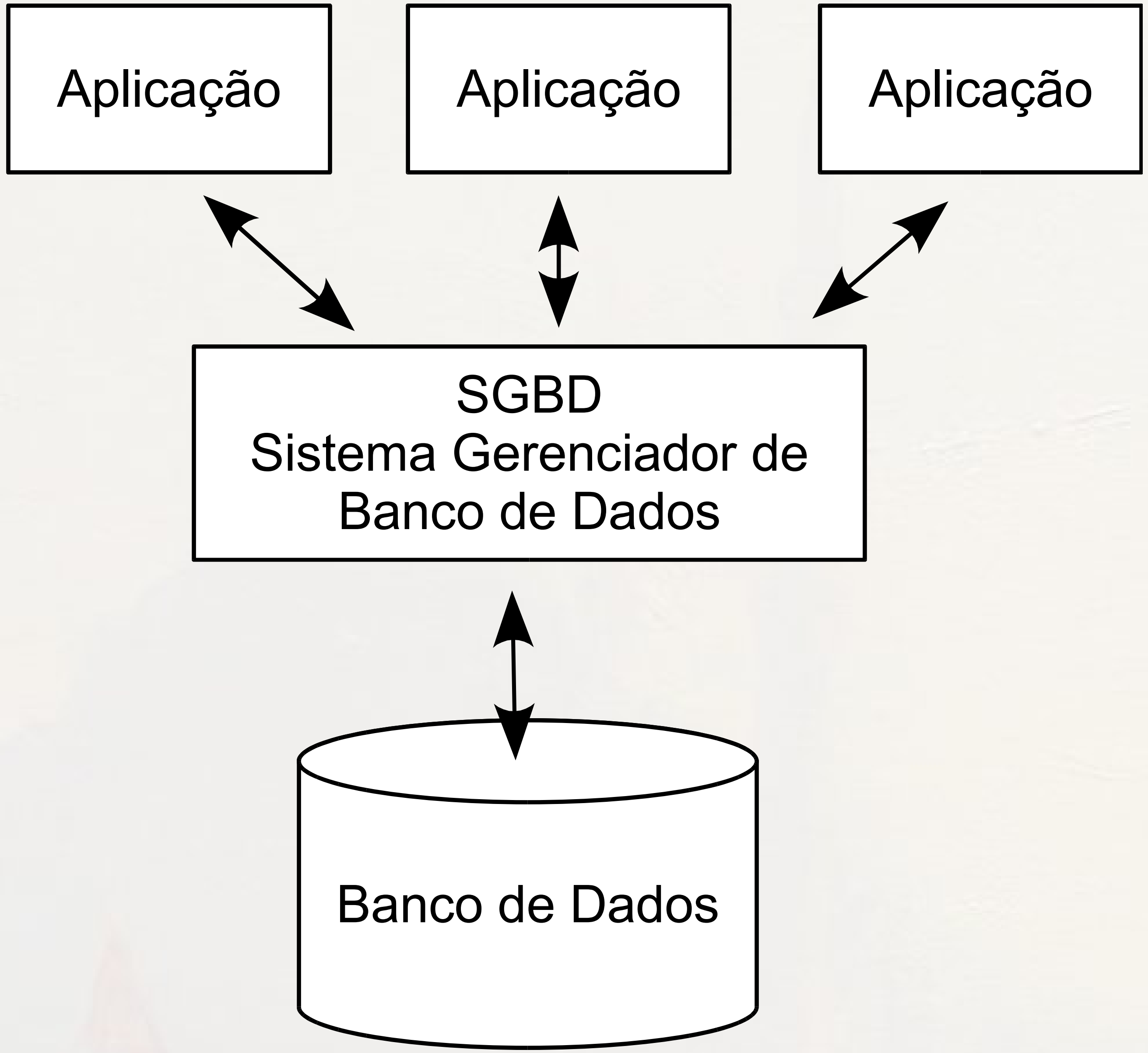
Aplicações

- Aplicações mais recentes
  - Bancos de Dados Multimídia
  - Sistemas de Informação Geográfica (GIS)
  - Data Warehouses
  - Internet das coisas
  - etc.

Sistema Gerenciador de Banco de Dados (SGBD)

- Sistema de software com finalidade genérica
- Projetado para a definição, construção e manipulação de bancos de dados
- Pode atender várias aplicações

SGBD


Aplicação
Aplicação
Aplicação
SGBD
Sistema Gerenciador de
Banco de Dados
Banco de Dados

Vantagens de um SGBD

- Independência de dados
- Acesso eficiente
- Tempo reduzido no desenvolvimento de aplicações
- Segurança e integridade de dados
- Administração de dados uniforme
- Acesso concorrente
- Recuperação contra *crashes*

(Ramakrishnan, 2003b)

O que está mudando?

- Dados estão por toda a parte
  - não somente centralizados em um banco
  - produzidos de forma distribuída e interligados
- Modelagem e semântica ganham importância
  - Web Semântica e ontologias
- Data deluge e Big Data
  - novas abordagens (NoSQL)
  - processamento e armazenamento descentralizados
  - bancos de dados em memória

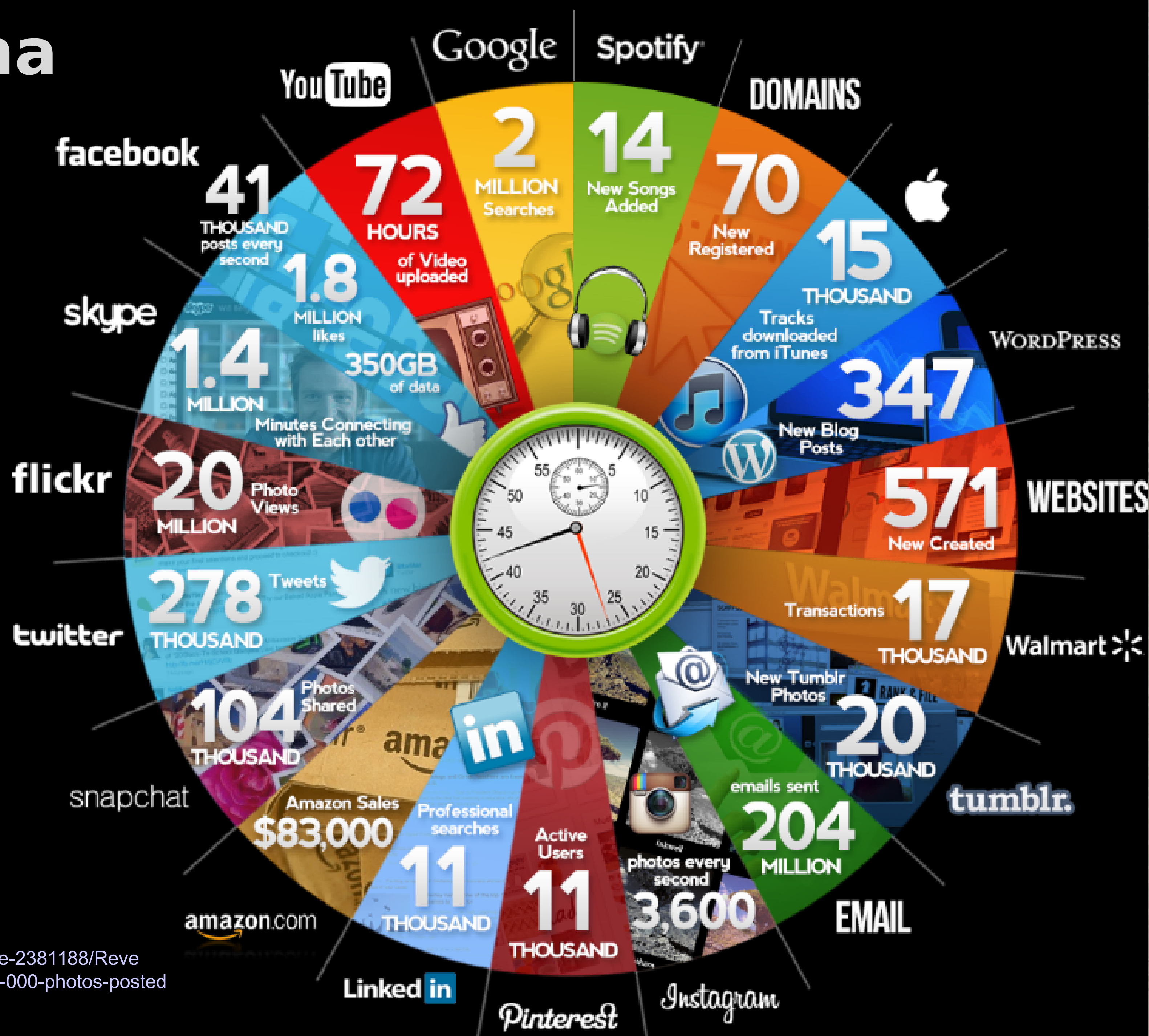
Data Deluge

- Genoma Humano
  - 3.3 bilhões base-pairs
- Facebook
  - 30/06/2016 – 1,71 bilhões de usuários ativos
    - http://newsroom.fb.com/company-info/

Lei de Moore

- Poder de processamento dobra a cada dois anos
- Como crescem os dados?

O que acontece na internet em 60 segundos?

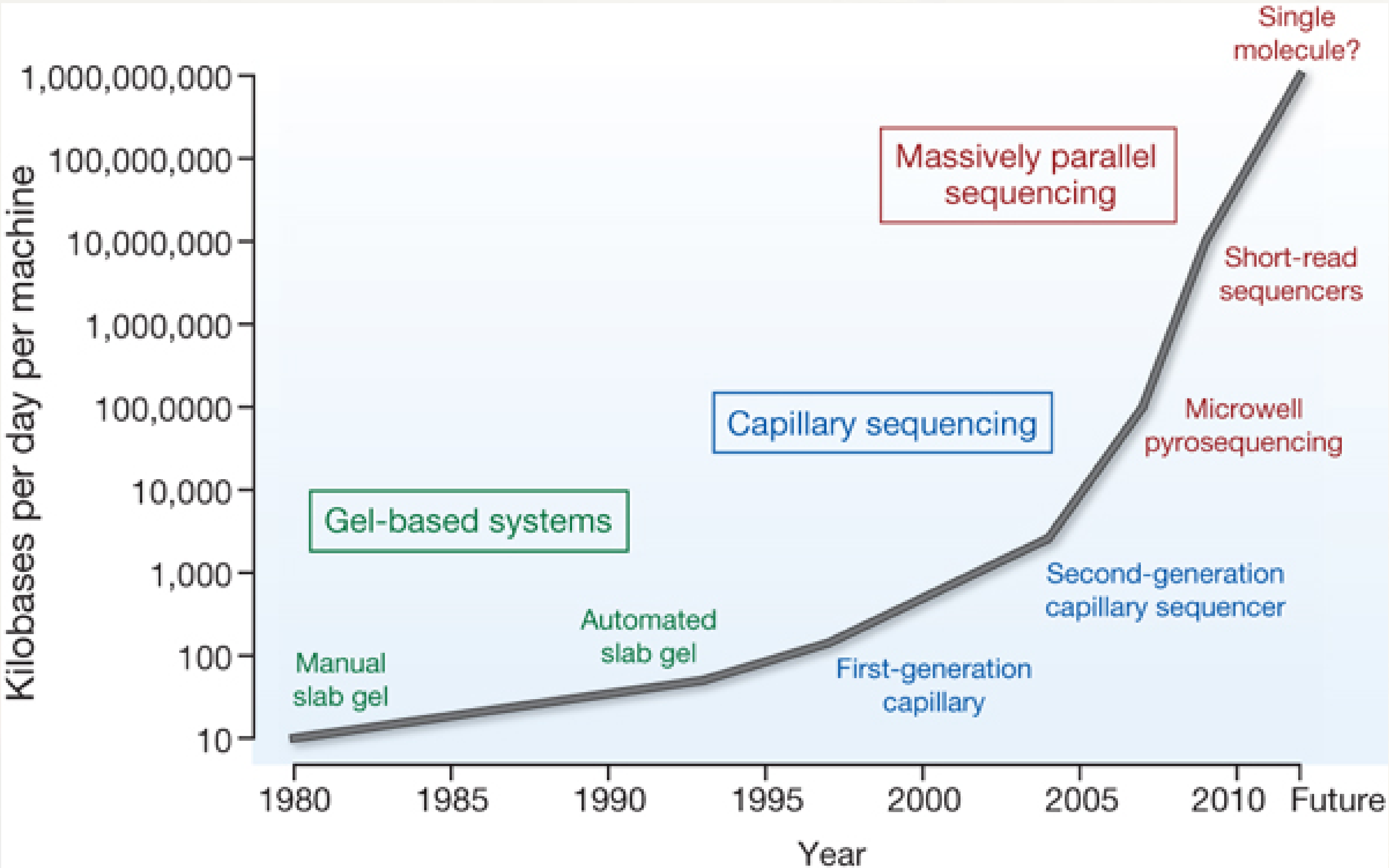


http://www.dailymail.co.uk/sciencetech/article-2381188/Revealed-happens-just-ONE-minute-internet-216-000-photos-posted-278-000-Tweets-1-8m-Facebook-likes.html

Como crescem os dados?

Sequenciamento de Genoma

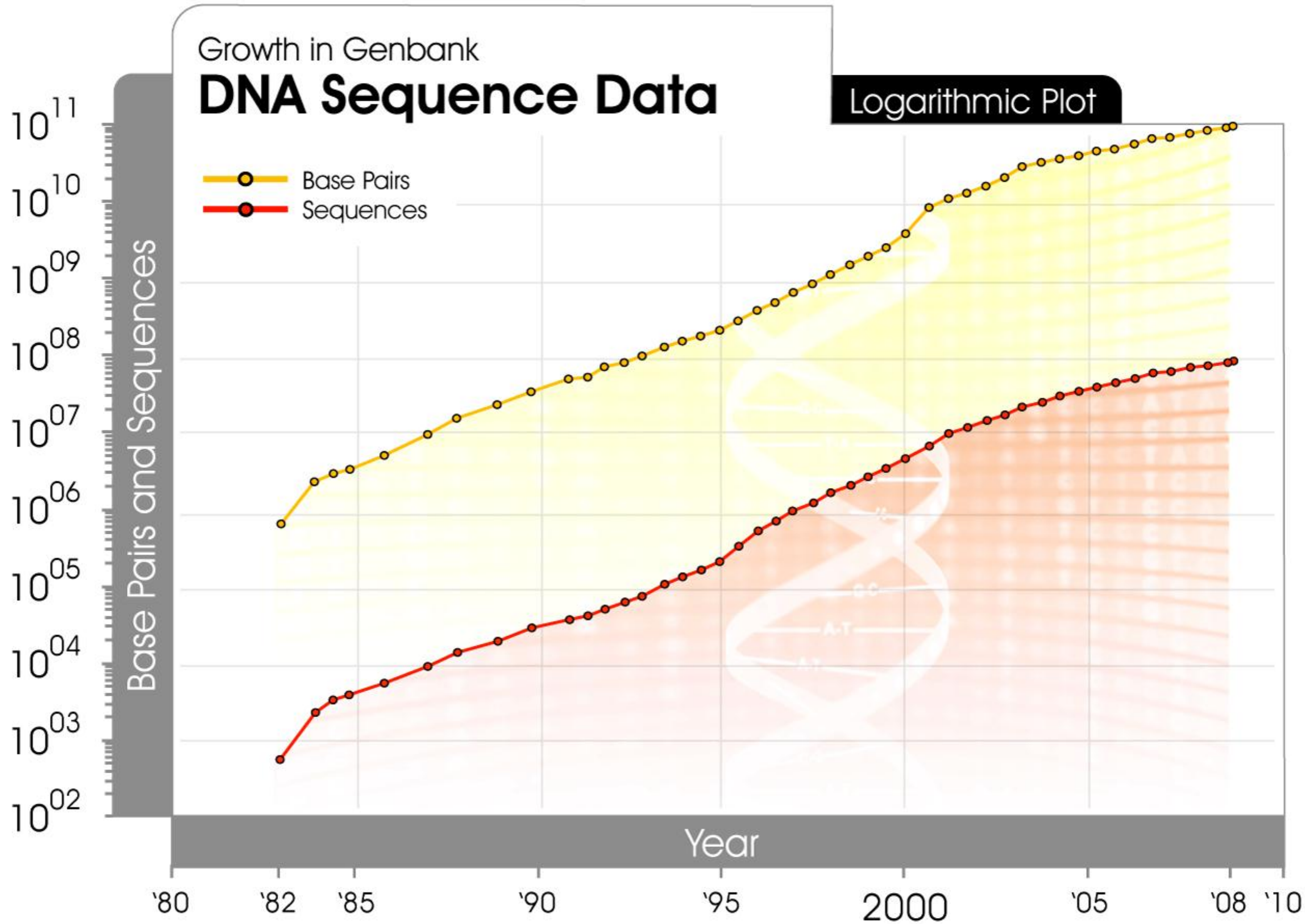
Sequenciamento de Genoma
Aumento na Eficiência



