COMPARATIVE CONTRACT LAW: METHODOLOGICALLY HUMAN OR ARTIFICIALLY INTELLIGENT?

Roy Andrew Partain, PhD, JD, MSc, MSc
Chair and Professor of International Law and Sustainability
School of Law, University of Aberdeen (Scotland, UK)

1. INTRODUCTION

This article addresses one of the most fundamental issues facing legal researchers today; how deeply should computers and artificial intelligence be relied upon in advancing legal science and in the formulation of legal policies?

The millennia long challenge to develop what we now call law is an innately human project, one with creative, cultural, and unavoidable questions of our *Grundnormen* and moral values. As such, the development of law should remain a primarily human-led and nurtured project, to attain legal systems that match our cultural identities and enable us to continue our journey to evolve as humans into a better future.

This article explores these issues from the research perspective of comparative contract law, as it is well documented for over two thousand years and can thus give illumination to the broader concepts of legal evolution, of law matching the cultures to which it belongs, and to an ever-changing aspect of law, for purposes including greater equity and efficiency for broader gains in social welfare.

Perhaps due to the nature of capitalism and its search for cost efficiency, perhaps due to the quantitative aspects of contract law, perhaps due to the focus interests of Silicon Valley, contract law has seen much attention from the AI researchers and thus this outcome enables early points of discussion that do not yet

exist in other others of substantive law.

2. ANCIENT CONTRACTS RE-EXAMINED AS STRUCTURED TEMPLATES

2.1. QUERY ON NATURAL LAW?

While perhaps it cannot be evidenced that all societies have, do, and always will share identical notions of contract law, a clear outcome of a century of comparative contract law research reveals that deal-making and bargain-making is surprisingly similar across cultures and across different historical eras. In examining the records of contracts across several thousand years and multiple cultures across the globe, the notions of equity, or of justice in private contract, is so persistent, it sometimes appears as if there were a Natural Law of Contracts.

2.2. CONTRACTS FROM OLD BABYLON (2000 BC TO 1600 BC)

There are and have been differences in the details of contract law, but we can actually legally understand ancient Mesopotamian contracts without much additional guidance, once the ancient language is translated into a modern language. Similarly, modern scholars read textbooks on Roman law to understand how to think about our own contract laws of today.[1] Ancient Mesopotamia and the Roman Empire were surely very different cultures from our own, yet, their contracts are similar to our own. When it comes to talking about contracts, we seem as humans ready to understand bargains and fairness in trade.

Archaeologists have discovered that textbooks to learn contract law are nothing new, for those books existed in ancient Mesopotamia over 3,800 years ago.[2] The ancient contract law books were primarily collections of models of abstracted contracts to which personal and commercial details could be added to convert the

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（1） For an example textbook used across the United Kingdon, see DU PLESSIS 2015.

（2） King & Hall 1906.

templates into actual contracts. Many of these legal primers have been found and recovered by archaeologists;[3] the forms of their contracts are readily recognizable to modern lawyers from both Civil and Common Law traditions.

First take a look at an Old Babylonian contract for a boat rental:[4]

- ・One [boat of 50 gur capacity], [one] rudder, [three] punting poles, four oars, [two] ropes for towing the boat:
- ・(this is) the boat of Nanna-meša (which) Ur-Šulpa'e has rented from Nanna-meša for two months.
- ・Ur-Šulpa'e will measure to Nanna-meša 6 gur of barley as its monthly rent
- ・The boat must be returned in good condition, together with its rent, at [the quay] of Nippur.

Next take a look at another Old Babylon contract for a loan of silver:[5]

- ・One third of a min[a of silver],
- ・an interest rate of 12 shekels per mina is to be added
- ・Ur-Ninsun received from Lugal-melam;
- ・(to be given back) [in the se]cond [month]

　　Once translated from Old Babylonian to a modern language, the elements of a contract are immediately obvious. A set of duties and obligations from one side matched with duties and obligations from the counter side. One finds objects of contract, quantity, pricing, the naming of parties, time and/or place of performance,

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（3）　For an online archive, including those discussed herein, see the University of Pennsylvania's "Old Babylonian Model Contracts" collection; available at　http://oracc.museum.upenn.edu/obmc/corpus

（4）　Contract 3N-T0567, *id*.

（5）　Contract CBS 06822, *id*.

even terms of returnable condition and interest rates. These are valid contracts in most legal systems today.

But what is also interesting, is the basic Babylonian mode of teaching and the basic method of drafting contracts. The Babylonians taught and used structured contracts − there was a lack of legal theory but a very strong presence of format and of structured information. Most Babylonian contract drafters were simply clerks, filling in a form, without substantial legal knowledge. And what is really interesting, is that this approach is very much how contract law software works today, based on structured templates. The ancient Babylonian lawyers were basically taught an algorithm for writing contracts and they did not need to understand contract law theory to be functional. And nor do computers today need to understand law, so long as they can receive the necessary data to complete the forms.

