Jörg Pohle

“A Legal Discipline of the Future”

A Short History of the Intersection of Law and Computer Science

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ABSTRACT

In the current hype about Legal Tech, one has to bear in mind that it is only the latest in a long line of forms of collaboration between law and computer or information science. This paper reviews the long history of research at the intersection of law and computer science, with a focus on German-language Legal Informatics. It aims to identify some of the key paradigms, insights, and findings from more than seven decades. It argues that they can still help today in describing, explaining as well as shaping the interrelationship between law and automated information processing, i.e., the conditions, applications, and implications of the use of computers in law and society.

KEYWORDS

Jurimetrics, Computers and Law, Legal Cybernetics, Legal Informatics, Artificial Intelligence and Law, Legal Tech, History

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1 INTRODUCTION

In the current hype around *Legal Tech*, it is easy to forget or brush aside the fact that what is today understood as *Legal Tech* is only the latest in a long line of different attempts to collaborate between law and computer or information science, each with its own name and specific form.[1]

The first organised attempt began in 1949, when Lee Loevinger founded *Jurimetrics*, now more commonly referred to as *Computational Legal Studies*: the application of quantitative methods, primarily from probability theory and statistics, to law. Then, in the early 1960s, *Legal Cybernetics* appeared on the scene, first in Eastern Europe (ru: *кибернетика и право*), and in the late 1960s in the West as well, with a focus on Germany (de: *Rechtskybernetik*) and Italy (it: *giuscibernetica*). *Legal Cybernetics* had a broader approach: law was seen as a means of controlling and regulating society, embedded in cybernetics as a general science on regulatory structures and processes, and with the then-new computers as a means of putting regulatory mechanisms into practice. When cybernetics as a discipline lost steam in the 1970s, it also had consequences for *Legal Cybernetics* – it was replaced by a field with a more limited theoretical scope: *Legal Informatics* (de: *Rechtsinformatik*, es: *informática jurídica*, it: *informatica giuridica*, sv: *rättsinformatik*, fi: *oikeusinformatiikka*, ru: *правовая информатика*, pl: *informatyka prawnicza*). Although *Legal Informatics* was at times used as a label for the discipline, the debate took place primarily under other labels, such as *Computers and Law* or *Artificial Intelligence and Law*, while *legal informatics* was understood more narrowly over time, whether as information *technology* or as computerised information *services* for lawyers.

Legal Informatics deals with the interrelationship between law and computers, or more generally: automated information processing, while refraining from a comprehensive (social) theory of regulation and control. It is generally divided into three subject areas: 1. *Legal Information Science* or *Legal Documentation Science*, at times simply called *Legal Information Retrieval*, which deals with how computers can be used to improve the accessibility of the vast amount of legal texts and documents such as laws, court decisions, or legal literature; 2. *Computational Law* or *Computational Legal Reasoning*, the mechanisation or automation of legal reasoning and decision-making; and 3. *Administration & Management*, i. e., the automation of legal office work. Within the German-language debate, there is also a second, slightly different, ordering structure: 1. the conditions, 2. the applications, and 3. the implications of the use of computers in law. Here, the first strand focuses on questions such as "What parts of legal work can be automated?" or "How must laws be formulated to be automatable?", the second strand focuses on the development of practical applications and their use in legal work, while the third strand covers the implications of the use of computers in society for the legal system, i. e. the development and enactment of laws to regulate computer use and mitigate the risks it poses to individuals, groups, organisations and society, e. g. copyright law, competition law or data protection law. Since at least the early 1980s, the field has narrowed considerably and, above all, has led to the virtual disappearance of basic research. Even internationally, research today is limited to three main areas: 1. automated legal reasoning, 2. software systems for lawyers and law scholars (this is what is now often called *Legal Tech*), and 3. computer or information law.

This contribution aims to shed light on the long history of research at the intersection of law and computer science, with a particular emphasis on the German *Rechtsinformatik*, in order to identify some of the most significant paradigms, insights and findings from more than seven decades that can still help today in describing, explaining, and shaping the interrelationship between law and automated information

[1] The present paper is a revised and extended translation of Pohle (2021), which was published in German as a contribution to an edited volume on the history of digitization from the perspective of the "Computers and Society" field.

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processing, i. e., the conditions, applications, and implications of the use of computers in law and society.

Here, the label *Legal Informatics* is used both for the field as a whole and for the subfield with the more limited theoretical scope that has developed since the early 1970s.

The paper is organised as follows. Section 2 will provide an overview of the application development in this field by identifying five main generations of application systems against the background of which the development of the research field took place. Section 3 will shed light on the trends and developments in *Legal Informatics*, paying particular attention to the subdisciplines and research fields which have been given their own identifiers and have left traces still visible today, namely *Jurimetrics* (section 3.1), *Legal Cybernetics* (section 3.2), *Legal Informatics* (section 3.3), *AI and Law* (section 3.4) and *Legal Tech* (section 3.5). In section 4, the paper will close with an outlook on the future of *Legal Informatics* and identify some of the challenges that have to be tackled to deal scientifically with the conditions, possibilities and implications of the use of automation-supported information processing in law against the background of the increasing computerization of society.

2 APPLICATION DEVELOPMENT AS A BACKGROUND OF THE DEVELOPMENT OF LEGAL INFORMATICS

It was the very development of concrete applications, be it in the form of prototypes in the context of academic research, be it for legal, judicial or administrative practice or that of other legal users, which strongly influenced *Legal Informatics*, with the general information technology development and the societal use of information technology systems largely being of secondary importance. *Legal Informatics* has, albeit often belatedly, jumped on every computer science hype of the past decades – and has sometimes downright pandered to these hypes (cf. Burkert 2004, 54).

As in other areas of software and systems development, American developments have exerted the greatest influence in practice, at least with regard to private users. In research, public administration and the judiciary, on the other hand, indigenous solutions, whether developed in-house or by local or national manufacturers, have been more widespread, at least for a very long time. If there was any transfer of research results into practice at all – and practice did not simply ignore academic research – it was by developers from industry (Schweighofer and Lachmayer 2017, 2 ff.).

While certainly a simplification, it is possible to identify five main generations of application systems in this field (cf. Bing 1990; Nagel 1989; Bing 2007; Bench-Capon et al. 2012; Lenk 2021b), whereby, of course, the types of systems – and not infrequently also the actual systems themselves – did not disappear at the end of a generation, but were further developed and used:

The 1st generation is characterised by calculating machines and public, later also private databases, i. e. (legal) documentation systems, information retrieval systems, such as LITE ("Legal Information Thru Electronics") or CELEX (merged into "EUR-Lex" in the 1990s), with the first practically usable electronic documentation systems for legal issues being observed in 1960 (Fiedler 1973b, 443).

