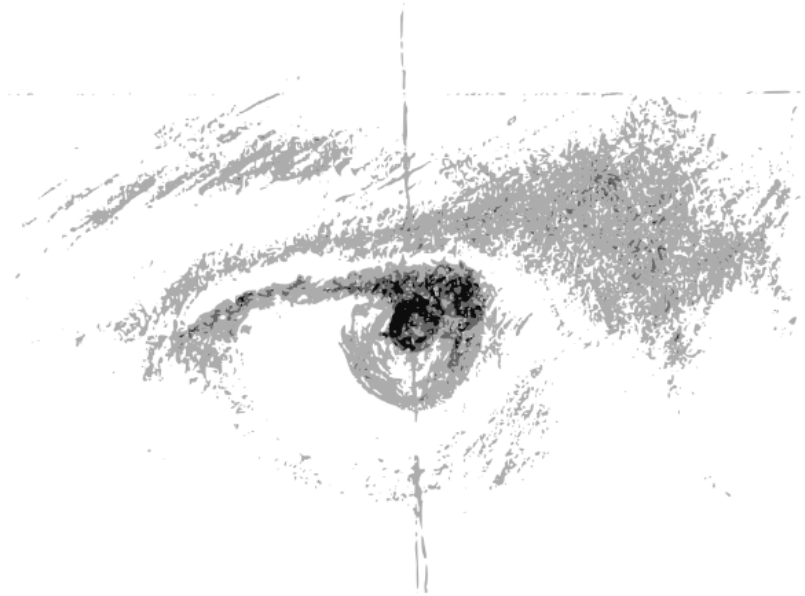
LAW VIA THE INTERNET 2018
Knowledge of the Law in the Big Data Age
Florence, October 11, 2018



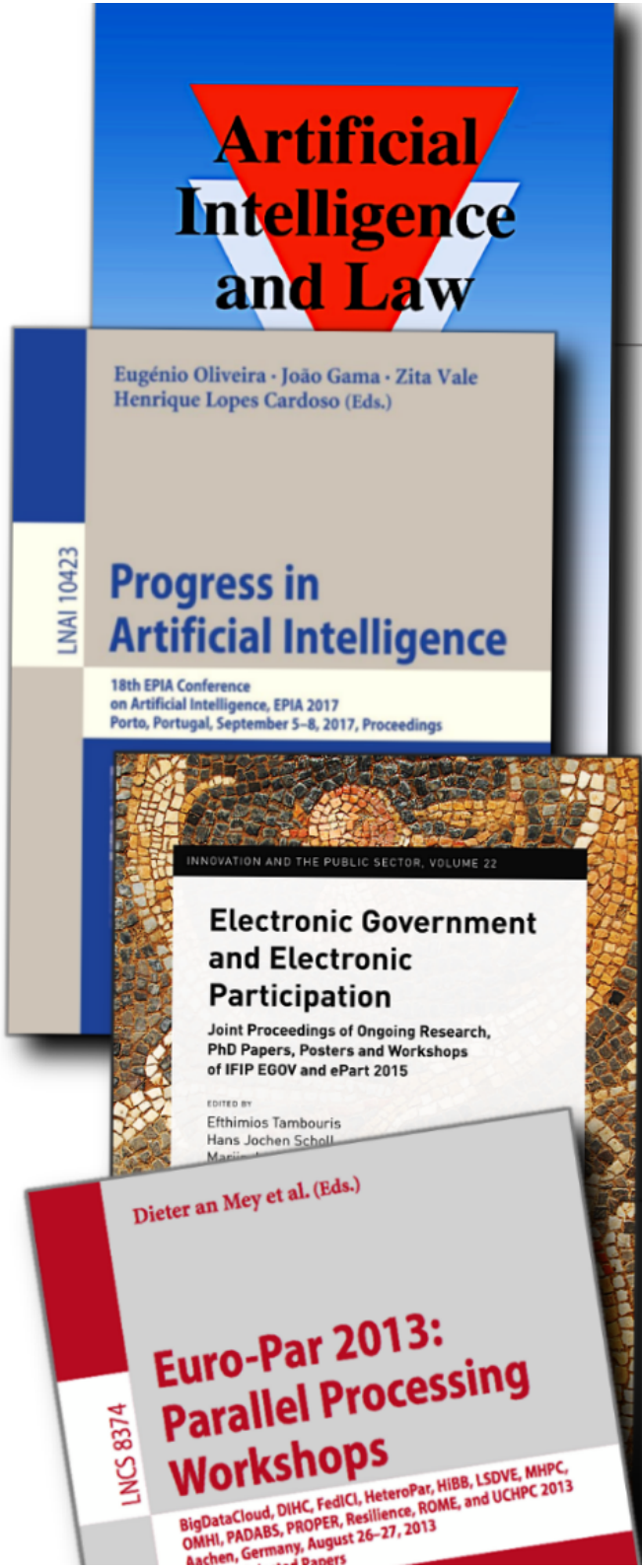
Visualizing LAW

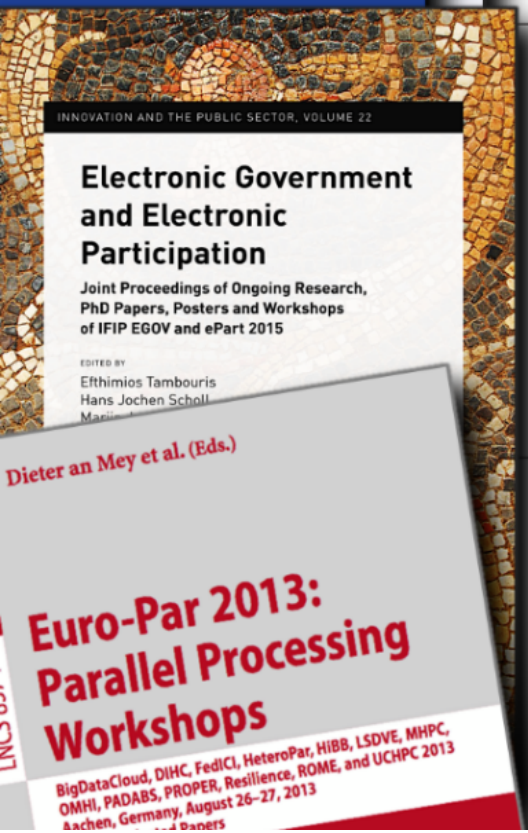
Visual legal analytics: experiences and perspectives

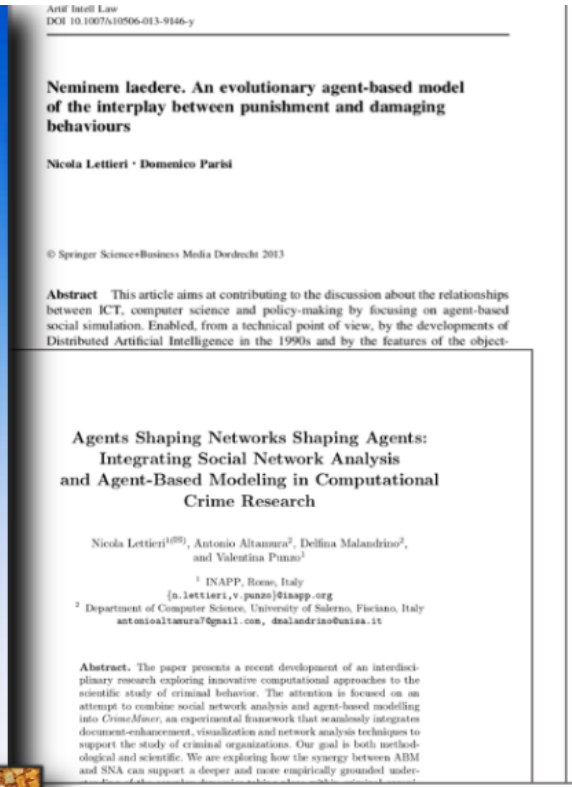
NICOLA LETTIERI
National Institute for Public Policy Analysis
University of Sannio
n.lettieri@inapp.org

A few words about

ME, MY RESEARCH...






Artif Intell Law
DOI 10.1007/s10506-013-9146-y

Neminem laedere. An evolutionary agent-based model of the interplay between punishment and damaging behaviours

Nicola Lettieri · Domenico Parisi

© Springer Science+Business Media Dordrecht 2013

Abstract This article aims at contributing to the discussion about the relationships between ICT, computer science and policy-making by focusing on agent-based social simulation. Enabled, from a technical point of view, by the developments of Distributed Artificial Intelligence in the 1990s and by the features of the object-

Agents Shaping Networks Shaping Agents: Integrating Social Network Analysis and Agent-Based Modeling in Computational Crime Research

Nicola Lettieri[1(✉)], Antonio Altamura[2], Delfina Malandrino[2], and Valentina Punzo[1]

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Abstract. The paper presents a recent development of an interdisciplinary research exploring innovative computational approaches to the scientific study of criminal behavior. The attention is focused on an attempt to combine social network analysis and agent-based modelling into *CrimeMiner*, an experimental framework that seamlessly integrates document-enhancement, visualization and network analysis techniques to support the study of criminal organizations. Our goal is both methodological and scientific. We are exploring how the synergy between ABM and SNA can support a deeper and more empirically grounded under-


Electronic Government and Electronic Participation 53
E. Tambouris et al. (Eds.)
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doi: 10.3233/978-1-61499-570-8-53

Simulating the Core Dynamics of a Social Dilemma. Individual Choices, Time and Sanctions in the Tragedy of the Commons

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[a]ISFOL, Rome, Italy
[b]University of Sannio, Dept. of Law, Economics, Management, Quantitative Methods, Benevento, Italy

Abstract. The understanding of the way in which collective phenomena emerge from the interaction between individual behaviors, environment and institutions, can play a crucial role in supporting the design of more contextualized policies. An apparently effective policy can easily fail if policy makers do not consider the interplay between individual decision making and social aggregate dynamics. This paper presents an ongoing research exploiting an agent-based simulation model to explore the core dynamics of the Tragedy of the Commons (ToC), a social


Sociality, Sanctions, Damaging Behaviors: A Distributed Implementation of an Agent-Based Social Simulation Model

Michele Carillo[1], Nicola Lettieri[2], Domenico Parisi[3], Francesco Raia[1], Flavio Serrapica[1], and Luca Vicidomini[1]

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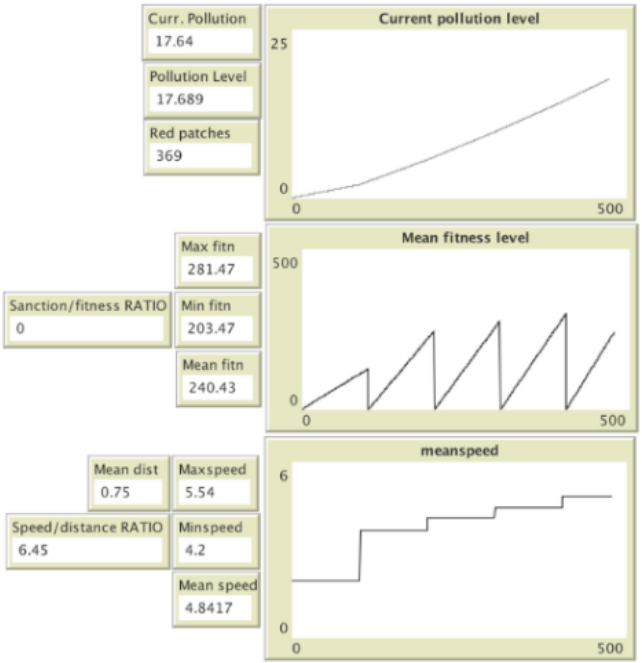