3. CONTRACT LAW AND FORMAL LANGUAGE

Since the earliest days of law, and this is found in letters sent by Hammurabi to his judges,[6] law has been an encounter between humans, a mode of documenting and communicating on our methods of coordinating rights and privileges. We speak of civil codes, of court cases, of Domat, Blackstone, and von Savigny. We are speaking of human thoughts and human words.

Indeed, most of the earliest samples of writing found by archaeologist is commercial in nature, documenting contracts, taxes, and notions of property. In ancient Mesopotamia, some of the earliest documented modes of writing appear to be clay envelopes, called *bulla*, that contained miniature models of inventory inside with personal identification details written outside; often these *bullae* appear to have

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（6） Johns 1904, 318. Chapter II is full of letters, in translation, from Hammurabi to his judges. *Id.*, 316-326. See also King 1898, LVII − LXIII, listing four dozen such letters.

facilitated trade, it is thought that they could have serve as proto-written contracts.

In Hammurabi's Code, in article 5, he required all judges to document their findings and decisions in writing.[7] At article 100, he requires that commercial loans be documented in writing. Articles 104 and 105 discuss requirements for keeping receipts of trades. Article 122 requires written contracts for transactions involving precious metals. For Hammurabi, almost 4,000 years ago, written private law and written public law were already standard procedures.

Even in early China, some of the earliest Kanji were 買 and 賣 , clearly reflecting the need to document commercial transactions. So, deal making and contractual *Grundnormen* go back millennia, if not even further back into prehistory, everywhere around the globe.

Thus, from the earliest of times, the law was in our language, in our speech, and in our human forms of communication.

Let us consider the Greeks of Athens.[8] The ancient Greek word for law, *nomos*, originally referred to songs or chorus, as the Greeks taught and conveyed their laws in songs. Even the Babylonians likely committed their contract models to memory by chanting.

Greek courts were held outside, in front of thousands of local citizens, usually on the edge of the local city market (' 市場 '). Greeks would hire orators to aid them in litigation, knowing that the *dikastes /dikastai* ('jury/judges') was composed of thousands of local men, who would engage in counter-chanting. And like football fans today, the Greeks would cheer and jeer during trials, singing songs of law.

But time marches on. These days, we seldom sing or chant law. We write and

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（7）　See generally: Lyon 1904, Jenkins 1905, and Pfeiffer 1920. For the specific citations to Hammurabi's Code, see King 1898. For notes on the economic content of Hammurabi's Code, including specific notes on contract law, see Nagarajan 2011, 112-113.

（8）　*See* Blackwell 2003.

document law and legal acts, and we do so, we act to formalize our language to speak more precisely of contracts based on our theories of contract law. And although our contractual language has approached formalism, through civil codes and international conventions, it remains in a language readily recognized.

Unlike the physical scientists and computer programmers, we lack an actual formal language for law; perhaps Leibniz is to blame.

4. LEIBNIZ AND TWO PATHS TO LEGAL SCIENCE

4.1. A MISSED CHANCE AT FORMAL CONTRACT LAW

A genius at mathematics and physics, Leibniz thought of himself as a lawyer and philosopher. He was seeking to develop the new *Wissenschaft*, ('science,' the German phrase means 'knowledge making'), become more robust with more rigorous foundations. Germans still speak of our legal arts as *Rechtwissenschaft*, of 'making legal knowledge', or as more commonly translated, as 'legal science.'

Wissenschaft quickly became the word for post-Renaissance efforts in science. And, there too, Leibniz created the mathematical method of calculus, as so widely used across the physical sciences.

It can be argued that Leibniz did not recognize the cognitive divide that we do today, that physical science is performed with mathematical structures while law remains safely away from calculus and advanced mathematics, safely discussed in 'human language.'

If Leibniz had chosen to equally develop a new formal language or formal methodology for discussing law, as he had done for physics, perhaps we today would have an equally rigorous method of discussing legal rules and juristic acts. But we know he hoped to create such a formal language, a *characteristica universalis*, a system of symbols wherein ideas could be combined algebraically via method called the 'calculus ratiocinator.' In 1685, in The Art of Discovery, Leibniz set down an

extraordinary idea:

> *The only way to rectify our reasonings is to make them as tangible as those of the Mathematicians, so that we can find our error at a glance, and when there are disputes among persons, we can simply say: Let us calculate ["calculemus"], without further ado, to see who is right.*[9]

And,

> *This is why, with the gradual progress of the human species, it can come about, perhaps after many centuries, that no one will any more be praised for accuracy of judgment; <u>for the analytic art</u> (which is still virtually confined to mathematics in its correct and general use) <u>will have become universal</u> and applied to every type of matter through the introduction of a scientific notation ('philosophical character') such as I am working on. <u>Once this has been accepted, correct reasoning, given time for thought, will be no more praiseworthy than calculating large numbers without an error.</u>* "[10]
>
> (underscoring added.)

Leibniz imagined that we could calculate legal arguments as objectively as physicist calculate the motion of spheres. Yet, we will never know what Leibniz's results would have been, as his formal law project went uncompleted at his death.

