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Beyond the Crystal Ball
Visions of AI in the Administration of Justice

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Abstract

Whether computing the probability of court decisions or assessing recidivism risks, predictive analytics systems replacing humans in decision-making have proven capable of effects far beyond the enticing promise of bringing efficiency and impartiality in justice administration. This paper advocates a man-machine cooperation perspective in which intelligent systems are designed to enhance more than replace human abilities. In this perspective, we present a research project bringing together AI and computational heuristics to 'augment' public prosecutors in exploring the features of criminal organisations and the dangerousness of individuals therein. The discussion is the starting point to reflect on the relationship tying IT and the future of legal science and culture.

Keywords: Artificial intelligence, Law, Justice, Human-machine cooperation, Computational social science, knowledge mining

1 Justice, AI and the lure of the algorithmic oracle

The relationship between justice innovation and technological evolution is a topic that has long attracted the interest of the international legal community (Donoghue 2017; Katsh & Rabinovich-Einy 2017; Engstrom & Gelbach 2020)[1]. Over the last decade, European institutions have repeatedly urged the Member States to exploit developments in information and communication technologies to increase the efficiency of courts and public prosecution services seen as a vital factors for upholding the rule of law and a critical component of a fair trial[2]. Such indications have more recently suggested the Italian legislator to foster, on a regulatory level, the adoption of organizational solutions capable of exploiting information technologies to improve the functioning of judicial systems[3].

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1. J. Donoghue. 2017. *The rise of digital justice: Courtroom technology, public participation and access to justice*. The Modern Law Review, 80(6): 995-1025; M. E. Katsh & O. Rabinovich-Einy. 2017. *Digital justice: technology and the internet of disputes*, Oxford University Press. D. F. Engstrom &, J. B. Gelbach. 2020. *Legal tech, civil procedure, and the future of adversarialism*. U. Pa. L. Rev., 169: 1001.

2. On this point see the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions,"*Digitalisation of justice in the european union a toolbox of opportunities*"COM/2020/710 final.

3. For example, we can consider the "Office For the Trial" (OFT) organisational structure introduced by art.16-octies of Law Decree No. 179 of 18 October 2012 to ensure greater efficiency and timeliness in judicial action through innovative organisational models explicitly oriented towards the use of information and communication technologies.

A great deal of attention has been paid, in such a scenario, to artificial intelligence (AI)[4], ever more considered the potential source of major benefits, a way of making use of information in new and highly efficient ways to enhance access to justice, including by reducing the duration of judicial proceedings[5].

As witnessed by an increasing number of projects at national and European level, the techniques in spotlight are first of all machine learning[6] and natural language processing[7], solutions growingly employed to extract information from huge amounts of legal documents (e.g., police files, trial proceeding, case law) and identify, inside them, patterns and regularities useful to predict future events like the occurrence of criminal behaviours or case law trends (Alarie, Niblett, & Yoon, 2016; Quattrocolo 2020; Re & Solow-Niederman 2019)[8].

Although the technical evolution of these tools has achieved results we may have defined as impossible until recently[9], the intersection between Justice and AI raises a range of issues.

A first, general, critical aspect concerns the basic purposes driving the use of AI in a judicial context. As has been stressed (Romeo 2020)[10], the development of intelligent systems predicting future judges' decisions is often seen as a way to answer the need for legal certainty by making case law less uneven and unpredictable. The problem is that how most such systems work risks altering the same idea of certainty, making it an ex-post feature resulting from the conditioning that the automatic predictions exercise on lawyers' choices and judges' conclusions.

A second critical point is related to the violation of fundamental rights that may result from shallow uses of data-driven solutions in the context of justice (Pasquale & Cashwell 2018)[11]. In recent years, the issue has raised a lively debate, especially after the spread of crime prediction and prevention systems: far from unfailing, indeed, such tools have often misled police officers in identifying crime suspects[12] or judges in assessing the conditions for adopting personal-freedom restrictions[13]. The opaque, inscrutable algorithmic mechanisms underling these systems have proven they can induce harmful effects on individual legal spheres, eventually weakening the Justice machinery rather than making it more efficient[14].

4. For a general overview depicting European and national policies and strategies as well as the state-of-play of the use of innovative technologies in justice, see European Commission, Directorate-*General for Justice and Consumers (2020), Study on the use of innovative technologies in the justice field* – Final report, Publications Office, https://data.europa.eu/doi/10.2838/585101

5. For a general and quite update overview of AI application in the legal field, see H. Surden. 2019. *Artificial intelligence and law: An overview*. Georgia State University Law Review, 35: 19-22.

