A Methodology of Automated Analysis and Qualitative Assessment of Legislation and Court Decisions

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Summary
This study aims to substantiate an interdisciplinary methodology for automated analysis and qualitative assessment of legislation and court decisions. The development of this kind of methodology will make it possible to fill a number of methodological gaps in various research areas, including law effectiveness assessment and legal monitoring. We have defined a methodology based on the interdisciplinary principles and tools. In general, it should be noted that even at the level of qualitative assessment made with the use of the methodology described above, the accumulation of knowledge about the relationship between legal objectives, indicators and computer methods of their identification can reduce the role of expert knowledge and subjective factor in the process of assessment, planning, forecasting and control over the state of legislation and law enforcement. Automation of intellectual processes becomes inevitable in a digital society, but, releasing experts from routine work, simultaneously reorients it to development of interdisciplinary methods and control over their application.

Keywords:
artificial intelligence, digital state, indicator, law, machine learning

1. Introduction

Dominance of a service approach to "electronic government" (e-government) and transformation of the state into a digital platform for effective control and service provision [1] led to the digitization of many legal procedures and the creation of information systems and databases for a legislative, judicial and administrative practice. Efforts are being made to move to a "digital government". This involves the full digitalization of services and replacement of paper documents with digital data [2]. "Smart government" advances this by provision of data and decisions available through a public platform for shared use of software, data and services [3]. However, scientific development of the methodology of digitalization of law and state lags behind the rapidly developing technologies.

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The condition, dynamics, structure and relationships inherent in the legal system are reflected in the information generated and documented in the legal process. Under the dynamic development of the legal system, the processing and analysis of legal data by traditional methods, including legal statistics and expert assessments, are extremely limited. These limitations are related, in particular, to the volume of processed information, complexity and diversity of data, the cost of resources for processing, analysis and interpretation of results. Consequences of these restrictions are the scarcity of information provided by legal statistics, sluggishness and subjectivism of conclusions made by experts, distrust and skepticism of scientific knowledge and recommendations shown by the legislator, law enforcer and society in general. The rapid growth of digital data requires an answer from the social and computer sciences. The opportunities and challenges for the social sciences associated with this "data avalanche" are very diverse [4].

To date, big data is accumulated in the field of law. This provides an opportunity to develop not only search, but also management, analytical, predictive and control information systems to support decision-making in a wide range of legal tasks. Technologies of applied artificial intelligence in law can become a serious addition to the existing "manual" methodology of legal research, as well as gain independent meaning. The introduction of methodology based on computational methods and big data can use the available information and computational potential to solve the problems of theoretical and practical jurisprudence and, ultimately, change the public attitude to the completeness, reliability, objectivity and social usefulness of scientific and legal knowledge and recommendations.

2. Related works

Since the late 1950s, many countries have implemented computer methods and systems for the study

of law, intellectual analysis and modeling of legal activities [5]. We can think of the following features that are implemented by the developed systems:
- integration of the argumentation function (for example, BankXX [6], LexrideLaw [7], as well as the NAI framework Web application on the SaaS architecture [8]);
- prediction function integration (for example, SPLIT-UP [9], SMILE+IBP [10], VJAP [11]);
- integration of document, content and knowledge management functions (FLEXICON [12], KONTERM [13], experimental software and hardware system for scientific and practical search and management of multimedia court content based on procedural ontology e-Sentencias [14], EUNOMOS [15], CLIEL [16]).

As a result of the widespread digitalization and the developmentsin the field of e-government, implementation of legal systems for reference purposes have become particularly important. For example, models have been proposed to ensure control and support of the legislative process in a multilingual environment in European countries [17, 18]. In the past 15 years, experiments have been conducted to introduce machine learning and data extraction methods into legal information systems for various purposes [19–22]. One interesting recent development of this kind is a system called CLAUDETTE [23]. Over the past few years, experiments have emerged to organize information legal systems on the basis of big data [24, 25].