MR Stratton *et al. Nature* **458**, 719-724 (2009) doi:10.1038/nature07943

Sequenciamento de Genoma

Volume de Dados



Raymond Kurzweil

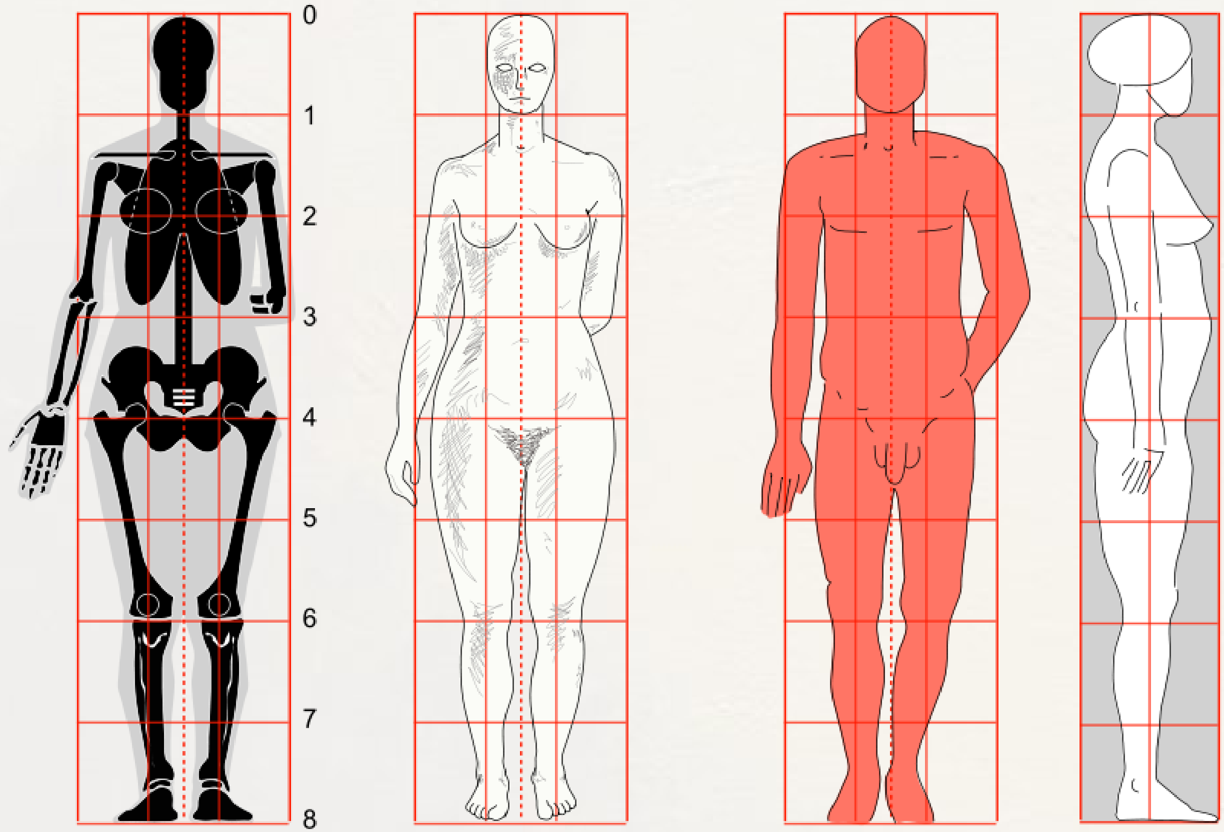
http://www.kurzweilai.net/dna-sequencing-data


Harvard Business Review
OCTOBER 2012
The True Measures of Success
10 Rules for Managing Global Innovation
What Ever Happened To Accountability?
GETTING CONTROL OF BIG DATA
How vast new streams of information are changing the art of management
PAGE XX
COMPUTERWORLD
WHY BIG DATA IS A BIG DEAL
COVER STORY
BI & ANALYTICS
A new group of data mining technologies promises to forever change the way we sift through our vast stores of data.
Science
11 February 2011 | $10
data
AAAS
The Economist
Obama the warrior
Misgoverning Argentina
The economic shift from West to East
Genetically modified crops blossom
The right to eat cats and dogs
The data deluge
AND HOW TO HANDLE IT: A 14-PAGE SPECIAL REPORT
4 September 2008 | www.nature.com/nature | £10
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
nature
THE BITER BIT
Viral infections for viruses
TROPICAL CYCLONES
The strong get stronger
BLACK HOLE PHYSICS
A new window on the Galactic Centre
BIG DATA
NATUREJOBS
Minnesota musings
SCIENCE IN THE PETABYTE ERA

Data Engineering
&
Data Science

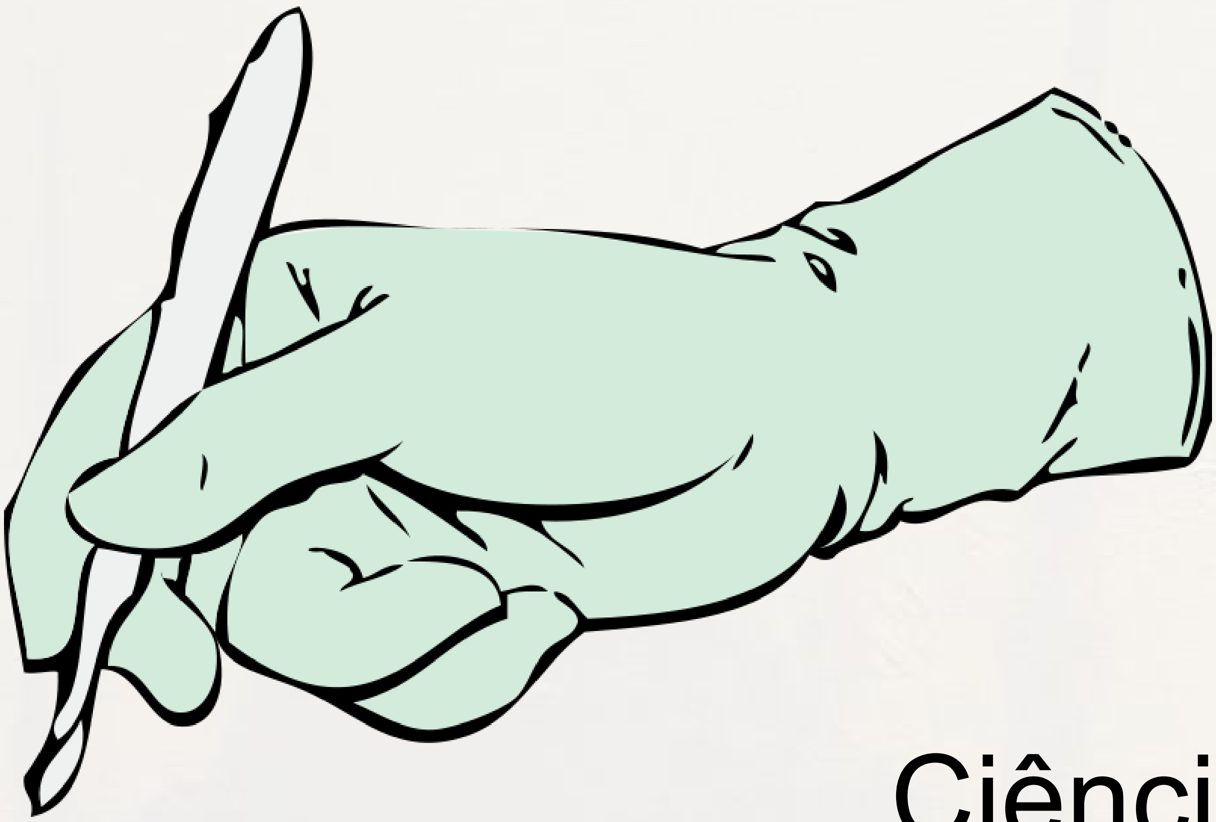
Como Aprendemos Computação?

Cirurgia



By Original by Schnorch retraced by LadyofHats

Cirurgia



Ciência da Faca

Ciência da Computação?

- Computer Science like Knife Science

(Dijkstra, 1986)

Data Science

Quarto Paradigma

The Fourth Paradigm: Data-Intensive Scientific Discovery
Editado por Tony Hey, Stewart Tansley, and Krist in Tolle
Microsoft Research
Redmond, 2009

Mineração de Dados
e
Descoberta de Conhecimento

What Wal-Mart Knows About Customers' Habits

Constance L. Hays

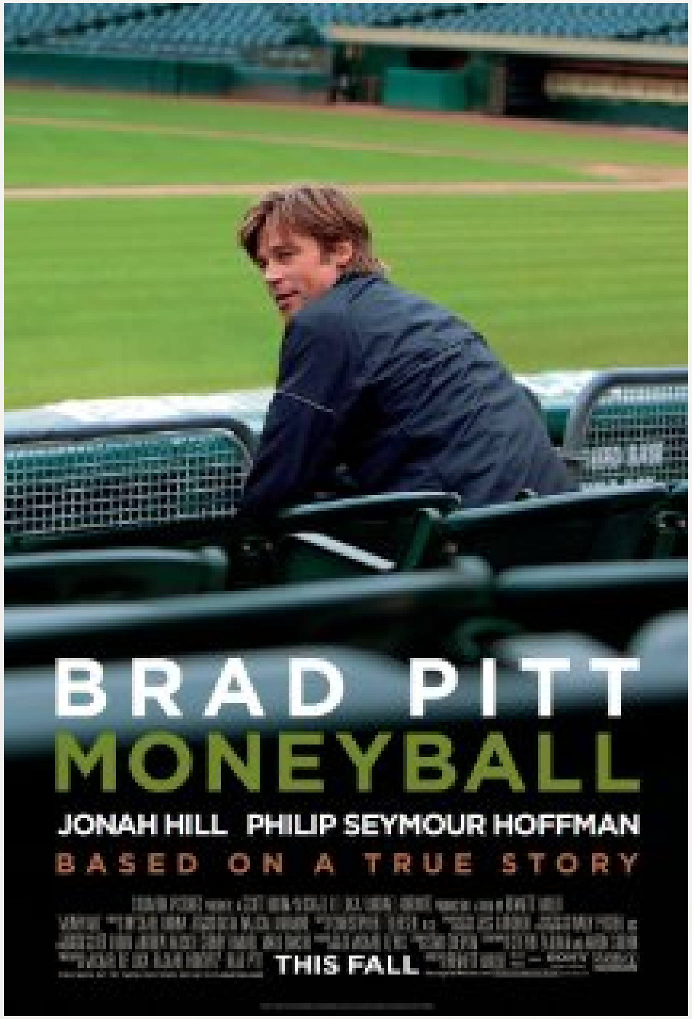
The New York Times, 2004

What Wal-Mart Knows About Customers' Habits

- "start predicting what's going to happen, instead of waiting for it to happen"
- “We didn't know in the past that strawberry Pop-Tarts increase in sales, like seven times their normal sales rate, ahead of a hurricane”
- “And the pre-hurricane top-selling item was beer”

Linda M. Dillman – Wal Mart

Dados e Estratégia



Alemanha e Big Data

SAP and Germany Make a Big Data Team at the World Cup

July 8, 2014 By Ben Hammonds

Sporttechie

http://www.sporttechie.com/2014/07/08/sap-and-germany-make-smart-big-data-choices-at-world-cup/

Alemanha e Big Data

- SAP is using Big Data to help the German coaching staff **make smart decisions** on tactics, player fitness, scouting, preparation as well as in game management. SAP has introduced a new concept called SAP **Match Insights** that assists players and coaches to prepare themselves for upcoming matches by dissecting key situations that may present themselves throughout the course of the match.

Basketball Analytics Database Programmer

- The Boston Celtics are seeking a Basketball Analytics Database Programmer

http://www.nba.com/celtics/contact/bball/analytics-database-programmer

Futebol

Divulgação/Rio 2016/Getty Images

Our Brand Is Crisis
by Rachel Boynton

- Documentary of the 2002 Bolivian presidential election
- Gonzalo Sánchez de Lozada x Evo Morales
- Tacts by the Greenberg Carville Shrum (GCS) company

Minerando na Web

- Information extraction
- Mining
- Searching
- Matching
- Entity resolution
- Deep Web

Redes Sociais e Dados sobre nós

Facebook – Looking for Love

5 cidades dos EUA com maior percentual de pessoas solteiras:

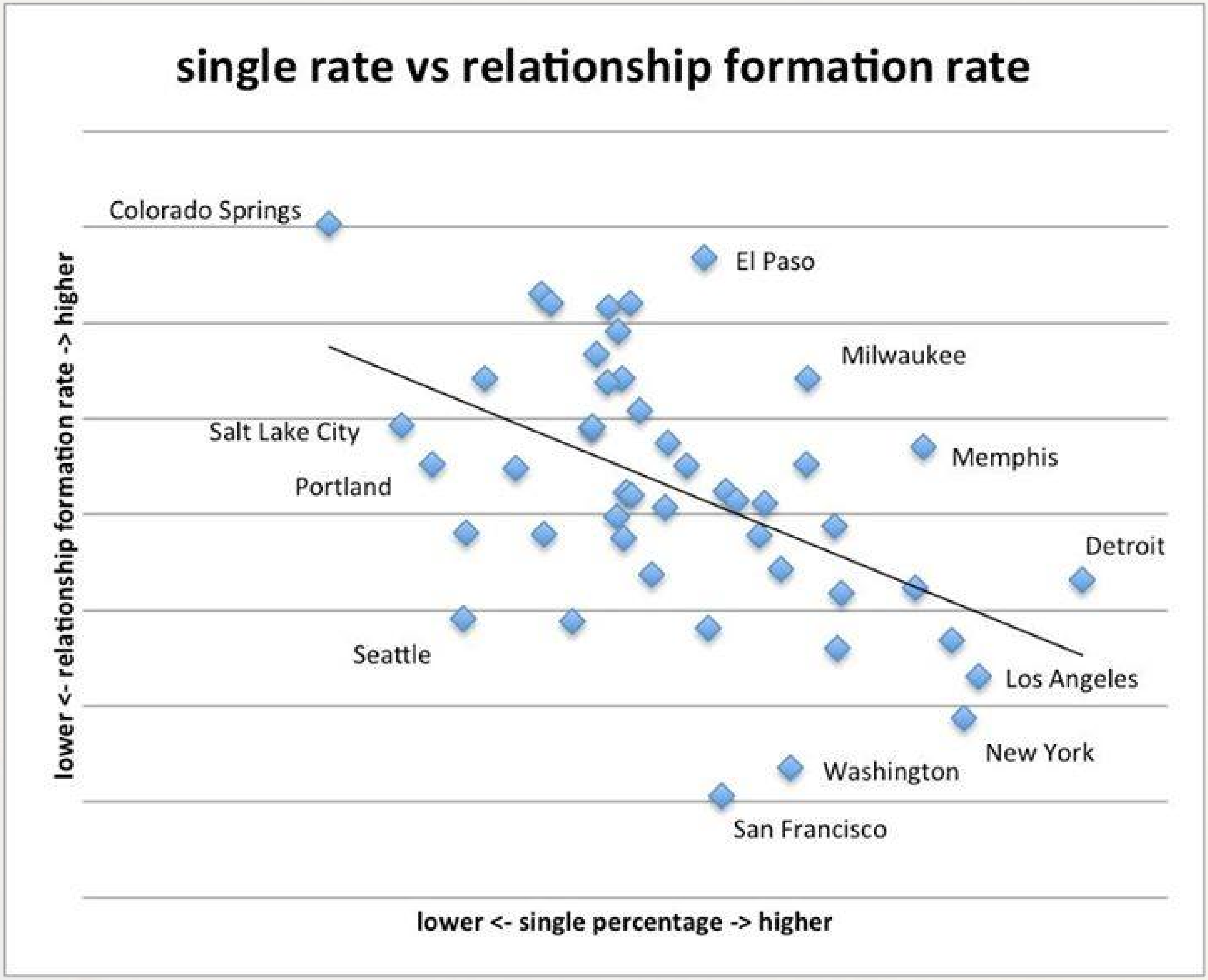
1. Detroit, MI
2. Los Angeles, CA
3. New York, NY
4. Miami, FL
5. Memphis, TN

Facebook – Looking for Love

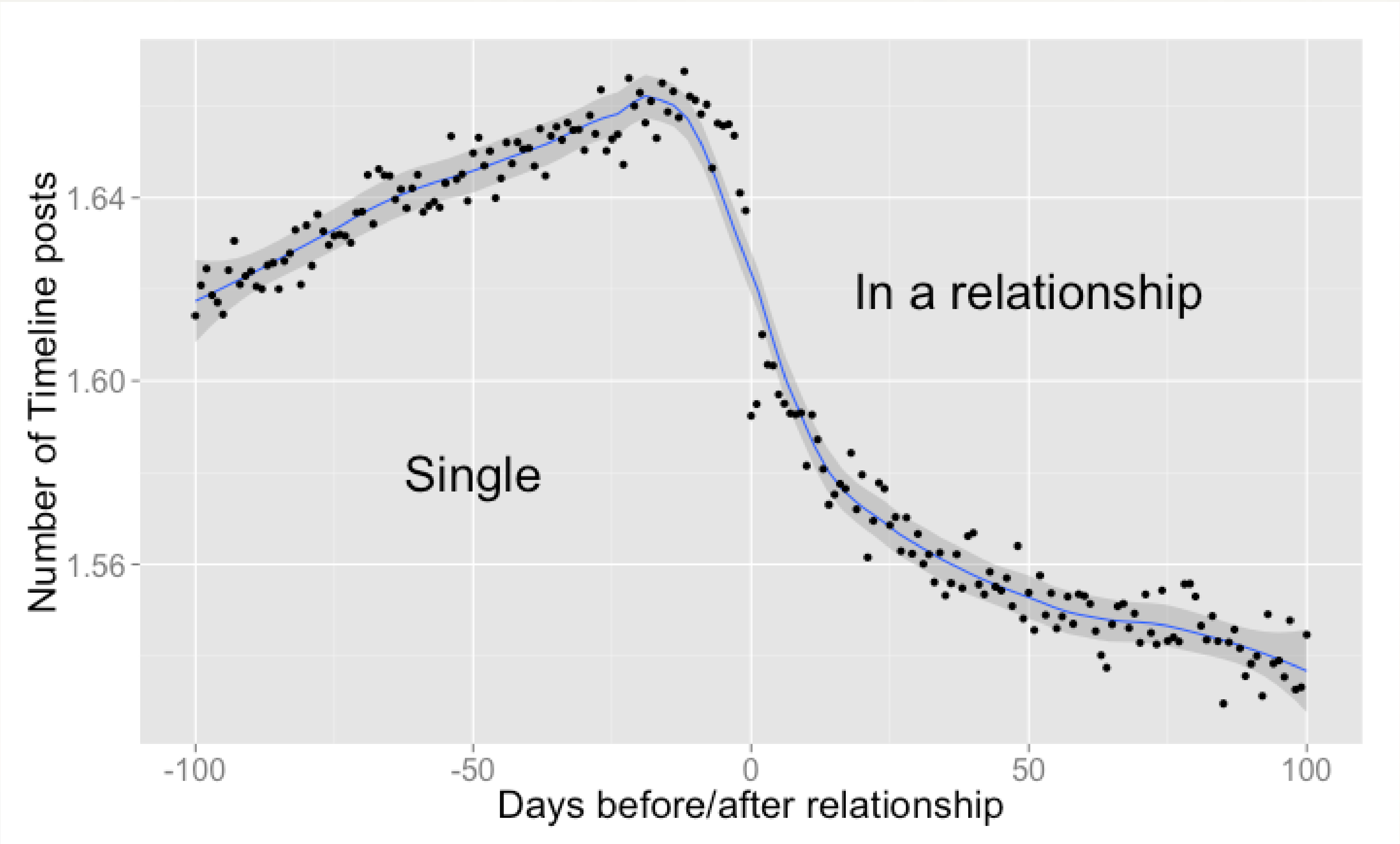
5 cidades dos EUA com maior probabilidade de formar relacionamentos duradouros:

1. Colorado Springs, CO
2. El Paso, TX
3. Louisville, KY
4. Fort Worth, TX
5. San Antonio, TX

Facebook – Looking for Love

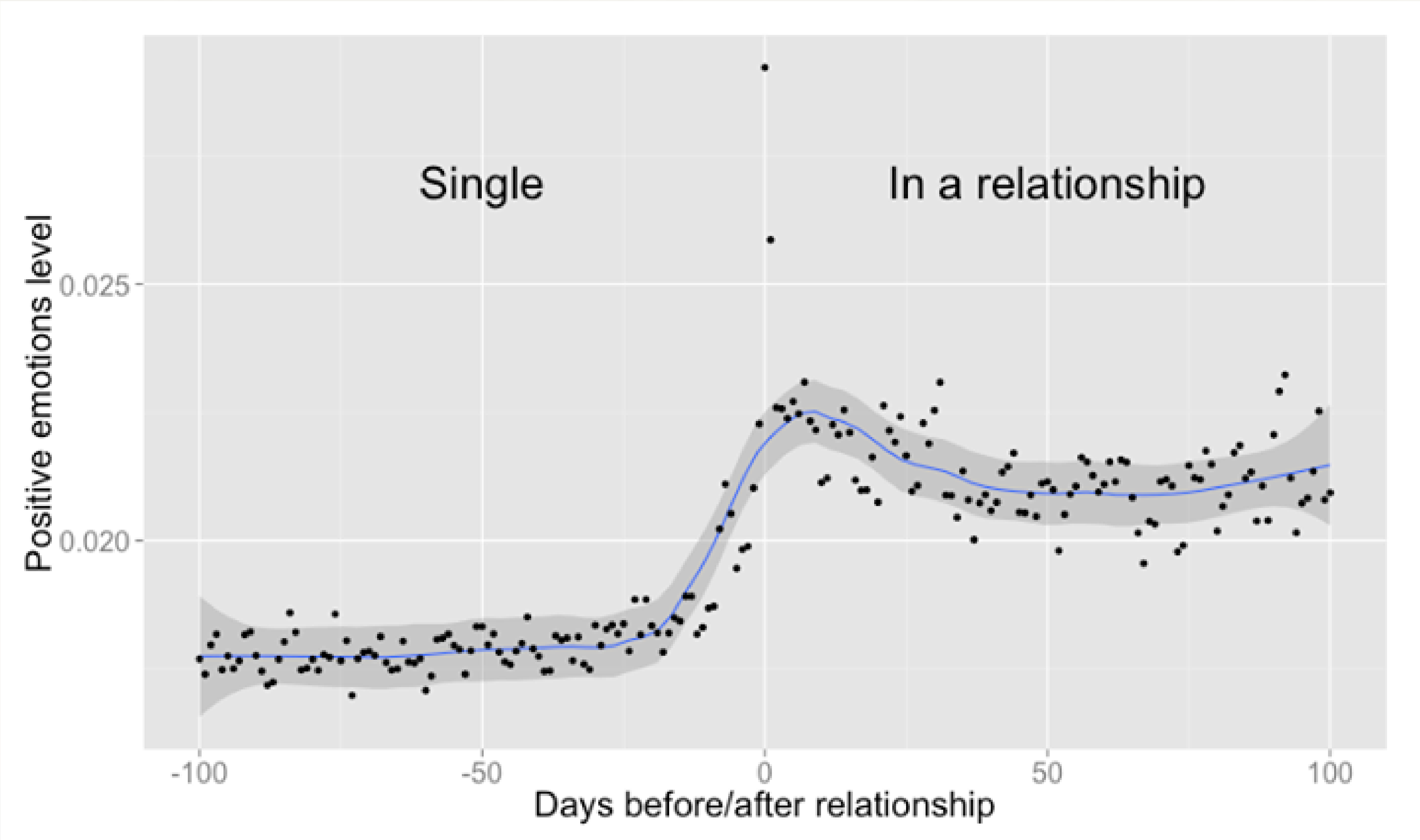


Facebook



(Diuk, 2014)

Facebook



(Diuk, 2014)

The Formation of Love

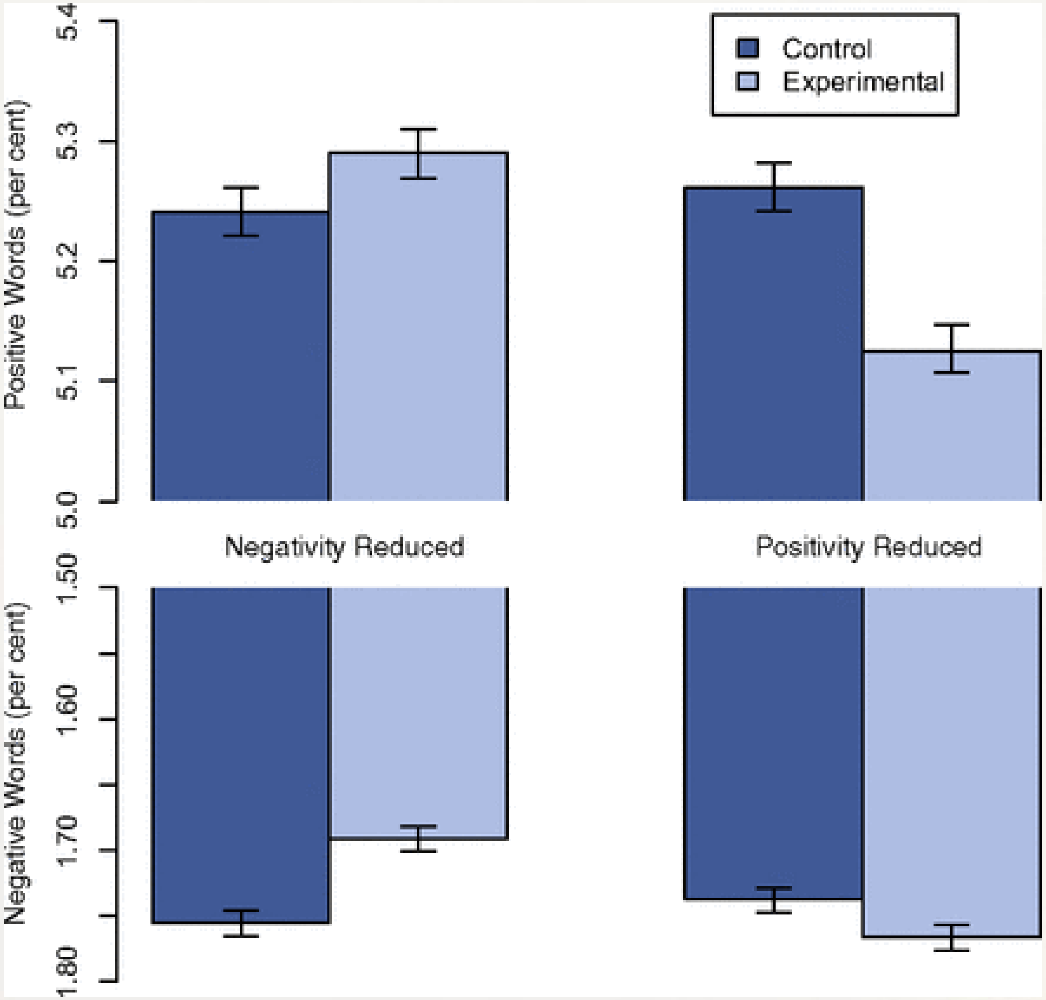
The Formation of Love

By Carlos Greg Diuk on Friday, February 14, 2014 at 3:59pm

by Carlos Diuk, Facebook Data Science

https://www.facebook.com/notes/facebook-data-science/the-formation-of-love/10152064609253859

Massive-scale Emotional Contagion



(Adam et al., 2014)

Massive-scale Emotional Contagion

Experimental evidence of massive-scale emotional contagion through social networks

By Adam D. I. Kramera (Facebook), Jamie E. Guillory (Cornell), and Jeffrey T. Hancock (Cornell)

Proceedings of the National Academy of Sciences of the United States of America (PNAS)

June 17, 2014 , vol. 111 no. 24

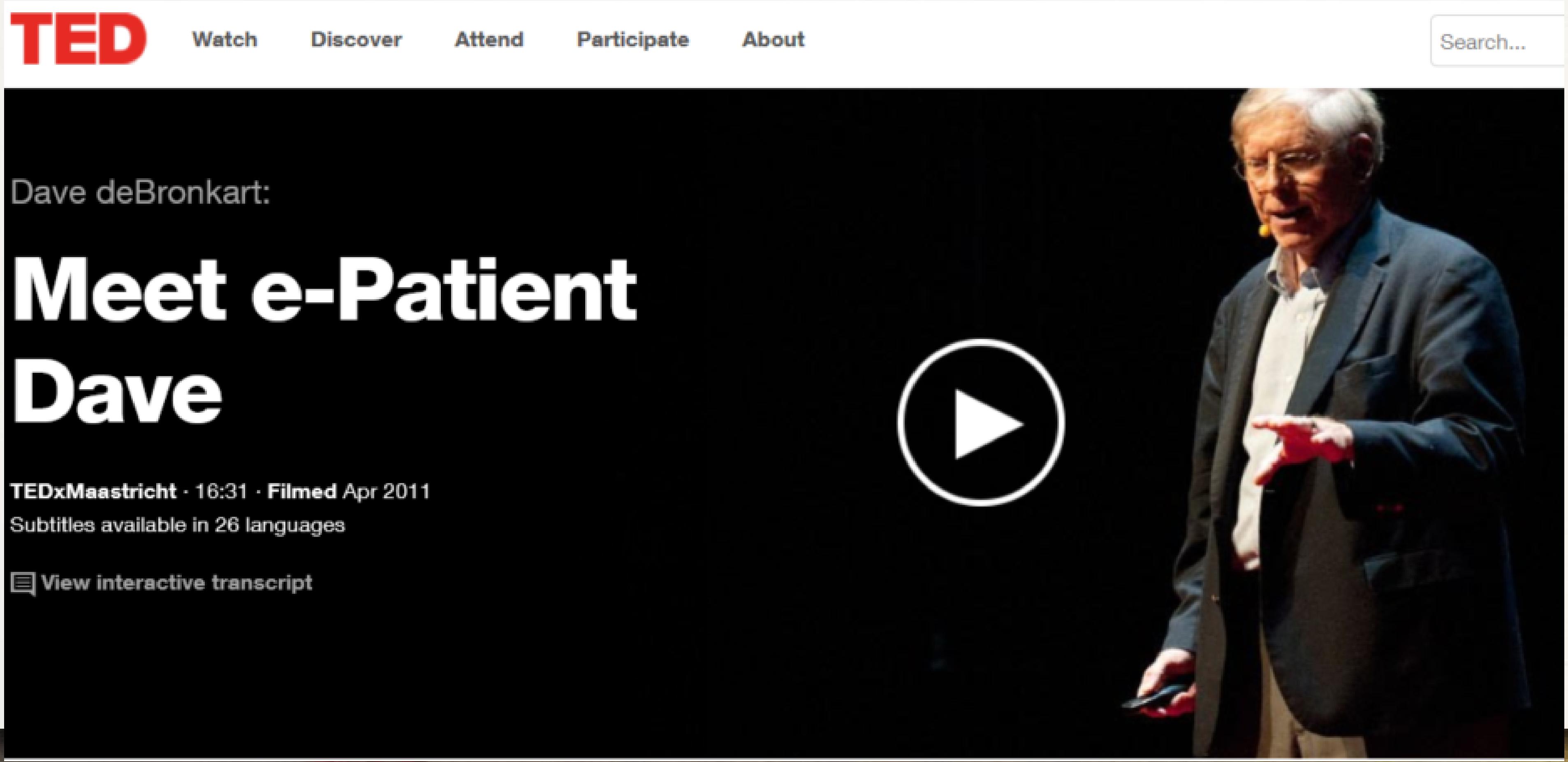
Minerando a Web & Saúde

Mining Data for Better Medicine

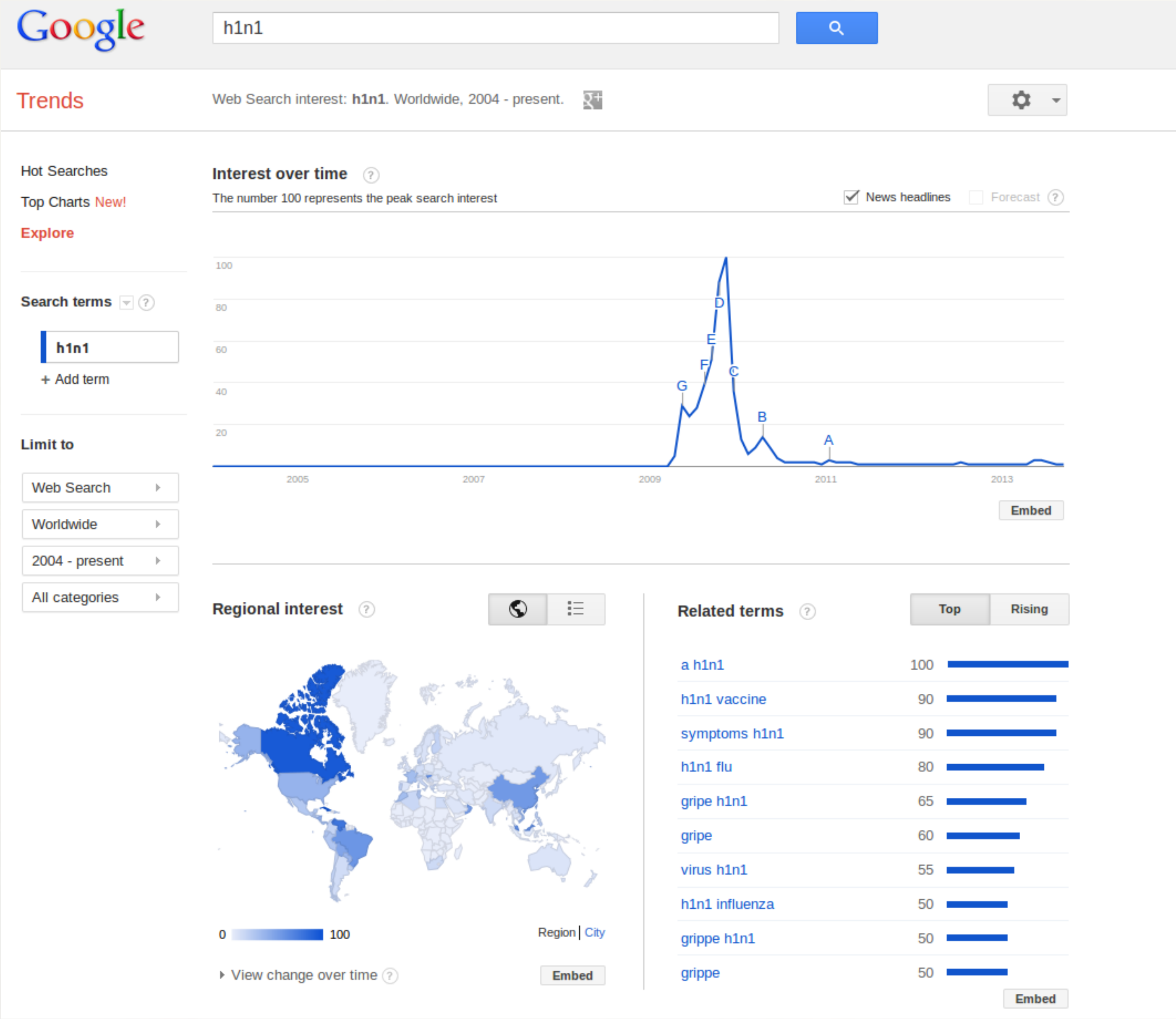
- Mining Data for Better Medicine
  Monday, September 19, 2011
  By Neil Savage
  http://www.technologyreview.com/news/425466/mining-data-for-better-medicine/
- “The health battles of millions, recorded digitally, open a world of virtual research.”

e-Patient

- When Dave deBronkart learned he had a rare and terminal cancer, he turned to a group of fellow patients online — and found the medical treatment that saved his life.
- https://www.ted.com/talks/dave_debronkart_meet_e_patient_dave