6. Machine learning (ML) refers to that artificial intelligence technique that enables a system to 'learn' from data, endowing it with the ability to identify correlations (patterns) between them and, eventually, to make predictions from the correlations identified.

7. Natural Language Processing (NLP) is defined as the automatic processing of both written and spoken information by a computer system.

8. B. Alarie, A. Niblett, & A. H. Yoon. 2016. *Using machine learning to predict outcomes in tax law. Can. Bus. LJ,* 58, 231; S. Quattrocolo. 2020. *Artificial Intelligence, Computational Modelling and Criminal Proceedings: A Framework for A European Legal Discussion* (Vol. 4). Springer Nature; R. M. Re., & A. Solow-Niederman. 2019. *Developing artificially intelligent justice*. Stan. Tech. L. Rev., 22:242.

9. A very recent evidence of the speed of innovation processes underway is for sure represented by the advent of the Generative Pre-trained Transformer or GPT, an autoregressive language model, introduced by Open AI in 2020, that uses deep learning and other NLP techniques to produce texts similar to human language (see. L.Floridi. & M. Chiriatti. 2020. *GPT-3: Its nature, scope, limits, and consequences.* Minds and Machines. 30: 681-694). Designed to generate high-quality texts so that it is difficult to distinguish them from those produced by a human, GPT has made its entry in the legal world opening up unforeseen scenarios. See, Katz, D. M., Bommarito, M. J., Gao, S., & Arredondo, P. 2023. *Gpt-4 passes the bar exam.* Available at SSRN 4389233; Choi, J. H., Hickman, K. E., Monahan, A., & Schwarcz, D. 2023. ChatGPT goes to law school. Available at SSRN.

10. F. Romeo. 2020. *Giustizia e predittività. Un percorso dal machine learning al concetto di diritto*. Rivista di filosofia del diritto, 9(1): 107-12.

11. F. Pasquale & G. Cashwell. 2018. *Prediction, persuasion, and the jurisprudence of behaviourism*. University of Toronto Law Journal, 68 (supplement 1): 63-81.

12. This is the case of crime forecasting systems, a slew of tools that should suggest to the police whether or not to perform tasks such as inspecting a suspect's home, listening in on his or her phone calls or using a body cam to record some unusual illegal activity. For a technical overivew of these systems, see N. Shah, N. Bhagat & M. Shah. 2021. Crime forecasting: a machine learning and computer vision approach to crime prediction and prevention. Visual Computing for Industry, Biomedicine, and Art, 4, 1-14. On harmful effects of automated-policing approaches see, in a wide literature, E. Santow. 2020. Can artificial intelligence be trusted with our human rights?. AQ: Australian Quarterly, 91(4), 10-17.

13. A well-known example is 'COMPAS', a platform developed to support judges in assessing the risk of recidivism of defendants and turned out to be - thanks to an inquiry of the non-profit association 'ProPublica' - a source for new forms of injustice and discrimination. For an overview of technical and ethical issues connected to the topic, see J. Angwin, J. Larson, S. Mattu & L. Kirchner. 2016. *Machine bias*, Ethics of Data and Analytics, Auerbach Publications: 254-264; R. Richardson, J.M. Schultz, K. Crawford. 2019. *Dirty data, bad predictions: How civil rights violations impact police data, predictive policing systems, and justice*. NYUL Rev. Online, 94:15.

14. The list of potential harms is extensive and includes not only phenomena of racial discrimination but also reductions in transparency and accountability in the decision-making processes that rely on these kinds of systems. For an overview on this point, see S.U. Noble. 2018. *Algorithms of oppression*. New

On the other hand, statistical inferences that feed data-driven predictive models are suitable to be fallacious for many reasons, causing their forecasts to be all but reliable[15]. AI systems used in courts to make evaluations of an individual's future criminal behaviour may thus easily return a twisted image of the reality on which the decision-making process is based.

It is no coincidence that the '*European Ethical Charter on the Use of Artificial Intelligence in Justice Systems and their Environment*'[16], adopted in 2018 by the European Commission for the Efficiency of Justice (CEPEJ), specifically advocates the possibility for judges to review the process behind the decisions made by artificial intelligence models and the data used for this purpose so that the decision-making autonomy of human practitioners is not restricted.