In the 2nd generation, systems appear that operate in all three areas of applications – legal information retrieval, computational legal reasoning, and administration & management – among them integrated management information systems (MIS) (Lenk 2021a), including the first systems with online access, and forms systems. The best-known legal information systems still in existence include LEXIS (today under the umbrella of Reed Elsevier) and WestLaw (today Thomson Reuters), but also the German systems JURIS

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and DATEV (on their early developments see Frohn 1984, 205ff.).

The 3rd generation includes (legal) expert systems, which were more or less silently renamed "decision support systems" sometime around the end of the 1990s (cf. Leith 2010), but above all (back) office systems for client administration as well as text and case management.

In the 4th generation, the first graphical user interface- and web-based implementations of existing approaches appear, as well as systems to support (alternative) dispute resolution, (online) consultations, and argument mapping, including, for example, the recently widely publicised COMPAS ("Correctional Offender Management Profiling for Alternative Sanctions").

The 5th generation sees the emergence of "legal tech" in the narrower sense, i. e. systems that serve only a single, often very limited purpose, such as the DoNotPay chatbot for disputing parking tickets presented in 2015, but also so-called "smart contracts."

In addition to these applications, which are aimed at practical use, systems have also repeatedly been developed in the context of research projects, whose classification in such a – or any other – generational sequence is difficult or outright impossible. Time and again, the debate notes that it seems impossible or at least very difficult to bring systems out of the laboratory stage and into practice.[2] As recently as 2007, Jon Bing claims that "the systems offered today are really only jazzed up versions of the 1970 technology" (Bing 2007, 77). The systems developed in academic research were often far ahead of their time, but just as often left traces only in the academic debate, not in practice. These include DISUM (Suhr 1970), JUDITH (Popp and Schlink 1970) or TAXMAN (McCarty 1976), LEGOL ("LEGally Oriented Language", a language for formal, computer-readable representation of law, Stamper 1977), HYPO CBR ("CBR" stands for "Case-Based Reasoning", Ashley 1987) or CATO as a program for legal education based on HYPO (Ashley 1999).

3 TRENDS AND DEVELOPMENTS IN LEGAL INFORMATICS

The various currents of *Legal Informatics* cannot easily be separated from each other. They do not emerge in a vacuum, but often in confrontation with debates taking place at the same time that use different identifiers. Nor do they simply fade away, even if their identifiers go out of fashion, but they leave traces – and be it in the names and titles of journals or conferences, research institutes, or software systems and services.

While Wilhelm Steinmüller points out in 1971 that extensive research in the field of what he calls "legal data processing" was being conducted "for more than ten years in East and West" under various names – he mentions "legal cybernetics", "computers and the law", "jurimetrics", "giuscibernetica", "informatique juridique" (Steinmüller 1971, 1), he later locates *Legal Cybernetics* in the period between 1949 and 1969 and considers *Legal Informatics* its successor (Steinmüller 1993, 111). And Herbert Fiedler states in 1973 that although a common basic understanding had developed internationally with regard to automation in law and government, the way of understanding and terminology were "not yet" uniform – the French "informatique juridique" was understood more narrowly than the German "Juristische Informatik" or "Rechtsinformatik", in the Anglo-Saxon countries one "still" spoke of "computers and the law", in the Eastern countries, however, of "legal cybernetics" (Fiedler 1973a, 234). While the term "Rechtsinformatik" is still widely used in German-speaking countries, the English-language debate has been taking place since the 1980s under the label "Artificial Intelligence and Law" and sees itself as a successor to *Jurimetrics* and

[2] See, e.g., Shannon and Golshani (1988, 305) focusing on expert systems, Jandach (1993) comprehensively on "artificial intelligence" techniques, or a panel discussion at the seventh *International Conference on AI and Law (ICAIL)* in Oslo in 1999 on the overall research produced in the field of *Artificial Intelligence and Law* (Bench-Capon et al. 2012, 63).

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Computers and Law. And in recent years, a new term, "Legal Tech," has moved into the focus of the debate, although it refers less to a field of research than to a field of application.

3.1 Jurimetrics

The term "jurimetrics" was introduced into the legal vocabulary by Lee Loevinger in the late 1940s. Embedded in the goal of a general scientification of law-making and law-application as well as of research in the field of law, Loevinger aims with *Jurimetrics* to investigate law and legal phenomena "in the field of social control of behavior" no longer (only) by "introspection, speculation or superstition" but by scientific "investigation" (Loevinger 1948, 478), pointing out that "the methods of semantics [later: semiotics] and statistics are already well established disciplines, while psychology, anthropology, sociology and econometrics, are rapidly developing more specialized techniques" (Loevinger 1948, 479). In essence, Loevinger, and later *Jurimetrics* as a whole, is concerned with the application of quantitative methods to law, or more generally: with the formal scientific investigation of legal problems.

> "The inescapable fact is that jurisprudence bears the same relation to a modern science of jurimetrics as astrology does to astronomy, alchemy to chemistry, or phrenology to psychology. It is based upon speculation, supposition and superstition; it is concerned with meaningless questions; and, after more than two thousand years, jurisprudence has not yet offered a useful answer to any question or a workable technique for attacking any problem." (Loevinger 1948, 483)

Among the subjects to which *Jurimetrics* should be devoted, Loevinger counts, for example, the behaviour of witnesses, judges and legislators, the language and communication of law, legal procedures and documentation, and macro-legal phenomena, i. e., the effects of law in general and of concrete laws in particular on society (Loevinger 1948, 484 ff.).

Relatively quickly, however, jurimetric research narrowed to three areas: electronic data storage and retrieval in the area of legal documentation, behavioural analysis of (legal) decisions, and the application of formal logic (Baade 1963, 1).[3]

The preoccupation with formal logic formed the starting point, and thus several major works on "legal logic" appeared in the 1950s, for example by Ulrich Klug ([1] 1951; [2] 1958) or Layman E. Allen (1956), both of whom later achieved great prominence in the field, but also by Loevinger himself (1952), though neither Klug nor Allen located themselves in the *Jurimetrics* field, either by reference to the term or by citation of Loevinger's fundamental contribution.

This focus on legal logic is also reflected in the journal *MULL: Modern Uses of Logic in Law*, launched in 1959 – at least in the title and in the first issues, before the focus shifted relatively quickly to the use of computers in legal practice, especially to "legal information retrieval". By the time the journal was renamed *Jurimetrics Journal* in 1966, legal logic had long been marginalised as a topic of contributions.

