Digital Humanities

TAU 2016-2017

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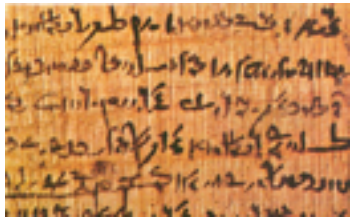
Digital Humanities

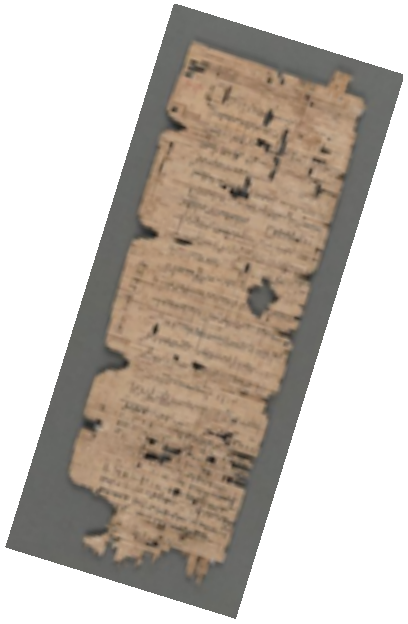
- The intersection of digital technology and humanities disciplines

- The humanities is the discipline that focuses on the arts, literature, music, dance, theater, architecture, philosophy, and other expressions of human culture

General process

Raw data (analog)





Converting analog to digital
(e.g., Scanning + OCR,
Recording + Voice-to-text)

Digital data

Analysis (e.g.,
machine learning,
NLP, Computer vision)

insights

Visualization

Graphic interface

Related CS topics

- Machine learning
- Vision and sound analysis
- NLP
- Graph analysis

Digital Humanities (DH) conference

- Some of 2016's topics:
  - 3d printing
  - agent modeling and simulation
  - anthropology
  - archaeology
  - archives, repositories, sustainability and preservation
  - art history
  - asian studies
  - audio, video, multimedia
  - authorship attribution / authority
  - bibliographic methods / textual studies

http://dh2016.adho.org/abstracts/browse/topics/

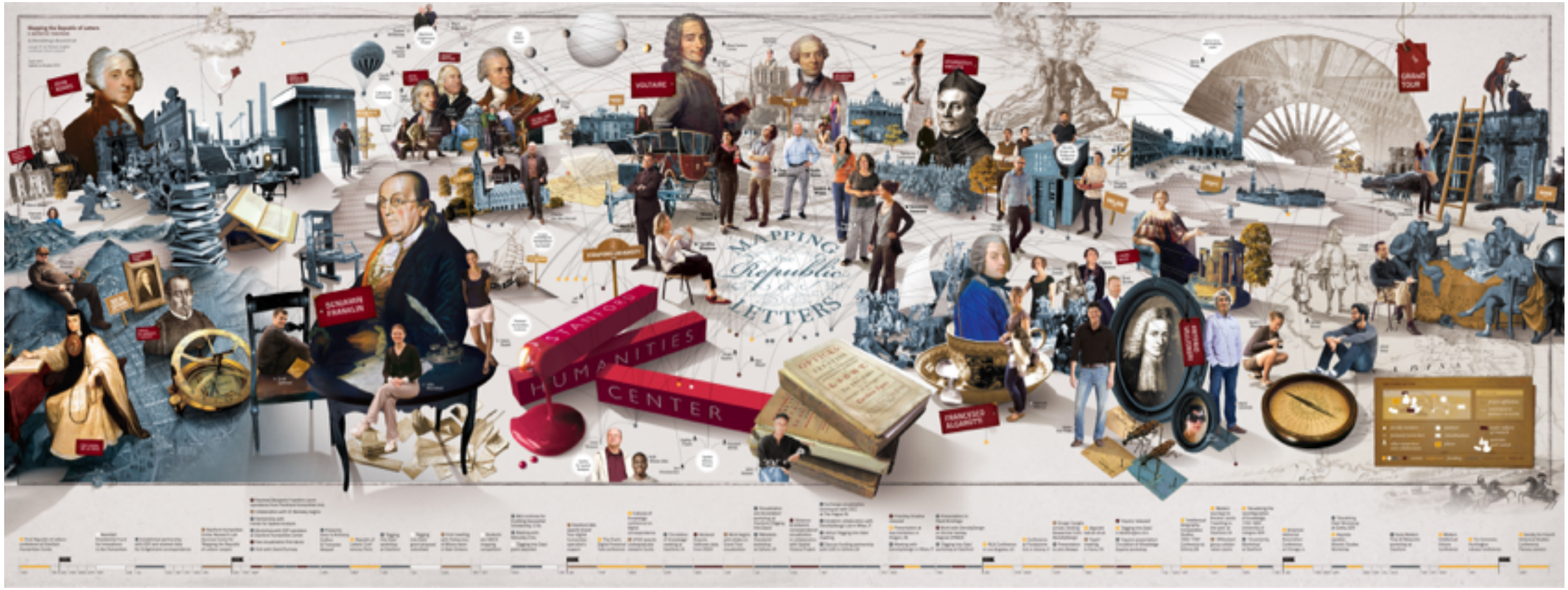
Digital Humanities (DH) conference - continue

