COLLANA DELLA RIVISTA DI DIRITTO ROMANO
Saggi

AUTOMATISIERUNG VON JURISTISCHEN ENTSCHEIDUNGEN

DIE KÜNSTLICHE INTELLIGENZ AM BEISPIEL DER RÖMISCHRECHTLICHEN KASUISTIK

Herausgegeben von Iole Fargnoli

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Revisiting the Digest through scripts and algorithms

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1. The idea for the project

The idea for this project arose from the suggestion of a robot-judge, made of electrical circuits, as an alternative to a flesh-and-blood legal practitioner in dispute resolution, from the perspective of predictive justice [1].

How can this suggestion be verified on the basis of Roman legal experience?

The debate in today's doctrine on artificial intelligence is as topical as ever [2]. The advent of an increasing number of AI systems, where law is only the most recent field involved, has raised the question of whether we should be able to rely on the decision of a 'thinking' machine.

With specific reference to the Roman legal experience, a first example of a

[1] N. Aletras, D. Tsarapatsanis, D. Preoţiuc-Pietro, V. Lampos, *Predicting judicial decisions of the European Court of Human Rights: a Natural Language Processing perspective*, in *PeerJ Computer Science*, 2:e93, 2016.

[2] As a mere illustration of the countless publications that are being printed in recent years on the subject, these studies on the sensitive issue of the possible handover between man and machine are given below: M.R. Covelli, *Dall'informatizzazione della giustizia alla «decisione robotica»? Il giudice del merito*, in *Decisione robotica* (*ed.* A. Carleo), Bologna, 2019, p. 125-137; M. Luciani, *La decisione giudiziaria robotica*, in *Decisione robotica* (*ed.* A. Carleo), Bologna, 2019, p. 67; F. Ceresa Gastaldo, *Il giudice-robot: l'intelligenza artificiale nei sistemi giudiziari tra aspettative ed equivoci*, in *Ius in itinere*, 22 March 2021, p. 3.

computer program of this kind based on artificial intelligence has been created: it has been given the name AILexA (acronym for 'Artificial Intelligence applied to the *Lex Aquilia*'), which emblematically recalls a now well-known intelligent personal assistant developed overseas some ten years ago and now widespread in many parts of the world. Like that assistant, AILexA was not designed to replace the human operator: on the contrary, to be at its service. Indeed, it is believed that new computer technology, which is expanding rapidly on many fronts, must always find a starting point in humans and an end point in humans. Although we speak of 'artificial' intelligence, the development of such systems cannot disregard the human reality in which they operate. Insofar as they are still addressed to humans, this places an insurmountable limit on their (claimed) autonomy. AILexA follows a model defined as an Expert System and avoids Machine Learning and even more its declination in Deep Learning [3]. The reason lies first and foremost in the chosen field of application, but also in a desire for reliable solutions and operational transparency. AILexA learns from its knowledge base and is able to process information by virtue of the scripts and algorithms given to it during programming. In the course of its operation, it is unaffected by new data input, remaining firmly adhered to the reference source without ever altering it.

AILexA is an artificial intelligence software that works on the textual data provided by Roman sources (specifically Title 9.2 of Justinian's Digest: *Ad legem Aquiliam*). It does not venture any new solutions but finds additional ones through an interpretative elaboration of the original text of the sources.

The hope is to be able to offer a tool that can support legal activity in various ways, given the fact that today it has to deal with computer-generated augmented reality. Thus, it is intended to pursue objectives such as the creation of an AI system that uses Roman legal experience as a reference, providing an alternative way for investigating the sources, and finally the presentation of a learning support tool, aimed primarily at young students, that follows a more gradual, interactive and casuistic approach.

2. Literary Foreword: Kubrick and the Symbology of Knowledge

It was Isaac Asimov, back in 1950, who seriously considered the question of a possible future world where humans and robots could coexist. Thus the so-called 'Three Laws of Robotics' [4] (or also 'Asimov's Laws') were born, presented in the

[3] K. WARWICK, *Artificial Intelligence. The Basics*, Abingdon-New York, 2012, p. 6 and 32-44.

[4] In 1985 (with the novel 'Robots and Empire') a fourth law was introduced, the so-called Zeroth Law of Robotics: «A robot may not injure humanity, or through inaction, allow humanity to come to harm».

fictional 'Handbook of Robotics, 56th Edition, 2058 A.D.': «1. A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2. A robot must obey any orders given to it by human beings, except where such orders would conflict with the First Law. 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law» [5].