Loevinger, however, considers technical developments in the computer field to be far more significant for legal practice, especially with regard to the storage and retrieval of information. The "industrial revolution" in the legal field that he envisions for 1985 runs on a computer "ten feet wide and ten feet high," equipped with tape drives and accepting input via punched cards, and is supposed to make it possible to completely record and process a legal question in a given legal field (Loevinger 1960, 57f.).

In the years that followed, research was concerned, among other things, with how to support the drafting

[3] See also the other articles in the thematic issue of *Law and Contemporary Problems* 28(1), Winter 1963.

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of legal texts, also in the hope of increasing systematisation, formalisation and at the same time linguistic clarity and precision of legal texts, especially laws (for example, Allen 1962), including the use of graphic representations, such as flowcharts (Allen and Caldwell 1963), and later also Petri nets (Meldman and Holt 1971). However, the extensive self-limitation of the research to the storage and retrieval of legal information with the help of computers on the one hand and the behaviourist analysis of court decisions on the other hand (Solomon 1968) led to a crisis of the field, which is not least reflected in the fact that the label falls out of use – apart from the title of the *Jurimetrics Journal*, since 1978 just *Jurimetrics*. As early as in the beginning of the 1970s, Mario Losano, one of the doyens of Italian *Legal Informatics* (cf. Contissa, Godano, and Sartor 2021), attributed "only historical significance" to *Jurimetrics* (Losano 1971, 93), and almost all of the articles published in the journal bearing this name made no reference to even a broad understanding of *Jurimetrics*, but simply dealt – and still deal – with technology law only.

3.2 Legal Cybernetics

Legal Cybernetics emerged at the end of the 1950s and the beginning of the 1960s. In the Eastern European countries, it was understood as an applied part of a broad – and sometimes quite radical (cf. Gerovitch 2004) – reform movement that saw cybernetics as a "science in the service of communism," with the help of which society was to be not only (better) understood, but also transformed. In the West, it started at about the same time, for example in France and Great Britain, but spread more slowly overall and formed rather localised hotspots, including in Italy and the Federal Republic of Germany. A few years later, it disappeared from the scene, not least because its "mother discipline," cybernetics, lost prestige in the East as well as in the West, not the least due to its highly exaggerated claims (Steinmüller 1993, 135f.).

In the Soviet Union, it started with a broad understanding of its field of application, but at the same time from the beginning strongly related to technical applicability (Garstka 1983, 103), narrowing over time, however, extremely to the use of computers and mathematical methods in the work of state authorities and in education in the field of law (Shliakov 1976, 38). And in Czechoslovakia, it was the suppression of the Prague Spring in 1968 that put an end to the use of *(Legal) Cybernetics* for the analysis of society, especially social regulation and control processes (Garstka 1983, 103).

In the German Democratic Republic, too, *Legal Cybernetics*, without explicitly bearing this name, pursued a very comprehensive claim and was thereby understood as part of the management science (de: *Leitungswissenschaft*), which was itself an applied cybernetics.[4] It pursued the goal of "optimal planning, management and organisation of society" with the help of "comprehensive integrated management and planning information systems" through the "comprehensive research of all forecasting, planning and execution and control processes in the state and economy" as the "totality of all real goal-oriented processes for regulating society" (Glaeßner 1977, 192). It is against this background that West German law scholar Wilhelm Steinmüller formulated his expectation that *Leitungswissenschaft* would offer an approach to an overarching theory of legal and administrative automation for Western, bourgeois societies as well (Steinmüller 1972b, 1 ff.). To this end, *Leitungswissenschaft* brought together methods from the structural and formal sciences (cybernetics, logic, mathematics), the technical and natural sciences, and the social sciences (especially economics, law, psychology, pedagogy, sociology) (Steinmüller 1972b, 11) with the strategic goal of "working out a cybernetic universal model of society to be automated with the aid of electronic data processing, irrespective of all practical and principled reservations" (Steinmüller 1972b, 14). Management itself was interpreted as the "compensating feedback of a learning system" with planning as the regulating process and the plan as the management variable, institutionally as a feedback information

[4] In this context, *Leitungswissenschaft* itself can again be understood as part of an even more comprehensive cybernetic theory of the state, as described, for example, by Georg Klaus in his book "Kybernetik und Gesellschaft" ("Cybernetics and Society"), which appeared in a first edition in 1964, in a second edition in 1965, and in a third edition in 1973 – albeit then significantly toned down with respect to the explanatory content attributed to cybernetics in terms of social, societal and state theory.

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system, procedurally as an "integrated information processing process," its representation in the computer as an "information model," and automation as the "'highest' form of rational planning and management" (Steinmüller 1972b, 15 f.). Legal and administrative science played a particularly important role in this context within *Leitungswissenschaft*, with Steinmüller attributing to socialist legal and state theory a much more comprehensive view of law as a "cybernetic and thus dynamic model and regulatory system" than the West (Steinmüller 1972b, 20). By the mid-1970s at the latest, *Leitungswissenschaft* or its "successor," Marxist-Leninist organisation science, clearly distanced itself from such a broad understanding after "the party[5] said goodbye to the idea that the uniformity of social action could be achieved with the help of system-theoretical regulatory mechanisms" (Glaeßner 1977, 184), a departure that began as early as the late 1960s (Köster 1976, 145 ff.) but accelerated sharply after the Eighth Party Congress of the SED in 1971 (Garstka 1983, 103).

As a representative of a "cybernetic theory of administration" (according to Luhmann 1966, 16), the French law scholar Lucien Mehl was at the same time an early Western legal cyberneticist.[6] As early as the end of the 1950s, he dealt conceptually and comprehensively with questions of automation in law, of law, and of the work with law (Mehl 1959). He distinguishes between two types of "law machines": the "information machine" to support work on legal texts (searching, finding, sorting, organising, writing, etc.), with which the observed information overload can be brought under control, and the "consultation machine," which he also calls – quite ironically – the "judgment machine," with which processes of legal thinking and argumentation can be "mechanized," albeit with the risk of decreasing flexibility, creativity and innovation in the law itself and in dealing with the law (Mehl 1959, 757 ff.). In the "mechanization of legal information", Mehl identifies a tendency toward centralization (Mehl 1959, 766), and in the logification and automation of legal decision-making, he sees the tendency not to deviate from the outputs of the machine (Mehl 1959, 777 f.), which is why he demands, "We shall have no 'electronic judges' in the world to come, any more than we shall have a machine to rule us" (Mehl 1959, 778).