- classical studies
- concording and indexing
- content analysis
- philosophy
- image processing
- film and cinema studies
- text analysis
- theology
- visualisation

http://dh2016.adho.org/abstracts/browse/topics/

Project examples

Digitization example: Mapping Republic of Letters



http://republicofletters.stanford.edu/

Digitization example: London Lives

- A fully digitized and searchable archive of a wide range of primary sources about eighteenth-century London
- Documents were manually transcribed twice by two different persons
- Named entities were marked up using dictionary and NLP based methods

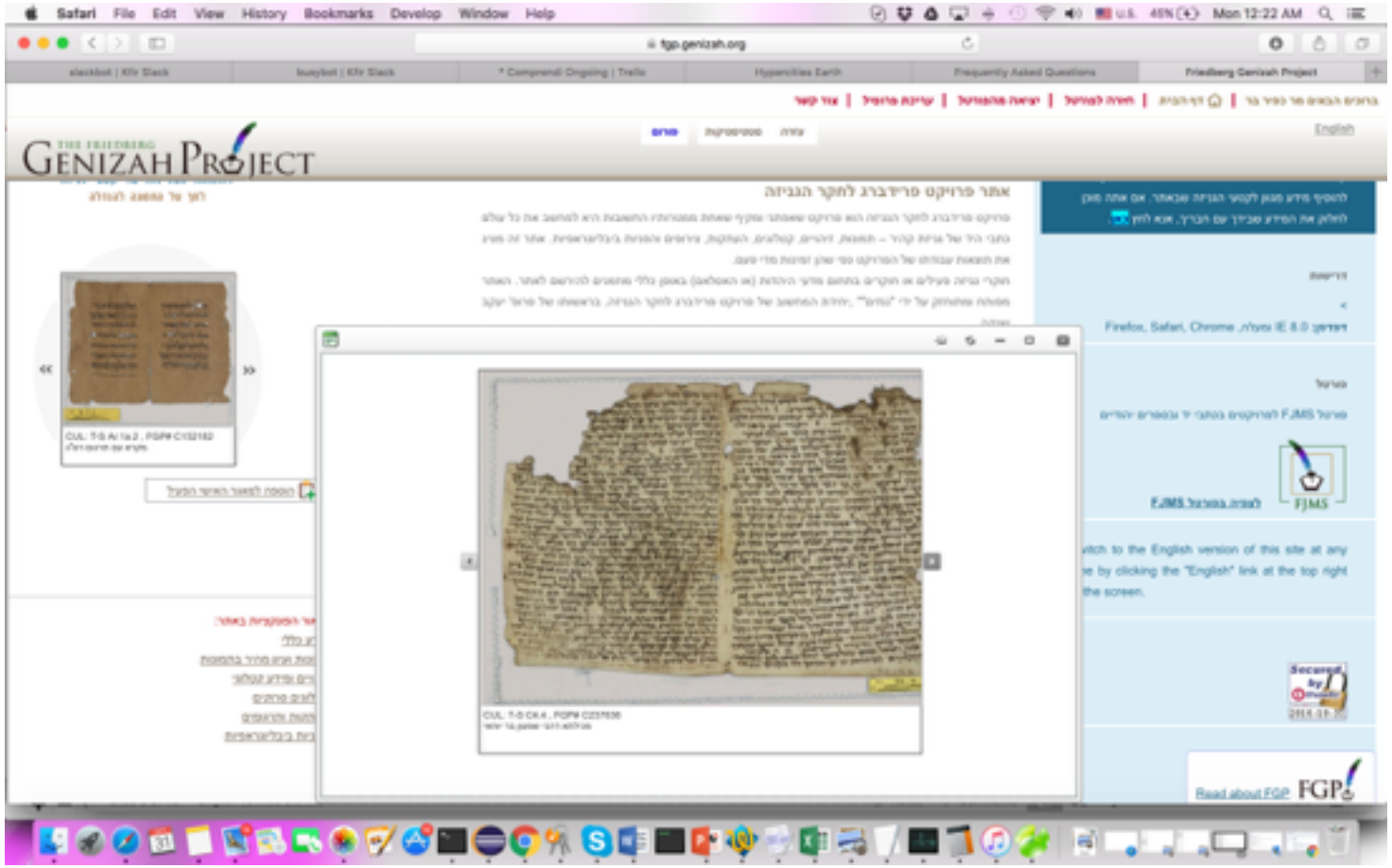
On the Origin of Species (Darwin)