Google Trends

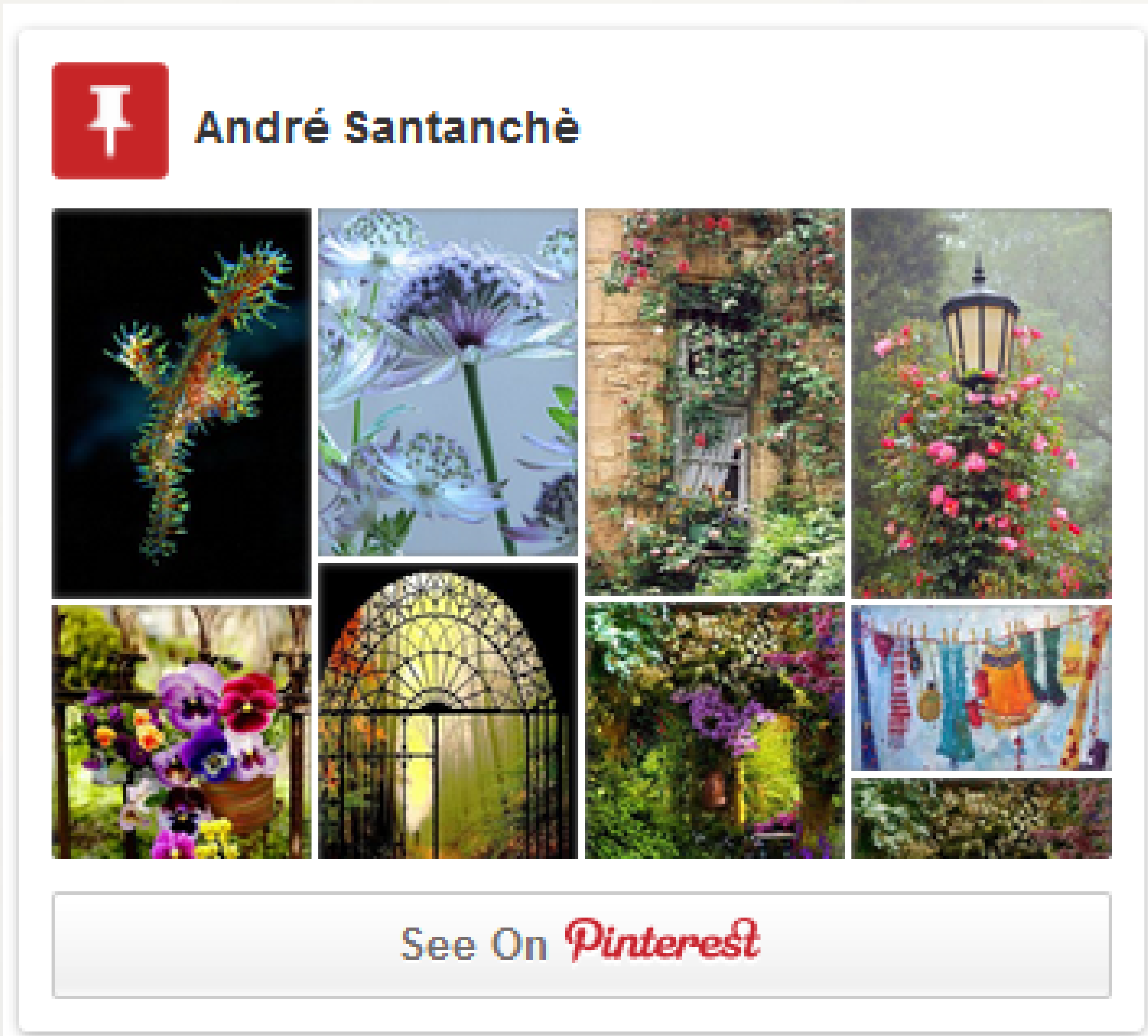


Web Observatory

Web Observatory

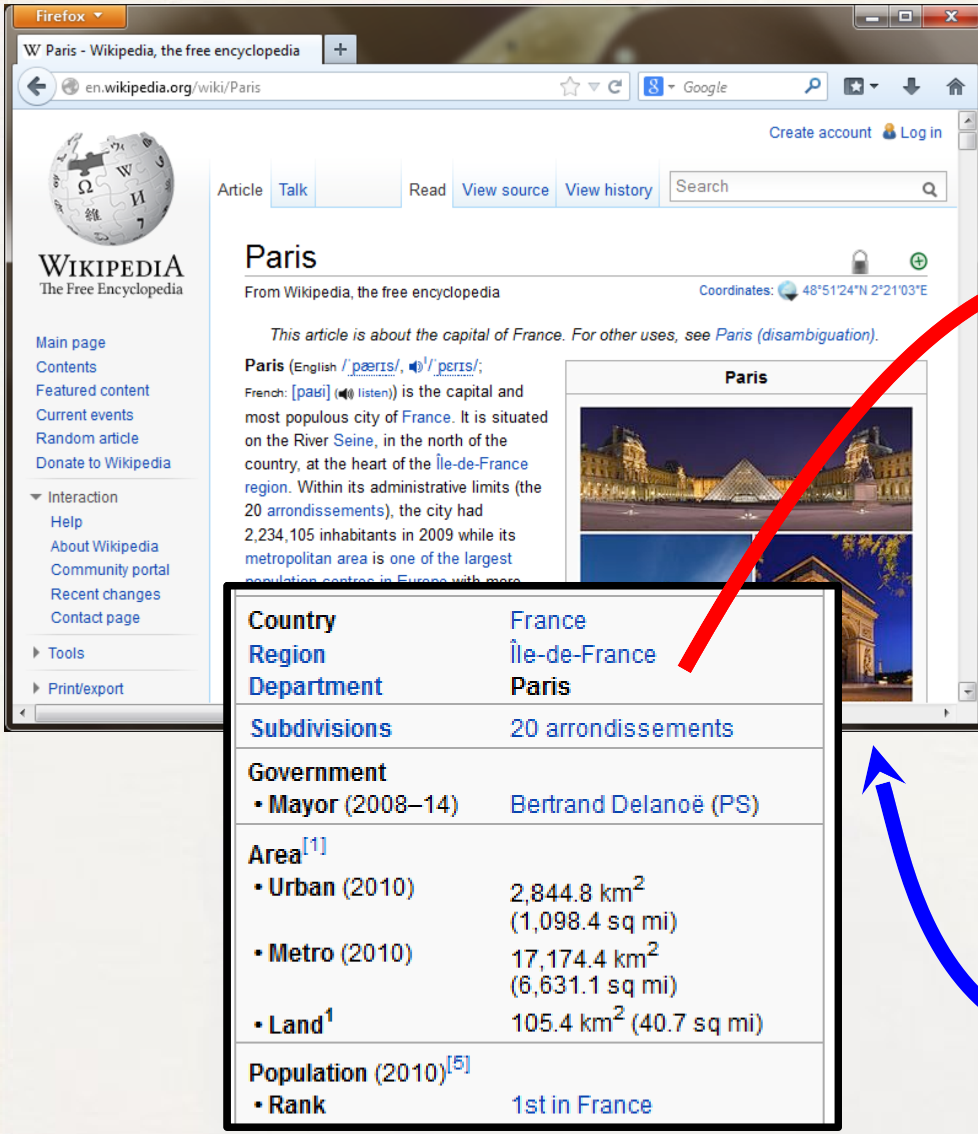
- INCT INWeb
  - http://observatorio.inweb.org.br/
  - Elections Observatory
  - Brasileirão Observatory
  - Dengue Observatory

Recomendação



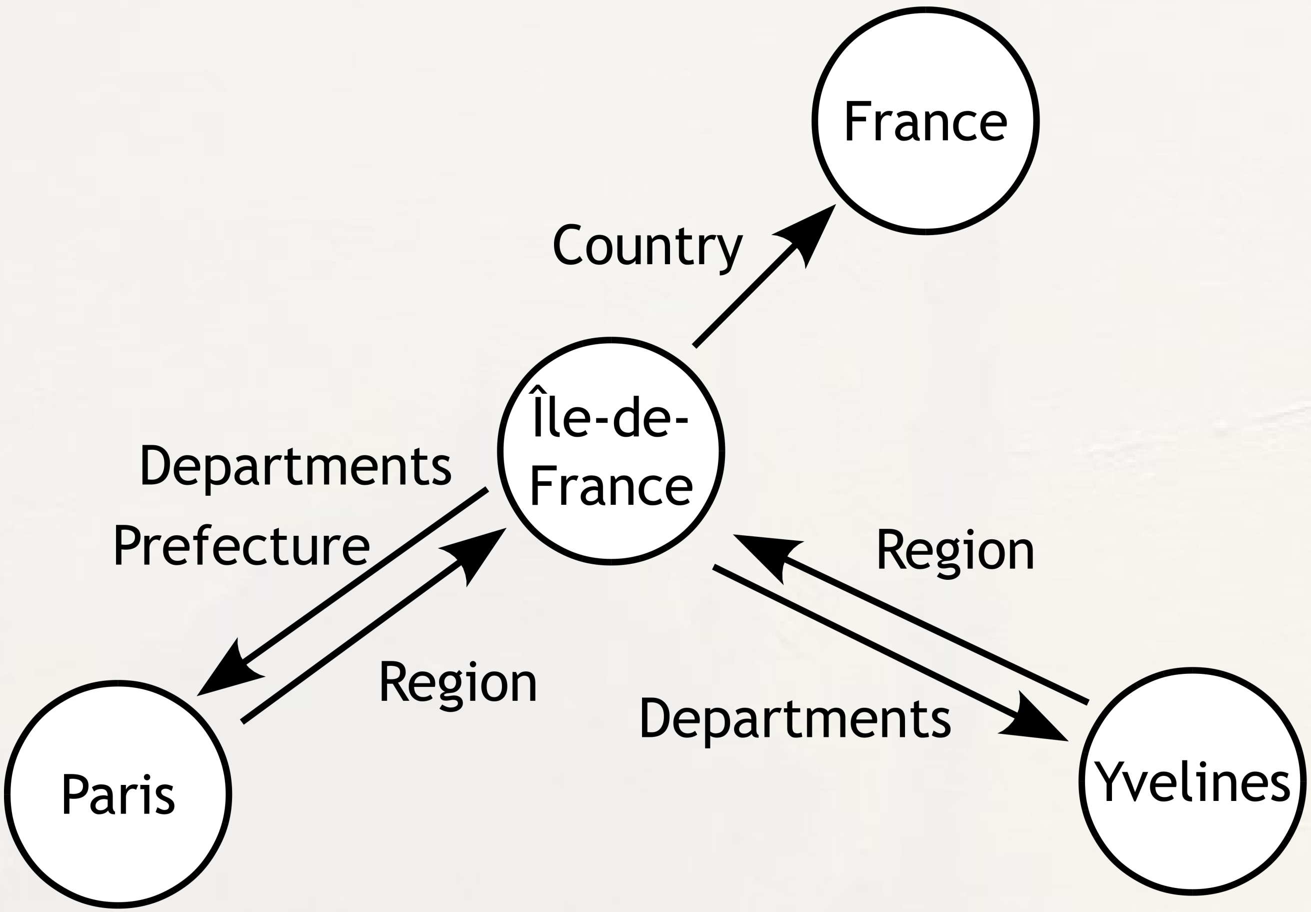
Linked Data

Wikipedia



Infobox

DBPedia


France
Country
Île-de-France
Departments
Prefecture
Region
Region
Departments
Paris
Yvelines

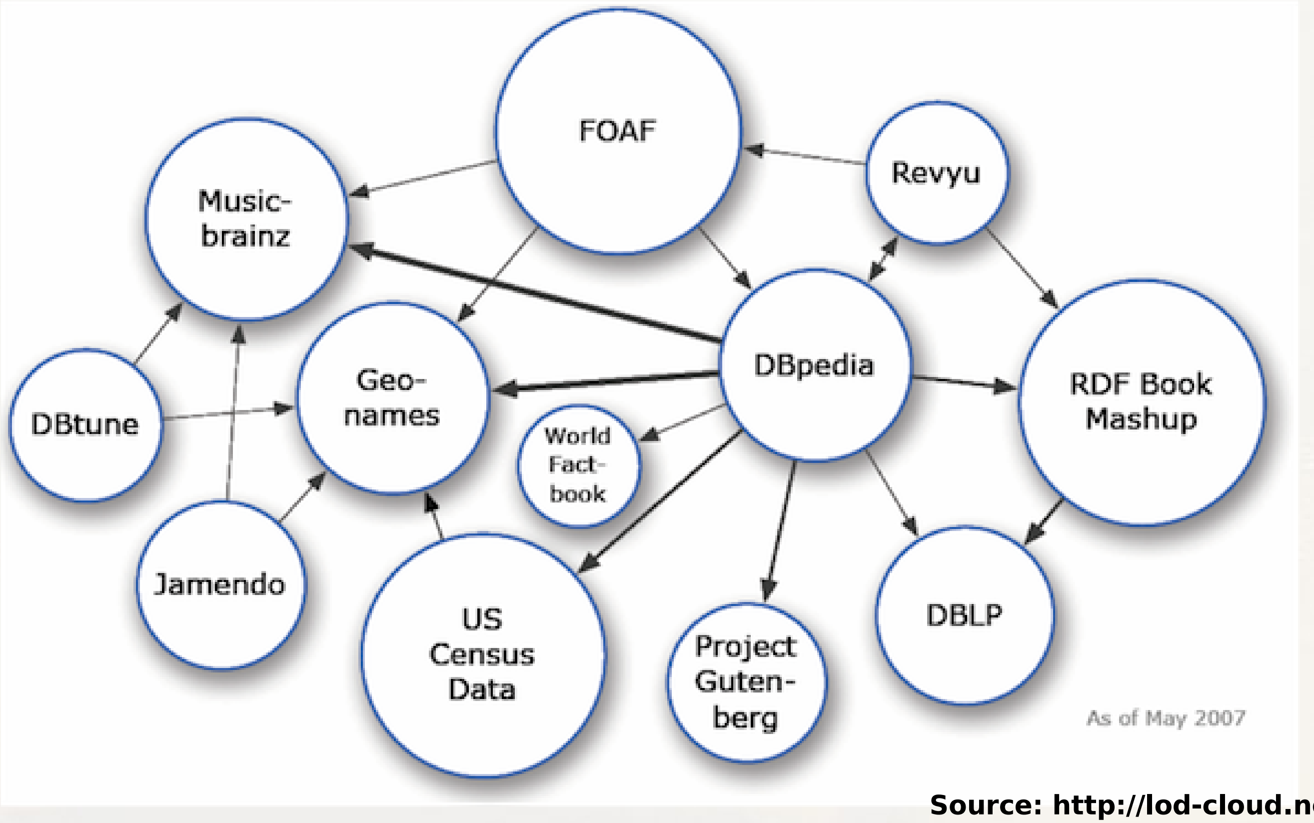
DBPedia – English

- **4 million things**
- 3.22 million classified in a consistent ontology
  - 832,000 persons
  - 639,000 places (427,000 populated)
  - 372,000 creative works
    - 116,000 music albums; 78,000 films; 18,500 video games
  - 209,000 organizations
  - 226,000 species
  - 5,600 diseases.

DBPedia – International

- 119 languages
- 24.9 million things
- 16.8 million interlinked with English
- 12.6 million unique things