3. Methods

As most of the data is stored in unstructured text arrays it is important to develop natural language processing and data extraction methods. Scientific studies showed the feasibility of text analysis of court decisions in different languages. For example, court decisions on human rights [26] and the research of the German court decision definitions using the specific semantics and language structure of the German language [27]. Models for extracting and intellectual analysis are being developed based on extensive court practice data [28, 29]. In the UK, Charles Stevens and his colleagues, who created the prototype JAES system, consider it promising to build systems based on legal reasoning on the type of cases, connected to the "whiteboard" template and service-oriented architecture [30].

But even now, as in early studies, the processing and input of raw data, which are unstructured documents in legal information retrieval systems require significant expert work. In addition, by becoming service-oriented, completer and more accurate through the use of complex logical, mathematical, statistical and computer methods and by facilitating the routine work of lawyers, these systems do not yet provide a high degree of completeness, accuracy and user simplicity for complex queries.

Data-driven methods employ large amounts of empirical data processed with statistical machine learning methods to abstract patterns. The need for validity and interpretability is currently recognized as an essential problem to be solved by researchers. Validation of data-driven models often requires lengthy and expensive practical evaluation, using metrics that are intuitive to lawyers and go beyond measures of technical accuracy and include measurements of quality and effectiveness. Implementation and adopting machine learning methods can be reasonably straightforward. Still, the interpretation of the provided outcomes is sometimes complicated and indistinct due to the black-box nature of machine learning models.

We suppose that these complex tasks can be solved only within a interdisciplinary methodology.

4. Results

4.1 Principles

The principles that we propose and develop in the study reflect the general view from the legal and computer sciences on the legal sphere as a subject area and on the applicability of research tools and methods to it. Formation of research methodology is determined by the properties of the object of the study [31]. Interdisciplinary approach implies searching for similar subject areas in the object [32]. Ideas are formulated as principal methodological provisions of this research. This allows integrating computer and legal tools, methods and interpretations of scientific results into a single research process. The basis for formulating the research principles is provided by the properties of the subject area, which can be considered as connotations of law in the mainstream of legal science. They are heuristically valuable from an interdisciplinary point of view, making it possible to achieve a conjoint computer and legal interpretation of the methodological results obtained, and thus ensure that the study is meaningful in both these aspects.

The principle of heterogeneity of the domain The principle is based on observable digital and legal reality (empirical material), which is characterized by heterogeneity in its broadest sense. Researchers who use computer methods in the subject area of law have long been aware of the heterogeneity of this domain. This is a serious obstacle to the development and application of computer technology in law for analytical, predictive and other research purposes. However, the understanding of this heterogeneity in computer sciences is linked, mainly, to the problems of intellectual text and data analysis (text mining, data mining). These problems are most often

solved by limiting the domain area to an array of texts or data with the level of homogeneity acceptable for specific computational tasks. Less often this is done by creating hybrid systems that combine different domain areas, each of which has its own language representation, methods of intellectual analysis and output mechanisms. The examples are the expert systems PROLEXS [33], SHYSTER [34] and CHIRON [35]). Along with "computational" heterogeneity, there is a purely "legal" heterogeneity in the law, caused by the variability of legal regulation and its subject, defects in the law, offenses, law-making and law enforcement discretion, as well as many other factors, including non-legal features. Despite the prevalence of the ideas of legality and axiomatization of the principles of universality and unity of legality, the real legal establishment, interpretation, application and implementation of law are far from being ideal. This is reflected in law and legal dogma. Without discussing the issues of legal comprehension, it should be stated that legal practice, in terms of information theory, has information entropy. In each particular case it is impossible to predict legal behavior (including law-making and law enforcement decisions) absolutely accurately and reliably, or to interpret it.