- Published first on 1859, and revised 5 times.
- https://fathom.info/traces/

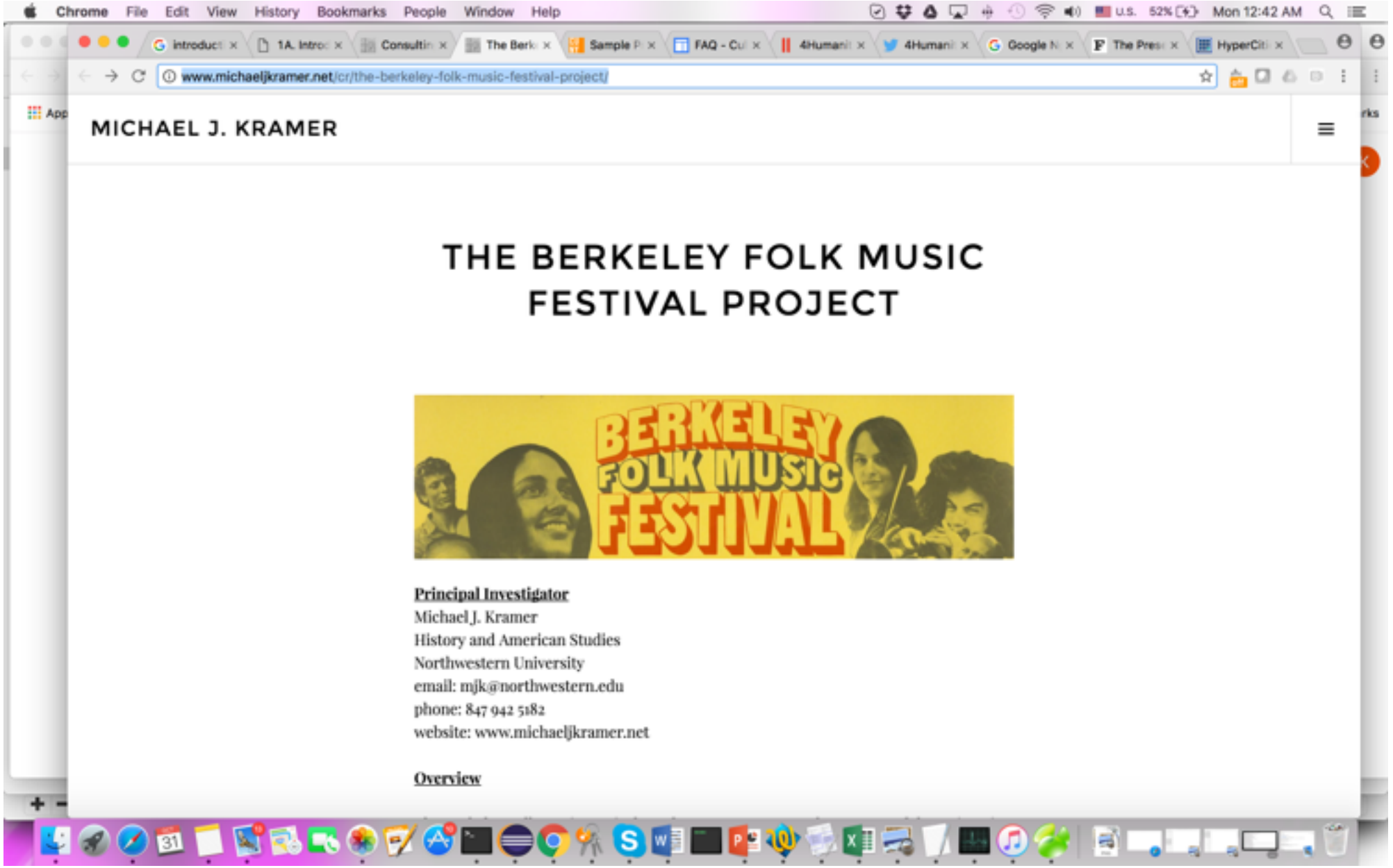
Google Books *n*-gram viewer

- Ngram viewer
  https://books.google.com/ngrams
- Project published @Science
  Quantitative Analysis of Culture Using Millions of Digitized Books

The Friedberg Genizah project



https://fgp.genizah.org



1958-1970

http://www.michaeljkramer.net/cr/the-berkeley-folk-music-festival-project/

General concepts

Structure vs. Unstructured data

- Structured data uses extra elements (such as labels), data structures or other means to add an extra level of interpretation to the data.

- Unstructured data refers texts, images, sound files, etc. that has not had a known format.

Mark-up language

- A way to structure the data
- Adding information, which helps analyzing the data (title, chapter, gender, proper noun, etc.)
- One of the known standards: TEI (Text Encoding and Interchange) (http://www.tei-c.org/release/doc/tei-p5-doc/en/Guidelines.pdf)
  - Widely used by libraries to represent digital resources

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          <p>Indiana University provides the information contained in this
                file for non-commercial, personal, or research use only. All other use, including but not limited to commercial or scholarly
reproductions, redistribution, publication or transmission, whether by electronic means or otherwise, without prior written permission of
the copyright holder is strictly prohibited.</p>
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            E.G.
            VAA4025-110-3-a01
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            BOOK REVIEW = bookReview
            EDITORIAL MATERIAL = editorialMaterial
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        <byline>PEGGY SEIGEL</byline>