The Italian *Giuscibernetica*, which entered the stage only towards the end of the 1960s, conceptualised the decidedly cybernetic part of the research as *Legal Cybernetic Model Theory* and distinguished it from *Legal Informatics* as the second research direction. While *Legal Cybernetic Model Theory* constructs "theoretical models of the legal system as one of the cybernetic systems existing in reality," *Legal Informatics* encompasses "the research (also theoretical) aimed at applying the electronic data processing system to the law" (Losano 1971, 93). In Italy, too, the development of the two directions diverged very quickly – *Legal Informatics* (it: *informatica giuridica*) flourished, while *Legal Cybernetic Model Theory* died out by the mid-1970s at the latest.

A comparable development can be observed in the Federal Republic of Germany. There, in addition to the fields of legal logic, information theory, legal systems theory and decision theory, the "doctrine of the normative regulation of social processes" was considered the "legal-theoretical core" of *Legal Cybernetics* (Podlech 1969, 163 ff.). It was a matter of incorporating legal policy into the field of problems to be dealt with in jurisprudential terms – in the language of the time, the "programming of general legal decisions," with "programming" understood as the "determination of rules of conduct with regard to a given goal" – with the aim that "first, the social costs of change amount to a minimum" and "second, the addition of norms can be embedded in the dogmatics of the applicable (partial) legal order" (Podlech 1969, 161).

From the understanding of "programmed application of law" as a control circuit embedded in a (legal and legal-political) regulation circuit, both of which are determined by the information processes involved

[5] The Socialist Unity Party of Germany (de: *Sozialistische Einheitspartei Deutschlands (SED)*), the GDR's ruling party.
[6] I would like to thank Klaus Lenk for pointing me to the legal cybernetics work of Lucien Mehl (see also Lenk 1999), who is otherwise consistently located within either the *Jurimetrics* or the *Computers and Law* field, see, e.g., Rissland, Ashley, and Loui (2003, 6) for the latter.

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(Garstka 1983, 181), two conclusions were drawn from the perspective of legal cybernetic theory, one temporal and one institutional. The mechanisation of the application of law requires, first, a shift in the focus of legal dogmatic work "to the point in time before legal codification" (Podlech 1969, 162) and, second, since the legal programs "cannot be fed back with social processes" and are thus incapable of "social learning processes," the institutionalisation of an "interplay of programmed application of law and control by the courts" (Podlech 1969, 169). The second conclusion thus means that any solution to these problems has to be generated at the level of the regulatory circuit, not at the control circuit level. To this end, Podlech argued long before Lawrence Lessig's 'Code is Law,' the source code of programs should be made public: "When legislation is applied by means of computer equipment, the actual applicable text is the computer program. Verification of the conformity of the normatively applicable text, as promulgated in the vernacular of the statute book, with the actually applicable text should be publicly possible." (Podlech 1970, 475).

When Herbert Fiedler in 1983 in the preface to Hansjürgen Garstka's dissertation *Regelkreismodelle des Rechts: Untersuchung zur Übertragung kybernetischer Vorstellungen auf das Recht* ('control circuit models of law: investigation into the transfer of cybernetic ideas to law')(Garstka 1983, see also Garstka 2021) lamented that *Legal Cybernetics* had "gone quiet" and that the "approaches from cybernetics and general systems theory, which remain largely abstract, are finding less and less attention in law," it was a vast understatement – *Legal Cybernetics* had long since been dead, and Garstka's work was clearly an obituary, not a contribution to an ongoing debate.

3.3 Legal Informatics

Like *Legal Cybernetics, Legal Informatics* has seen itself as a (sub-)discipline – and not only as a field of research – dealing with the interrelationship between law and automated information processing, but with a more limited theoretical scope than *Legal Cybernetics*, mainly by refraining from a comprehensive (social) control theory.

In contrast to *Legal Cybernetics*, *Legal Informatics* succeeded in becoming institutionalised relatively early on; in some cases, entire *Legal Informatics* institutes were established, or at least dedicated chairs, usually at law faculties, not in computer science departments. For example, the *Istituto per la Documentazione Giuridica (IDG)* was founded in Florence in 1968, which has published the journal *Informatica e diritto* since 1975, was then renamed *Istituto di Teoria e Tecniche dell'Informazione Giuridica (ITTIG)* in the early 2000s, and finally merged in 2019 with the *Istituto di Ricerca sui Sistemi Giudiziari (IRSIG)* to form the *Istituto di Informatica Giuridica e Sistemi Giudiziari (IGSG)*. Also in 1968, a working group on electronic data processing and law was founded at the Faculty of Law at Stockholm University, which in 1981 became a research institute of its own, the *Institutet för Rättsinformatik (IRI)*, and co-founded the *Nordic Conferences of Legal Informatics*, which have been held annually in one of the Nordic countries since the mid-1980s. The *Norwegian Research Centre for Computers and Law (NRCCL)* was founded in 1970 at the Faculty of Law, University of Oslo, shortly after Jon Bing gave an introductory seminar on computers and law there. And in Austria, although it was not a dedicated institute, the chairs of Ota Weinberger, who did not return to Czechoslovakia after the suppression of the Prague Spring in 1968 and accepted a professorship in Graz, and Ilmar Tammelo, who came to Austria from Australia and accepted a professorship in Salzburg, acted as key institutional crystallisation points. In the Federal Republic of Germany, the institutionalisation was of a mixed type: on the one hand, there were research institutes, such as the *Forschungsstelle für Juristische Informatik und Automation (FJI)* at the University of Bonn, which had been in existence since 1970, and the *Institut für Juristische Datenverarbeitung* as part of the *Gesellschaft für Mathematik und Datenverarbeitung (GMD)*, both headed by Herbert Fiedler, the *Forschungsstelle für Informationsrecht (FOSIR)* founded by Wilhelm Steinmüller at the University of Regensburg, or the *Forschungsstelle für Informationstechnologie* established in 1978 by Wolfgang Kilian at the University of Hanover, which was reestablished in 1983 as the *Institut für*

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Rechtsinformatik (IRI) (cf. Kilian 2021). On the other hand, there were a number of professorships that added "legal informatics" to their chair titles, and above all many journals and book series (Steinmüller 1993, 138f.).

While there was *Legal Informatics* research, teaching and publishing, and congresses in all of the countries mentioned and beyond, for many years the stronghold of *Legal Informatics* was clearly in the Federal Republic of Germany.