The EU Proposal for a regulation of the European Parliament and of the Council laying down harmonized rules on artificial intelligence (COM(2021) 206 final), on the other hand, explicitly qualifies as "high-risk" the AI systems intended to "*assist judicial authorities in researching and interpreting facts and the law and in applying the law to a concrete set of fact*"[17], due to the potentially significant impact they can have *"on the rule of law, individual freedoms as well as the right to an effective remedy and a fair trial"*[18].

In such a scenario, a crucial issue becomes the "involvement of human beings" as underlined by the Recital 48 of the Proposal, stating: *"high-risk AI systems should be designed and developed in such a way that natural persons can oversee their functioning. For this purpose, appropriate human oversight measures [...] should guarantee that the system is responsive to the human operator"*[19].

Based on the above, it becomes clear that one of the future challenges for the legal world is to find new ways to "keep humans in the loop", solutions and approaches ensuring not only "ex-post" human control over AI, but also new forms of integration and collaboration between human and machines.

The following pages argue for a man-machine cooperation perspective in which intelligent systems are designed to enhance more than replace human abilities. Heading in this direction, we will present a research project that integrates into a single pipeline machine learning with explicit, equation-based, social network analysis techniques to support public prosecutors (PPs) investigating criminal organisations and the dangerousness of individuals therein, avoiding the risk of "black box" often associated with purely data-driven AI approaches.

2 Beyond prediction

The scenario sketched in the previous section poses challenges going largely beyond technology alone. As we see it, the point is not just to solve technical problems related to data selection and curation or the characteristics of the predictive analytics methods used. The point is to imagine a different logic of use, an approach to system design that does save the role, the control capabilities and, ultimately, the interests of human beings.

The risk, in fact - particularly relevant when individual rights and freedoms are at stake - is that systems and workflows are designed in such a way as to force the judge to rely blindly on predictions without having any idea of the data and processes behind them, without having, in essence, a better understanding of the facts on which to base his or her decisions[20].

York University Press; F. Pasquale. 2015. *The black box society,* Harvard University Press, Cambridge.

15. For a reflection on legal, ethical and computational implications of the topic, see N. Lettieri. 2020. *Law, rights, and the fallacy of computation. On the hidden pitfalls of predictive analytics*, Jura Gentium: Rivista di filosofia del diritto internazionale e della politica globale, 17(2): 72-87; J. Kleinberg. J. Ludwig. S. Mullainathan & C.R. Sunstein. 2018. *Discrimination in the Age of Algorithms.* Journal of Legal Analysis. 10: 113-174.

16. CEPEJ, European Ethical Charter on the Use of Artificial Intelligence in Judicial Systems and their environment adopted by the CEPEJ during its 31st Plenary meeting, Strasburgo, 3-4th december 2018, disponibili al link https://rm.coe.int/ethical-charter-en-for-publication-4-december-2018/16808f699c

17. See, *Proposal for a Regulation of the European Parliament and of the Council laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union legislative acts, Brussels, 21.4.2021, COM(2021) 206 final, 2021/0106(COD),* Recital N 40.

18. *Ibidem*

19. *Ivi*, Recital 48.

20. The circumstance is effectively summarized in a paper a few years ago that discusses the evolving prospects of computational social science. The inherent characteristics of data mining techniques applied to the analysis of social phenomena often lead to "accurate predictions of poorly understood phenomena". See R. Conte, M. Paolucci. 2014. *On agent-based modeling and computational social science*. Frontiers in Psychology, 5, 668.

In this respect, there are two fundamental questions to address: the role to be assigned to intelligent systems in judicial decision-making, and how the knowledge produced by such intelligent machines must interact with human skills.

About it, it may not be obvious to state that the interaction between AI and Justice does not necessarily have to turn into a sort of "blank delegation" to the machines leading to uncritically entrusting human tasks to computational artefacts (Lettieri 2020)[21]. A different vision is possible that goes beyond the perspective of predictive justice and the side effect of automating judges' activities: the idea is that of intelligent systems keeping the man at the centre to expand rather than replace human analytical abilities and, at the same time, to protect citizens' rights more effectively. To pursue such a goal, we should take action in different directions.