        <p>
          In April 1957, the Museum of New Mexico in Santa Fe honored
84-year-old Olive Rush with a retrospective of her work from the past
forty years. The Hoosier-born painter, considered “one of the city’s most
lovable personalities” and “greatest artists” had “brought fame, dignity,and beauty” to the
vibrant artist center that she helped to develop in the
```

TEI example

Data classification

- A higher order of organization
- Organizing texts, physical objects, files, images, recordings etc. into classes, or labels, which form a higher level structure

- Examples:
  - Thompson. Motif-index of folk-literature (http://www.ruthenia.ru/folklore/thompson)

Data classification

- Manual vs. Computational approaches for classification
- Computational approaches
  - Rule based
  - Data driven (e.g., using Bayes)

$$P(C|\mathbf{X}) = \frac{P(\mathbf{X}|C)P(C)}{P(\mathbf{X})} \qquad Posterior = \frac{Likelihood \times Prior}{Evidence}$$

Ontologies and taxonomies

- In general:
  a naming system, lists of terms/names, organized in a hierarchical structure
- Used to represent a domain of knowledge in a standard way
- No real difference between taxonomy and ontology. If at all, one may say that a taxonomy is a tree and ontology is a graph (for more read http://www.ideaeng.com/taxonomies-ontologies-0602)
- Examples: Wikipedia, Wordnet

Example: WordNet