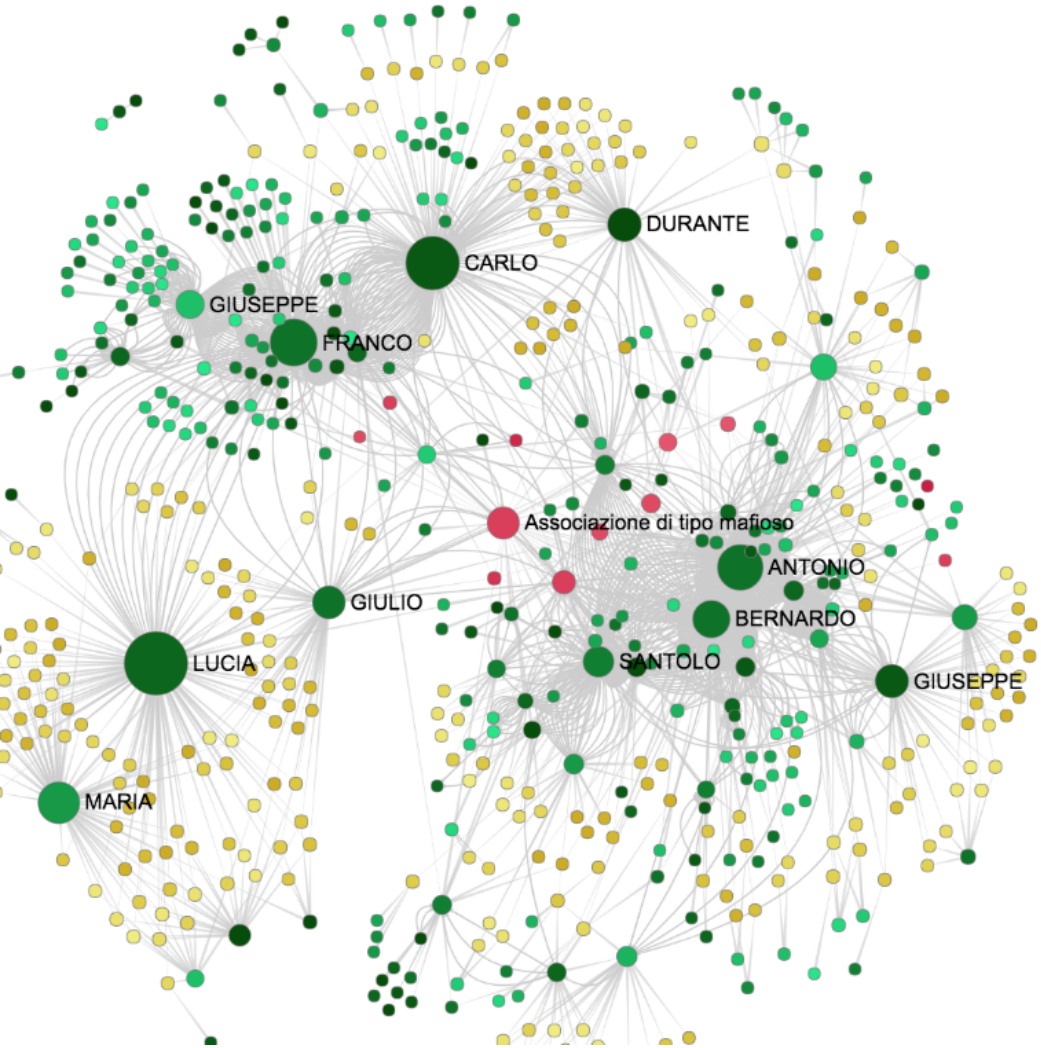
DURANTE
CARLO
GIUSEPPE
FRANCO
Associazione di tipo mafioso
ANTONIO
GIULIO
BERNARDO
LUCIA
SANTOLO
GIUSEPPE
MARIA


A computational approach for the experimenta
law: analysis and implementation
SOCIAL NETWORK
ANALYSIS
AND MINING
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International Series edited by
SEBASTIANO FARO, NICOLA LETTIERI
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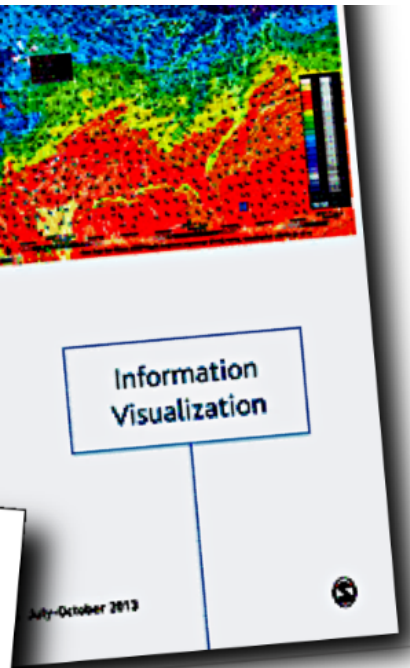
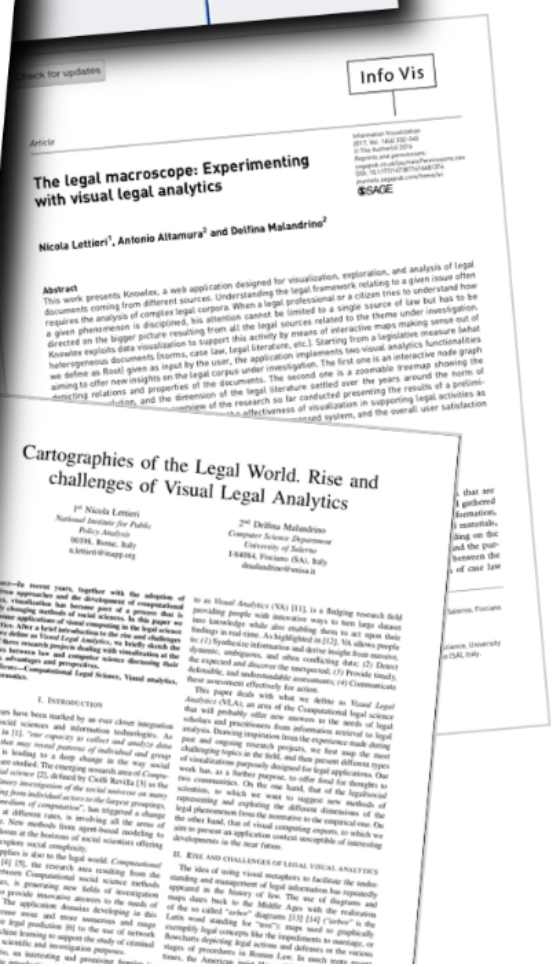
Law
and
Computational
Social
Science
edited by
Sebastiano Faro
Nicola Lettieri
Author's personal copy
By investigation, I mean computation
A framework to investigate the societal dimension of crime
Nicola Lettieri - Delfina Malandrino - .
Luca Vicidomini
Volume 19 • Number 2, June 2016
Trends in
Organized Crime
ARTICLES/BRIEF COMMUNICATIONS
BOOK REVIEWS
PUBLICATION MONITOR
Text and Social Network Analysis
As Investigative Tools: A Case Study
NICOLA LETTIERI, DELFINA MALANDRINO, RAFFAELE SPINELLI*
SUMMARY: 1. Introduction – 2. Social Network Analysis – 3. Social Network Analysis
in the Legal Field – 4. Text and Social Network Analysis as Investigative Tools – 5. The
Case Study – 5.1. Implementation – 5.2. Text Filtering – 5.3. Information Extraction
and Graph Generation – 5.4. Graph Visualization – 6. Conclusions
1. INTRODUCTION


Information Visualization
July–October 2013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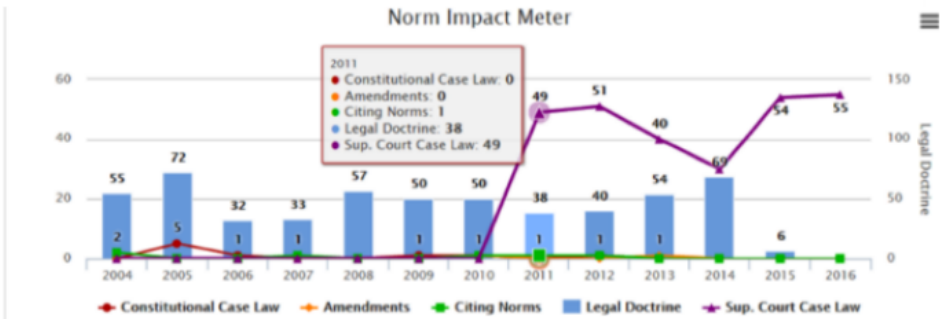
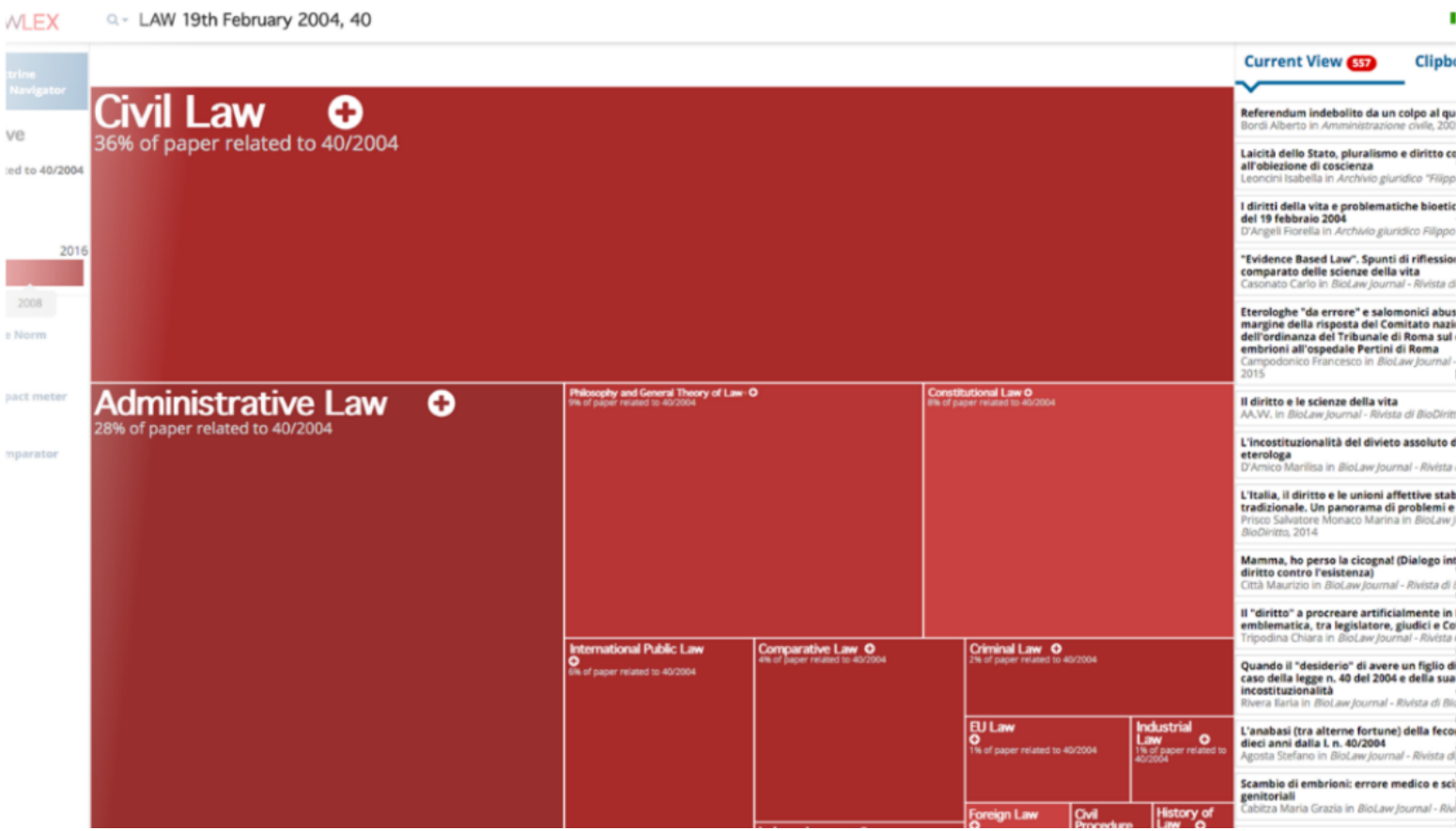
The legal macroscope: Experimenting with visual legal analytics
Nicola Lettieri, Antonio Altamura and Delfina Malandrino
Cartographies of the Legal World. Rise and challenges of Visual Legal Analytics