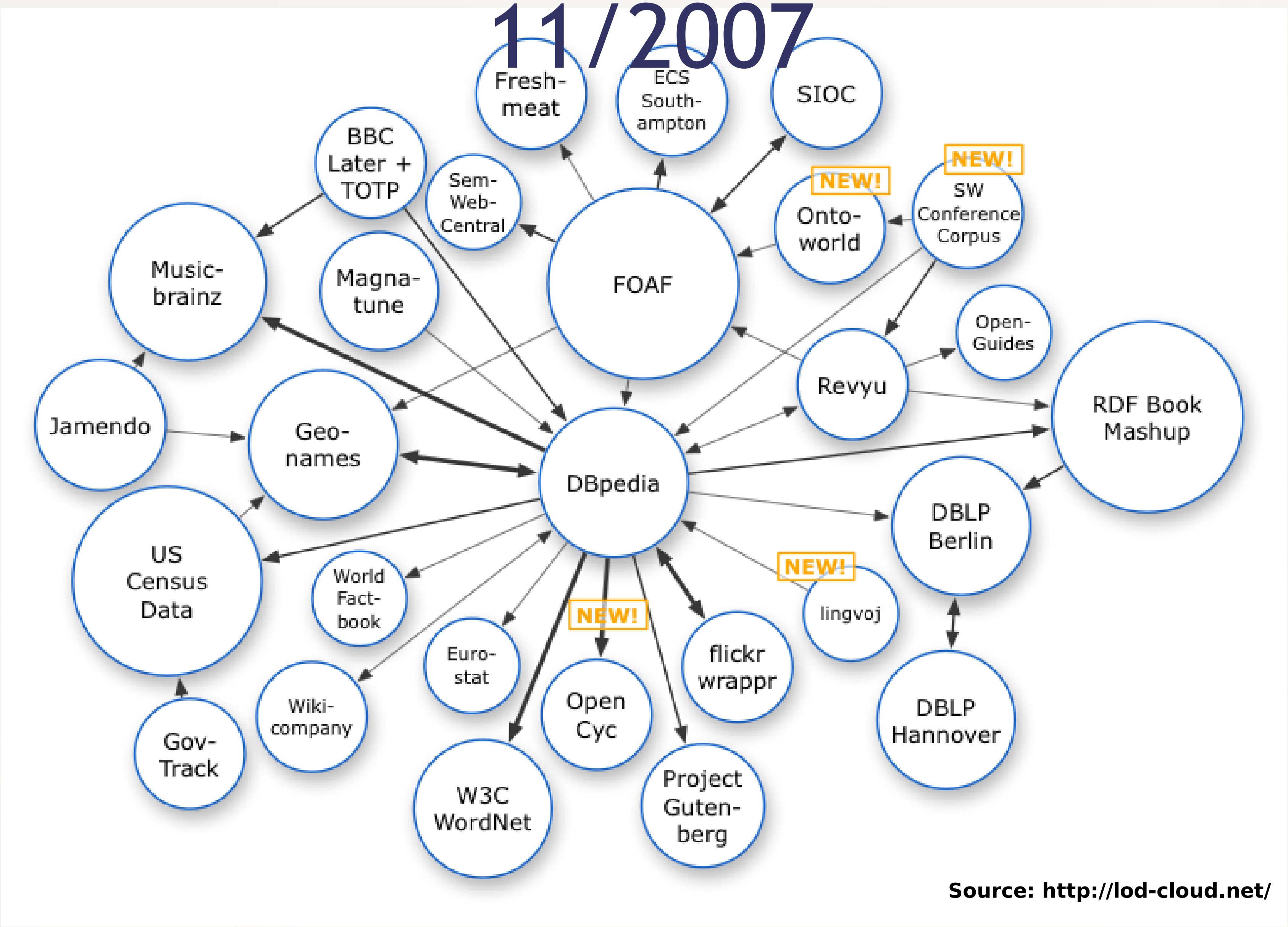
Linked Data 05/2007



Source: http://lod-cloud.net/

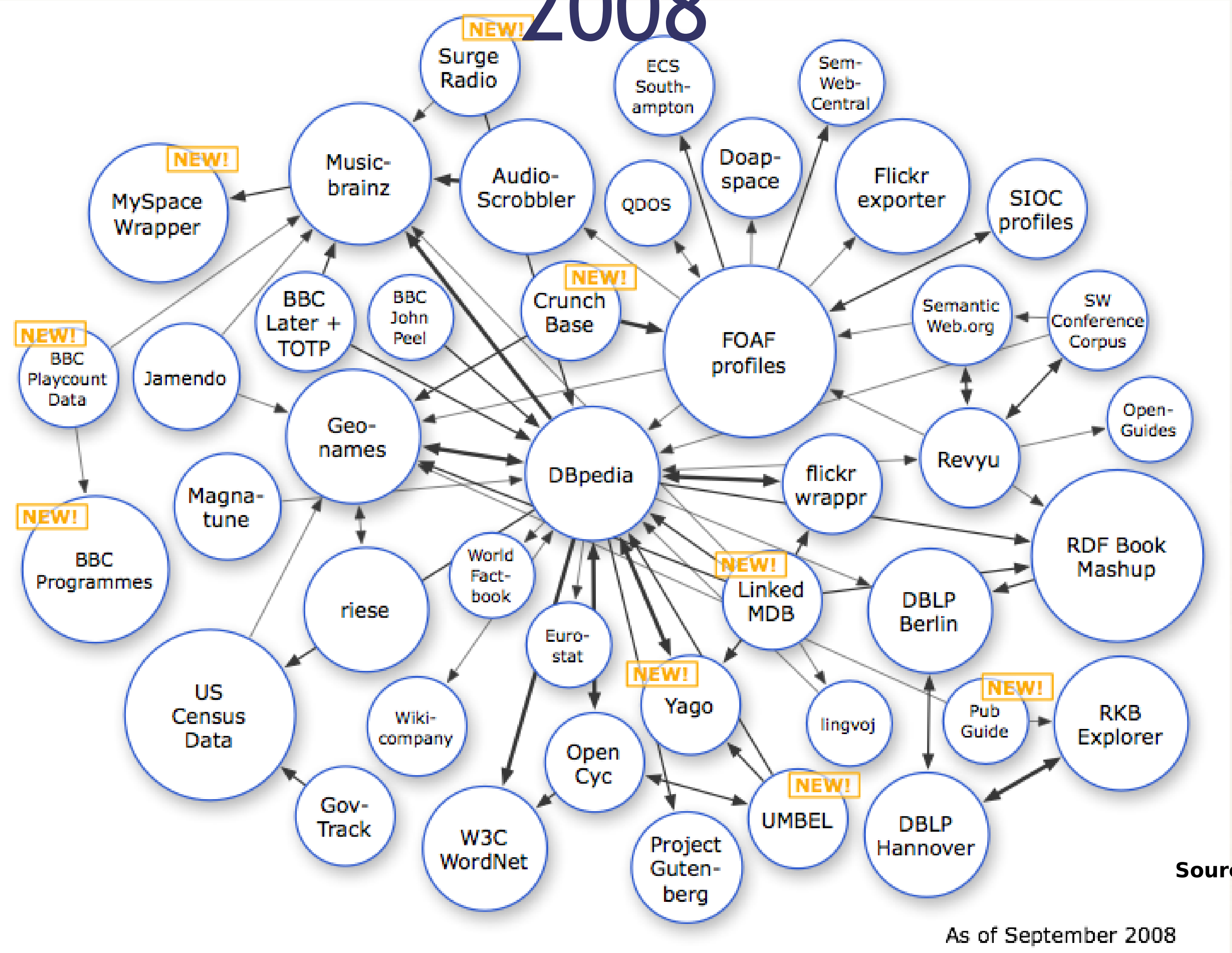
Datasets published following Linked Data ‘format’: **05/2007**

Linked Data 11/2007



Datasets published following Linked Data ‘format’: **11/2007**

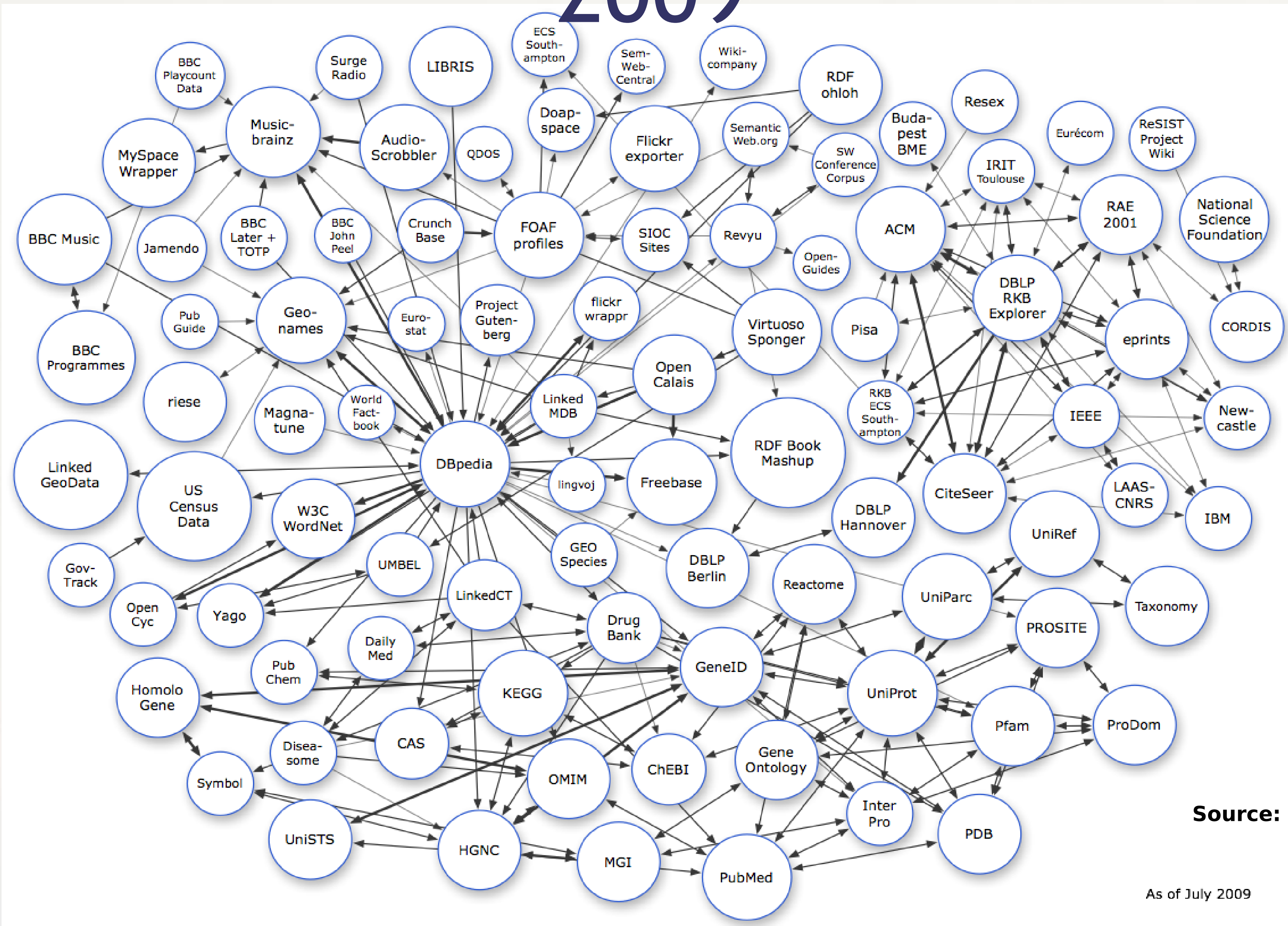
Linked Data 2008



Source: http://lod-clou

Datasets published following Linked Data ‘format’: **2008**

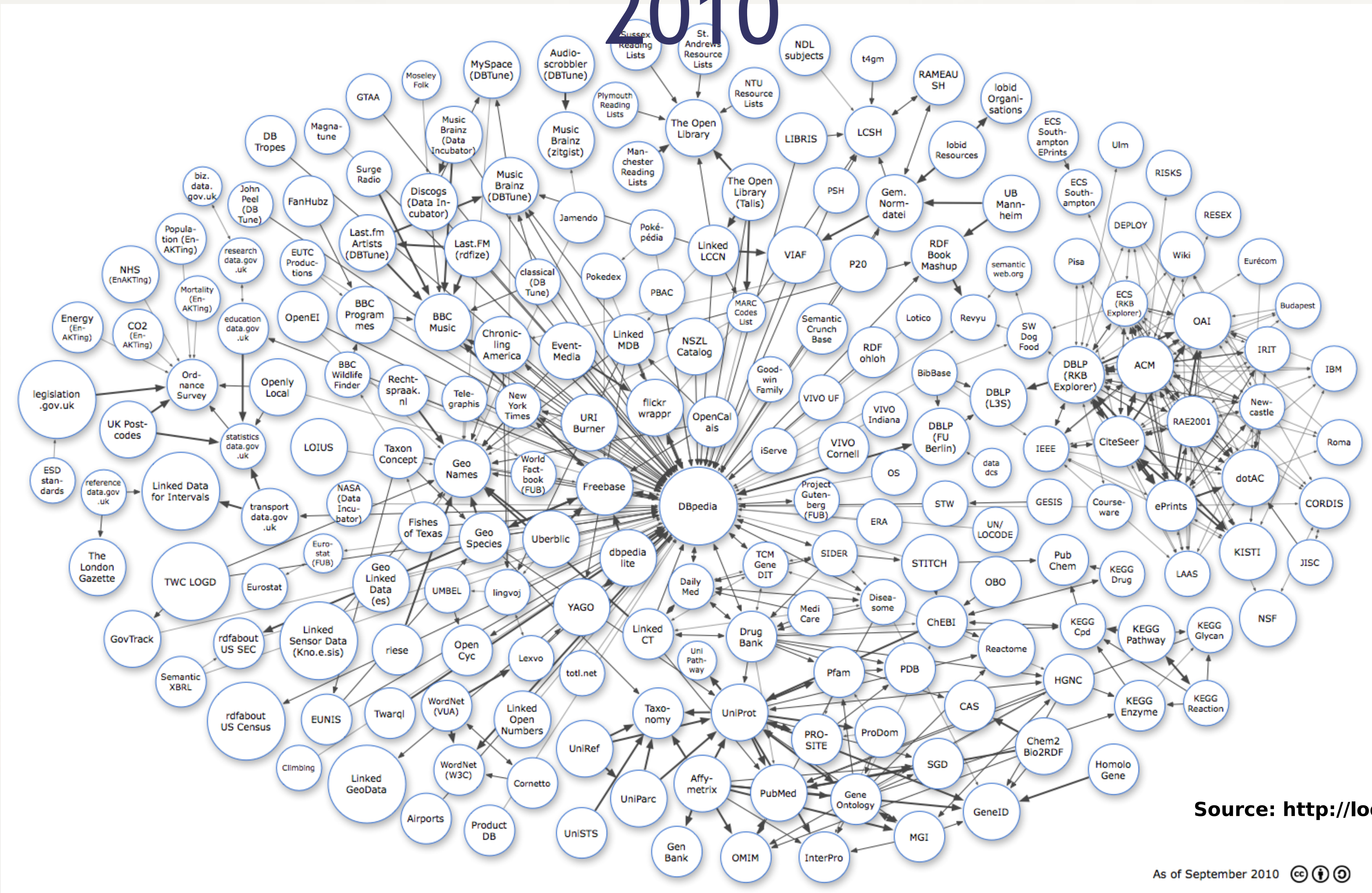
Linked Data 2009



Source: http://lod-cloud.

Datasets published following Linked Data ‘format’: **2009**

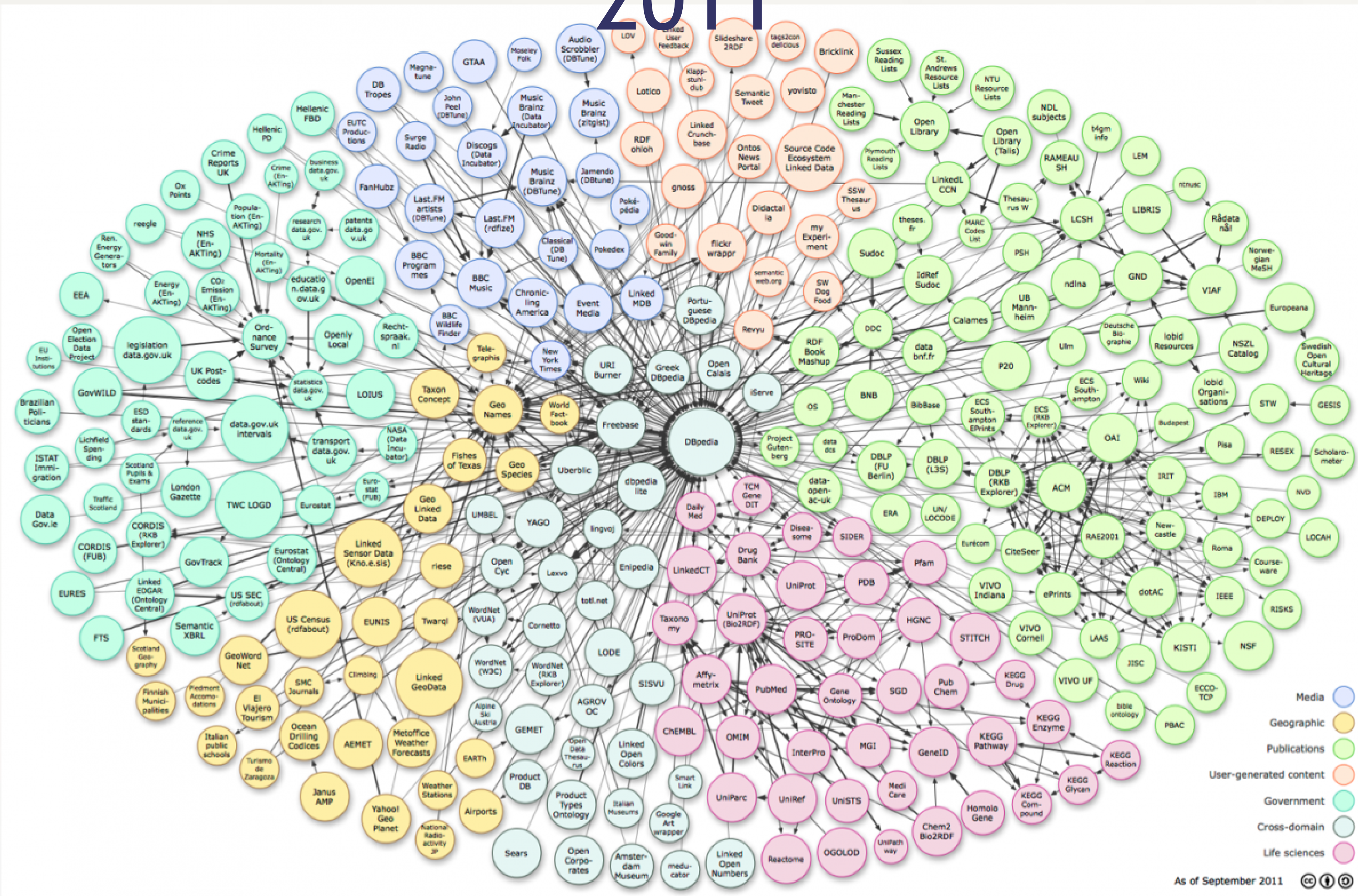
Linked Data 2010



Source: http://lod-cloud.