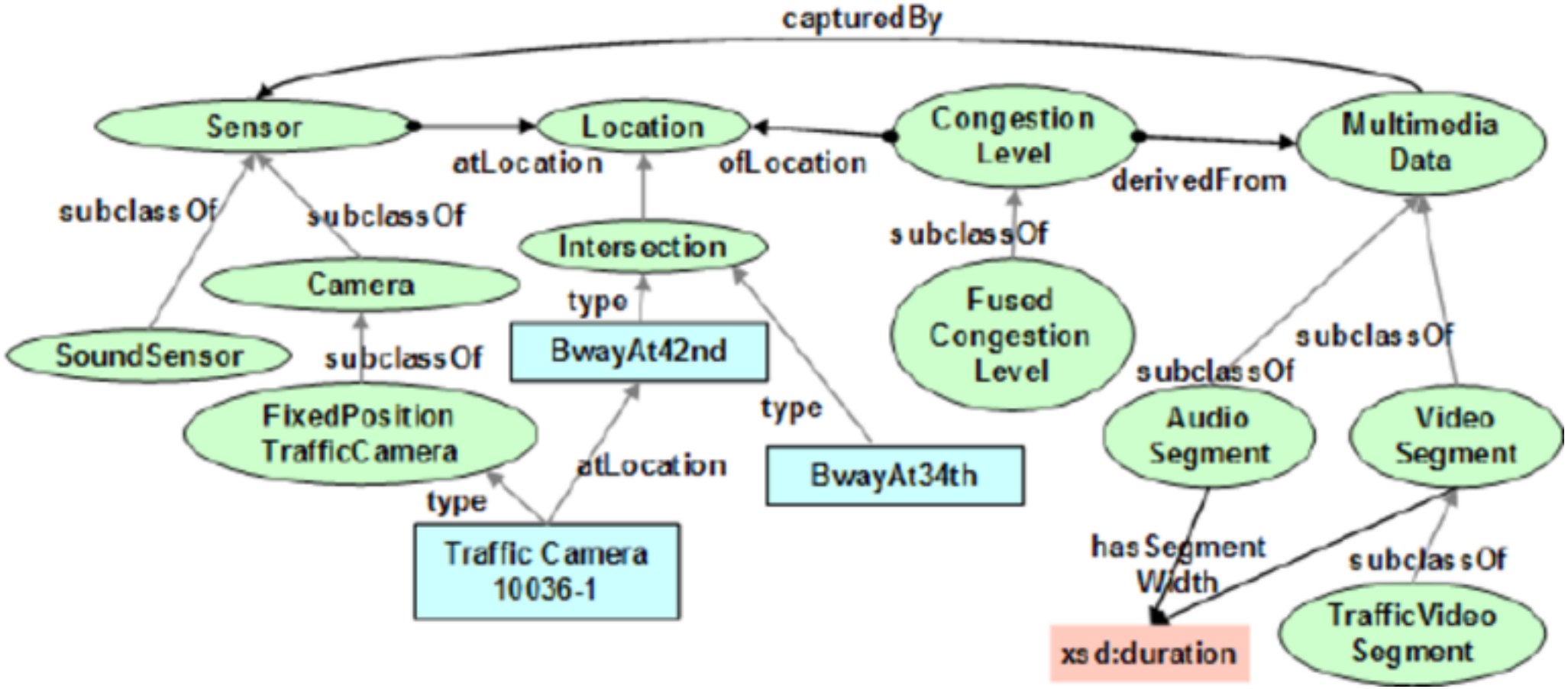
synonyms: *sofa=couch*

antonyms: *good/bad*, *life/death*, *come/go*

hyponyms / hypernyms :
class inclusion: *cat<mammal<animal*

meronyms: the part-whole relation: *line<stanza<poem*

Example: Traffic ontology



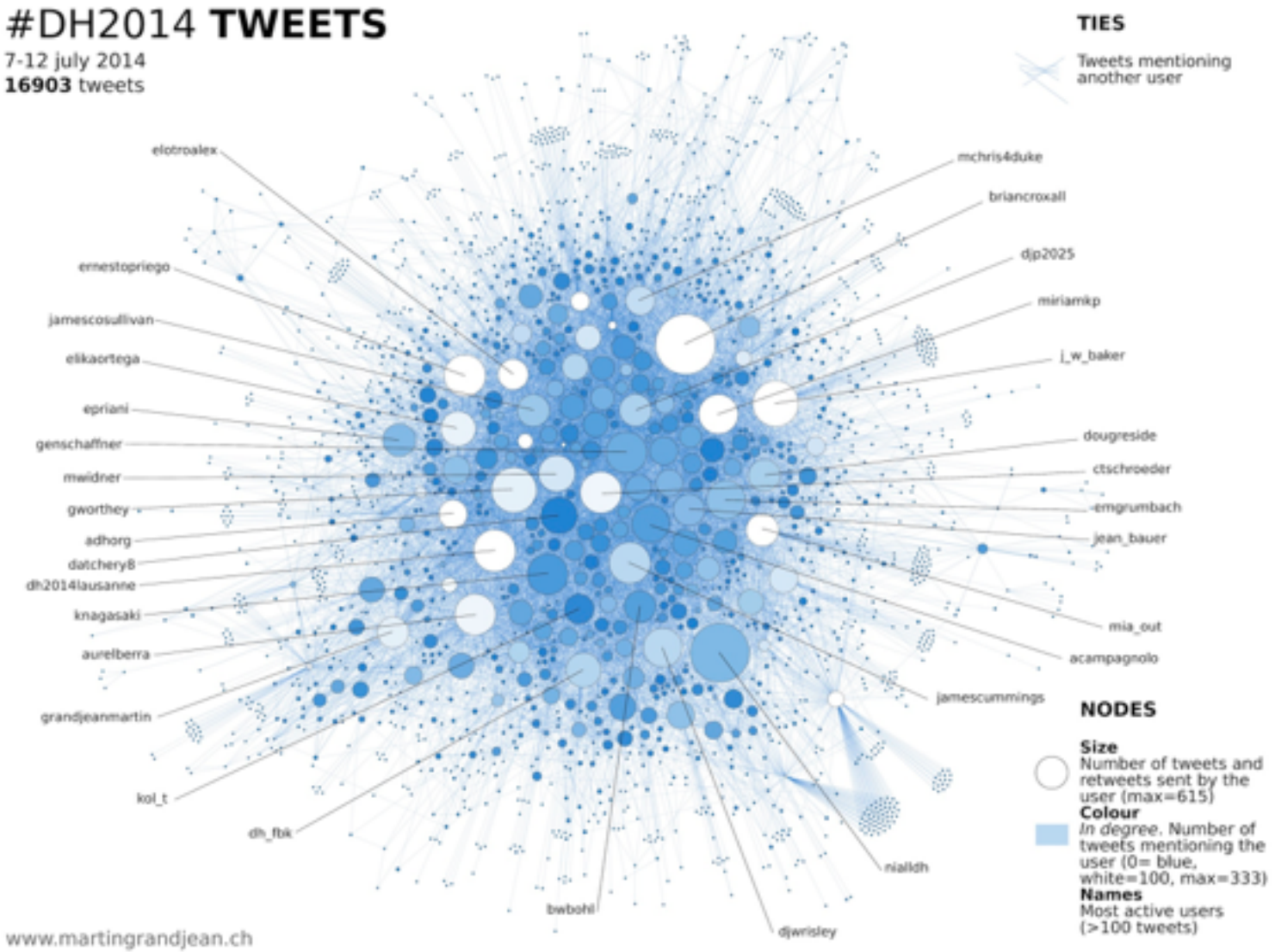
https://www.researchgate.net/figure/220974898_fig2_Fig-3-Example-ontology-in-Traffic-Services-domain-defining-concepts-like-Sensor-and

Automatic data tagging/labeling

- Extracting ontology-based tags/labels from unstructured data using rules/data driven approaches
  - Computer vision
  - Text analytics (natural language processing)

Visualization

- Showing features/ patterns in a condensed form
- A dataset can be visualized in different formats



Graph analysis

- A system of elements or entities that are connected by explicit relations
- good examples of networks are social networks, traffic networks, communication networks

- Snap (http://snap.stanford.edu/)
- RDF/XML - standard for representing a graph using triplets (subj, predicate, obj)

Natural language processing

- Relevant applications:
  - Document classification (e.g., Tibetan original vs. translated source)
  - Summarization (e.g., Yahoo Summly)
  - Machine translation (e.g., Google translate)
  - Chat bots (e.g., Alexa, Siri)
  - Search (e.g., Morphological/semantic search)
  - Question answering (e.g., IBM Watson)

