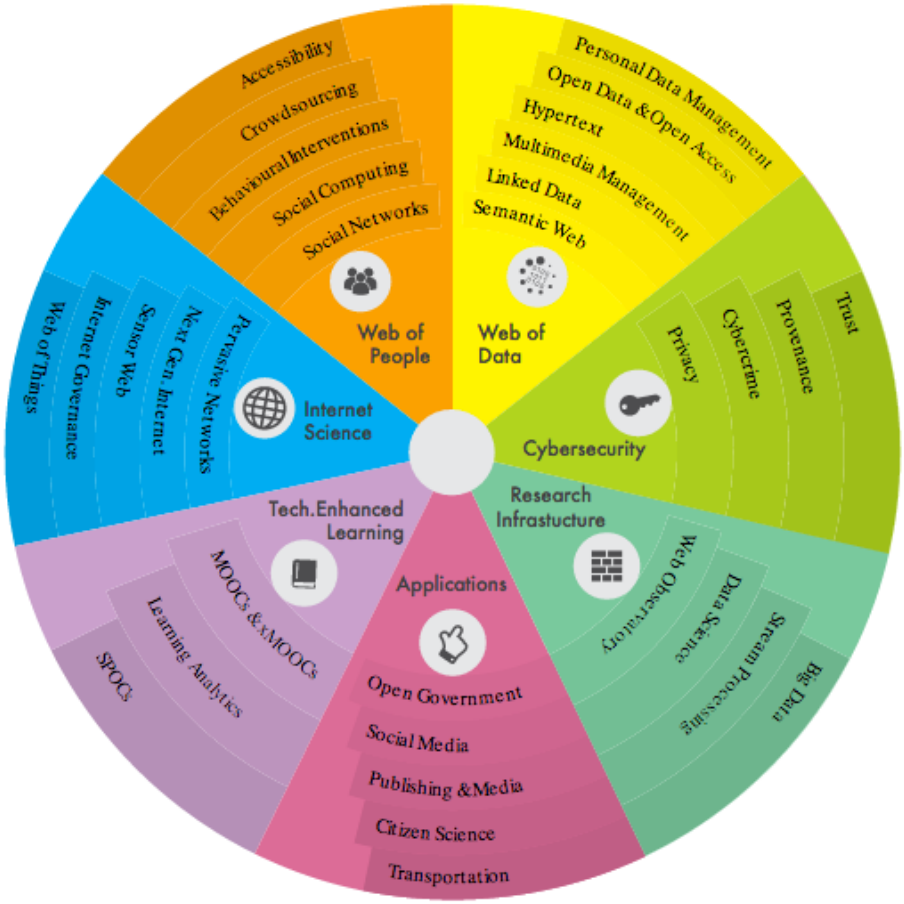
# Big data analytics
# People, infrastructure, provenance

Electronics and Computer Science
Web and Internet Science (WAIS)