In the mass culture of the second half of the 20th century, the symbol of universal knowledge is represented by the very famous large black monolith, the figment of Arthur Clarke and Stanley Kubrick's imagination in the sci-fi masterpiece '2001: A Space Odyssey' released both in cinemas and bookshops in 1968. A certain degree of reliability in the insights with scientific verisimilitude by Clarke, an author of hard science fiction, is given by the fact that he was the first to hypothesise, in a 1945 article [6], the geostationary orbit of the Earth – later christened 'Clarke's Belt' in his honour – to be used for the installation of telecommunications satellites.

The monolith, therefore, accompanies humanity throughout the history of its evolution and different interpretations are projected onto it. In Kubrick's symbolism, it is a generator of knowledge. The representation is symbolic because it is almost impossible to depict in a logical manner what gave rise to human intelligence. That which initiated knowledge is, in fact, unknowable by definition.

The viewer's interest is often diverted towards the monolith in the expectation that its meaning will be explained. However, the expectation is disappointed because the message is not decrypted, at least not until the year 1987 when '2061: Odyssey Three' was published. There, in chapter 59 entitled 'Trinity', a dialogue is reported on the Jovian satellite Europa, at the foot of a horizontally arranged monolith, between Chris Floyd, second officer of the starship Galaxy, and the vision of his grandfather Heywood Floyd, president of the National Council of Astronauts in '2001: A Space Odyssey'. As the reading continues, it will later be discovered to be the apparition of a superior life form comparable to what had become David Bowman who, in '2001: A Space Odyssey', had been transfigured by the monolith into a new being, the Star Child. Here is the extract of the dialogue: [HEYWOOD FLOYD:] «Yes. The Jovians were weighed in the balance against the Europans-and found wanting. Perhaps, in that gaseous environment, they could never have developed real intelligence. Should that have doomed them? Hal and I are still trying to answer this question; that is one of the reasons why we need your help.» [CHRIS FLOYD:] «But how can we match ourselves against the monolith... the devourer of Jupiter?» [HEYWOOD FLOYD:] «It is only a tool: it has vast intelligence, but no consciousness. Despite all its powers, you, Hal, and I are its su-

[5] I. ASIMOV, *Runaround*, in *I, Robot (The Isaac Asimov Collection ed.)*, New York, 1950, p. 40.
[6] A.C. CLARKE, *V2 for Ionosphere Research?*, in *Wireless World*, 35, 1945, p. 58.

perior» [7].

The figure of the monolith thus refers to the idea that knowledge and intelligence are not equivalent but complementary and the latter is superior to the former. Declining intelligence as artificial triggers a whole series of questions, starting with the shadow cast on the decision-making mechanisms of these new technological systems, particularly in relation to predictive justice.

3. Legal Foreword: AI applied to justice, behind a calculation of probability and statistics

The software for the 'Predicting judicial decisions of the European Court of Human Rights' project, developed by University College of London with reference to decisions of the European Court of Human Rights, dates back to 2016 [8]. The program was able to correctly predict the Court's decisions with a particularly high accuracy result of 79 per cent, although with a minimum peak of 56 per cent when specifically considering the possible violation of Article 3 of the Convention alone. Provocatively, one may recall that, according to the rules of pure statistics, everyone is able to causally predict an event at 50 per cent probability [9]. Moreover, all this was the result of a statistical-probabilistic treatment of the input data, whereas there was no real legal reasoning. The major criticism therefore lies in the observation that reaching a decision in an uncritical manner, following the majority or average of the solutions already rendered in the past for a specific dispute, does not seem acceptable. This mode of operation even runs the risk of becoming self-perpetuating over time, because continuing to prefer some solutions over others would increase the weighting to be given to the former, altering predictivity.

Notwithstanding these observations, a statistical analysis may well serve to provide a prediction of the degree of probability of a future judicial decision, in the context of predictive justice, which, however, must in no way be able to directly condition judicial decisions, because it would cause their paralysis [10].

The relationship between judges and technology, particularly with artificial

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[7] A.C. Clarke, *2061: Odyssey Three*, New York, 1987, p. 263.

[8] C. Barbaro, *Uso dell'intelligenza artificiale nei sistemi giudiziari: verso la definizione di principi etici condivisi a livello europeo? I lavori in corso alla Commissione europea per l'efficacia della giustizia (Cepej) del Consiglio d'Europa*, in *Questione Giustizia*, 4, 2018, p. 193 ff.; C. Castelli, D. Piana, *Giustizia predittiva. La qualità della giustizia in due tempi*, in *Questione Giustizia*, 4, 2018, p. 156 ff.