NLP layers

- Phonetics/phonology: how words are actually sound?
- Morphology: what words (or sub-words) are we dealing with?
- Syntax: what phrases are we dealing with? Which words modify one another?
- Semantics: what's the literal meaning?
- Pragmatics: what should you conclude from the fact that I said something? How should you react?

Eliza (Weizenbaum, 1966)

- Remarkably simple “Psychologist”
- Uses pattern patching to carry on limited form of conversation
- Seemed to pass the Turing Test! (Machines Who Think, McCorduck, 1979)
- Demos:
  - http://www.manifestation.com/neurotoys/eliza.php3

“A computer would deserve to be called intelligent if it could deceive a human into believing that it was human”

Ambiguity

I made her duck

Ambiguity

I made her duck ??

- I cooked waterfowl for her benefit (to eat)
- I cooked waterfowl belonging to her
- I created the (ceramic?) duck she owns
- I caused her to quickly lower her upper body
- I waved my magic wand and turned her into undifferentiated waterfowl

NLP-based labeling tools

- **Part of speech tagger**

  I/*pro-noun* would/*aux* like/*verb* to/*prep* buy/*verb* a/*det* ticket/*noun* to/*prep* New/*proper-noun* York/*proper-noun*

- **Named entity recognizer**

  Yaron/*B-person* London/*I-person* traveled/*O* to/*O* London/*B-location*

Machine learning