A first need to be addressed is to ensure that the AI technologies used in the courts are designed to enable human beings (judges in the first place) to have an effective control over machines' outcomes and, thus the decision-making they perform. Another essential need is to enhance data-driven computational inferences by integrating them with the domain experts' knowledge[22] which should guide and improve the automatic learning processes. To move in this direction, we should look at 'intelligence' not as a characteristic of the technology alone but as a property of the system emerging from the interaction between man and the IT solution.

The idea of human-machine integration is not new but rather a leitmotif in the history of computer science and artificial intelligence[23]. A preliminary, explicit definition of this concept can be traced back to the early 1960s when John Licklider, an American psychologist and computer scientist considered to be among the most prominent figures in the history of general computing[24], proposed to drive the development of future computer technologies toward the goal of '*Man-Computer symbiosis*' (Licklider 1960)[25].

According to Licklider, interactions between users and machines were due to run more and more closely: by cooperating with machines, humans would have the chance to make the most of computers' data processing and information retrieval capabilities and perform more efficiently the complex operations needed for developing technical and scientific thinking (Licklider 1960, 7)[26].

Over the years, Licklider's vision re-emerged in different shapes, also in line with scientific and technological developments. '*Intelligence Augmentation*' (Carter & Nielsen 2017)[27], to give just an example, is a paradigm inspired right to the goal of bringing together machine intelligence and human skills to improve both our understanding of the world and ability to solve problems. The same holds true for the *'Human-centered Artificial Intelligence'* (HAI) perspective (Li & Etchemendy 2018)[28] which promotes the design of intelligent systems able to cooperate with humans, expanding their cognitive abilities and thus enabling them to perform new or more efficient tasks[29].

The HAI perspective today involves scholars and researchers from very different fields[30] who increasingly stress the benefits coming with the development of a new generation of AI systems designed to foster man-machine cooperation and support humans

21. N. Lettieri. 2020. *Law, rights, and the fallacy of computation.* cit. work.

22. These include judges, public administration officials or political decision-makers.

23. N. Lettieri., A. Guarino., R. Zaccagnino & D. Malandrino. 2023. Keeping judges in the loop. A human-machine collaboration model against the blind spots of AI in criminal justice, Soft Computing.

24. From 1962 to 1964, Licklider was director of the Information Processing Techniques Office (IPTO), a department of the Advanced Research Projects Agency (ARPA), a US federal agency in charge of funding research projects. In this capacity, he initiated, among others, the MAC project at MIT, which envisaged the possibility of connecting up to 30 users to a single large computer, each of whom could interactively use the computer's resources as if they were personal.

25. J.C. Licklider. 1960. *Man-computer symbiosis*. IRE transactions on human factors in electronics.1: 4–11.

26. As he pointed out: "The main suggestion conveyed by the findings just described is that the operations that fill most of the time allegedly devoted to technical thinking are operations that can be performed more effectively by machines than by men. [...] If those problems can be solved in such a way as to create a symbiotic relation between a man and a fast information-retrieval and data-processing machine, however, it seems evident that the cooperative interaction would greatly improve the thinking process" (see, J.C. Licklider. 1960. cit., p 7).

27. For a general overview of this topic, see S. Carter. & M. Nielsen. 2017. *Using artificial intelligence to augment human intelligence*. Distill 2(12).

28. Li F.F, Etchemendy J. Oct 18, 2018. Introducing Stanford's Human-Centered AI Initiative. Human-Centered Artificial Intelligence (HAI).

29. According to the definition proposed by the HAI Center at Stanford University: *'HAI seeks to develop new human-centred design methods and tools so that AI agents and applications are designed and created with the ability to communicate with people, to collaborate with them and augment them more actively, and to make their work better and more enjoyable'.*

30. To get an idea of the variety of research fields interested in the perspective today, you can look at the scientific publications reported by Stanford University HAI Center website (see https://hai.stanford.edu/research/publications).

in decision-making instead of replacing them. In the justice realm, this could turn into the use of AI to help judges and legal practitioners with heuristics allowing them to derive actionable empirical knowledge from legal documents rather than providing a sort of computational crystal ball that throws out predictions produced by inscrutable computer code.

3 Exploring man-machine cooperation in criminal justice

Moving along the lines traced in the previous Section, we dwell here on an interdisciplinary research (Lettieri, Malandrino & Vicidomini 2017; Lettieri & al. 2022)[31], started in 2013 (Lettieri, Malandrino & Rinaldi 2013)[32], that aims to bring the HAI paradigm to the Justice context.