[9] C. Barbaro, *Uso dell'intelligenza artificiale*, cit., p. 191.

[10] A. Garapon, J. Lassègue, *Justice digitale. Révolution graphique et rupture anthropologique*, in *Revue interdisciplinaire d'études juridiques*, 81, 2018, p. 395-403.

intelligence systems, must be a collaborative one, as argued loudly by Giovanni Canzio during his speech at a conference in Padua in 2018 [11]: «I giudici fanno già previsioni, ma allo stesso tempo danno garanzie di contraddittorio, terzietà e imparzialità. C'è necessità di un confronto col mondo della scienza, senza che il giudice sia un suo mero consumatore».

4. The design of the IT model and the internal structure of AILexA

In a nutshell, the process of a predictive artificial model, once the elements to be investigated have been chosen and their collection arranged, consists of three steps: data classification, model creation and predictive analysis.

Classification of data means that the data must be previously labelled and assigned to a certain category before it can be passed on to the artificial intelligence.

The creation of a model, for its part, is fundamental so that the operating algorithm can analyse the example data and thus derive a general rule thanks to which, when a new unlabelled case arises, it will be able to classify it.

Finally, based on the model created and the data supplied to it, the realisation of a specific algorithm will allow the system to perform predictive analyses on the results.

Specifically, with regard to the training to be given to AILexA, a figure was imagined that could serve as a symbolic visualisation of the model, as a reference scheme, taking an architectural emblem typical of ancient times. The choice fell on the front of a Roman temple with two columns, where the latter represent the pairs of subjects involved in the dispute (that is, the *agens-reus* and the *victima-actor*, i.e. respectively the subject who has engaged in the behaviour, in tandem with the one who will play the role of defendant in the case, and the subject who has suffered the behaviour of the former, in turn paired with the one who will play the role of plaintiff in the suit), the pediment that unites them and identifies the behaviour engaged in by the acting party (defined *factum*), and finally the interior of the temple that contains the solution to the case (the so-called *responsum*) to which AILexA arrives on the basis of the reference source, which served as training.

An example taken from one of the passages in the Digest may better clarify the concept. The text of the Ulpian fragment contained in D. 9.2.27.30 [12] has been

[11] Study conference entitled 'Certezza del diritto, prevedibilità della decisione e giustizia predittiva. Verso una nuova calcolabilità del futuro giuridico?', Padua, 24 October 2018.

[12] D. 9.2.27.30 (Ulp. 18 ad ed.): *Si cum maritus uxori margaritas extricatas dedisset in usu eaque invito vel inscio viro perforasset, ut pertusis in linea uteretur, teneri eam lege Aquilia, sive divertit sive nupta est adhuc.*

deconstructed and simplified as follows: *mulier* or *uxor* identify the subject 'agens'; *usuarius* [13] is the 'reus'; *margarita* is the 'victima'; *dominus* is the 'actor'; *perforare* is the 'factum' that provoked the *damnum* as 'exitus'; finally, *actio legis Aquiliae III caput* is the decisive 'responsum' suggested by the jurist.

Each of the one hundred and seventy-four sources contained in Title 9.2 of Justinian's Digest has been reworked in this way, ensuring that the computer program can compare on a uniform basis. The database consists of one hundred and eighty-nine labels for over eighty thousand entries. Six hundred and one useful cases were extrapolated. The unique values known by the machine – including Latin, English and Italian, as it is multilingual – are almost four thousand [14]. Based on all this, the total number of combinations searchable by the system exceeds eighty-five trillion [15].

For the fields 'agens', 'victima', 'actor' and 'reus' eight categories of nominative values have been provided, which are: generic; thing; animal; *res mancipi*; slave; person; *dominus*; and qualified subject. This last category has, in turn, been divided into thirteen sub-categories: the harvesting and breeding sphere; the inheritance sphere; the contractual sphere; the real rights sphere; the conduction-driving sphere; the teaching sphere; the magistrates' sphere; the medical sphere; the professions' sphere; the disease or madness sphere; the possessory sphere; the sporting sphere; the guardianship, curatorship *et similia* sphere.

Each of these categories may intertwine with some of the others. This is the case, for example, of the animal label which may contain the *res mancipi* label, which in turn may include the slave label, and all of which may be made to fit into the generic label. The work of interlacing is carried out by the machine which, depending on the degree of forcing carried out, will offer a result more or less adherent to the case in point: in these cases, we will speak of *extensiones*.