Prof Luc Moreau
l.moreau@ecs.soton.ac.uk

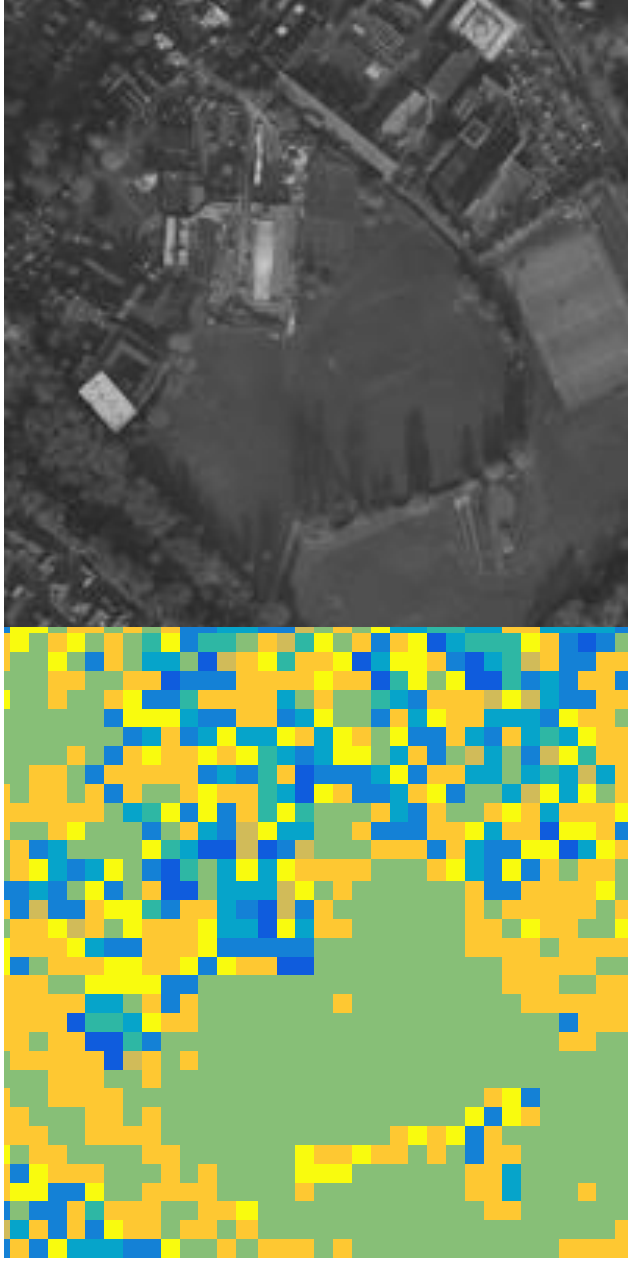
# Big data analytics

- Multimedia Analytics
- People and machines
  - Social media
  - Crowd sourcing
  - Human agent collectives
- Infrastructure work
- Provenance



# Unstructured Data Analytics

- Focus on Multimedia data (images, video, audio, text, metadata, etc)
  - Necessarily “big” by their nature
- Looking at:
  - Event mining (esp. from streams of media)
  - Representation learning
    - Particularly in the context of aerial photoreconnaissance (with Ordnance Survey)
  - Scalable approaches
    - Distributed & GPGPU

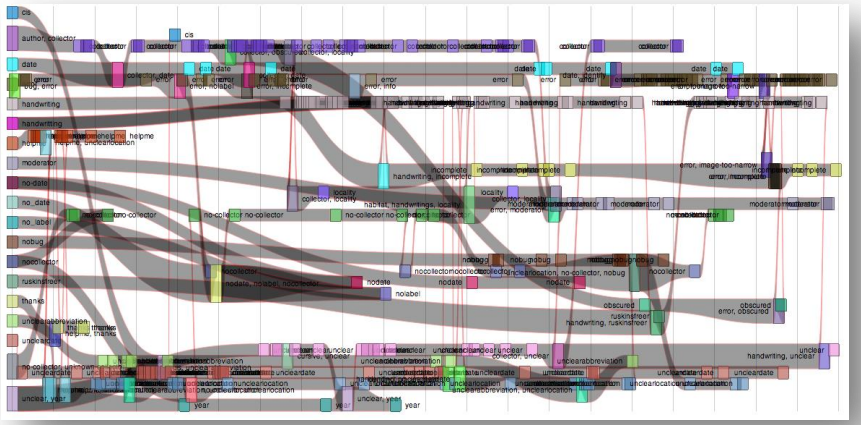


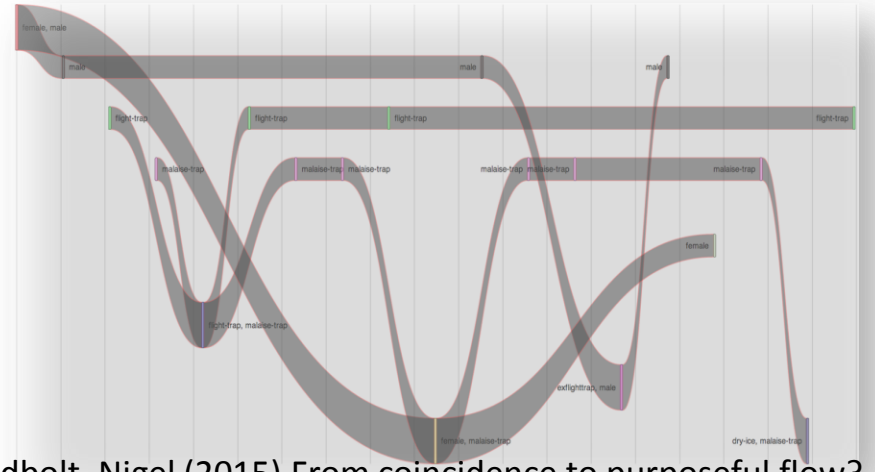
*Unsupervised segmentation of an aerial photo using a learned feature representation*