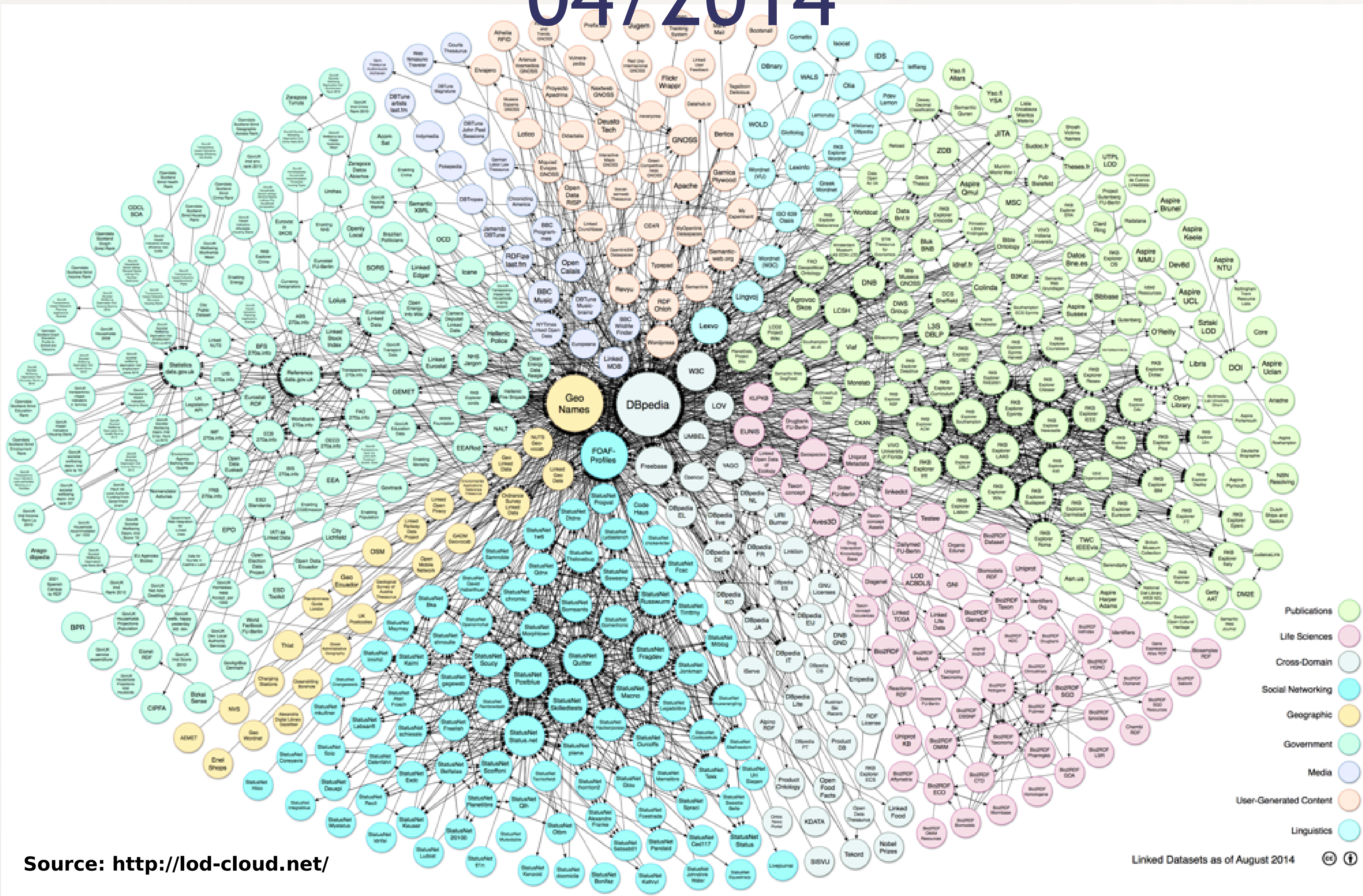
Datasets published following Linked Data ‘format’: **2010**

Linked Data 2011



Datasets published following Linked Data ‘format’: **2011**

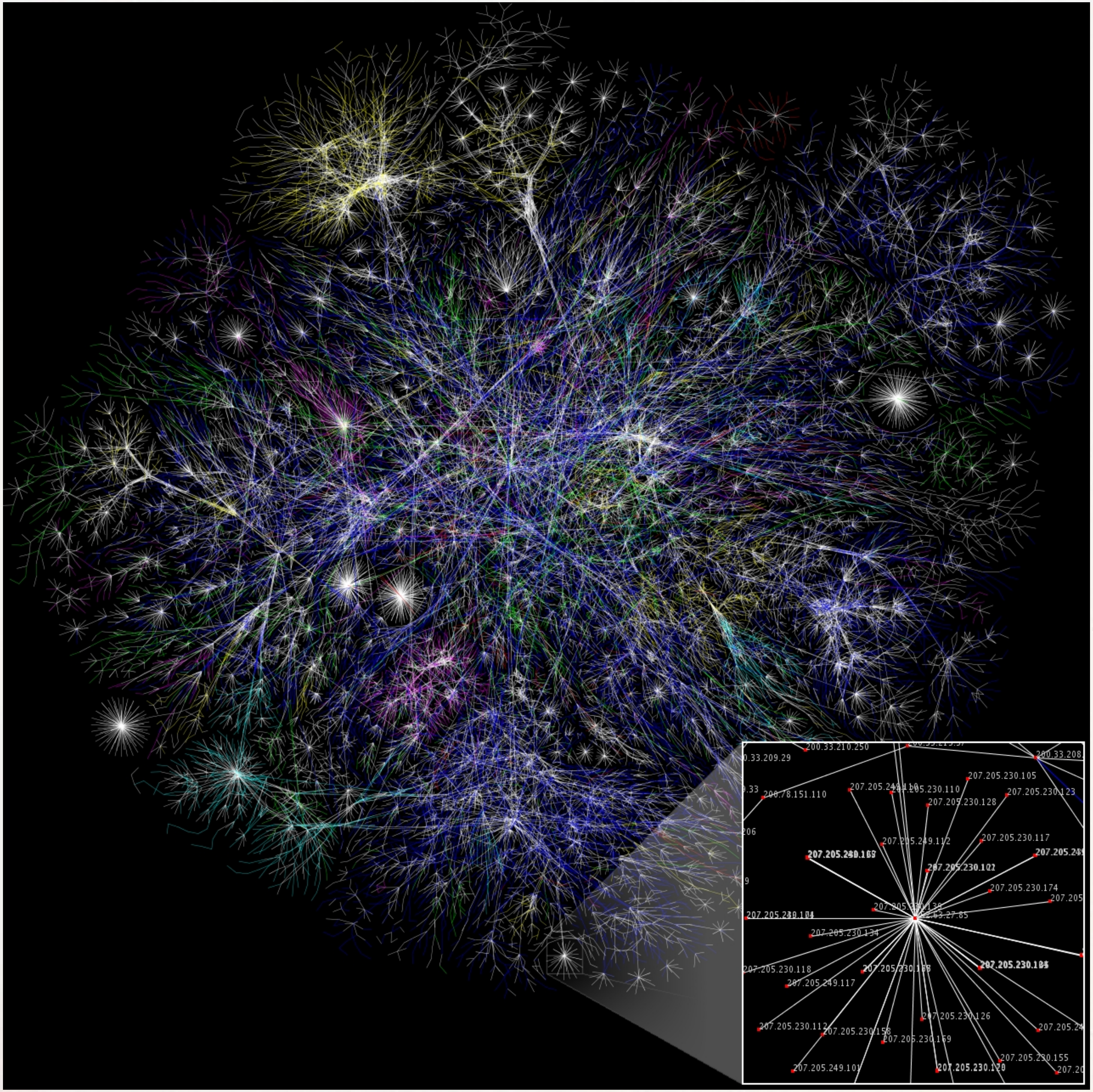
Linked Data
04/2014



Source: http://lod-cloud.net/

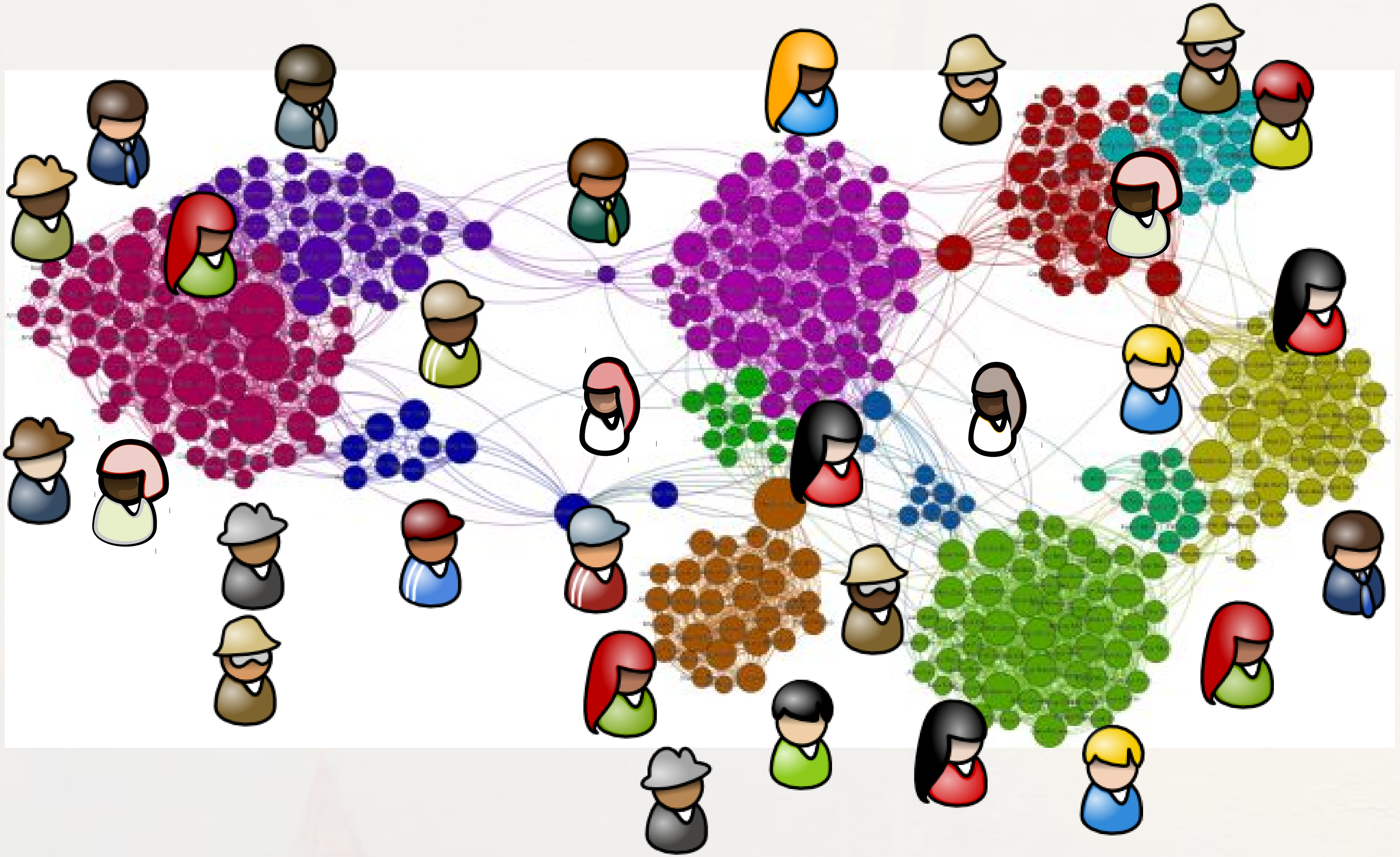
Dados em forma de rede
&
Network Science