For the 'factum' field, the main categories of verbs conjugated in the infinitive and referring to behavior are four: generic; potentially lawful; aimed to harm; aimed to kill. The secondary categories, on the other hand, are thirteen: to kill; to

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[13] The *utendum dare* to transmit some of the husband's property to his wife, for the latter's personal use, was permitted as a remedy to the prohibition of donations between spouses: cfr. P. ŚWIĘCICKA, *D. 9.2.27.30: mąż, żona i przedziurawione perły. Kilka uwag na temat stosunków osobistych i majątkowych między małżonkami w starożytnym Rzymie*, Kraków, 2008, pp. 23-26.

[14] The unique values known by the machine are distributed among the search fields as follows: 2,338 for the 'agens' field; 2,338 for the 'victima' field; 1,304 for the 'factum' field; 51 for the 'exitus' field; 2,338 for the 'actor' field; 2,338 for the 'reus' field; 39 for the 'responsum' field.

[15] Curiously enough, the trillion is the same unit of measurement shared with the total permutations (over forty trillion) referred to the Rubik's cube, a well-known Hungarian algorithmic solution puzzle that has been very popular since it was first distributed three years after its invention back in 1977.

harm; to provoke; to fall; to make use of; to warn; to exercise; to collide; to medicate; to hold; to evade; to lead; to forbid.

Finally, for the field 'exitus' the categories provided on the possible epilogues of the behavior are also four: generic; damage; death or destruction; preservation or integrity.

The structure just described allows the machine to master the contents of Title 9.2 of the Digest *Ad legem Aquiliam* through a computer language more conducive to comparison than the original Latin text might be.

The knowledge base thus organized is then ready to be investigated by AI. The intelligent engine specifically consists of scripts and algorithms.

Scripts serve as programming tools, prepared specifically on Claris' FileMaker platform. They make it possible to give the machine all the instructions it needs to execute at each stage of its functioning.

Through algorithms, however, the extent of predictive computation is established. Specifically, a value has been provided for each search field based on its labeling [16]. In addition, each field carries its own weighted value, established on the greater weight it has on the configuration of the case [17]. Associated with it is a multiplier [18] if the field turns out to have actually been activated in the search (i.e., if the user will have actually typed something in that text box). Two additional parameters complete the calculation: the uniqueness (or otherwise) of the *responsum*, without prejudice to all other field values, and a coefficient of the sentence predetermined during machine training [19].

5. Examples of operation

Research using AILexA follows five steps: thinking about a case; starting the machine; typing the search; consulting the results; refining the search. In particular, you start by thinking about an unpublished case in its essential terms, then starting

[16] The field value varies according to the level of forcing in the labelling, in particular: a value of 26 was attributed when the indication contained in the field was *authentica* (i.e. actually present in the Latin text of reference: e.g. «horse»), 3 if classified as *extensio minor* (i.e. forced at a first level: in the same example above «res mancipi» or «mula»), finally only 1 if *extensio maior* (i.e. forced at a maximum level: the example could be «animal» or even «thing»).

[17] The weighted values refining the algorithmic calculation are as follows: 'agens' x2; 'reus' x1; 'victima' x1.7; 'actor' x1.3; 'factum' x3; 'exitus' x1.5; 'responsum' x2.5.

[18] The multiplier is 3.

[19] The coefficient of the condemnation was necessary in order for the machine to understand which actions, in the specific case, are more favourable to the plaintiff or which appear less unfavourable to the defendant. This is done on the basis of two parameters: the admissibility or otherwise of the action, and the amount of the possible sentence.

the AI machine and typing the search in all or only some of the seven fields; you can now consult the search results returned by artificial intelligence processing and possibly refine the search to improve the results.

Let us assume that we want to investigate a case which, in its minimal configuration, involves a barber as the agent subject who slashed someone's throat causing their death. We can query the machine in this way: we write «barber» in the 'agens' field, «slaughter» in the 'factum' field and «mors» in the 'exitus' field. Starting the search, AILexA returns *actio legis Aquiliae I caput* as 'responsum', indicating that this is an *authentica* solution based on the following *ratio iuris*: *et sane si ibi tondebat, ubi ex consuetudine ludebatur, est quod ei imputetur*. The result just obtained was found by training on the fragment D. 9.2.11pr. (Ulp. 18 ad ed.).