Especially in the international debate, *Legal Informatics* is widely divided into three subfields, which had already characterised *Jurimetrics*: the first is *Legal Information Retrieval*, which deals with the question of how computers can be used to improve the accessibility of the vast amount of legal documents such as laws, court decisions or legal literature. The second area represents *Computational Law* or *Computational Legal Reasoning* and aims at mechanising or automating legal reasoning and decision-making. The third area can be summarised as *Administration & Management*, i. e. simply the automation of legal office work. In the German-language debate, preponderantly following Steinmüller 1971, a slightly different distinction is made: between firstly the conditions, secondly the applications and thirdly the effects of the use of computers in law. The core of the discipline of *Legal Informatics* is then the theory about those prerequisites, possibilities and implications (Steinmüller 1972a, 114). In this context, the first subfield focuses on questions such as "Which parts of legal work can be automated?" (e. g., Frohn 1984; Kilian 2021) or "How must laws be formulated to be automatable?" (e. g., Berg 1968; Rödig 1972; Fiedler 1976). The second subfield focuses on the development of practical applications and their use in legal work, including education (e. g., Popp and Schlink 1975b), while the third subfield covers the use of computers in society and their repercussions on the legal system, i. e., the development and enactment of laws to regulate computer use and mitigate the risks it poses to individuals, groups, organisations, and society, e. g., copyright law, competition law, or data protection law.

In the Federal Republic of Germany, the application of data processing in law and administration was initially a matter of practice; academia at this time concentrated primarily on collecting, reviewing, and organising these use cases, with Fiedler (1966) as the first attempt at an overview and Haft (1970) as the first comprehensive overview. Soon, however, it became a matter of developing a theoretical understanding that could serve as a basis for an assessment of the possibilities and implications. Fiedler, in particular, argued for choosing a "mathematical foundation" and two starting points: firstly, the "concept of the 'algorithm' as a formal-schematic working procedure" and, secondly, "the mathematical methodology" (Fiedler 1973a, 230 ff.). He saw in computerization a "peculiar organisational principle of intellectual labour" which, in the legal sphere of application, "can influence the tasks as well as the structure of the task bearers," whereby, in the context of system developments, in each case "one sets the course for a restructuring [of legal or administrative work] at an early stage which will but have an effect many years later and at present hardly comes to consciousness" (Fiedler 1973a, 231 ff.). Early on, the example of the program flow chart, which was added as an annex to the administrative regulations for the implementation of the German Federal Training Assistance Act (de: *Bundesausbildungsförderungsgesetz (BAföG)*), showed how such a "fixing of the procedure" prejudices legally contested issues and, at the same time, excludes case workers as possible control instances due to a lack of confrontation with the legal situation (Eberle and Garstka 1972).[7] This "fixing" goes deeper, however: in the course of a system's development, *vague* terms and criteria frequently found in law tend to be replaced by *strict* terms and criteria (Bing 1990, 229).[8] This becomes socially visible in particular when it is a matter of dedicated value decisions, which are either stripped of particular aspects

[7] Cf. Perrow (1984) for a comprehensive study on the consequences of staff falling out as a control instance.
[8] If the aim is not only to support the application of the law by technical systems, but also to automate the law's application itself, both the vague and the strict terms and criteria will be replaced by computable ones (cf. Fuchs-Kittowski 2021). And this transformation then will be done primarily by "technologists" who thus make normative choices (Schartum 2020, 301).

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or even completely modelled away (cf. Haft 1970, 100; Fiedler 1973a, 234).

While Fiedler focused on modelling as a *process*,[9] Steinmüller analysed models both as a *product* and as *'raw' material* for further processing.[10] With recourse to a model-theoretical concept of information (cf. Klaus 1969, 271 f., 411 ff.; Stachowiak 1973), Steinmüller pointed out that automated data processing allows "an informational model of people and groups of people to be created," which allows for experimenting and thereby doing "everything that one cannot do or is not allowed to do with the original that is represented" in order to learn about the original (Steinmüller 1971, 2). A "mere individual protection of privacy" would thus be insufficient to address this problem; instead, what would be required is the protection of minorities, democracy and the separation of powers (Steinmüller 1971, 7).

Steinmüller thus took up aspects of the debate about the implications of computerization that are at best slowly coming back into focus today: the distinctly *societal* implications. As early as the formulation of the "Großer Hessenplan" for the comprehensive computerization of the German State of Hessen's public administration by 1980, the "danger of technocratic forms of rule" was explicitly problematized in connection with this development (Hessische Zentrale für Datenverarbeitung 1970, VI), and Haft also referred not only to "the dangers of total control, domination and manipulation" for individuals, but also to "the particular effects of data processing on changes in political structures" and the "concerns about an information monopoly and political predominance of the executive based on this" as risks for democracy and the separation of powers (Haft 1970, 5).[11] The goal of research in *Legal Informatics* was not only to identify and analyse these effects of the use of computers in law, but also to make them solvable both legally and informatically – in the first case through legal design, in the second through systems design (Steinmüller 1980).

This focus on research that is theoretically sound and comprehensively reflected, but at the same time aims at practicable solutions, also characterised the work at the 'lower' end of the connection between law and computer science: legal users' information practices. In the early 1970s, Popp and Schlink, with their project JUDITH, and Suhr, with his project DISUM, pursued the idea that legal automation could only be achieved in a meaningful way in a dialogue-oriented IT system in which different aspects of the work are transferred to the human or the machine, respectively, and the added value is generated only by the very interaction of humans and the machine (Popp and Schlink 1970; Suhr 1970; cf. Gordon 2021). And the working group around Fiedler has shown in their studies on "formalisation in law as a contribution to basic research of legal data processing" that such a formalisation of law beyond small, narrowly defined cases cannot show any success if the pragmatic dimension is not included as well, i. e. the design of cognitive labour and communication processes (Fiedler, Barthel, and Voogd 1984). As an alternative to a purely algorithmic understanding of legal decision-making processes,[12] Popp and Schlink suggested in the mid-1970s that these processes should be understood as social, i. e., via the legal users involved, individuals as well as organisations, feedback pattern-recognition processes. To this end, they proposed a research

[9] Already in his habilitation thesis of 1969 at the University of Cologne, *Die Bestimmtheit der gesetzlichen Straftatbestände als methodisches und verfassungsrechtliches Problem* ('the legal certainty of statutory criminal offences as a methodological and constitutional problem'), Herbert Fiedler conceptualised the application of law as 'modelling', in which neither the facts of the case nor the legal principle are assumed to be predefined, but rather "both are only comprehended in the course of the process by specifying paraphrases, which are coordinated with each other in multiple comparisons" (Fiedler, Barthel, and Voogd 1984, 23). He considered the process of modelling as the central 'boundary object' between jurisprudence and computer science – a concept that he later elaborated further, also with others (e. g., Fiedler and Traunmüller 1986), and which can still be considered instructive today when searching for a link between the two disciplines (cf. Gordon 2021).

[10] For a comparison of the two theoretical approaches see Burkert (1975).