Norm Impact Meter
2011
Constitutional Case Law: 0
Amendments: 0
Citing Norms: 1
Legal Doctrine: 38
Sup. Court Case Law: 49
Legal Doctrine
Constitutional Case Law
Amendments
Citing Norms
Legal Doctrine
Sup. Court Case Law


LAW 19th February 2004, 40
Civil Law
36% of paper related to 40/2004
Administrative Law
28% of paper related to 40/2004
Philosophy and General Theory of Law
9% of paper related to 40/2004
Constitutional Law
8% of paper related to 40/2004
International Public Law
6% of paper related to 40/2004
Comparative Law
4% of paper related to 40/2004
Criminal Law
2% of paper related to 40/2004
EU Law
1% of paper related to 40/2004
Industrial Law
1% of paper related to 40/2004
Foreign Law
Civil Procedure
History of
Current View 557
Referendum indebolito da un colpo al qu
Laicità dello Stato, pluralismo e diritto co all'obiezione di coscienza
I diritti della vita e problematiche bioetic del 19 febbraio 2004
"Evidence Based Law". Spunti di riflessio comparato delle scienze della vita
Eterologhe "da errore" e salomonici abus margine della risposta del Comitato nazi dell'ordinanza del Tribunale di Roma sul embrioni all'ospedale Pertini di Roma
Il diritto e le scienze della vita
L'incostituzionalità del divieto assoluto d eterologa
L'Italia, il diritto e le unioni affettive stab tradizionale. Un panorama di problemi e
Mamma, ho perso la cicogna! (Dialogo int diritto contro l'esistenza)
Il "diritto" a procreare artificialmente in emblematica, tra legislatore, giudici e Co
Quando il "desiderio" di avere un figlio di caso della legge n. 40 del 2004 e della suar incostituzionalità
L'anabasi (tra alterne fortune) della feco dieci anni dalla l. n. 40/2004
Scambio di embrioni: errore medico e sci genitoriali

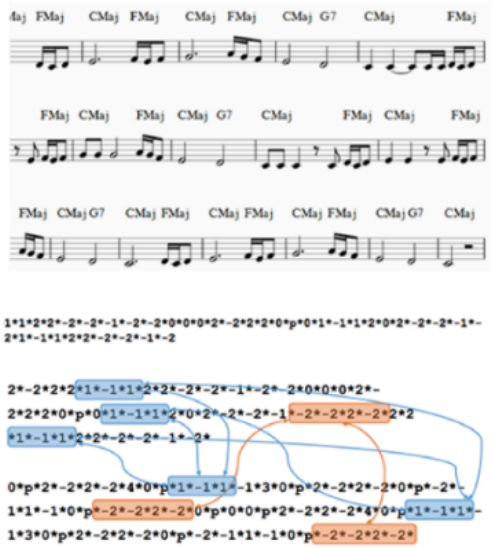


Figure 3: Common n-grams between "Will you be there" and "I cigni di Balaka".

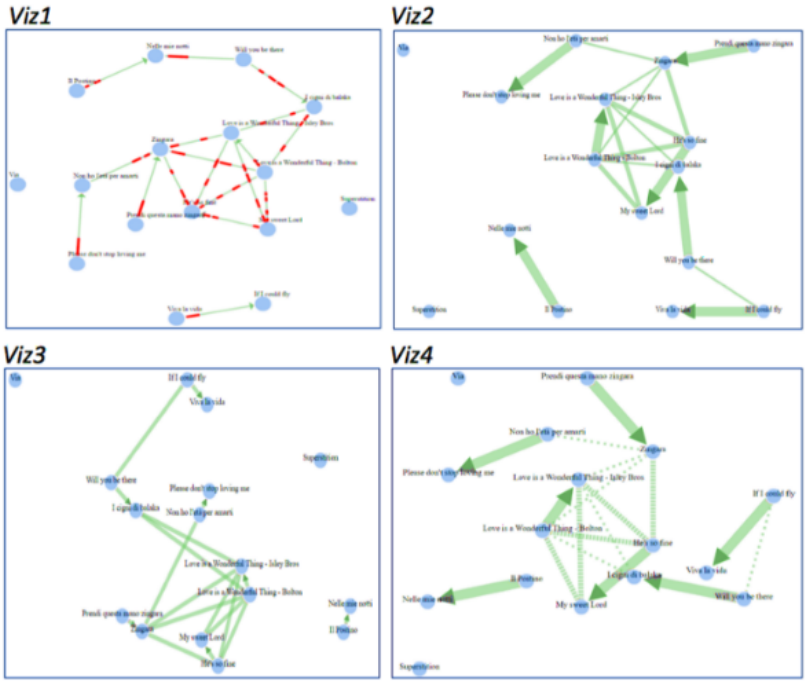


Figure 2: Different visualizations of the same dataset of plagiarism cases.

Music Plagiarism at a glance: metrics of similarity and visualizations

oberto De Prisco[2], Antonio Esposito[2], Nicola Lettieri[1], Delfina Malandrino[2], Donato Pirozzi[2],

[2]Departmer
{robdep, c

Visualization of Music Plagiarism: Analysis and Evaluation

Roberto De Prisco[2], Nicola Lettieri[1], Delfina Malandrino[2], Donato Pirozzi[2], Gianluca Zaccagnino[2], Rocco Zaccagnino[2]

[1]ISFOL, Rome, ITALY
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{robdep, dmalandrino, dpirozzi}@unisa.it, zaccagnino.gianluca@gmail.com, zaccagnino@dia.unisa.it

Abstract

Nowadays plagiarism is an interesting and debated topic in different fields. In music, the plagiarism is a very common phenomenon which touch the vast amounts of money that music melodies are able to generate in today's

the misappropriation of the authorship of (parts of) musical compositions. Plagiarism occurs when two works are *"substantially similar"*, whereas the owner of one of the two works has copied or has been inspired by the work of another. Interpreting or measuring the concept of substantially similarity is actually an open issue.

(b) *Viz2* (c) *Viz3*

ism cases.

(c) *Viz3*

...and about

THIS TALK

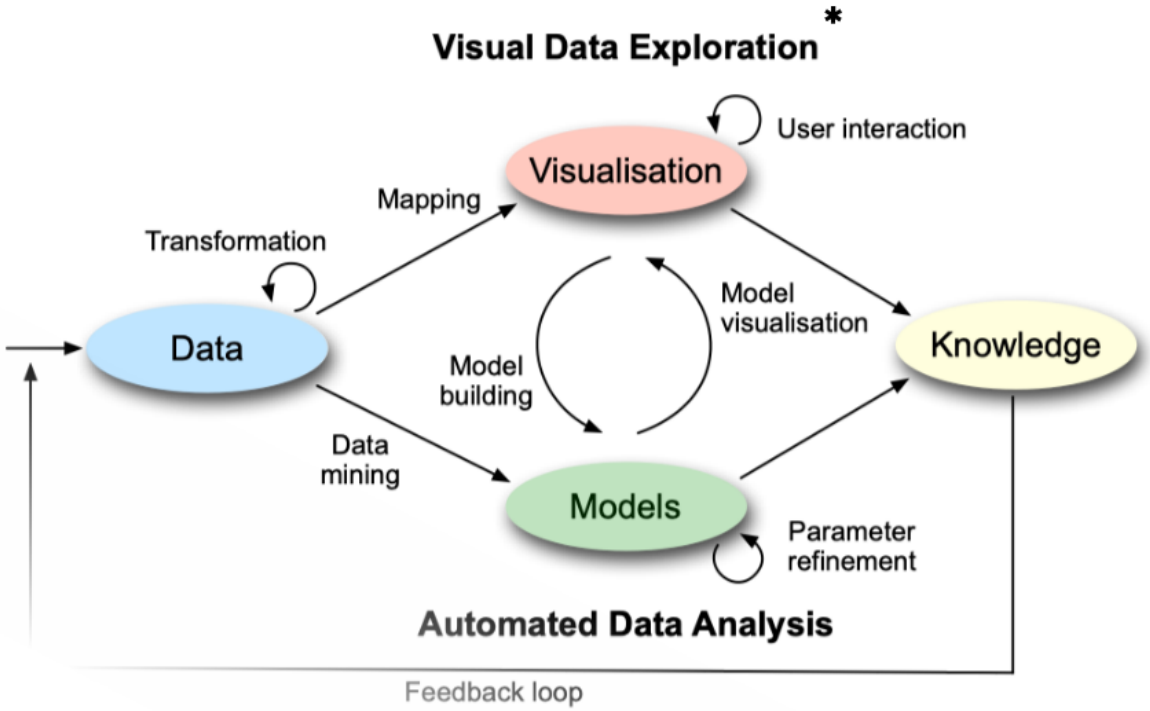
THE SCENARIO:
The emerging field

Visual Analytics is a multidisciplinary research field that combines data analysis, human-computer interaction and visualization to draw up new ways to turn large dataset into knowledge while enabling users to act upon their findings in real-time.