The project explores how the combination of AI models with Computational Social Science (Cioffi-Revilla 2014)[33] methods can boost the study of crime for judicial inquiry and scientific purposes starting from the analysis of even simple relational and investigative data. Drawing on a collaboration with PPs from the Italian Anti-Mafia Investigation Directorate, the initiative aims primarily at exploiting the power of computation to provide the judiciary with a better understanding of the structural and functional features of criminal organizations at hand. Such a task, indeed, becomes particularly burdensome when judges deal with a huge number of individuals and complex assessments, such as that of criminal dangerousness, an inherently hybrid concept resulting from the analysis of legal, and empirical (social, criminological) elements.

The core of the research is the crime analysis platform *CrimeMiner*, a knowledge-mining[34] online infrastructure that, as a result of a long methodological exploration[35], has gradually brought together a plurality of computational heuristics - including machine learning - not as much to make predictions but rather to increase the judge's understanding of the phenomena involved in his or her decision.

The aim emerges, on the whole, from the workflow (see fig. 1) that, unfolding on a three-tiers architecture (*Data*, *Heuristics, Interaction*), leads from the data contained in the pleadings to PPs' investigative assessments and knowledge. Without going into details, the building blocks of the strategy so far set up can be summarized as follows:

Fig. 1 - *CrimeMiner: three-tier knowledge mining architecture.*

Source: adapted from (Lettieri et al. 2022)

Parsing

Extraction, from pleadings (criminal proceedings, request for precautionary measures), of information of both factual (data relating to social interactions between the suspects: e.g. number, direction and content of tapped telephone calls; data relating to the meetings between the suspects and captured with environmental tapping), and legal (criminal records, charges associated with members of the organization) nature.

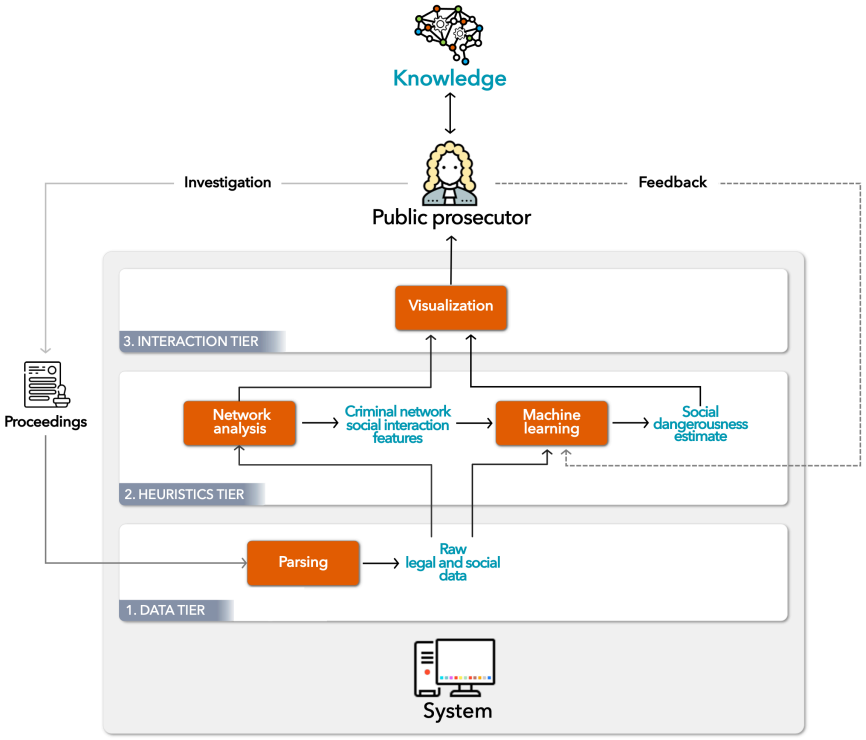
31. On this point, see N. Lettieri, D. Malandrino & L. Vicidomini. 2017. *By investigation, I mean computation.* Trends in Organized Crime, 20(1): 31-54; N. Lettieri., A. Guarino., D. Malandrino & R. Zaccagnino. 2022. *Knowledge mining and social dangerousness assessment in criminal justice: metaheuristic integration of machine learning and graph-based inference.* Artif Intell Law. https://doi.org/10.1007/s10506-022-09334-7

32. N. Lettieri., D. Malandrino., R. Spinelli., C. Rinaldi. 2013. *Text and (social) network analysis as investigative tools: a case study*. In: Law and Computational Social Science, pp 263–280. ESI.