[11] It is against this background that one can explain, for example, why the Hessian State Data Protection Act between 1978 and 2018 defined the aim of the Act in Section 1(1)(2) as being "to protect the constitutional structure of the state, which is based on the principle of separation of powers, in particular the constitutional organs of the state and the organs of local self-government among themselves and with each other, from being endangered as a result of automated data processing."

[12] Frohn later explicated the underlying logical fallacy: even if the legal decision-making process can be understood as a sequence of information processing operations, it is inadmissible to conclude from this that it can be algorithmised (Frohn 1984, 217 f.).

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program for the empirical investigation of this pattern-recognition hypothesis, which has yet to be implemented. These patterns to be identified would function as conditions of legal conditional programs (Popp and Schlink 1975a, 319 ff.), i. e. frames connected with scripts, and at the same time they would serve as a nexus for possible automation or automation support.

Despite the many instructive approaches, research in *Legal Informatics* petered out in the course of the 1980s, it stagnated, as Steinmüller stated at the beginning of the 1990s: "there is not much new in sight," "the theoretical interest has faded," the "heroes have also grown tired," "there are few teaching and research facilities," and "the situation is bleak for young academics" (Steinmüller 1993, 140). This assessment of the stagnation was and is widely shared, even if there has been and still is disagreement regarding the reasons for this stagnation. Fiedler saw it in the fact that *Legal Informatics* has "for too long remained unreflectively attached to its initial paradigms," which he identified as "the computer as an exotic, exclusive instrument in the hands of the powerful." He called for a "second birth" of *Legal Informatics* (Fiedler 1993b) with a renewal in the direction of its application component, referring to "hypertext systems and methods, many other elements of a developing 'language technology', CSCW (Computer Support of Cooperative Work), Artificial Intelligence with its 'connectionist' alongside the 'symbolist' direction (i. e., especially also applications of neural networks)" (Fiedler 1993a, 2350). Lothar Philipps located the slump already in the 1970s, from which it has not recovered, as shown by a look at the international scene, in which German *Legal Informatics* scholars were more than rare, since they dealt almost exclusively with "legal problems of the computer" (Philipps 1993). A decade later, Herbert Burkert saw not one, but many reasons for the failure of *Legal Informatics*:

> "the lack of persuasive power of the concept in terms of science policy, the excessive demands of a concept that required a double qualification, or at least a considerable willingness to communicate across disciplines, and then also those aforementioned centripetal forces that acted on the individual issues separately in each case" (Burkert 2004, 50).

Nevertheless, the renewal of *Legal Informatics*, it's "second birth," failed in the early 1990s – and this has not changed since, despite loud whistling in the woods (Hoeren and Bohne 2009; Kilian 2017; Schweighofer and Lachmayer 2017) and even the attempt of a "third birth" at the *International Legal Informatics Symposium (IRIS)* in 2010 in the form of a roundtable in which Fiedler, among others, participated – only Thomas Hoeren wrote bluntly in 2018: "the discipline itself is dead" (Hoeren 2018, 226), at least in Germany. In any case, "significant design research has not developed under the label of Legal Informatics"; instead, it takes place "bypassing Legal Informatics," concludes Bizer (2004, 47), referring to the work of the *Verfassungsverträgliche Technikgestaltung* (*provet*, en: "constitutionally compatible technology design") project group at the University of Kassel. There, however, the work on technology design also is and has always been at best legal work, while the practical design of technology remained and to this day remains almost completely unaffected by it – except terminologically. To this day, Paliwala's observation holds true that those who are interested in information technology in jurisprudence are more likely to aspire to the field of information law than to *Legal Informatics* (Paliwala 2010, 19), and in the English-speaking world perhaps to the field of *Artificial Intelligence and Law* or, if rather unspoiled by deeper understanding and following the latest hype, to *Legal Tech*.

3.4 Artificial Intelligence and Law

In contrast to *Legal Cybernetics* and *Legal Informatics*, *Artificial Intelligence and Law* has never seen itself as a (sub)discipline, neither in relation to jurisprudence nor to computer science, but as a field of research. The name of the field was coined by British and American researchers, to whom the fact that *Legal Informatics* existed was and is largely passed by,[13] and who saw and see themselves rather in the succession of *Jurimetrics*

[13] This is not intended to give the impression that they bear sole responsibility for this. At the *Fundationes* conference in February

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and then *Computers and Law*.

While for Anne von der Lieth Gardner the beginning of *Artificial Intelligence and Law* can be dated to 1970, with a paper by Bruce Buchanan and Thomas Headrick on *Some Speculation About Artificial Intelligence and Legal Reasoning* (Buchanan and Headrick 1970, see Gardner 1987b, 457), for L. Thorne McCarty the independent history of the field, which was helped along by the high expectations associated with AI, begins with an international workshop held in Swansea, Wales, in September 1979, entitled *Computer Science and Law* (Niblett 1980; McCarty 1990). The goal was "to go beyond document retrieval and explore the more ambitious task of retrieving and interpreting the law itself" (Niblett 1980, 3). Despite – or perhaps because of – this blind spot, the series of conferences organised by the *IDG* in Florence, *Logica, Informatica, Diritto* (Ciampi and Martino 1982 on the first conference), which understood itself to be part of *Legal Informatics*, for example, was considered by McCarty as a self-evident part of the history of the field of *AI and Law*. At the same time, McCarty was forced to concede that the field did not make significant progress in the 1980s, although he claimed that participants learned a great deal about where to direct their efforts in the future (McCarty 1990, 189).[14] The field combines a practical orientation – the goal of developing "intelligent legal information systems" – with a theoretical orientation – the goal of better understanding the process of "legal reasoning and legal argumentation" using computational models and methods (McCarty 1990, 190). The focus of the work, however, is clearly on the development of practical application systems. While Fiedler saw the problem in the drifting apart of "methodologically ambitious and sophisticated systems, which are not of practical use" and "methodologically less ambitious systems, which have some potential to be used in practice" (Fiedler 1991, 144), Oskamp, Tragter, and Groendijk (1995) criticised the juxtaposition of theory and practice as such as well as the lack of research connecting both sides, which they saw as the cause of the sluggish development in this field. And Hall and Zeleznikow (2001) accused the field of the lack of well-founded evaluations of application systems, without which they could not be developed further in a meaningful way. While Rissland, Ashley, and Loui saw the field "clearly well on its way to tackling some of the central issues in legal reasoning" (2003, 12), Paliwala noted as late as 2016 that whatever "significant changes have taken place in the application of information technology to law-work, these have resulted mainly from ordinary information technology processes [. . .]", while when it has been applied "to deeper legal processes, which involve the very nature of law, the result has not been very successful" (Paliwala 2016, 108).