VA integrates automated analysis techniques with interactive visualisations for an effective understanding, reasoning and decision making on the basis of very large and complex datasets.

Its ultimate goal is to combine the strengths of human and electronic data processing

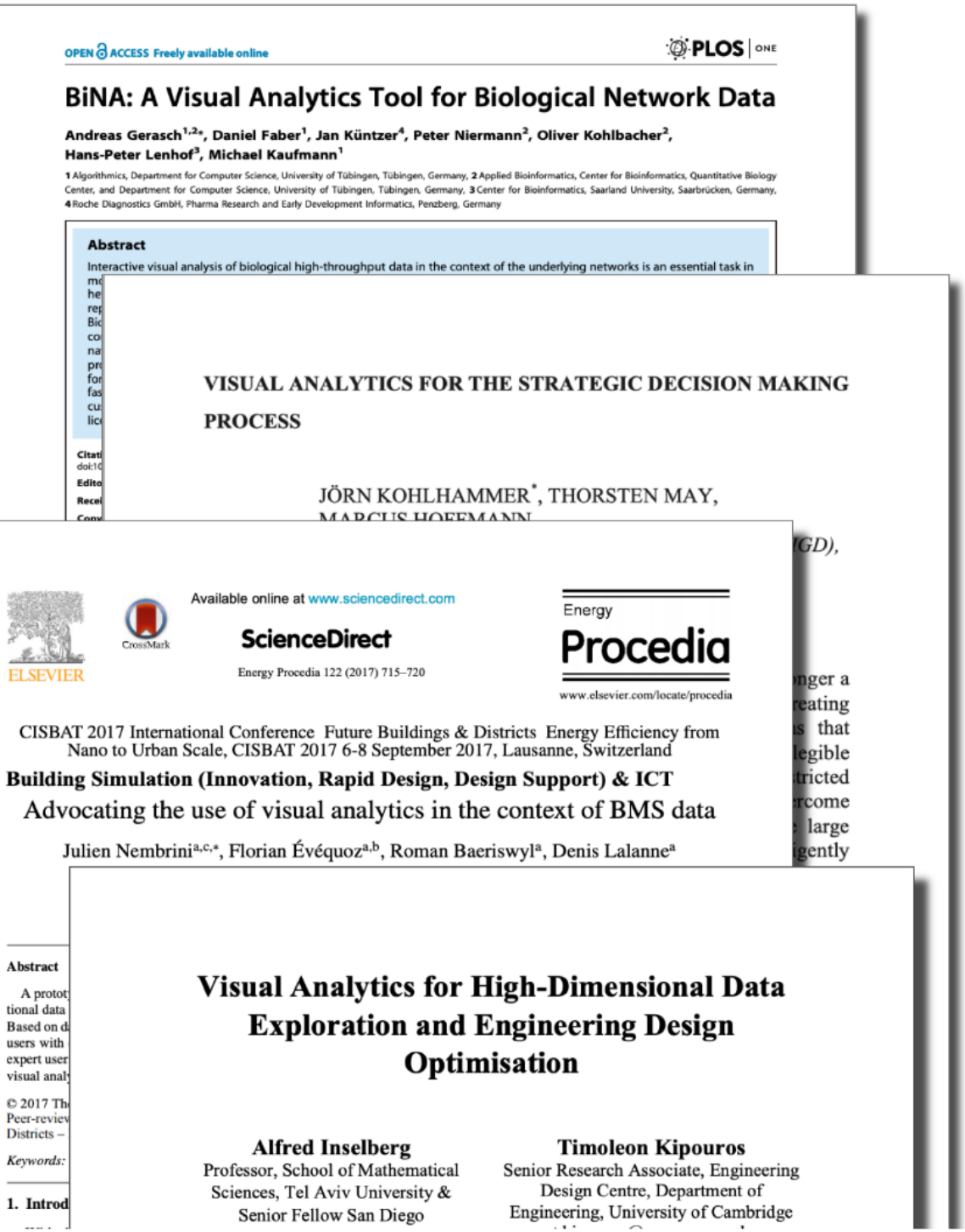
Visual Analytics
GOALS & BENEFITS*



Better understanding of cause-effect relationships
Identification of correlations
Information synthesis
Insights from massive and dynamic data
Detection of expected and discovery of the unexpected
Timely and understandable assessments.
Effective assessment communication for action

[*]

Ellis, G., & Mansmann, F. (2010). Mastering the information age solving problems with visual analytics.



OPEN ACCESS Freely available online

PLOS ONE

BiNA: A Visual Analytics Tool for Biological Network Data

Andreas Gerasch[1,2*], Daniel Faber[1], Jan Küntzer[4], Peter Niermann[2], Oliver Kohlbacher[2], Hans-Peter Lenhof[3], Michael Kaufmann[1]

1 Algorithmics, Department for Computer Science, University of Tübingen, Tübingen, Germany, 2 Applied Bioinformatics, Center for Bioinformatics, Quantitative Biology Center, and Department for Computer Science, University of Tübingen, Tübingen, Germany, 3 Center for Bioinformatics, Saarland University, Saarbrücken, Germany, 4 Roche Diagnostics GmbH, Pharma Research and Early Development Informatics, Penzberg, Germany

Abstract

Interactive visual analysis of biological high-throughput data in the context of the underlying networks is an essential task in

VISUAL ANALYTICS FOR THE STRATEGIC DECISION MAKING PROCESS

JÖRN KOHLHAMMER*, THORSTEN MAY,

ELSEVIER

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Energy Procedia

www.elsevier.com/locate/procedia

CISBAT 2017 International Conference Future Buildings & Districts Energy Efficiency from Nano to Urban Scale, CISBAT 2017 6-8 September 2017, Lausanne, Switzerland

Building Simulation (Innovation, Rapid Design, Design Support) & ICT

Advocating the use of visual analytics in the context of BMS data

Julien Nembrini[a,c,*], Florian Évéquoz[a,b], Roman Baeriswyl[a], Denis Lalanne[a]

Visual Analytics for High-Dimensional Data Exploration and Engineering Design Optimisation

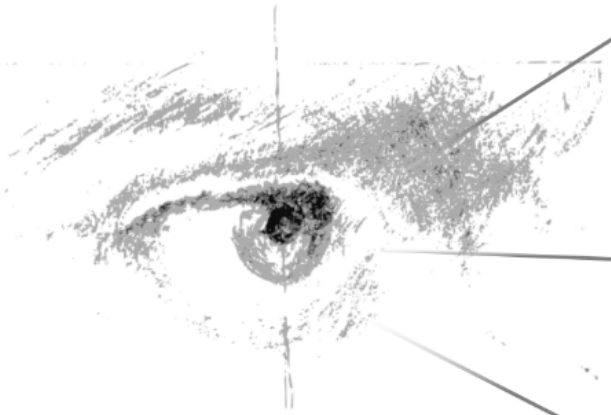
Alfred Inselberg
Professor, School of Mathematical Sciences, Tel Aviv University & Senior Fellow San Diego

Timoleon Kipouros
Senior Research Associate, Engineering Design Centre, Department of Engineering, University of Cambridge

In the last decade, in step with technological evolution, VA techniques have taken hold in a growing number of research areas from Physics to Biology where huge amounts of information need to be understood.

The time is ripe also for law...

Overview



1 *Visual Legal Analytics*

2 *VLA: some experiences*

3 *Final remarks*

1 Visual Legal Analytics

VISUALIZATION
&
LAW

not a brand new idea...

MIDDLE AGES...

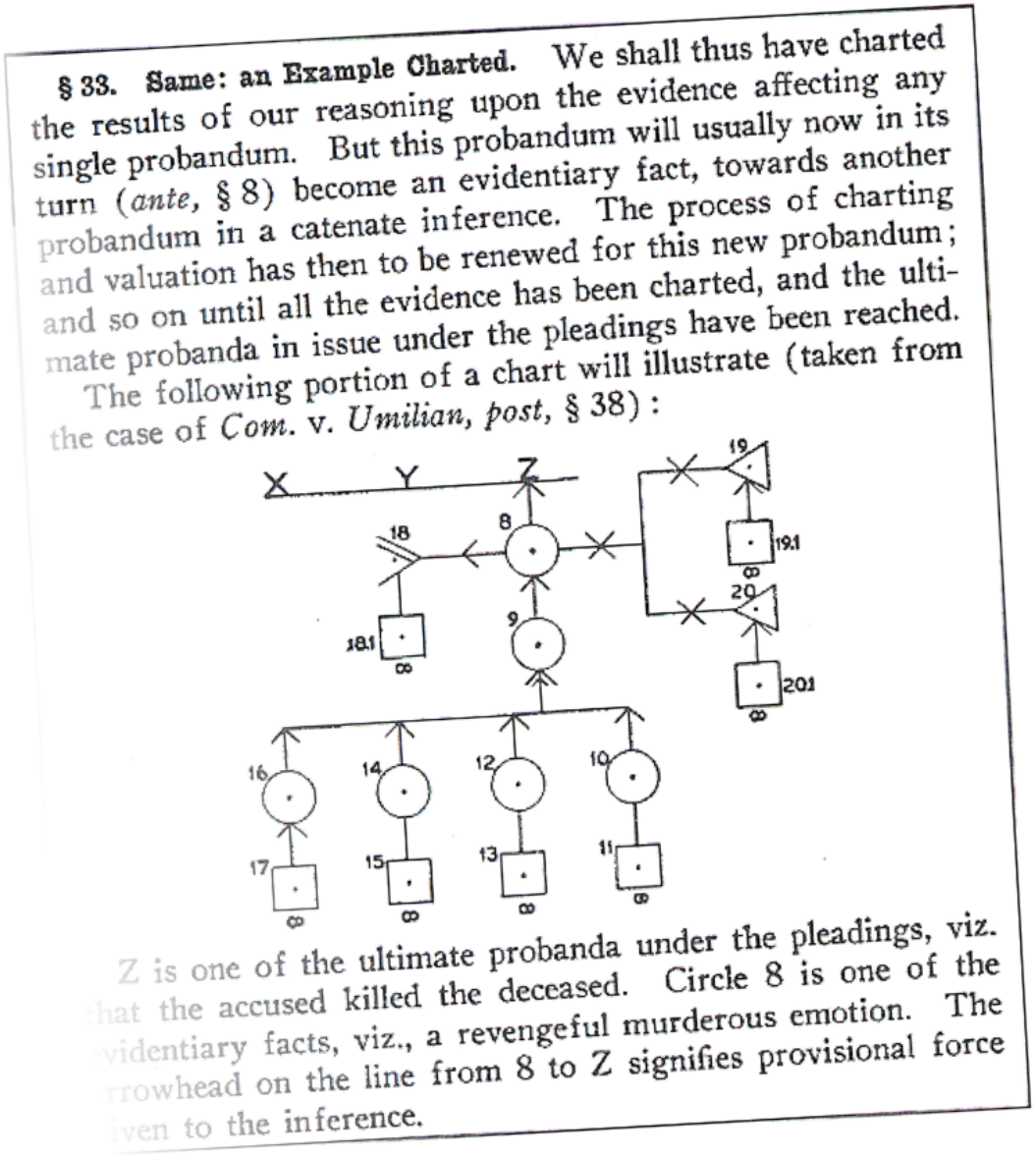
Arbor actionum:
diagram/map used
to graphically depict
legal concepts like the
impediments to marriage,
or the various stages
of legal procedures
in the Roman Law.