Internet

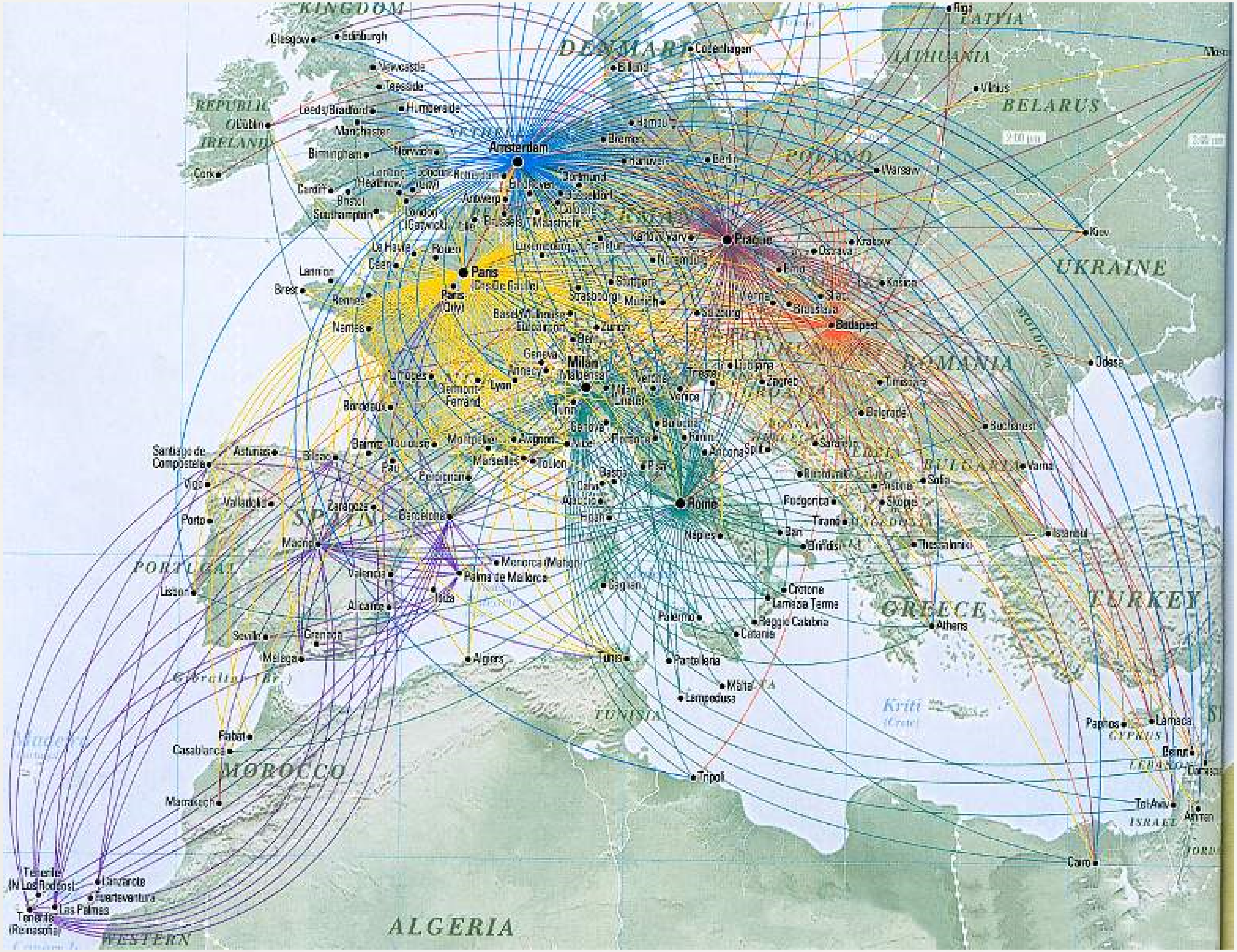


By https://commons.wikimedia.org/wiki/User:Mmxx

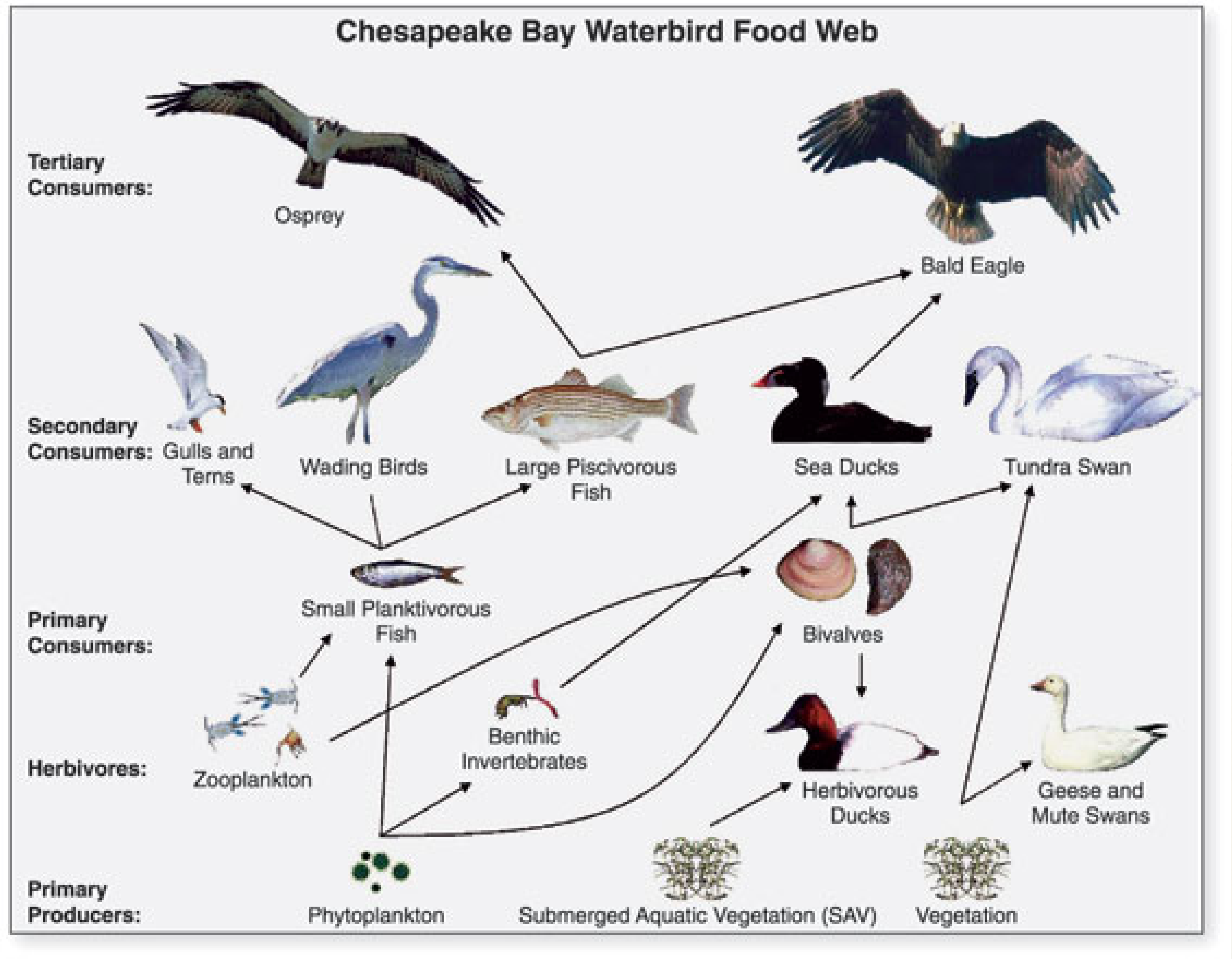
Redes Sociais



Redes de Transporte Aéreo

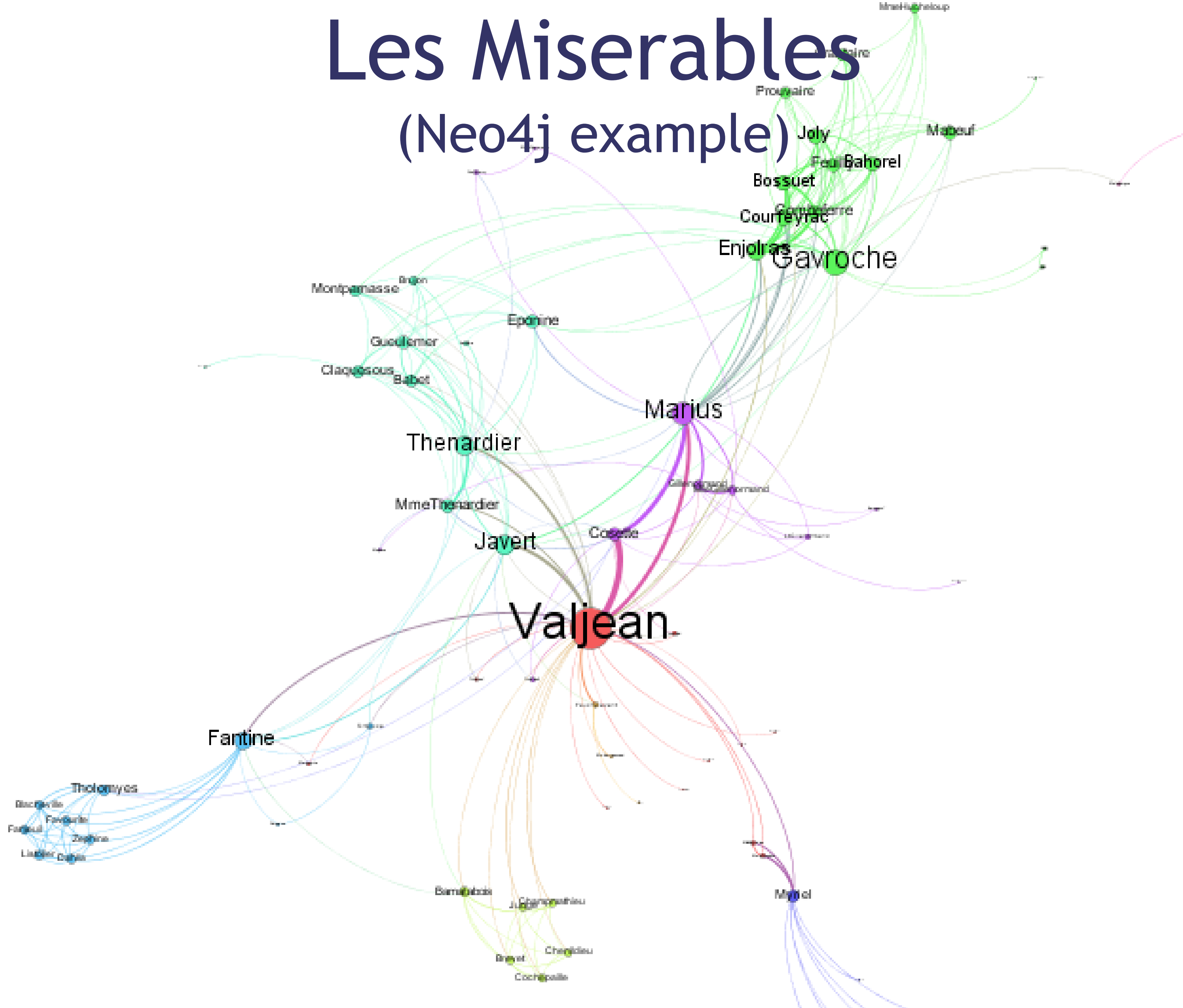


Cadeia Alimentar

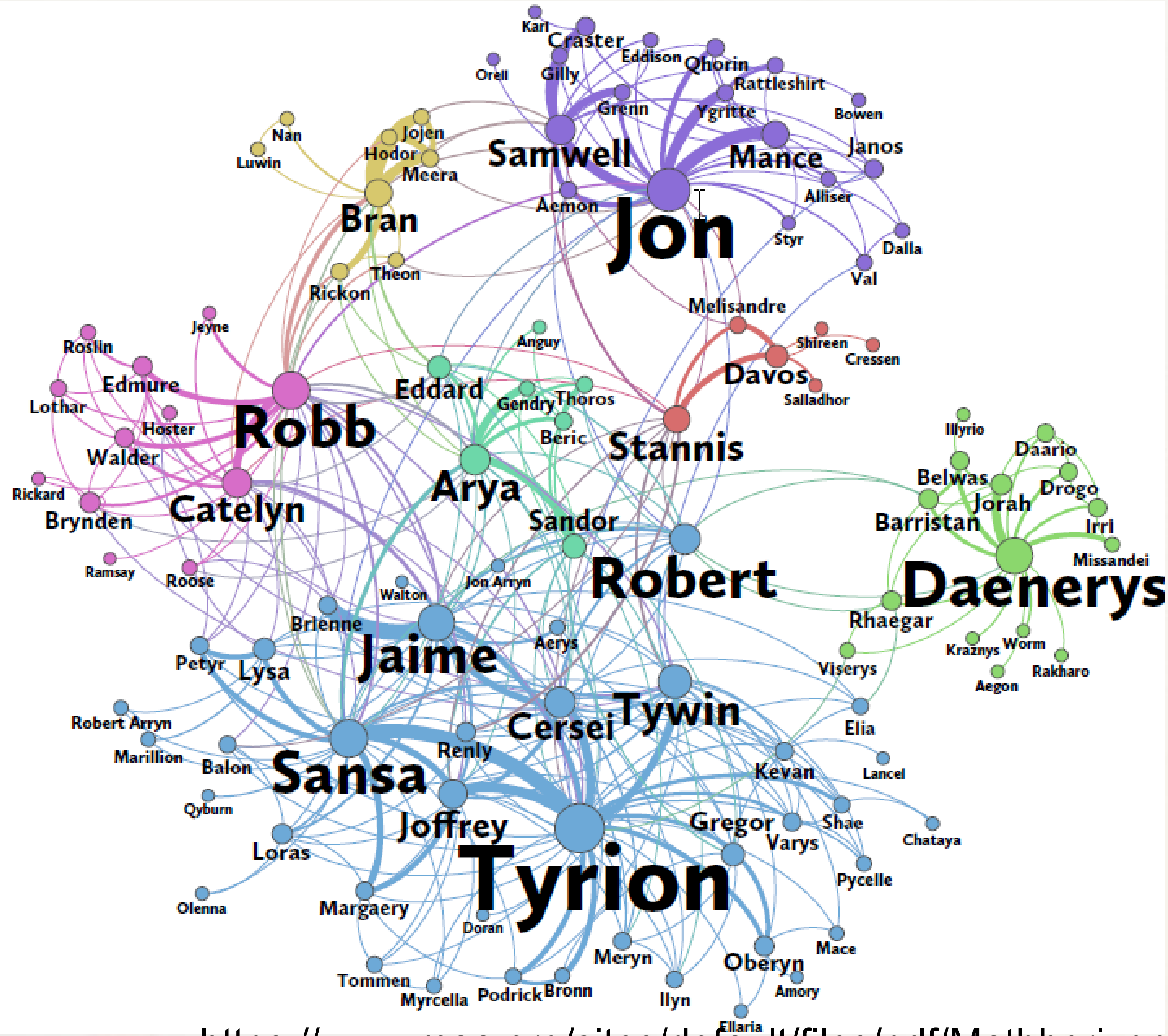


Les Miserables

(Neo4j example)

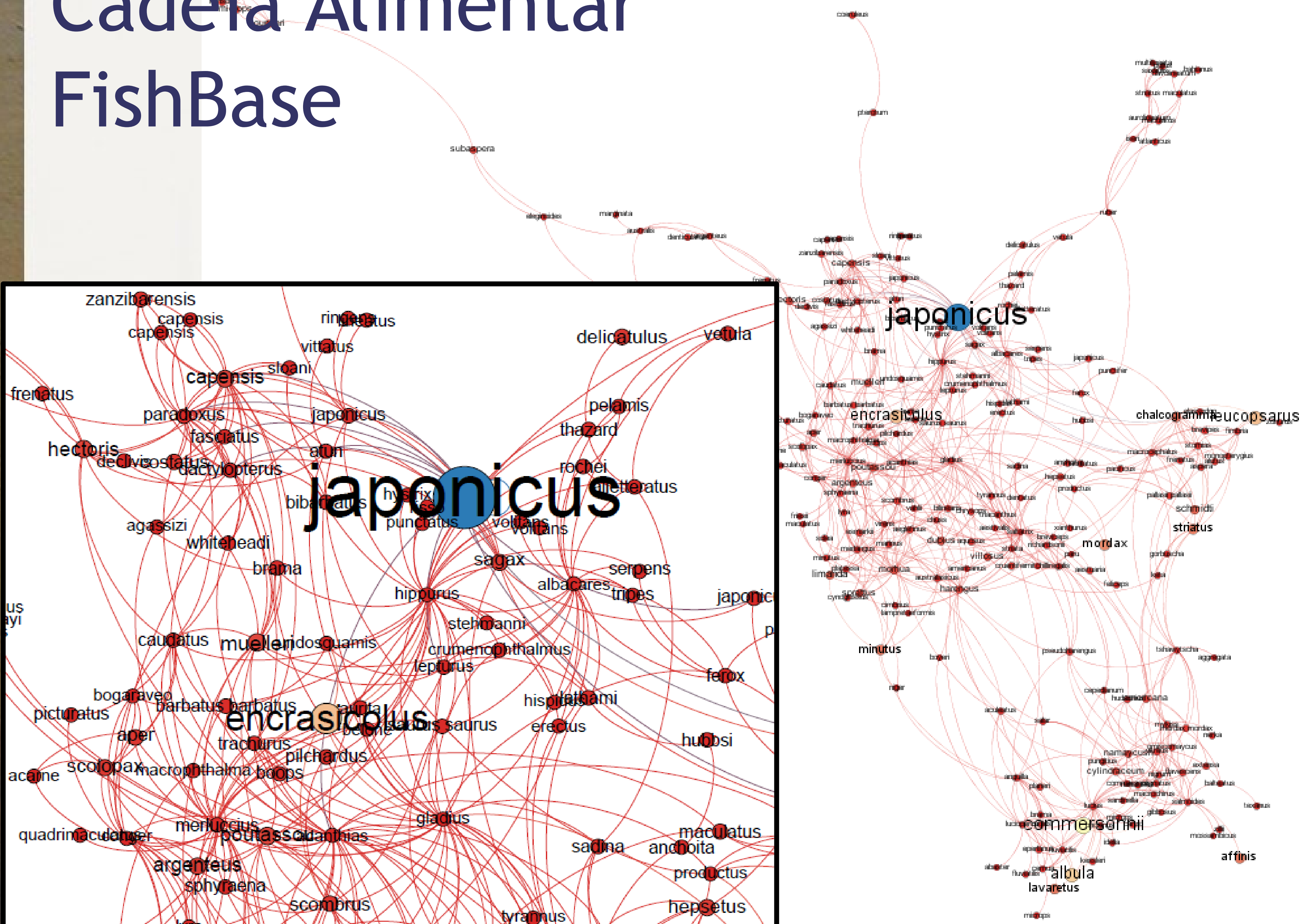


Network of Thrones

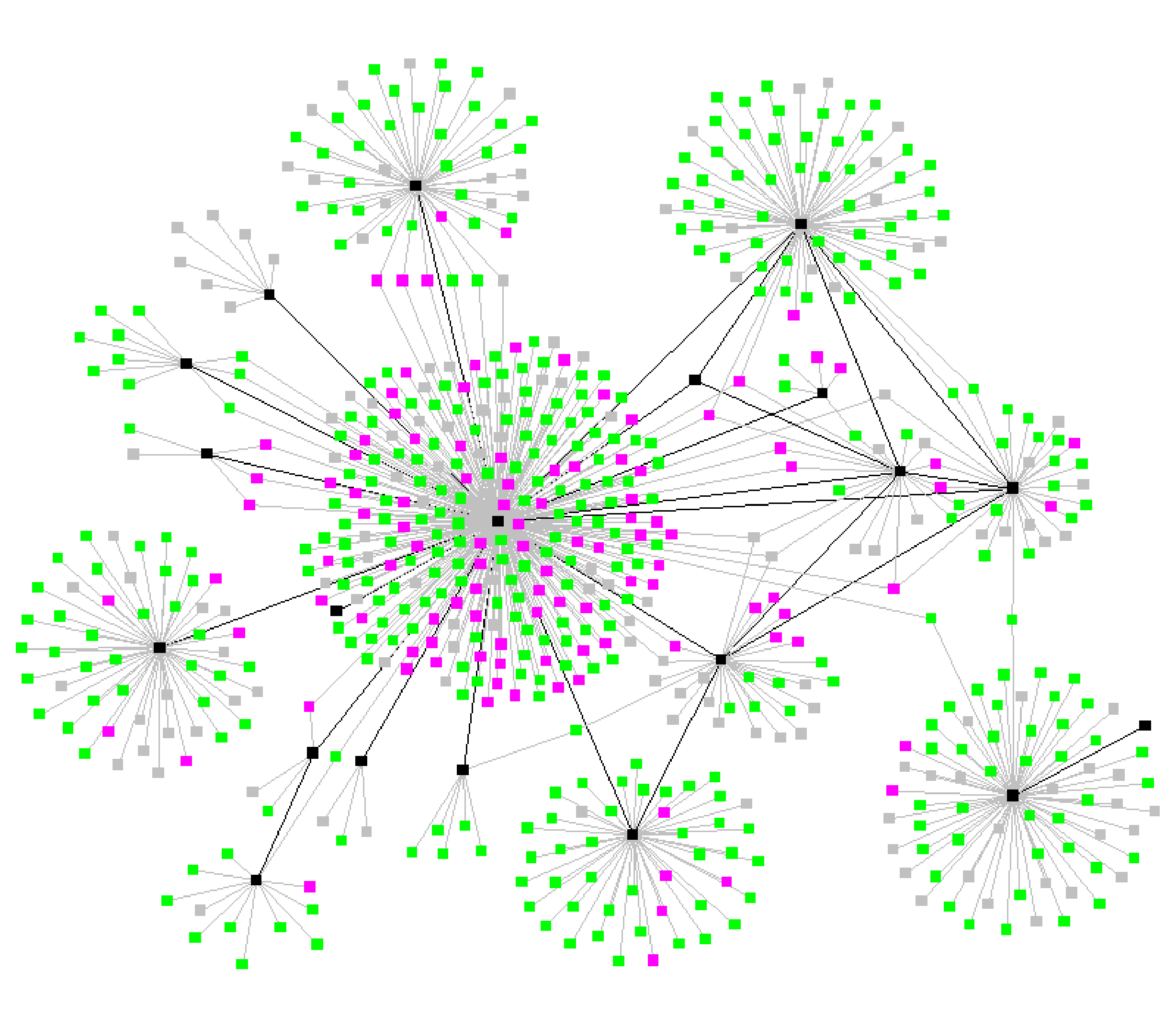


https://www.maa.org/sites/default/files/pdf/Mathhorizons/NetworkofThrones%20(1).pdf

Cadeia Alimentar FishBase

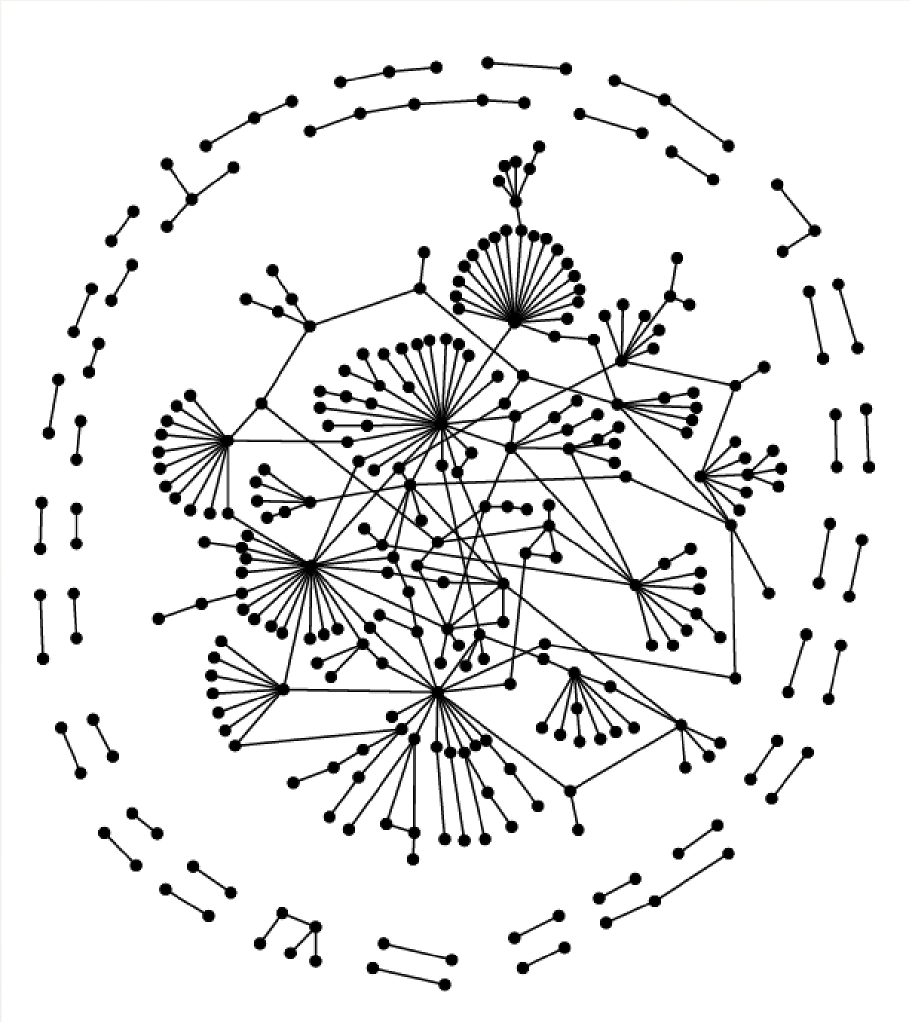


Contágio da TB



Contagion of TB, books on politics: Valdis Krebs, www.orgnet.com.