Hare, Jonathon et al.(2015) Detection of Social Events in Streams of Social Multimedia. International Journal of Multimedia Information Retrieval

# Information Cascades

- Turning flat data streams into networks preserving the temporal order and showing patterns of information co-occurrence
- Varying configurations of the matching functions allow to derive different structures from the same source data stream
- The Transcendental Information Cascades method has been applied to:
  - social media data: capture collective action
  - urban traffic data: mobility management and resilience
  - EEG data: longitudinal sampling to find spatial-temporal relationships in brain signals

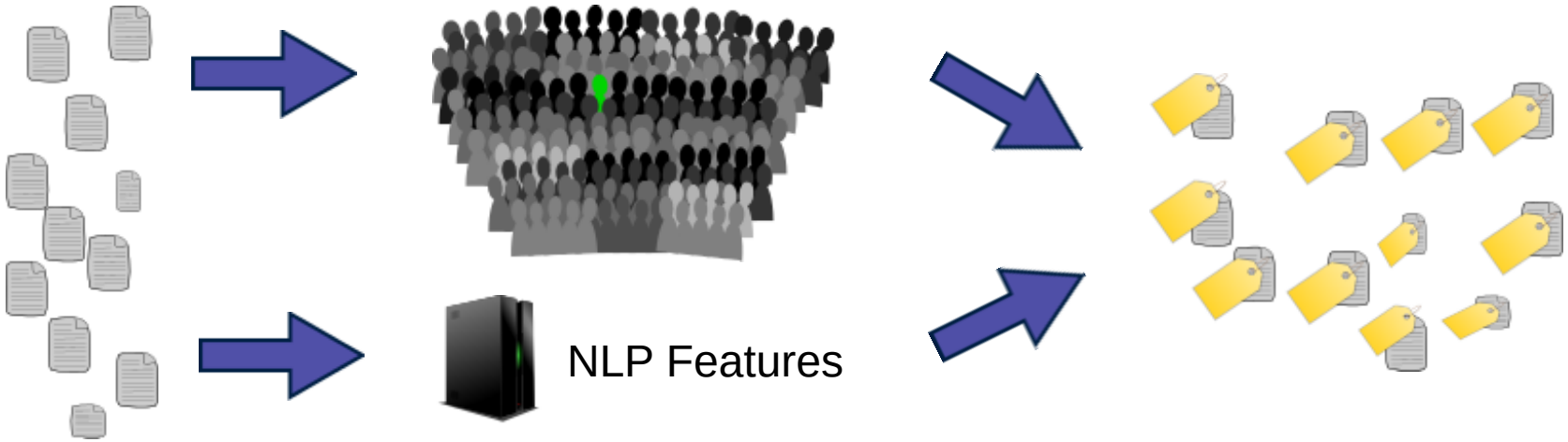




Luczak-Rösch, Markus, Tinati, Ramine, Van Kleek, Max and Shadbolt, Nigel (2015) From coincidence to purposeful flow? Properties of transcendental information cascades. In, IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM), Paris, FR

# TREC Crowdsourcing Challenge

- Task: Label documents relevant to a complex query (15K documents)
- Combining Bayesian classifiers with crowdsourcing → minimize crowdsourcing costs



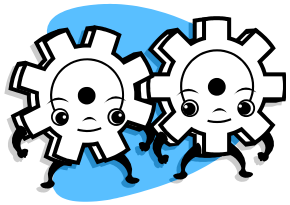

E. Simpson, S. Reece, A. Penta, G. Ramchurn (2013). *Using a Bayesian Model to Combine LDA Features with Crowdsourced Responses,* Proceedings of the 21st Text Retrieval Conference, NIST

EPSRC Engineering and Physical Sciences Research Council

ORCHID

# Atomic Orchid

Crowd Reporters



Planner Agent

Commander

CrowdScanner

UAVs

Bronze UAV Operator

Bronze Responders

Ramchurn, Sarvapali, et al.. (2015) HAC-ER: A disaster response system based on human-agent collectives. In, 14th Internatio Conference on Autonomous Agents and Multi-Agent Systems, Istanbul, TR, 04 - 08 May 2015. , 533-541.