33. Scientific and methodological paradigm - still little explored in the legal field - we can define as «the interdisciplinary investigation of the social universe on many scales, ranging from individual actors to the largest groupings, through the medium of computation». See, Cioffi-Revilla, C. 2014. *Introduction to computational social science*. London and Heidelberg: Springer.

34. Here understood as the "*derivation of high-level concepts and descriptions" by means of processing that involve both "data and relevant background knowledge*", see Kaufman, Kenneth A., and Ryszard S. Michalski. "*From data mining to knowledge mining."* Handbook of Statistics 24 (2005): 47-75.

35. The exploration has tackled different research topics: i) automatic extraction, from unstructured case files, of information (e.g., social entities and relationships) to be used in further analyses; ii) generation of criminal network graphs and application to them of network analysis to understand the features of criminal organizations and of individuals belonging to them; iii) visual browsing and analytics of investigative data; iv) integration of SNA with Agent-Based Models to perform what-if analysis in simulates criminal scenarios. See, N. Lettieri, D. Malandrino & L. Vicidomini. 2017. *By investigation, I mean computation. Trends in Organized Crime,* 20(1): 31-54; N. Lettieri, A. Guarino, and D. Malandrino, "*E-science and the law. Three experimental platforms for legal analytics*," in Legal Knowledge and Information Systems - JURIX 2018: The Thirty-first Annual Conference, Groningen, The Netherlands, 12-14 December 2018., 2018, pp. 71–80. [Online]. Available: https://doi.org/10.3233/978-1-61499-935-5-71; N. Lettieri., A. Altamura., D. Malandrino & V. Punzo. 2017. September. *Agents shaping networks shaping agents: integrating social network analysis and agent-based modeling in computational crime research.* In EPIA Conference on Artificial Intelligence. Springer.:15-27.



Network analysis

Application, to collected data, of social network analysis techniques[36] allowing to quantitatively derive reliable empirically grounded insights about the social structure of the criminal network at hand[37]. Relationships between individuals and their data are transformed into graphs (data structures made of nodes and edges) and analysed by applying metrics[38] that enable investigative meaningful inferences about the features of the criminal organization (degree of internal connectedness, existence of subcommunities, etc.) and its components (role: leader, intermediary, broker etc.).

Visualization

Use of visual analytics[39] techniques allowing users to dynamically interact with both *information* (data contained in court docu-

36. Tightly linked to other disciplines like *Graph theory* and *Sociometry*, Social Network Analysis (SNA) is a research methodology that seeks the explanation of collective behaviours in the structure of social interactions rather than in the features of single individuals alone. In SNA social relations are conceptualised, represented and studied as graphs built according to a given criterion (e.g., mapping of friendship, cultural exchange, organisational position, etc.) and then analysed using specific metrics. For a general introduction to the subject, see: D. Easley, J. Kleinberg, 2010. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, Oxford, Cambridge University Press. For an overview of SNA applications in the legal field see, among the others, R. Winkels, N Lettieri & S. Faro (eds). 2013. *Network Analysis in Law*, Napoli, Edizioni Scientifiche Italiane; R. Whalen. 2016. Legal networks: The promises and challenges of legal network analysis. *Mich. St. L. Rev*., 539.

37. SNA has fed the emergence of *Criminal Network Analysis* (CNA), a new approach to the study of criminal organizations that is yielding interesting results on both scientific and application levels. Among the works in this field see, within a growing literature, C. Morselli, 2009. *Inside criminal networks* (Vol. 8). New York, Springer.

38. In SNA, different metrics are used to infer different structural and functional features of the network and its components. Among the most relevant we can mention *Centrality* measures which allow to assess issues such as the dominance, subordination, influence or prestige of social actors. *Degree centrality*, to give an example, provides precious insights about the activity of an actor in the network: a high degree (high number of both incoming and outgoing communications) means it is likely to be a leader or a "hub" within the group. Similarly, *Betweenness centrality* suggests the degree to which a node serves as an intermediary in an organization. For an in-depth analysis of centrality measures, see LC, Freemann. 1978. *Centrality in social networks conceptual clarification*. Soc Netw 1(3):215–239.