JOHANNES BASSIANUM
Arbor actionum, 1177

...EARLY XXTH CENTURY...

WIGMORE CHARTS
graphical methods
for the analysis of connections linking legal evidences in trials

WIGMORE J. H. (1937)
The Science of Judicial Proof: As Given by Logic. Psychology, and General Experience. Boston, MA.



§ 33. Same: an Example Charted. We shall thus have charted the results of our reasoning upon the evidence affecting any single probandum. But this probandum will usually now in its turn (*ante*, § 8) become an evidentiary fact, towards another probandum in a catenate inference. The process of charting and valuation has then to be renewed for this new probandum; and so on until all the evidence has been charted, and the ultimate probanda in issue under the pleadings have been reached.

The following portion of a chart will illustrate (taken from the case of *Com.* v. *Umilian*, *post*, § 38):

Z is one of the ultimate probanda under the pleadings, viz. that the accused killed the deceased. Circle 8 is one of the evidentiary facts, viz., a revengeful murderous emotion. The arrowhead on the line from 8 to Z signifies provisional force given to the inference.

More recent TIMES...

Bayesian NETWORKS

graphical models made of nodes, arrows between nodes and probability assignment enabling the visualization of dependencies between hypothesis and evidences. BN allow to integrate probabilistic reasoning in legal settings

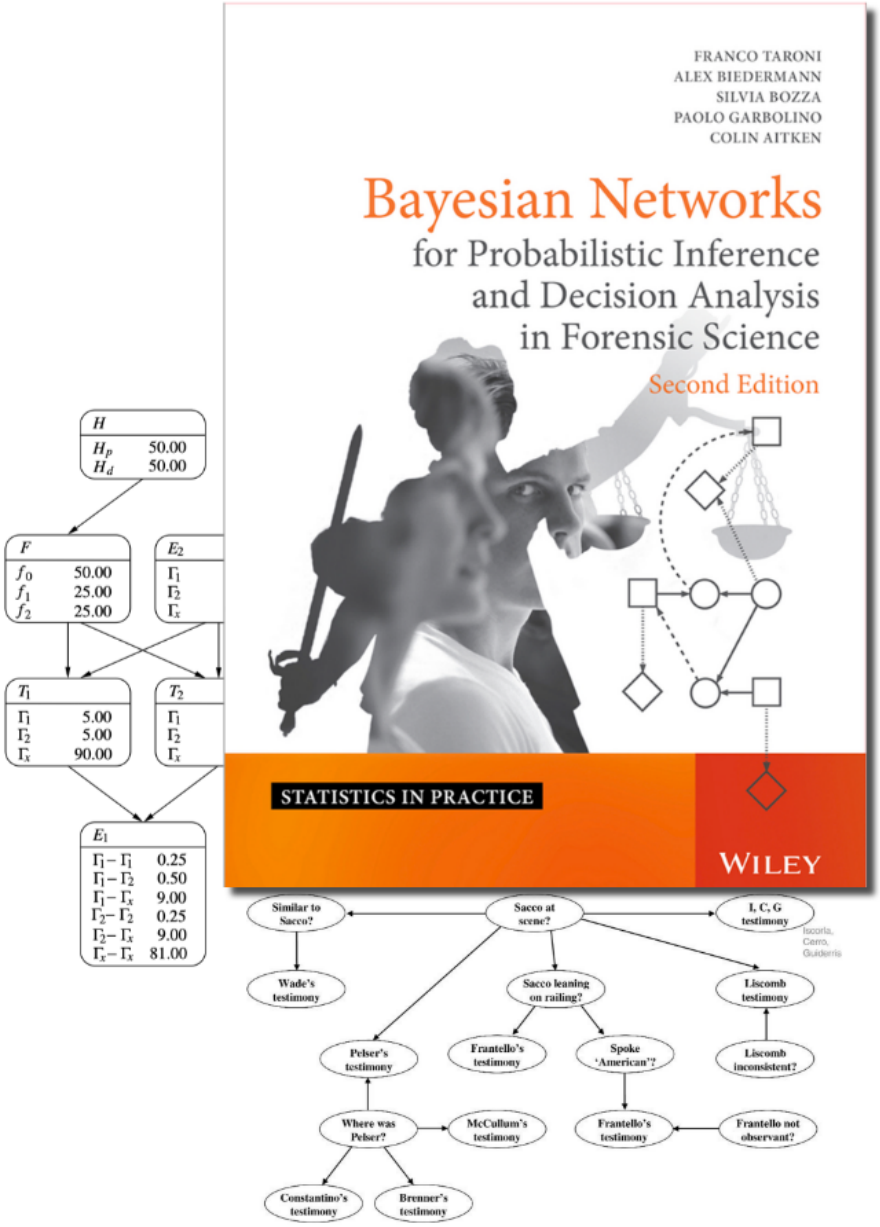
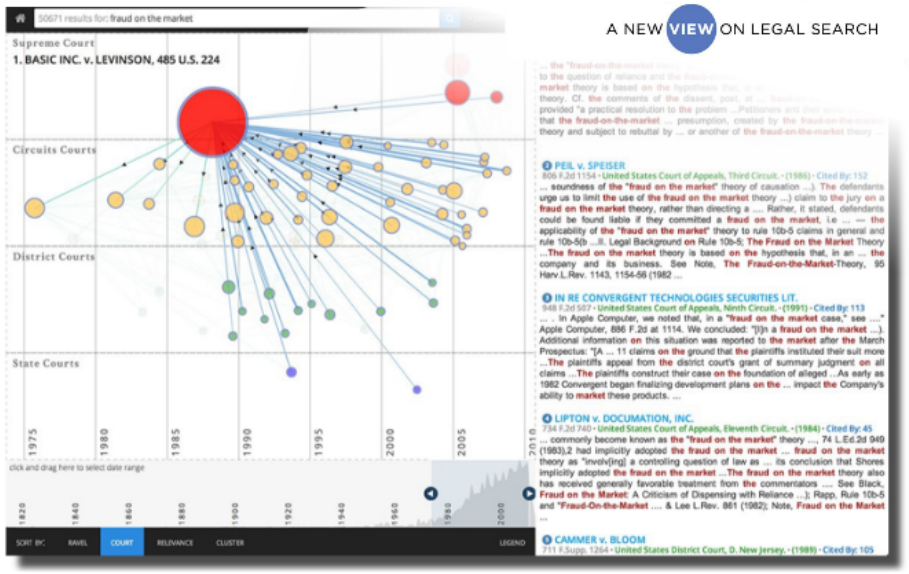
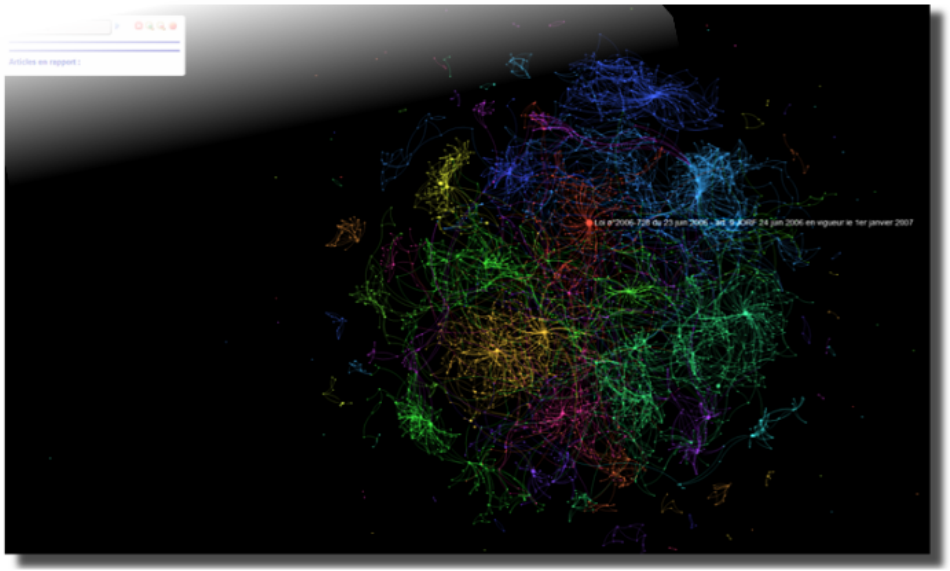


FIG. 4. BN for the eyewitness evidence.

LATEST DEVELOPMENTS

recent years have witnessed the integration of computational social science methods (network analysis, machine learning, information extraction etc) to develop advanced tools supporting the interaction, management and understanding of legal information





Building legal macroscopes:

VISUAL LEGAL ANALYTICS

An emerging branch in the computational evolution of the legal research that integrates advanced computational heuristics and visualization to provide new insightful ways to deal with legal data.

Benefits potentially deriving from VLA research are different: not only more effective and intuitive solutions for the management of huge amounts of legal information, but also new scientific tools to investigate complex and multidimensional legal phenomena

AREAS OF VLA
A preliminary classification

1

ENHANCED INFORMATION RETRIEVAL

Legal universe is complex, made up of different types of documents (statutory norms, case law, scientific articles, administrative documents) produced by different authorities (local, national, international) and often interrelated. A first group of visual solutions is designed to make data recovery and interaction more intuitive, effective and insightful.

2

LEGAL CORPORA ANALYSIS

Another of applications - stemming from the integration of graphic representation and computational heuristics - is oriented to discover intrinsic properties of legal corpora. In this context, the aspects enlightened by visualization are various, from the relevance of judgments, to the relations that bind legislation, legal doctrine and case law.

3

ANALYSIS OF LEGALLY RELEVANT PHENOMENA

Visualization can be used to support the understanding of social facts

2

LEGAL CORPORA ANALYSIS

Another of applications - stemming from the integration of graphic representation and computational heuristics - is oriented to discover intrinsic properties of legal corpora. In this context, the aspects enlightened by visualization are various, from the relevance of judgments, to the relations that bind legislation, legal doctrine and case law.

3

ANALYSIS OF LEGALLY RELEVANT PHENOMENA

Visualization can be used to support the understanding of social facts playing a role for the application of legal rules. E.g. visualization can be used to help prosecutors enhancing the empirical analysis of facts like the social structure of criminal networks or the "features" (dangerousness, social embeddedness) of individuals under investigation.