BAE SYSTEMS

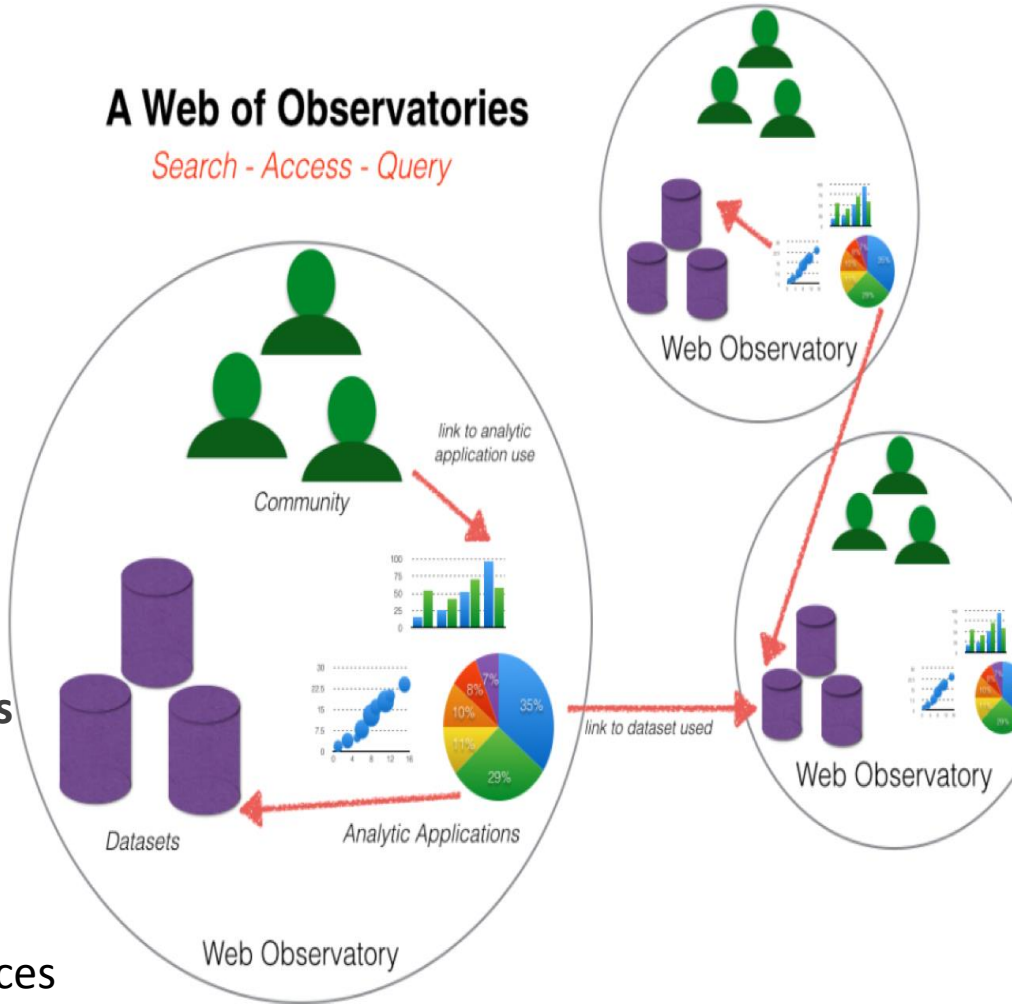
SECURE

RESCUE GLOBAL
Crisis and Disaster Response

ACFR
AUSTRALIAN CENTRE FOR FIELD ROBOTICS

# The Web Observatory: A Middle Layer for Broad Data. (2014).

Tiropanis, T, Hall, W, Hendler, J A, De Larinaga, C. Big Data, 2(3).




**User engagement with datasets and analytics**

- trends across social media, Wikipedia and other web resources (Southampton WO)
- identify and respond to natural disasters combining social media and IoT data sources (Korean WO)
- improving government by measuring how the elderly feel about the government services available to them (Adelaide WO)

http://online.liebertpub.com/doi/pdfplus/10.1089/big.2014.0035

# Provenance


World Wide Web Consortium:

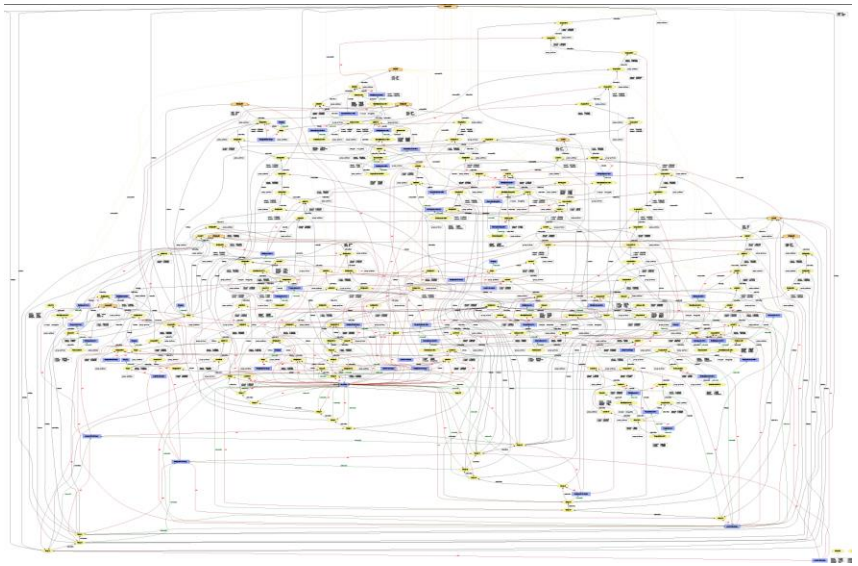
Provenance is a record that describes the people, institutions, entities, and activities, involved in producing, influencing, or delivering a piece of data or a thing in the world

W3C PROV

Moreau, Luc and Missier , Paolo (eds.) (2013) PROV-DM: The PROV Data Model. , World Wide Web Consortium

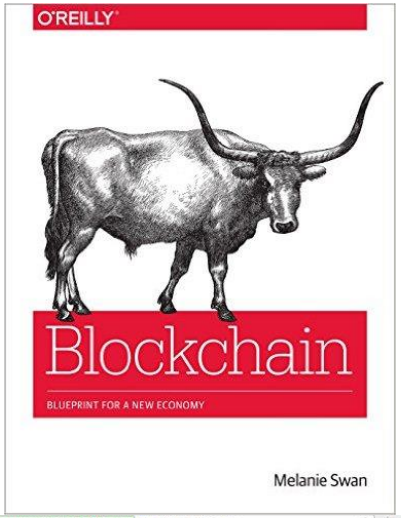
# Understanding Provenance at Scale

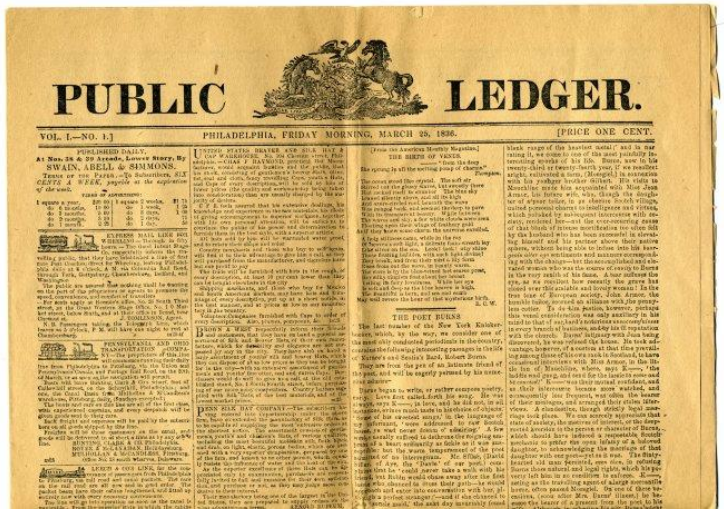
- Provenance Network Metrics:
  - summary of topological structure of provenance graphs
  - network metrics that are specific to provenance graphs
- Predictive Models:
  - network metrics inputs to construct predictive models
  - to gain useful knowledge about the data described by provenance
- Summarisation:
  - extracts outliers
  - finds common pattern
- Radical approach:
  - not relying on any knowledge about the application,
  - except ground truth, labeling of data on a training set



# Public ledgers & Provenance

- Block chain technology offers unforgeable public ledger
- Combine private/public provenance with public ledgers to make provenance trustable
- Doesn't have to be on Bitcoin's blockchain, but could be hosted on trusted host.





PUBLIC LEDGER.

VOL. I.—NO. 1.] PHILADELPHIA, FRIDAY MORNING, MARCH 25, 1836. [PRICE ONE CENT.