Proteínas da Levedura

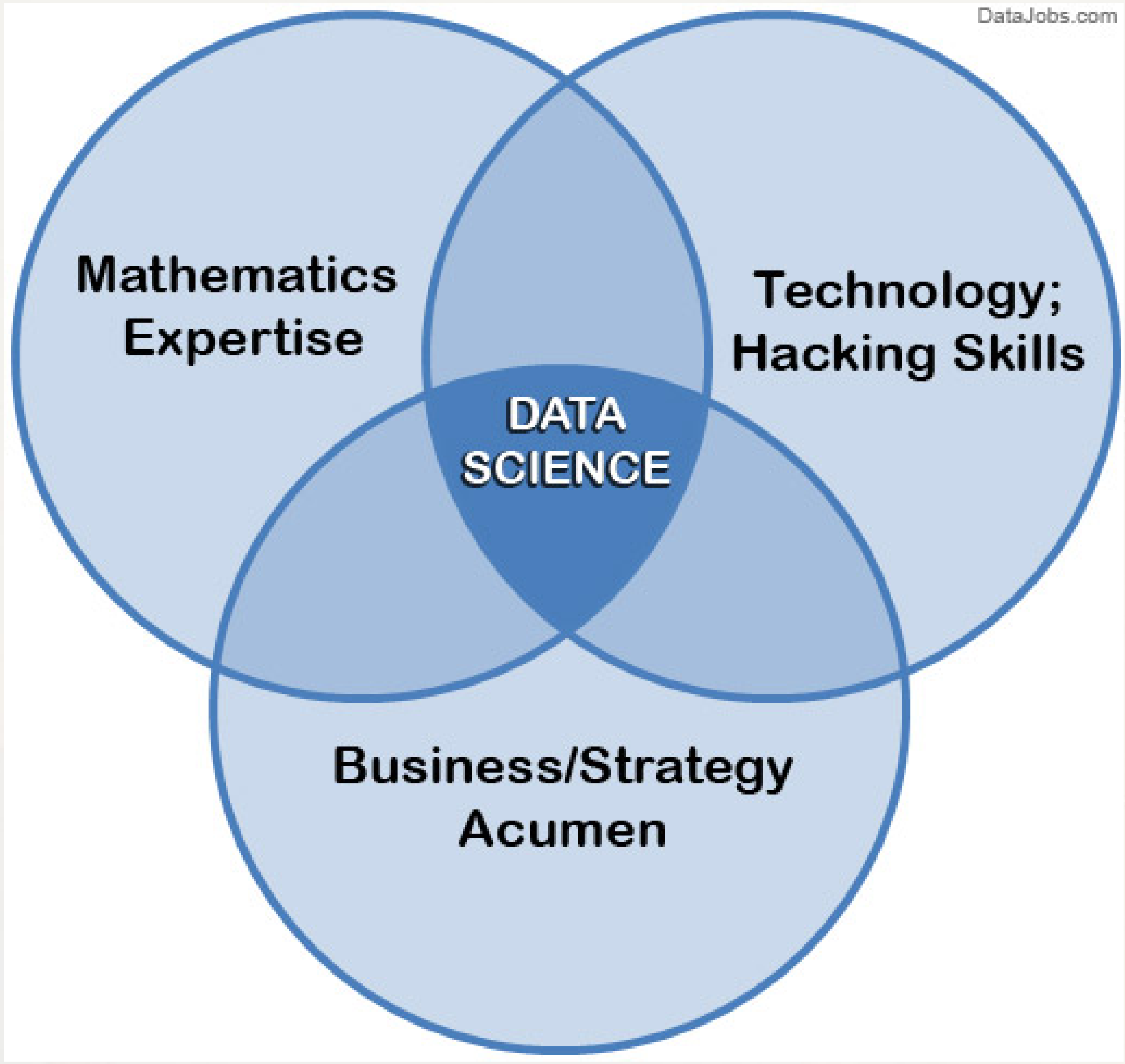


Yeast proteins: Sergei Maslov and Kim Sneppen, Specificity and stability in topology of protein networks, Science 296, 910-913 (2002).

Data Scientist

What is Data Science?

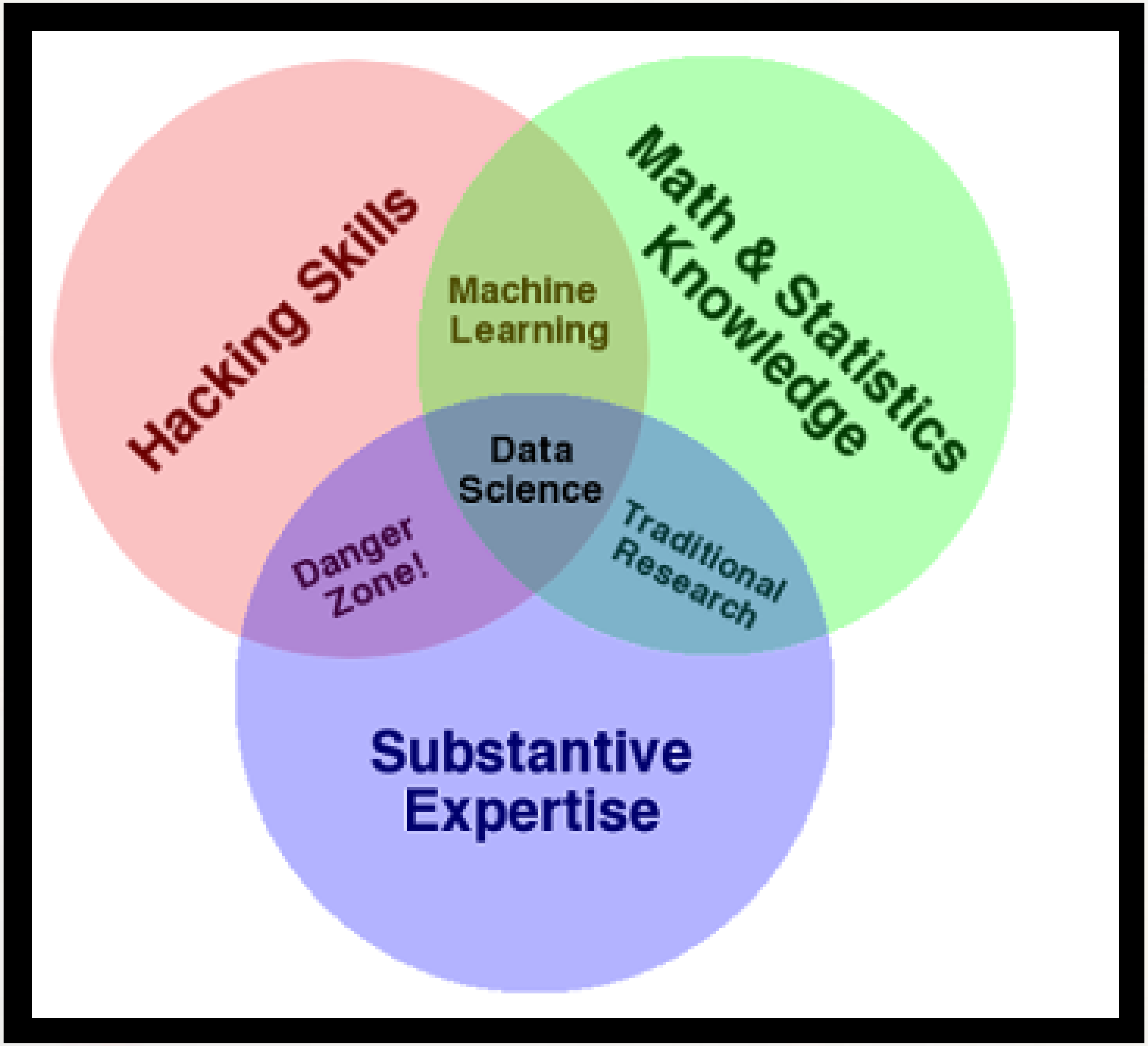
https://datajobs.com/what-is-data-science



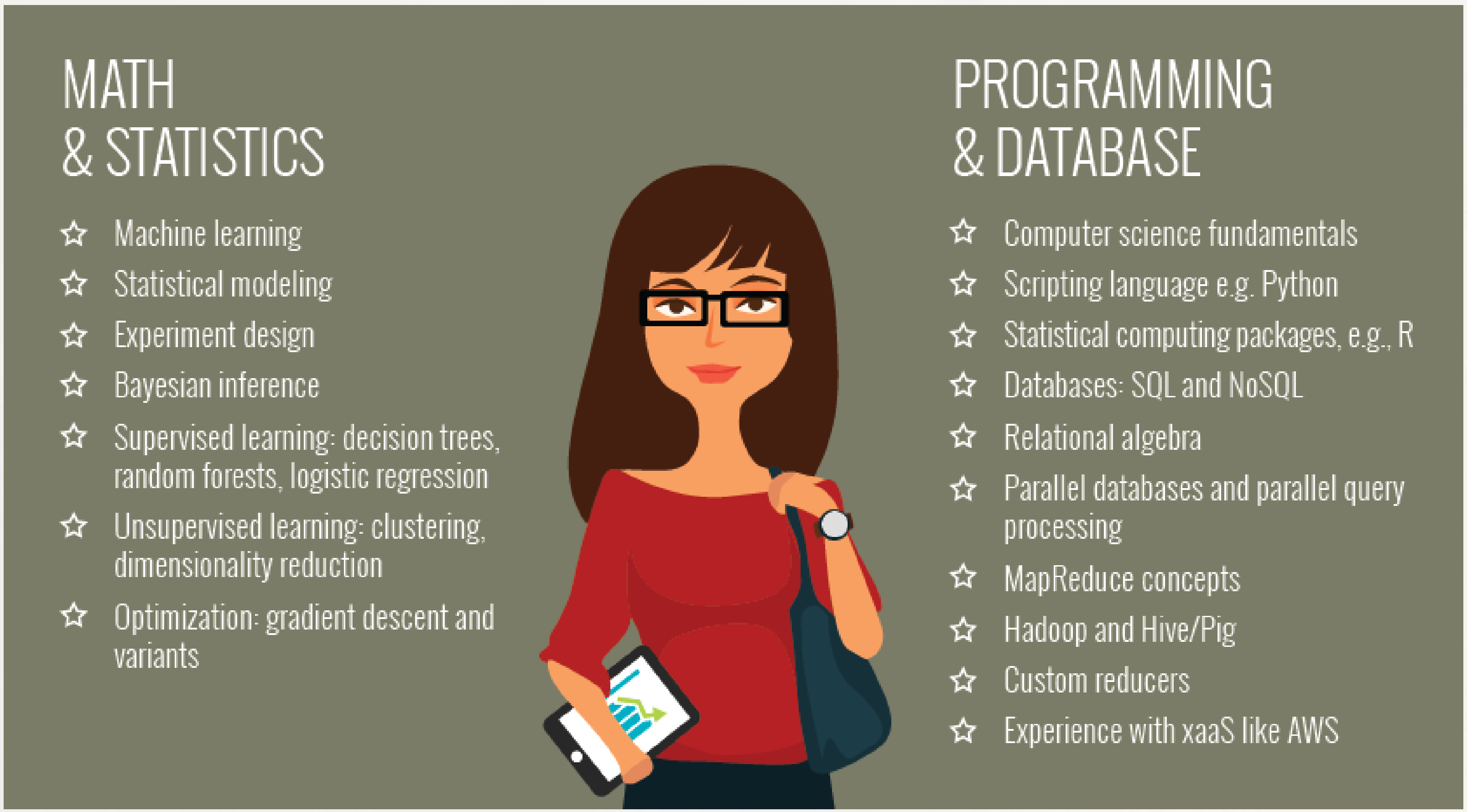
So you Want to be a Data-Scientist

Michael Spencer – 21/07/2015

https://www.linkedin.com/pulse/so-you-want-data-scientist-michael-spencer



Você quer ser um Data Scientist?



http://www.marketingdistillery.com/2014/11/29/is-data-science-a-buzzword-modern-data-scientist-defined/

Você quer ser um Data Scientist?

http://www.marketingdistillery.com/2014/11/29/is-data-science-a-buzzword-modern-data-scientist-defined/

Competências mais buscadas por recrutadores brasileiros – LinkedIn / 2015

Ranking	Categoria de competência
1	Análise estatística e mineração de dados
2	Desenvolvimento mobile
3	Segurança de qualidade (QA) de software e teste de usabilidade
4	Logística
5	Arquitetura da web e frameworks de desenvolvimento

http://exame.abril.com.br/carreira/noticias/as-competencias-mais-buscadas-por-recrutadores-no-linkedin

Competências mais buscadas por recrutadores globais – LinkedIn / 2015

Ranking	Categoria de competência
1	Computação em nuvem e distribuída
2	Análise estatística e mineração de dados
3	Gestão de campanhas de marketing
4	Marketing, SMO e SEO
5	Middleware e softwares de integração

http://exame.abril.com.br/carreira/noticias/as-competencias-mais-buscadas-por-recrutadores-no-linkedin

Vagas na Região de Campinas e São Paulo

Data Scientist
Big Data Brasil
São Paulo Area, Brazil
Trabalhar com uma equipe de pessoas que envolve DevOps e outros **data** scientists junior, al m de interlocu o direta com o CEO da empresa e...

Data Scientist
TOTVS
São Paulo e Região, Brasil
Strong statistics background, ideally experience with Natural Language Processing techniques; loves building mathematical and ...

Analista de Big **Data** com experiência em Cassandra e Hadoop
CI&T
São Paulo e Região, Brasil
Como Analista voc trabalhar com Big **Data** e ferramentas de processamento de um auto volume de dados com a miss o de tra ar perfil ...

Senior **Data Scientist** - Advanced Analytics
McKinsey & Company
Sao Paulo-Brazil
Working on projects and exchanging experiences with your colleagues means you will face new intellectual challenges on a daily basis, ...

https://www.linkedin.com/vsearch/j?type=all&keywords=data%20scientist

Vagas na Região de Campinas e São Paulo

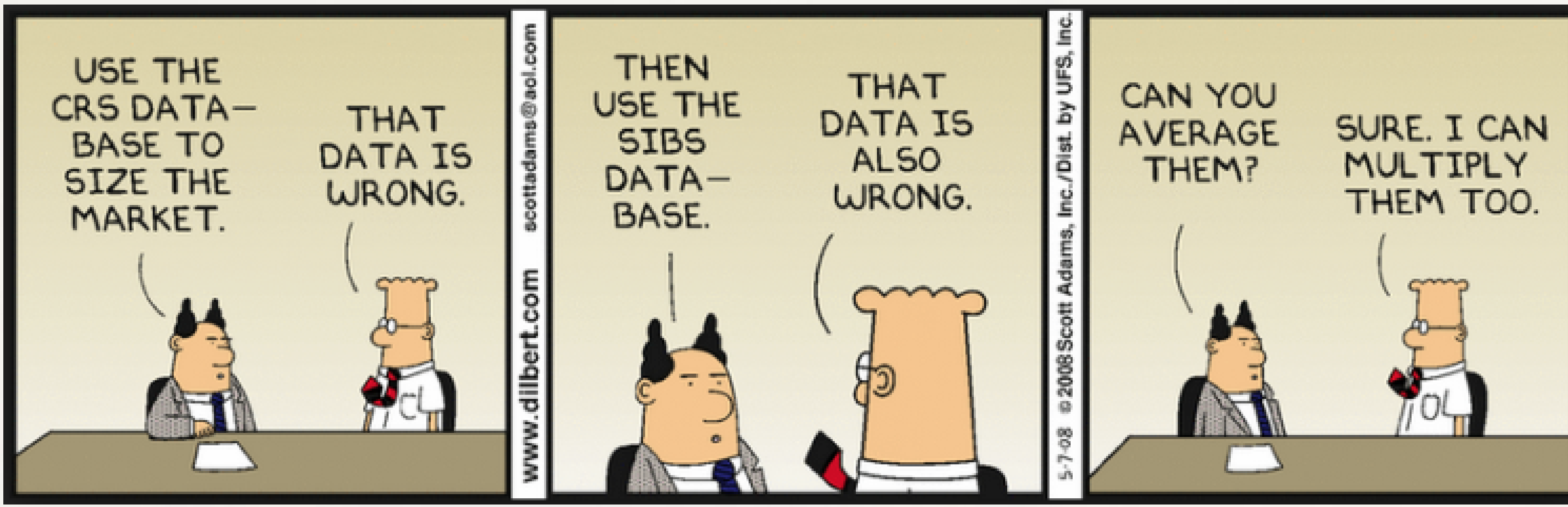
Data Analyst, Communications
Facebook
São Paulo -Brazil
The **Data** Comms team mission is to create **data** stories that highlight the many ways in which people come together on Facebook during those...

Scientist
Philips
Brazil-São Paulo-São Paulo
For this, we are seeking a research engineer to investigate and drive technical innovations to bring Big **Data** concepts to clinical ...

Consultant (**Data Scientist**)
Accenture
São Paulo, 27, BR
Ph.D. in Econometrics, Statistics, Economics or Mathematics (with sound time series and/or statistical background) - Experienced ... careerarc.com

Analista de Ciencia de Dados Pleno/Senior
Itaú Unibanco
São Paulo, São Paulo, Brazil
Aplicar vis o hol stica e considerar iniciativas atuais de consumo de dados e o ambiente de dados j existente. Racioc nio anal tico.

https://www.linkedin.com/vsearch/j?type=all&keywords=data%20scientist



http://www.dilbet.com

Referências

- Dijkstra, E. W. (1986) **On a cultural gap**. The Mathematical Intelligencer. vol. 8, no. 1, pp. 48-52.
- Ramakrishnan, Raghu; Gehrke, Johannes (2003) **Database Management Systems.** McGraw-Hill, 3rd edition.

Agradecimentos

- Luiz Celso Gomes Jr (professor desta disciplina em 2014) pela contribuição na disciplina e nos slides. Página do Celso: http://dainf.ct.utfpr.edu.br/~gomesjr/

André Santanchè

http://www.ic.unicamp.br/~santanche

Licença

- Estes slides são concedidos sob uma Licença Creative Commons. Sob as seguintes condições: Atribuição, Uso Não-Comercial e Compartilhamento pela mesma Licença.
- Mais detalhes sobre a referida licença Creative Commons veja no link: http://creativecommons.org/licenses/by-nc-sa/3.0/
- Fotografia da capa feita por André Santanchè no Petit Palais (Paris) em 17/02/2013 do quadro: Fantasia à Constantinople de Felix Ziem