The defining element of the research field has been the *International Conference on AI and Law (ICAIL)*, held every two years since 1987. It quickly became a central venue for the development, exchange, and publication of ideas within the research field and led to the founding of the *International Association for Artificial Intelligence and Law (IAAIL)* in the late 1980s to organise subsequent *ICAILs*. Finally, in 1992, the *Artificial Intelligence and Law Journal* was founded. In Europe, the annual *JURIX* conferences were held from 1988 onwards, organised by the *JURIX Foundation for Legal Knowledge Based Systems*. Originally intended to bring together Dutch-speaking researchers, *JURIX* quickly developed into an international, albeit predominantly European, conference and has been held regularly outside the Netherlands since 2002. All other conferences in this field, including, for example, the *International Workshops on Juris-informatics*

2019 in Berlin at the Alexander von Humboldt Institute for Internet and Society, Thomas F. Gordon rightly pointed out that the relative invisibility of *Legal Informatics* was not least due to the fact that its representatives could not, or could only very rarely, bring themselves to present their research at English-speaking conferences or to publish in such journals, as Bing (2010, 43) also noted. This relative invisibility of German-language research and its representatives is evident even within the English-language *Legal Informatics* debate, see Paliwala (2010, 16). At the same time, German researchers have for a long time – and perhaps still – stayed largely out of research in the field of *Artificial Intelligence and Law*, as shown by the continuous lack of submissions from Germany, which Gordon already noted in the introduction to the proceedings of *JURIX* 2004.

[14] Fiedler, too, saw at best little progress in the course of the 1980s (1991, 144), and Popp and Schlink complained already in the mid-seventies about the discrepancy between what was promised and what was delivered: "Especially in the field of AI research, reading project outlines and reports to possible funders often gives the impression that the majority of the problems addressed have already been solved and that this solution has been translated into workable machine code, an impression that does not stand up to closer examination of the systems in the field" (Popp and Schlink 1975a, 307). On the other hand, Rissland, Ashley, and Loui (2003, 7) claimed that in the 1980s, work in *AI and Law* "intensified tremendously."

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(JURISIN) organised by the *Japanese Society for Artificial Intelligence* since 2007, which despite its name sees itself as part of the *AI and Law* field, are at best of regional, often only of local significance.

In the mid-1980s, there was a broad debate about the challenges posed by the informatization of law. In a panel discussion at the *International Joint Conference on Artificial Intelligence (IJCAI)* in 1985, an initial list of challenges was compiled: the "open-textured nature" of legal concepts, the complementarity of rule- and case-oriented legal reasoning, the important role of analogy in legal reasoning, the special role of hypothetical legal cases for legal argumentation and strategy, and the intertwining of legal reasoning, explanation, and argumentation. This list was subsequently supplemented by Fiedler and Traunmüller with aspects that are fed by the tradition of German legal methodology: the normative (deontic) character of legal rules, the importance of intentional aspects in law, the character of legal methodology aimed at interpretative understanding (teleological method, hermeneutics, pragmatics) as well as the specific structuring of legal rule systems with their associated conventions (Fiedler and Traunmüller 1986, 373f.). And Anne Gardner, in her then influential book *An Artificial Intelligence Approach to Legal Reasoning* (Gardner 1987a), also discussed the challenges at length, including the role of legal rules in relation to examples in legal reasoning, the performance of heuristics in distinguishing between "hard" and "easy" legal questions, and, most comprehensively, again the "open texture" of legal language and human language in general.

The development of the field can best be traced by looking at the papers presented at the conferences. For a long time, *ICAIL* was characterised by the dominance of formal, especially logical, methods (Schweighofer and Lachmayer 2017, 6); information law issues were only discussed from the early 2000s onwards in the context of parallel workshops, and about ten years later increasingly at the main conference itself (see the historical tracing in Bench-Capon et al. 2012). At *JURIX*, formal methods were at no time comparably dominant, but the general development towards "softer" topics was similar, although in each case somewhat later than at *ICAIL*. The thematic broadening also has downsides, such as the fact that more and more works are presented that no longer even attempt to build upon earlier works, but rather present their topic as new, even if they at best resort to new identifiers in the process, or that the increasingly arbitrary topics seem to be less and less penetrated analytically.

Less surprising is the pervasive preoccupation with various models of "legal reasoning," whether rule-based, case-based, or hybrid approaches, whether teleological, analogical, or hypothesis-based approaches, thereby primarily symbolic and less subsymbolic approaches, with questions of knowledge representation, from legal domain models to the modelling of world knowledge and process knowledge, such as conflict resolution knowledge, as well as with text processing, whether "legal information retrieval," natural language processing, or text mining.[15] Rather, it is those approaches that are sometimes revisited or reinvented after decades in the debate, or those that disappear again after a brief flowering, but for which it is plausible, considering the experience in other areas of computer science, that they might have been prematurely discarded. Among the former is, for example, the return of research on dialogical systems in the early 1990s (see, for example, Gordon 1993; Gordon 1995), followed from the end of the 1990s by a brief phase of preoccupation with the use of the World Wide Web and graphical user interfaces (GUI) for dialogical argumentation, for example, for (political) online consultation systems, before they disappear again, at least from research. Notions also resurfaced, such as those prevalent in *Jurimetrics* or *Legal Cybernetics*, about the role of law and technology in influencing social behaviour, with an almost social engineering-like understanding of law and technology design (cf. Bart Verheij in his outlook on the 14th

[15] Only rarely was and is it pointed out in the literature that there is a difference between how organisational and legal decisions are produced and how they are presented (cf. Luhmann 1966, 49–60), and that most approaches to legal automation in *AI and Law* are only concerned with the latter, not with the former (cf. Gardner 1987b, 461). Stated differently, *AI and Law* research mainly addresses how legal decisions are presented, i. e. legal reasoning, though researchers market their "solutions" as ones for legal decision-making or, at least, decision support.

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ICAIL 2013 in Bench-Capon et al. 2012, 93 f.), albeit without actually being based on a well-grounded (e. g., cybernetic) theory or connected to it in research. And long before the practical successes evident in the use of the currently much-researched Generative Adversarial Networks (GAN), Henry Prakken introduced a proposal for "adversarial legal reasoning" that operates at three levels: a "logical level" at which arguments are generated, an "argument level" that organises these arguments and determines the ratios between them to determine their acceptability at a particular point within an argumentative dispute, and a "dialogue level" that decides which lower-level arguments should be selected in the dispute at any given time (Prakken 1995). In addition, there are changes that seem to be taking place all the time – at least that is how they are described – such as the repeatedly observed shift from automated systems that perform legal activities themselves to those that support legal users in performing their activities.