The principle of discrete legal practice summarizes the observed facts at the intersection of digital and legal reality and reflects changes in the body of legally relevant acts (texts, data) when legal policy changes. Significant acts of legal policy lead to changes in lawmaking, interpretation, application and enforcement. These influential events that occur outside the scope of the digital and legal phenomenon quickly change the volume, structure and/or content of information generated in the legal process. Such an event is usually a new legal act (including an amendment to an existing act), but it can be any act reflecting a new (adjusted) legal policy in a certain area: an act of interpretation of the law, a court decision (with a precedent effect), oral guidance and other managerial impulses reflecting changes in the legal policy. Up to now, legal discretion has been understood as the historical discretion of the legal system or the discretion of the law [36] as well as a property of the objects of the law [37]. At the same time, rather slow (due to the conservatism of law) development of a legal practice sometimes experiences peculiar "stresses" under the influence of some external events (legal policy acts). The consequence of these events is an observable change in the number of acts of lawmaking, interpretation, application and (or) exercise of law, the content of these acts and the structure of legal practice. Understanding the discrete properties of the legal-digital sphere allows developing approaches and models for solving the fundamental scientific problem of legal forecasting. The legal sphere is characterized by a two-dimensional logical structure and the relationship by the type of "antecedent - consequent". The thesis about acts of legal policy as a reason for the discrete legal practice is in line with this legal understanding. In addition, it should be considered how a general property of the law (normative regulator), reflects a real trend towards its implementation in social reality. The presence of an ideal description of behavioral patterns in legal norms allows us to believe with some certainty that these patterns of behavior are also found in social (legal) practice. The requirement of predictability imposed by science, society and the law for law-making [38] and law enforcement [39] is linked to this property of law. So far, legal prediction has been associated mainly with the use of sociological tools [40]. However, the above-mentioned causality and predictivity in law correlate well with the computational tasks of predictive analytics. Computer sciences have a methodological toolkit for solving direct and reverse analytical problems on abstract objects. Such methods have already been tested in the legal domain: for example, in CABARET [41] and FRANK [42] systems. This serves as a basis for the development of an interdisciplinary computer-legal methodology similar in its goal setting, but specific in its content.

The principle of model identifiability is the result of combining the cybernetic idea of identifiability as an object property with the legal idea of legal certainty as a general legal principle. In the contiguous legal-digital field this research principle concerns the tasks and results of modeling and assumes experimental finding of some parameters of the system under study. The complexity of implementation of this principle in the considered subject area is connected with the search of adequate correspondence of the identified elements simultaneously in legal and digital realities. This happens in the conditions of empirical and theoretical uncertainty of the processes and identification results in both legal and exact sciences. In legal science, the principle of legal certainty, while intuitive, has no strict formalization [43]. In addition, it has a high degree of cultural marking, depending on the legal system [44]. At the same time, this principle is focused on the effective operation of the law [45]. In computer sciences, the solution of identification problem is, in essence, an intellectual process of data processing with obtaining new knowledge in the form of a mathematical model [46]. At the same time, from the mathematical point of view, there may be ambiguity of parameter estimates caused, for example, by the lack of agreement between the complexity of the model and the number of parameters contained in it on one hand, and the limited information about parameters that can be extracted from the experiment, on the other hand [47]. Taking into account the computational complexity of identification, the hypothesis formulated in the theory of system identification is accepted as a methodological reference point. According to this hypothesis, for any reality

(phenomenon, process, etc.) and any predetermined (but not absolute) accuracy, there is a mathematical structure that describes this reality with this accuracy [48]. Thus, despite the unattainability of absolute accuracy in identification of legal and digital reality models, achieving maximum certainty is a common research agenda that brings together legal and computer sciences.

4.2 Tools

Indicators are characteristics of the legal activity or, more broadly, the legal system of a society that are available for monitoring, measurement and evaluation. They reflect the quality of the processes that take place in lawmaking and law enforcement. Implementation of a methodology at the intersection of computer and legal sciences with an emphasis on big data, sets the task of finding and using the indicators that are acceptable both for expressing the results of intellectual analysis of empirical big data (i.e. in the digital sphere) and for assessing the state and processes of the domain area (i.e. in the legal sphere).

In this study, the indicators were divided into two groups, conditionally designated as mathematical and social. This division is based on the fact that mathematical indicators (metrics) are developed in mathematical and computer sciences to study abstract (mathematical) objects. Social indicators are directly related to the domain. In this case - legal activity or, taking into account the complexity of the phenomena and processes in the legal system and the society.