39. The expression refers to an area of computer science that explores the integration of graphical representations and computational heuristics to: i) synthesize information and derive insights from massive, dynamic, ambiguous data; ii) support timely, defensible and understandable assessments; iii) communicate the result of the analyses effectively. For an overview of visual analytics applications gradually emerged in the legal field see, among the others: P. Mazzega, D. Bourcier, & R. Boulet. 2009. *The Network of French Legal Codes*. In Proc. of the 12th International Conference on Artificial Intelligence and Law. 236--237. https://doi.org/10.1145/1568234.156827; N. Lettieri., A. Altamura., D. Malandrino. 2017. *The legal macroscope: experimenting with visual*

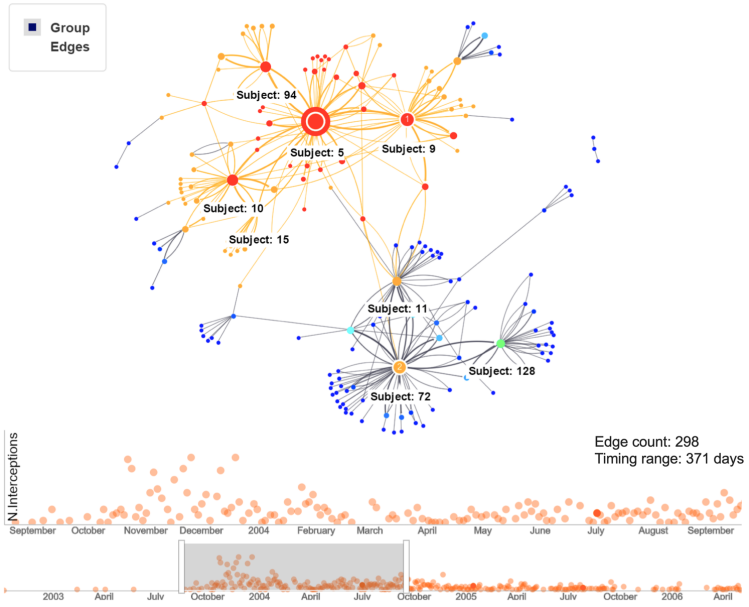


Fig. 2 - *CrimeMiner visualization:* Individual-Phone calls multi-graph.

ments and data resulting from analysis carried out on them) and the system. The integration of different visualizations (e.g. graphs and timelines depicting the structure of criminal network at hand and its features over time, see fig. 2), foster a deeper and more intuitive vision of the phenomenon under investigation and its possible evolutions.

Machine learning

Application of supervised[40] and online learning[41] techniques to both data extracted from the documents (e.g., criminal records) and data stemming from processing (data resulting from the application of network analysis metrics). Each individual in the network goes through the assessment of a pre-trained classifier which suggests an estimate of his/her degree of social dangerousness according to criteria defined on a regulatory level. The evaluation made by the classifier, however, is not conceived to have a binding value. On the contrary, it is included in a feedback mechanism (see dotted line in fig. 2) which allows the public prosecutor to train the classifier transferring to the latter his investigative know-how on social dangerousness, similar to what happens with the recommendation systems that in music streaming platforms learn to suggest the tracks most suitable for the user[42].

As it emerges from the brief description above, while exploiting machine learning, CrimeMiner moved away from today's prevailing idea of endowing justice administrations with AI-driven systems mainly aimed at predictive purposes. Design choices made so far (to get a match, see Table 1) have been indeed all devised firstly to enhance human ensuring, at the same time, greater control over the role played by the machine.

legal analytics. Inf Visual. 16(4):332–345; P. Boniol and ali. 2020. *Performance in the courtroom: Automated processing and visualization of appeal court decisions in France.* ArXiv preprint arXiv:2006.06251; L. La Cava, A. Simeri & A. Tagarelli. 2022. *LawNet-Viz: A Web-based System to Visually Explore Networks of Law Article References,* Proceedings of the 45th International ACM SIGIR Conference on Research and Development in Information Retrieval.

40. Machine learning technique that uses training datasets to teach models to yield the desired output. Training datasets include inputs and correct outputs, allowing the model to learn over time. *Ad hoc* algorithms measure the accuracy of the learning process through a loss function, adjusting until the error has been sufficiently minimized.

41. Machine learning technique in which data becomes available in a sequential order and is used to update the best predictor for future data at each step, as opposed to batch learning techniques which generate the best predictor by learning on the entire training data set at once.