3.5 Legal Tech

Not only does *Legal Tech*, unlike *Legal Cybernetics* or *Legal Informatics*, not claim to be a discipline, but unlike *Jurimetrics* and *Artificial Intelligence and Law*, it is not a research field, but at best an application field. The field itself is characterised by highly simplified applications on the one hand and the lack of both generalisation and theorization attempts on the other.

Simplification is, and this was already noted by Popp and Schlink in the mid-1970s, an essential basis for successful implementation of legal automation projects: if one selects a small, sufficiently clearly delimited legal problem, it can be represented as a structure with a very manageable number of elements, and at the same time one is also dealing with a very manageable set of typical solutions – and both together are particularly amenable to automation (Popp and Schlink 1975a, 308). Schweighofer and Lachmayer welcome this as "thinking in apps," which has finally reached law as well (Schweighofer and Lachmayer 2017, 2).

The analysis of the BAföG program flow chart (Eberle and Garstka 1972) shows that it was recognized early on what implications this kind of approach could have: existing legal differentiations, which are often the result of deliberate acts of political interest or serve to protect minorities, tend to fall victim to simplification – rather than the regulatory alternatives, or normal or standard cases that serve the interests of designers, decision-makers or majorities.

Last but not least, these narrowly tailored implementations pose a challenge when it comes to generalising the lessons learned from implementing and using the systems. Against this backdrop, it is hardly surprising that generalisation attempts in the field of *Legal Tech* are more than rare.

4 TOWARDS THE FUTURE OF LEGAL INFORMATICS

When Podlech called *Legal Cybernetics* a "legal discipline of the future" (Podlech 1969, hence the title of this paper), it was not only on the verge of its zenith, but almost as close to its demise. The scope and the concrete form of the collaboration between jurisprudence and computer science or information science have changed, but the necessity to deal scientifically with the conditions, possibilities and implications of the use of automation-supported information processing in law against the background of the increasing computerization of society has remained. This is especially true in the sense of a "constructive science"[16] that provides "positive guidelines and examples" (Steinmüller 1993, 140), and thus not only operates in jurisprudence but also in computer science. Which challenges have to be tackled for this purpose and upon which earlier work can this be built?

[16] One could also call it "design science" but that would invite misinterpretation. In today's debate, this would too easily be associated – or confused – with "design thinking," a very hyped solutionist approach to design, cf. Seitz (2020).

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The first essential challenge is that of mutual observation between law and computer science, which must precede the creation of functioning interfaces between them that will then aid in translating between the two – in both directions. Thus, the theories that the disciplines make of themselves and their subject (or subjects) are first and foremost internal rationalisations, which thus only make sense from the internal perspective and can only be put to practical use from within. The essential legal concepts are just essential for jurisprudence, but not necessarily also for computer science - and vice versa. Paliwala has therefore rightly called for discipline-internal models to be approached from an external rather than an internal perspective (Paliwala 2000, 329 f.). Law and jurisprudence, for example, are characterised by many rarely reflected premises that impede or even prevent interfacing from computer science, but are often simply ideological concretions, scientifically outdated, or misconceived. These premises include, for example, the anthropocentrism deeply rooted in law,[17] which at the same time leads to a relative blindness towards organisations as entities that are distinct from social groups. Only with such a reflected mutual observation can it be prevented that the disciplines interface terminologically but not substantially, as can be observed, for example, in the relationship between data protection law and ICT design.[18]

The most useful of the starting points for interfacing law and computer science proposed in the *Legal Informatics* debate to date seems to be the method shared across the two disciplines for translating from the non-legal or non-formal world to legal or computable models: modelling (on this, see especially Gordon 2021). Not only the solution – or rather the decision – of legal questions is hermeneutic, but also the modelling in systems design takes place under "wandering back and forth of the eyes" (as Karl Engisch is quoted regularly in the German legal literature on this methodological approach), but not "between the facts of life and the norm," as in law, but between the non-formal world and the formal machine for which the model is created. Linking conceptually to modelling as a specific transformation that does not simply describe or – in the strict sense – map an existing thing or concept in another language, but rather creates it anew in the target language, allows at the same time for connecting with other transformations that can be observed in the context of the increasing informatization of society, such as the quantification discourse in the social sciences (cf. Porter 1994), or the problem of "datafication" (Fiedler 1975, 80) addressed by data protection and data protection law. Above all, however, it creates a link to a concept of information that is equally suitable for jurisprudence and computer science – the concept of information interpreted in terms of model theory, which derives from semiotics and comprises the four dimensions of syntax, semantics, pragmatics, and sigmatics (Steinmüller et al. 1972, 42 f., referring to Klaus 1969, 271 f., 411 ff.; for an introduction to model theory see also Stachowiak 1973).

Another challenge concerns both the location as well as the adequate level of abstraction to search for a possible interface between law and computer science, especially software development. To this day, location and level of abstraction primarily oscillate between formal law, i. e. specific regulations, at the level of individual legal provisions in the law, e. g. in legal requirements engineering (cf. Boella et al. 2014), on the one hand and more abstract conceptual entities, such as argumentation schemes (cf. Macagno, Walton, and Reed 2017; Atkinson and Bench-Capon 2021), but then not in the law, only in legal reasoning, i. e. the justification or presentation part, on the other hand. It might be especially worthwhile to bring together Popp and Schlink's approach of understanding legal decision-making processes as social feedback pattern-recognition processes (cf. Popp and Schlink 1975a, 319 ff.), Anna Christensen's understanding of law as normative patterns in a normative field (cf. Christensen 2000), and the concept of design patterns as articulated first in architecture and urban design (cf. Alexander 1979) and software development (cf. Gamma et al. 1994). Legal design pattern recognition would not only facilitate both the identification of existing functional models and their subsequent use across legal fields, but might also open up new insights

[17] See, e. g., Koulu (2020) on the resulting erroneous conclusions for questions of supervising "algorithmic systems in automated legal decision making."
[18] See, e. g., Hölzel (2019) on the similarities and differences between how identifiability and anonymization are conceptualised in the legal and the engineering debates.

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into automation of legal decision-making processes by developing a shared vocabulary between legal and engineering experts as well as avenues for successful software development and deployment in this field (Koulu, Peters, and Pohle 2021).

And last but not least, the historical examination also shows that it is worthwhile to re-explore the connection between law as a politically regulated instrument for controlling not only individual but also societal behaviour, social structures and processes, which is determined by the information processes involved (Garstka 1983, 181), and information technology and software systems, which (can) comparably regulate the social as "organisational principles and communication media" (Fiedler 1975, 80). This may yield insights for both legal regulation and technical design that point beyond the approaches (such as Hildebrandt 2008 or Leenes 2011) that predominantly belong to methodological individualism and shape the current debate.

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