Let us look at a second example, according to which a *dominus* wants to know the possibilities of legal action for his mortally wounded slave. We can query the machine in this way: we write «chiunque» in the 'agens' field, «vulnerare» in the 'factum' field, «slave» in the 'victima' field, «mors» in the 'exitus' field and «servus» in the 'actor' field [20]. Starting the search, AILexA gives us a triplicity of possible solutions from the fragment D. 9.2.15.1 (Ulp. 18 ad ed.). They are: *actio legis Aquiliae I caput* (solution present in 50 per cent of the cases so configured), *non actio legis Aquiliae I caput* (solution present in 30 per cent of the cases), and *actio legis Aquiliae III caput* (solution present in the remaining 20 per cent of the cases). This means that the basic configuration shares multiple solutions, the distinction of which is represented by the *rationes iuris* that underlie the jurist's response: for the first, *si servus vulneratus mortifere postea ruina maturius perierit, si manumissus ex vulnere periit, quasi de occiso agi posse: quia verum est eum a te occisum tunc cum vulnerabas, quod mortuo eo demum apparuit*; for the second, the justificatory reason is *si servus vulneratus mortifere postea ruina maturius perierit, de occiso agi non posse: nam non est passa ruina apparere an sit*; finally, for the third, it is indicated *si servus vulneratus mortifere postea ruina maturius perierit, de occiso agi non posse, sed quadi de vulnerato: nam non est passa ruina apparere an sit occisus*.

6. Final considerations

Beyond the algorithmic functioning of a machine, one of the most critical points about artificial intelligence systems lies in the quality of its training data. AI is

[20] We write «servus» and not «dominus» in the 'actor' field because the sphere of interests gravitates around the slave anyway and not the person, generically understood, of his master. So «servus» means *<qui interest> servum-victimam*, as AILexA rightly already indicates in the screenshot.

thought to be third and unbiased, but this is a misunderstanding because it is based on data extracted from the real world, which are potentially affected by the same biases when describing it. Thus, the consequence is that outputs can also be affected by discrimination.

At the current stage of technological progress, the solution that has been thought of, taking advantage of the 'Internet of Things', is to develop artificial intelligence systems based on a very large amount of data (so-called Big Data). However, even if no discriminatory criteria are included in the datasets (such as sex, race, religion or personal tendencies), it is the very strength boasted by AI that weakens it: its ability to bring out correlations between data may in fact bring to the surface, by other means, those same deviant elements that were intended to be avoided. Besides, as we know, quantity is always the enemy of quality.

For these reasons, it was decided to proceed in another way in AILexA, favouring reliability above all else. It was decided, therefore, to start with controlled input data in order to arrive at verified and always explainable output results.

The strengths of AILexA are closely linked to the chosen artificial intelligence model. In fact, it is an Expert System whose known dataset, as such, is not subject to manipulation or interference by the number of searches performed, thus averting the danger of the emergence of so-called cognitive bias, which is absolutely detrimental to justice. The knowledge base always remains faithful to the content of Title 9.2 of the Digest, guaranteeing maximum reliability of the data, and the elaboration processes merely recognise the unpublished values to be researched, inserting them in a reasoned manner into the text of the Latin source. The learning of the data is not automatic, which could have led to cognitive distortions, but the processing of that same data is. The system, therefore, is closed in its inputs, being characterised by a clearly defined set of data, but open in its outputs (thus, it is the inverse of what is usually understood as an open AI system, such as Deep Learning models usually are): while providing a set of reliable solutions, the core of the machine has been developed to be able to question the output, and this on a par with the interpretive work of comparison that can be carried out between human lawyers. The graphic interface is always rich and exhaustive, allowing the user to have all the operations processed by the machine under control. We are in the presence of what could be called a White Box: far from following a Black Box model (i.e. a system that is describable essentially in its external behaviour, only in terms of how it reacts in output to a given input), AILexA follows a model whereby adherence to the text and transparency of the results are emphasised to the utmost degree, so that it is possible to understand how the machine came at the solution.

In conclusion, in offering an innovative scientific product, a triplicity of objectives was considered: development, research and teaching.

In pursuing the goal of development, a real AI system was realised with reference to Roman law, in the wake of the idea of the robot-judge and predictive justice.

As part of the research, an alternative way of investigating Roman sources was presented, i.e. different from the traditional paper model.

Finally, AILexA can be a valuable learning support for young people, thanks to a more gradual and engaging approach as well as a casuistic and interactive one.