Mathematical indicators are metrics that allow to identify the quantitative characteristics of the algorithm as a direct consequence of the quality of the empirical base (for example, data from legislation or court practice).Thus, frequent solution of classification tasks on the materials of court acts allows using such indicators as the share of correct answers (accuracy), precision and recall. These metrics, used in the machine learning to assess the quality of the algorithm. As applied to the array of court acts, the can serve, in particular, as indicators of the uniformity of court practice. The error matrix on a heterogeneous array shows not the quality of the algorithm, but the quality of the domain area itself, namely the coincidence of instances of court decisions with the general model of legal justification. In this case, the rules for calculating mathematical indicators are accepted in the form in which they are justified in the computer sciences [49].

Social indicators are static or dynamic indicators of a society's legal system. Legal goals and socio-economics statistical indicators were studied as social indicators, so that in general social indicators should be considered targets of legal policy. The use of social indicators requires a heuristic search for adequate computer methods to identify these indicators, their justification, testing and verification in computational experiments. On the data of legislation, the results are well interpreted using socio-economics statistical indicators [50]. On the big data of court cases, the results are well interpreted using the time indicator , the indicator of individualization of punishment (or the indicator of legal regulation), the rationality indicator, the subject homogeneity indicator, the indicator of the offender's awareness of the inevitability of punishment, the abuse indicator, the indicator of the functionality of the legal norm, the indicator of humanization of the legal regulation. These indicators are provided with proven computer methods of their application [51].

5. Discussion and conclusion

In modern legal policy it is customary to operate with legal purposes as grounds for choosing legal means. Legal science already knows the experience of using indicators to measure law [52]. This is done by making certain decisions in the area of lawmaking, interpretation and application of law. Use of indicators creates necessary conditions for planning the consequences of legal policy acts.It also allows forecasting the consequences and controlling the real results (consequences) of decisions that have political and legal significance and are designed to lead to qualitative changes in legal regulation, making lawmaking and/or enforcement more optimal. At the same time, a number of identified problems and limitations should be noted.

Firstly, due to the objective limitation of the scope and duration of the research, the question remains unclear as to whether it is possible to use any legal objectives (legal policy objectives, regulatory ideas) as social indicators. This is because certain data categories and methods of intellectual analysis need to be compared to each legal objective. This heuristic task in this study has been solved in an expert manner.

Secondly, the problems are related to the complexity of the issue of quantitative measures (measurements) of legal regulation. In the absence of a universally recognized measure, it is intuitively more understandable to use a qualitative (comparative) approach to assessing legal phenomena and processes. This approach has been used in this study because a qualitative assessment of legal regulation optimization can be shown as a "more" or "less" optimal state of lawmaking or enforcement compared to some reference (e.g., initial) state. Nevertheless, computer sciences have a great potential in the use of numerical methods, which raises a question about the prospects of conjugation of qualitative assessment with quantitative ones.

This perspective, thirdly, makes it possible to raise the question of further interdisciplinary integration through the inclusion of methodology and statistical data in the sphere of interdisciplinary methodological interest. The statistical science has accumulated extensive experience in quantitative measurement of various socio-economic phenomena and processes. This in aggregate with computer methods of intellectual analysis of big data and methods of scientific and legal study of legal means and legal purposes can lead to certain progress in understanding of available data complexes. This will make it possible to reveal the existence, nature and regularities of implicit links between digital, legal and socio-economic reality.

However, in general, it should be noted that even at the level of qualitative assessment made with the use of the methodology described above, the accumulation of knowledge about the relationship between legal objectives, indicators and computer methods of their identification can reduce the role of expert knowledge and subjective factor in the process of assessment, planning, forecasting and control over the state of legislation and law enforcement. Automation of intellectual processes becomes inevitable in a digital society, but, releasing experts from routine work, simultaneously reorients it to development of interdisciplinary computer-legal methods and control over their application.

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