- Supervised – when you have labeled data and you want to automatically learn how to label unseen instances

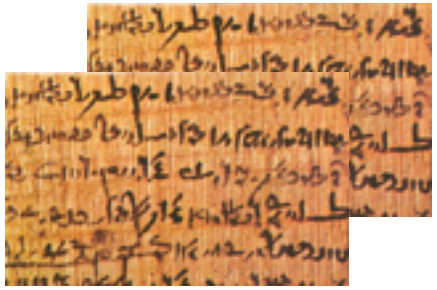
- Unsupervised – when you have unlabeled corpus, and you want to find an interesting structure in the corpus

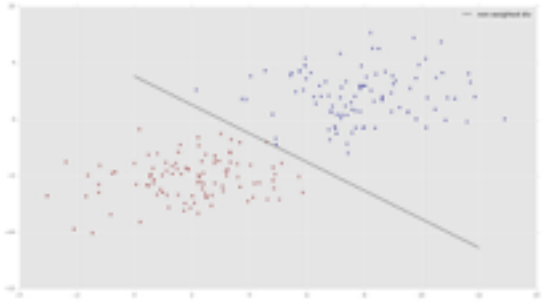
- Reinforcement learning – predicting actions in an environment so as to maximize some notion of cumulative reward

A generic supervised learning approach

Training

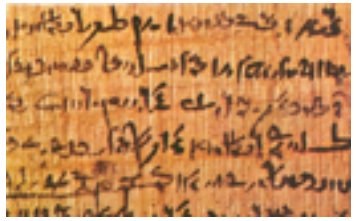
Labeled data → Feature extraction → Vector representation → Learning → **Classifier (model)**

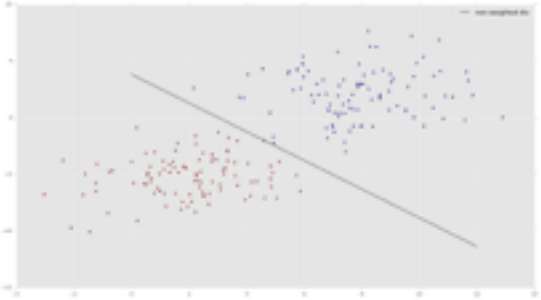




Predicting

Single instance → Feature extraction → Vector representation → Predicting → **Label**





Classifier

Learning algorithms

- Generative models– given an instance, predicting the distribution of the labels (e.g., Naïve Bayes, GMM, LDA, HMM)

- Discriminative models – finding the dependency between a label and the input data (e.g., SVM, Logistic regression, NN, CRF)

Relevant links

- http://dh101.humanities.ucla.edu/
- http://4humanities.org/
- https://amicus.uvt.nl/

Seminar requirements

- Presenting a paper in class (1 hour presentation + discussion)
- Attending all classes
- Taking part in class discussions (reading the papers before class)
- 500-1000 word summary of what learned in the seminar (to be submitted on the last meeting)