2 *VLA: some experiences*

Underlying Philosophy

Create open source and on line analytical tools allowing to experiment different combinations of data and computational heuristics to support the investigation of legal issues

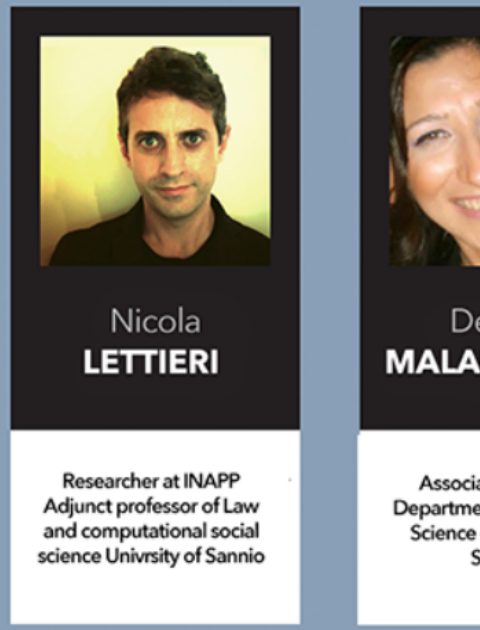
Main Goals

Identify and measure the COMPUTATIONAL CORRELATES of LEGAL CONCEPTS and PHENOMENA

Extend and enhance the METHODOLOGICAL APPARATUS available to scholars interested in the EMPIRICAL ANALYSIS of law

INTERDICIPLINARY collaborations...

a heterogeneous research group involving people from law, computer science, visualization, computational biology



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Vincenzo
SEVERINO

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Luca
VICIDOMINI

Research fellow
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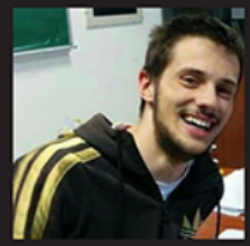

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Three tools...


1
knowLEX beta
legal information visual analytics experiment
2
CRIMEminer
computational crime analysis project
3
EUcasenet beta
Making experiments with visualization,
network analysis and EU caselaw

e tools...

1

knowLEX beta

legal information visual analytics experiment

2

CRIMEmine

Outline

KnowLex is an on-line "visual analytics toolkit", implemented as web application, whose main objective is to experiment new ways to explore (and interact with) heterogeneous legal documents (norms, case law, legal doctrine) coming from different sources and connected to the same piece of legislation.

Technicalities

KnowLex exploits mainstream technologies. On the client-side, it has been developed using JavaScript open-source libraries (*Sigma.js*,*Linkurious.js* and *D3.js*).
On the server-side, data are gathered through HTTP requests using cURL, while PHP wrappers parse different external sources and produce structured data in JSON format. Data are also saved in a MySQL database

knowLEX beta

legal information visual analytics experiment

2

CRIMEminer

computational crime analysis project

casenet beta

Outline

CrimeMiner is an experimental analytical platform for computational crime analysis exploring how the combination of data mining, SNA, and visualization techniques can illuminate structural and functional features of criminal organizations starting from the analysis of simple relational and investigative data. Data currently handled come from real criminal proceedings and consist in people records and telephone/environmental tapping: people are transformed into nodes of a graph; telephone and environmental tapping depicting a relationship between two or more people are represented as edges to be analyzed using SNA metrics.

Technicalities

CrimeMiner is built upon the Java EE Spring Data Neo4j framework.The front-end is implemented using JavaScript libraries.


2
CRIME
computational crime ana
3
EU casenet
beta
Making experiments with visualization,
network analysis and EU caselaw

Outline

EUCaseNet is an online platform experimenting new approaches to the analysis of legal corpora. The goal of the project is to create an online laboratory allowing legal scholars to explore the ECJ corpus (entirely downloaded with all its metadata) in real time using both computational heuristics (e.g. centrality measures) and visualization techniques. *EuCaseNet* allows users to make basically two kinds of activities: 1) study the features of the ECJ case law citation network and (2) visually explore ECJ judgments' metadata.

Technicalities

EUCaseNet has a three-tier architecture, implemented by following a typical *Model-View-Controller* layer architecture, The *Data Persistence* and *Business* layers are implemented server-side, through Java Servlet components, within Apache *Tomcat*. The User Interface Layer is implemented with commonly used JavaScript libraries.

...and their features

1 ENHANCED INFORMATION RETRIEVAL

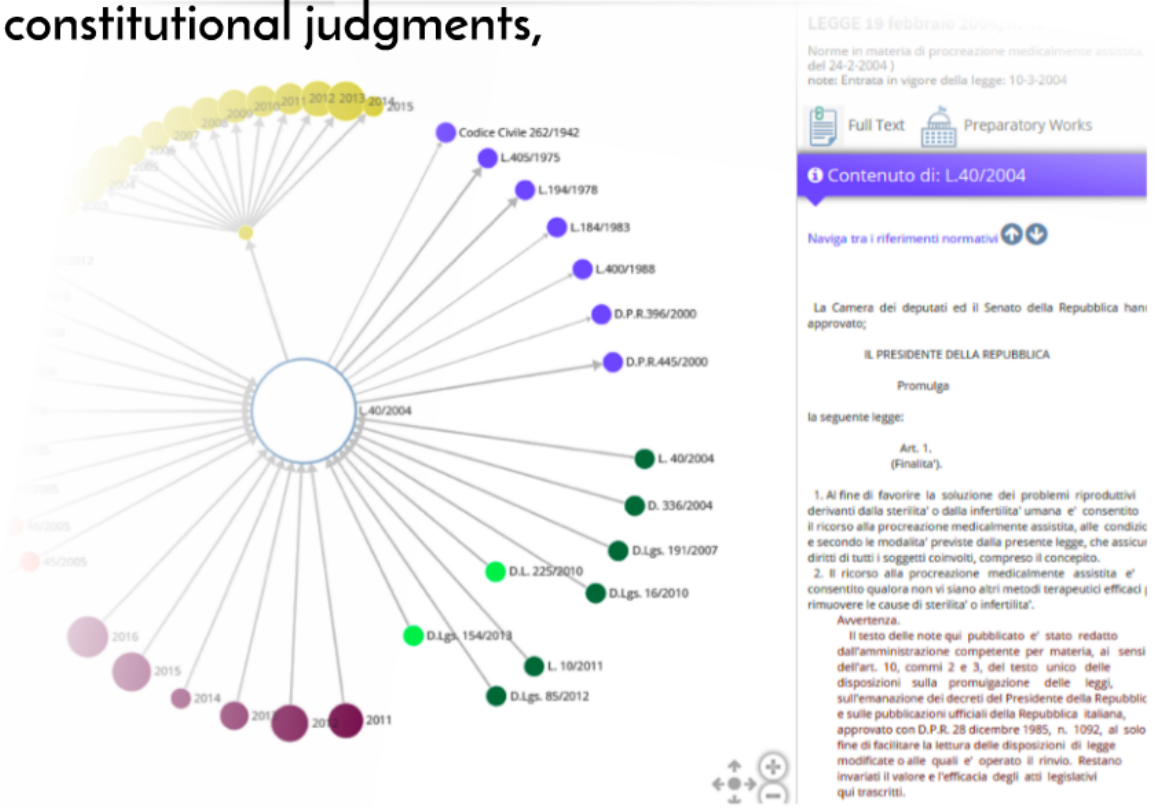

knowLEX
beta
legal information visual analytics experiment

NORM "NEIGHBORHOOD"

KnowLex implements an interactive graph - the "Reference Network of the Norm"- showing a wide selection of legal documents connected with a piece of legislation. The graph: i) depicts documents and their relations in the shape of nodes/edges; ii) allows to access documents' full-text and related information.

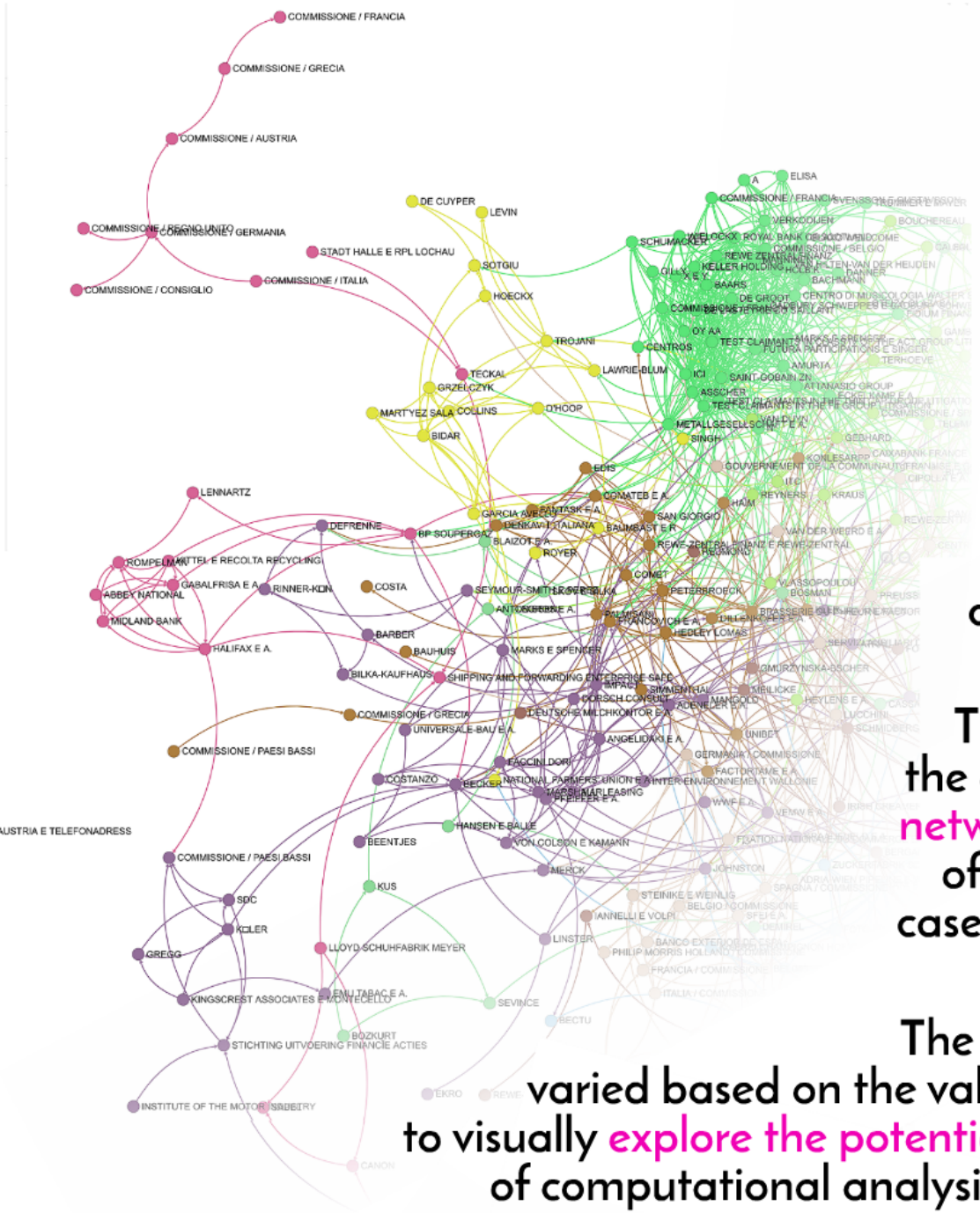
Starting from a norm chosen by the user ("Root" norm), KnowLex gathers online and puts in the same graph different types of documents (national laws, Supreme Court judgments, constitutional judgments, legal literature,preliminary works etc.)