42. A concrete example may help to understand. Let us imagine that the prosecutor is dealing with a criminal organization in which the most dangerous individuals (e.g., leaders, hitmen) begin to exhibit new characteristics (e.g., quantity and frequency of social interaction, degree of connection with persons with given criminal records) than in the past. Through the feedback provided by the judge using the visual interfaces, the system is able to gradually learn to redefine its "notion" of dangerous individual defined in terms of the values assumed by the features chosen to make the assessment.

The goal, in other terms, has been first of all that of boosting up -in various ways, not only through AI - PP's ability to interpret empirical evidence and information hidden in trial documents rather than focusing on the ability - important and worthy of exploration - that AI has to identify into data regularities and patterns used to make predictions.

	AI Blind Spots	
	Triggers	**Mitigators**
Dataset	Large sized; unknown by the user; third party creation	Small sized; known by the user; created by user
Heuristics	Implicit (e.g., deep learning); unknown by the end user; AI non-trainable by the user; only one heuristics	Explicit (e.g., equation-based); known by the end user; AI trainable by the user (e.g. online learning); different heuristics are combined
Features	Number, identity, value, significance, and meaning substantially unknown to the user	Number, identity, value, significance; and meaning largely known to the user
Interaction	No user interaction with data; AI and heuristics; panel and table-based UI	User can interact with data, AI and heuristics; intuitive visual UI

Table 1 - Features and design choices that impact the risk of AI blind spots in intelligent systems

The results achieved by moving in this direction are clearly provisional. The platform and the methods used still have very wide room for improvement, notwithstanding the need to continue experimenting with real data. At the same time, we are aware that, albeit decreased, the risks of bias and errors in data selection remain even in the pipeline we have implemented within the project.

That said, the choice of integrating predictive AI techniques, computational social science methods, and visual analytics solutions to enable novel forms of man-machine heuristic cooperation around the facts involved in the investigation seems a path worthy of exploration in the future. On the other hand, to use the words of the cognitive scientist Margaret Boden, AI concepts and models are not just to "get useful things done". They can be used to help "answer questions about human beings and other living things", to understand real-world facts, a challenge that, however not scientist, the judge is no stranger to.

4 A new research agenda

Beyond making the chance to explore how intelligent systems can be used in the administration of justice to enhance rather than replace human abilities, the research experience above discussed has provided us with cues for more general considerations.

A first point to dwell on concerns the way of conceiving the relationship that ties information and communication technologies with the law. In this respect, it is not uncommon for legal scholars to assign the technological component an absorbing role in defining the contents of this relationship. However, although relevant, computational tools are just a part of the story: the other crucial factor is the vision that drives application choices i.e., the objectives we decided to look at.

The issue, not trivial, involves the legal culture as a whole touching upon disciplines and perspectives lawyers meet during their education. As a matter of fact, the definition of the problems technology - including AI - can help answer in the law realm depends not only on the strictly technical familiarity of legal scholars with the latest tool. What is also needed is to learn how to "translate" legal research questions and needs into computational terms. More interdisciplinary educational paths heading towards new forms of 'computational thinking' would be precious to help more consciously and creatively explore the answers AI can offer to the needs of law. On the other hand, even if they become buzzwords in the legal debate, machine learning or language models very often represent real black boxes whose underpinnings, implications and applications are still unclear to the vast majority of lawyers.

The point paves the way to a second consideration concerning the role intelligent systems can have in the evolution of legal science. Our idea is that, if properly coupled with cultural and scientific models inspired by cross-fertilization with other disciplines, computational tools can open up new research perspectives in terms of both methods and phenomena to be investigated[43]. The capacity shown by computational social science in providing a deeper and empirically truthful understanding of social complexity somehow confirms our claim.

43. N. Lettieri & A. Pluchino (eds). 2022. Research Topic "*Hammer or Telescope? Challenges and Opportunities of Science-oriented AI in Legal and Sociolegal Research*", in Frontiers in Artificial Intelligence.

Such an evolution could push legal scholars towards innovative theoretical and analytical models as well as new research questions by bringing to their attention pieces of reality hitherto ignored. The research experience described above somehow represents a good case in point of what we are talking about: computational heuristics combined with AI within the *CrimeMiner* project made it possible to identify - legally relevant - features of criminal organisations that could not have been detected by relying only on human cognition and traditional legal expertise.

How to deal with this challenge largely depends on humans, not machines. The possibility to gain a more aware view of AI technologies and their potential requires lawyers not only to understand how IT systems work but, even before, to clarify the questions they want such technologies to answer. After all, you cannot satisfy needs you have not adequately defined first.

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