The visualization and the interactive exploration of different categories of legal sources and of the connections tying them represent an intuitive way to deal with the complexity of legal systems



2 LEGAL CORPORA ANALYSIS


EU
casenet
beta



CITATION ANALYSIS

EUCaseNet allows the interactive application of network measures (centrality, Page Rank, Community detection etc.) to the network of the citations connecting all the judgments of the European Court of Justice.

The goal is to create a place to explore the advantages potentially deriving from network-based inferences in the discovery of features characterizing both the EU case law as a whole and single judgments (e.g. the relevance of precedents)

The size and the color of the nodes can be varied based on the value of specific measures allowing users to visually explore the potential correspondence between the results of computational analysis and the features of judicial decisions

"HOT" TOPICS & TRENDS

A heatmap allows to visually compare the topics most covered by the entire EU case law (a sort of "trending topics" defined by the system using official ECJ data).

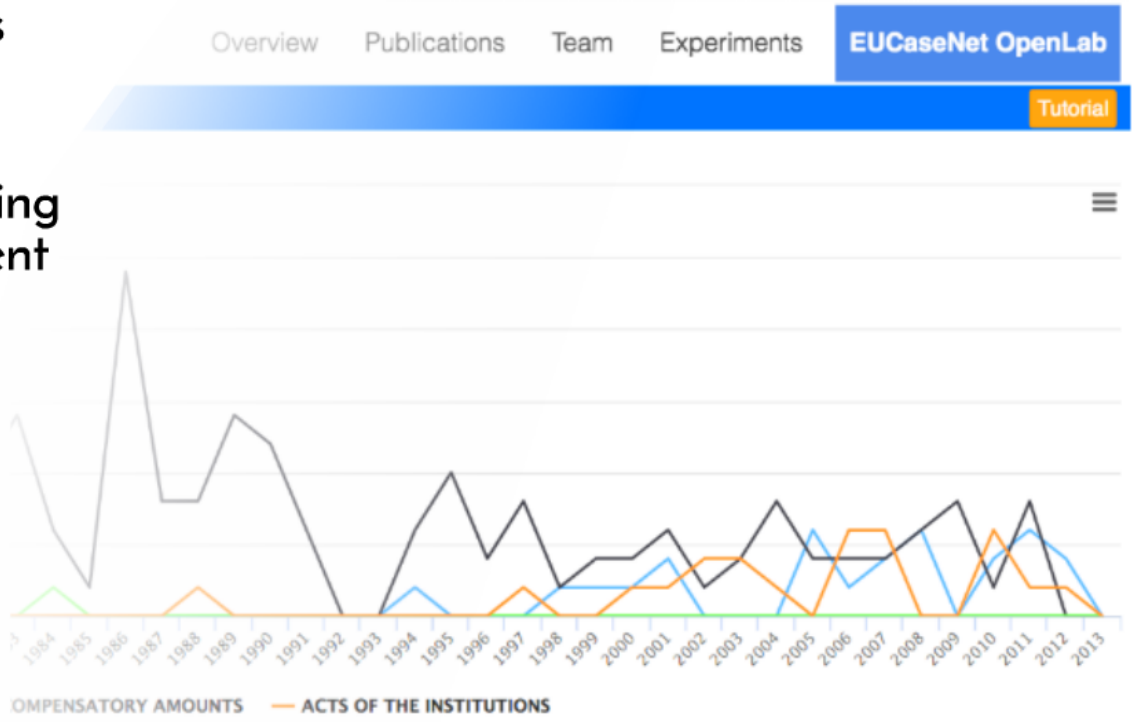
The visualization allows to intuitively understand if a given ruling (e.g. a judgment recognized as particularly important by legal literature) deals with issues to which the EU case law has already reserved particular attention in the past.

The measurement suggests the emergence of new trends, offering ideas for further investigations.

EVOLUTION OF EU CASE LAW

A linegraph depicts, in diachronic terms, some aspects of the evolution of the EU case law allowing to see how the number of judgments dealing with a given topic (e.g. free movement of goods in EU) evolved over time.

The possibility of superimposing several lines related to different topics, allows to make useful comparisons and to identify notable correlations in the changesof most frequent topics dealt with by the European Court of Justice

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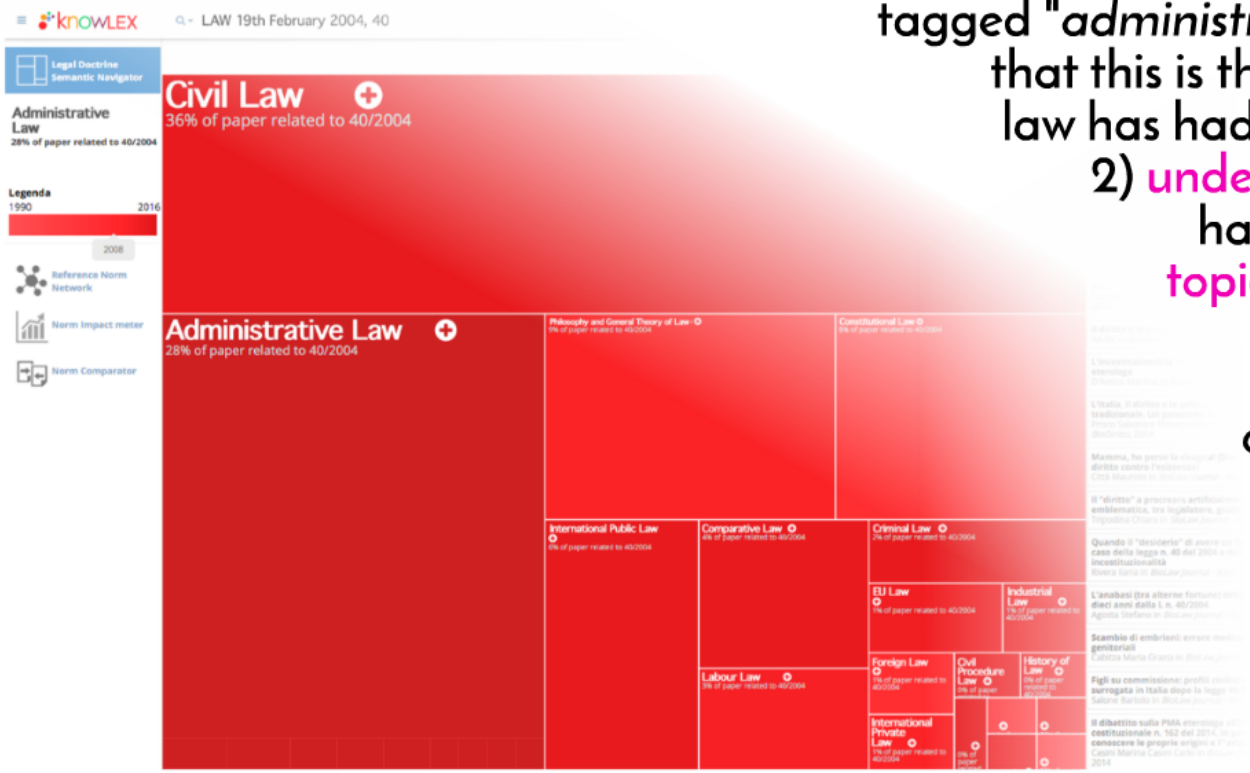
SEMANTIC TREEMAP

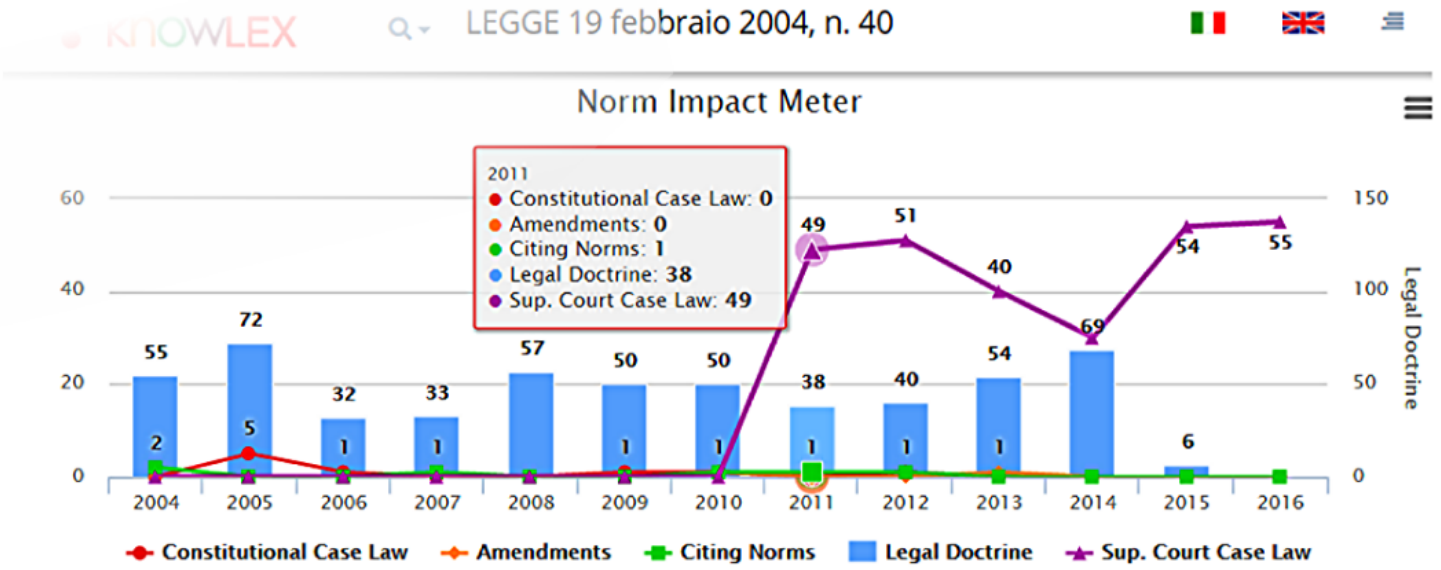
A treemap allows to extract information and inferences from the corpus of legal doctrine relating to a given law, exploiting the classification by subject of the papers published with reference to it.

The map allows to: 1) visually explore the impact of a law on the different areas of the legal system (e.g., if 70% of the papers related to *law x* are tagged "*administrative law*", it is likely that this is the area on which the law has had most of its impact); 2) understand how doctrine has evolved and which topics have drawn more attention over time (areas' color varies according to papers' publishing date).



NORM IMPACT METER

The linegraph of the Norm Impact Meter module combines graphs relating to different categories of documents that refer to a specific law (amendments, repeals, citations contained in other laws; judgments of different authorities that apply the norm; reviews of constitutionality) allowing to tease out a quantitative image of the impact of the law on the legal system.



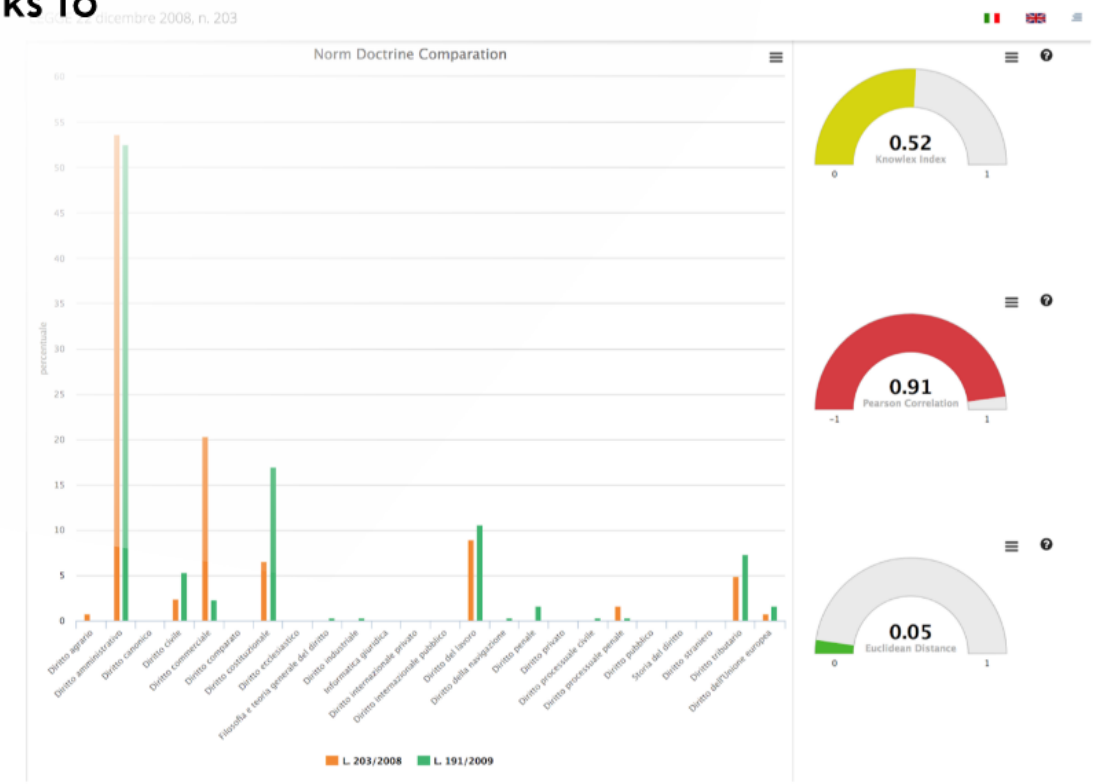
NORM COMPARISON

KnowLex exploits data provided by its modules to implement a sort of "semantic comparison" between different laws.

2 views allow to understand: 1) if the laws have dealt the same topics (which is obtained from the semantic tags of the papers relating to each law); 2) how much two laws are similar to each other (thanks to similarity indexes represented through gauge meters).

The feature is interesting if used to compare norms of the same type like Finance acts.

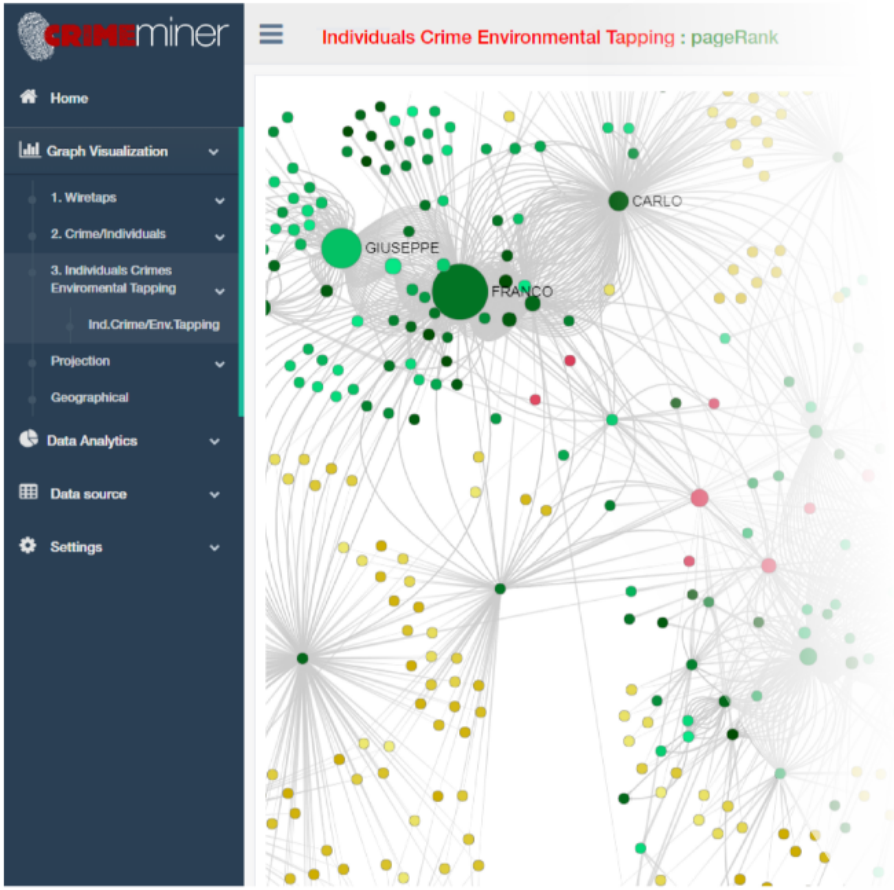
A different "semantic fingerprint" suggests that the legislator has focused its attention on different priorities (e.g., public education rather than health-care).



3 ANALYSIS OF LEGALLY RELEVANT SOCIAL PHENOMENA


CRIMEminer
computational crime analysis project

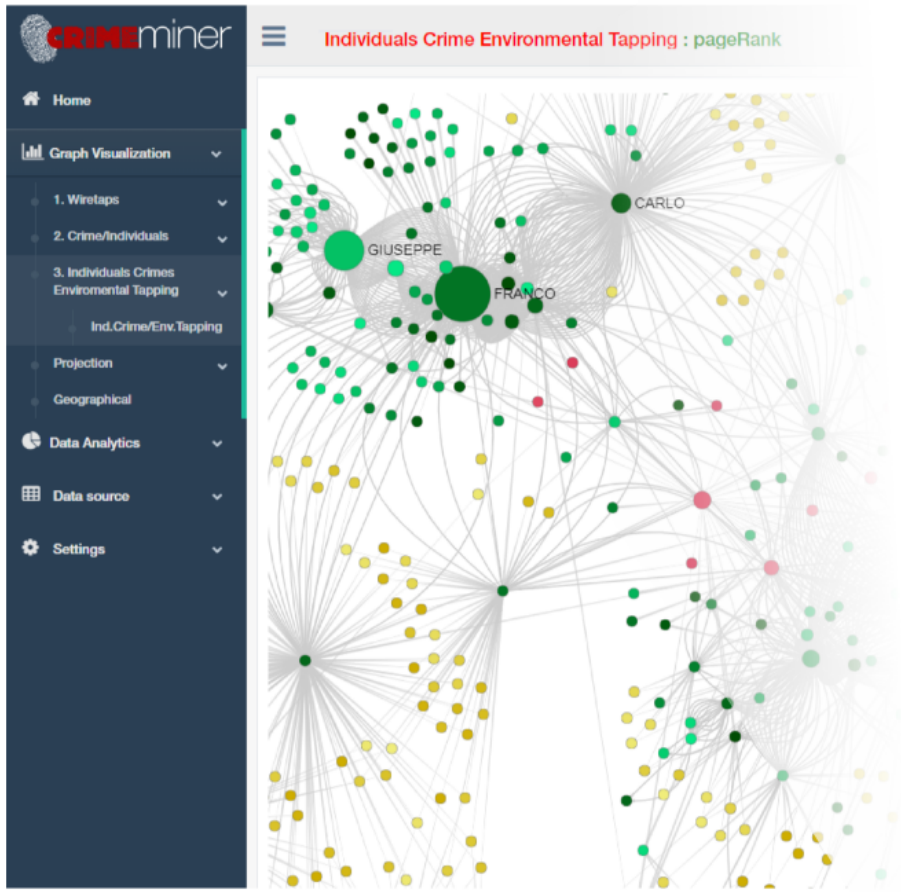
ROLES AND INTERACTIONS IN CRIMINAL NETWORKS



A wiretaps graph offers an intuitive view of the social interactions taking place within the organization by representing the suspects as nodes and communications as edges.

The application of NA measures allows to display different features of the organization (dimensions, subcommunities) and of individuals (connections, social role, level of social activity)

CRIMINAL RELEVANCE OF SOCIAL INTERACTIONS



Bi and tripartite graphs, created by connecting in a heterogeneous graph nodes describing different entities (individuals, criminal records, meetings in presence), allow to visualize information and - thanks to NA - draw inferences about relevant features of the criminal network under investigation such as the criminal relevance of meetings involving members of the group.

SIMILARITY
OF CRIMINAL PROFILES

A 3D Scatterplot, based on the analysis of data about members of the network (criminal records, social activity, relationships etc.) made using a similarity algorithm (SimRank), allows to visualize which are, within the organization, the most similar individuals according to their overall criminal profile

MACHINE LEARNING & CRIMINAL DANGEROUSNESS

+

WEKA
Open Source Data Mining and Machine Learning Software

A recent development of our project has led to the integration of machine learning features into CrimeMiner.

By analyzing the features of the members of the organization (value of NA measures, criminal records etc.), a previously trained classifier suggests to the domain expert (e.g. the prosecutor leading the investigation) the identity of potentially dangerous individuals.

User can provide feedback to the classifier by interacting with the nodes of the graph, so to dynamically change the "notion" of criminal dangerousness.

3 Final remarks

1

There's a long way to go...

Prototypes (and ideas) presented today are only a first attempt to create new links between legal world and developments that are taking place in the area of visualization and visual analytics.

There's the need for an in-depth and interdisciplinary reflection capable of leading us to understand and imagine new ways to exploit visualization in legal research and practice.

2

...but prospects are promising

Prospects are undoubtedly promising especially if one sees in the use of computational visualization not only a way to describe or make accessible traditional legal materials, but instead a way to enable new heuristics, new forms of understanding legal reality.

3

Thanks are due to...

Gregorio Amendola
Antonio Altamura
Raffaele Aramo
Carmine Capo
Armando Faggiano
Rosalba Giugno
Alfonso Guarino
Delfina Malandrino
Alfredo Pulvirenti
Margherita Vestoso
Francesco Vicidomini
Luca Vicidomini
Rocco Zaccagnino
and.....

...all the students of my class in
Law and computational social science

Thank you !

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Abstract

Visual Analytics (VA) is a fledgling multidisciplinary research field that combines data analysis, human-computer interaction and visualization to draw up new ways **to turn large dataset into knowledge** while also enabling users to act upon their findings in real-time.

In the last decade, in step with technological evolution, VA has become relevant in a growing number of areas spanning from Physics to Business intelligence where huge amounts of information need to be analyzed and understood.

The talk presents three projects dealing with the application of VA to legal issues. After a brief introduction to the rise and challenges of what I define **Visual Legal Analytics**, I will sketch the results of the projects discussing their objectives, advantages, limits and perspectives.