If he had succeeded, comparative contract law might be more mechanical in nature, more automatic in its detection and inspection of differences in contract law rules across legal cultures. What would it be like to write law in a structural language,

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（9）　Navarro M.G. (2013) *On Fuzziness and Ordinary Reasoning*. In: Seising R., Trillas E., Moraga C., Termini S. (eds) On Fuzziness. Studies in Fuzziness and Soft Computing, vol 299. Springer, Berlin, Heidelberg

（10）　Marciszewski 2001, 41; with reference to Ross 2004.

perhaps it could be like HTML, as we use to design webpages, or could it be like LISP, used to program artificial intelligence programs?

4.2. COMPARATIVE CONTRACT LAW － A SUCCESS STORY OF INTELLECTUAL SPIRIT

What Leibniz did achieve, however, was to reinvigorate the idea of comparative law.

In his *Nova Methodus Discendae Docendaeque Iurisprudentiae* ('New Methods of Studying and Teaching Jurisprudence'), he advocated seeing law as clustered into family groups. This established the very foundation of modern comparative law.

In 1900, Edouard Lambert and Raymond Saleilles expanded on Leibniz's objective vision of comparative law to a new normative project, to find ways to improve civil law via the comparative examination of private law, and potentially, to establish a new universal *ius commune*.

Saleilles had been inspired by the writings of another scholar, Gustave Boissonade; the same scholar involved in the Meiji era legal reforms in Japan. Boissonade had several goals for his vision for the goals of the comparative law research project: (i) continual progressive improvement of law, (ii) to induce a convergence of legal rules, (iii) and a particular focus on these effects for commercial law and contract law.

Saleilles wrote of a "a concept of <u>natural law</u> superior to all domestic laws and would be the aim of all laws."[11] Thus, this comparative law project of continual, progressive convergence of law was intended to achieve a re-discovery of a higher Natural Law, and especially a 'Natural Law' for commercial and contract law.

4.3. OUR NEW 'NATURAL LAW' FROM BOISSONADE AND SALEILLES

And in many ways, these early goals of comparative contract law have been achieved.

（11）　Jamin 2002, 175 (Underscoring added.)

A few decades ago, a student would have needed to learn the whole of the contract systems of certain major legal cultures, such as the private law systems of France, Germany, and England. And some comparative law text books remain that way, but most modern text books now focus on a short list of key issues that often arise in intra-Member State multi-national contract law negotiations:

- What are 'offers' versus 'invitation to offers'?
- Post-formation updates to the basic bargain
- How many material terms need to be agreed to in order to achieve a contract?
- Priority of standard language versus negotiated terms
- Objective versus Subjective interpretation of contractual terms
- The revocability of already tendered offers
- When is the onset of good faith duties, pre-bargain, at bargain, post-bargain?
- How completely does acceptance need to 'mirror' the offer to obtain a bargain?
- Do you need 'consideration', do you need a *causa*?
- Does contract law contain protections in equity or are you committed to your risks?
- How broadly can a judge use 'reasonableness' to restructure a contract?
- Does good faith apply in un-negotiated areas, does reasonableness?
- Does 'responsibility' for breach behavior affect liability?
- How does *force majeure* affect breach and liability for breach?

Of course, there are many other potential other areas of differences can be found in comparative contract law, but for most students and most practitioners, this list is probably sufficient.

And this great convergence, this result of approaching legal harmony for contract law, is in many ways a direct result of comparative contract law and the role its scholars played in developing the great modern legal conventions to coordinate international or interstate contracts[12] .

We now can see where private law appears to have converged in many aspects, as comparative scholars have analyzed various rules, examined efficacy and efficiency of those rules, and made various recommendations of legal reforms. As a result, a better understanding of legal evolution and of distinct clusters of legal origins have been gained.

In more recent years, comparative law has also revealed how the market place of ideas is a contagious forum, that legal rules or habits can find application in new jurisdictions; thus, legal rules can become transplanted in new legal cultures. Convergence in legal rules for contract law and commercial law has been everywhere found.

But this was by far not the historical trend nor data, for before the comparative legal scholars began, there was great divide and distance between scores of nations and legal cultures around the world.

The results of the comparative law project, both theoretical and diplomatic, are not to be found in historical data and were not the result of machines and drone worker, but in the intellectual spirit, originality, and creativity of the humans engaged in the project.

5. Coase and the Complexity of Contract Law

What this has done, is to leave comparative law a very different course at the

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（12） Examples such conventions from 'Hard Law': (i) United Nations Convention on Contracts for the International Sale of Goods (CISG); (ii) Uniform Commercial Code (UCC) as adopted by all 50 states and many territories in the US; and indirectly via historical adoption by US common law courts, (iii) the ALI's Restatement (Second) of the Law of Contracts. Examples of converging norms in contract law from 'Soft Law': (i) UNIDROIT Principles of International Commercial Contracts; (ii) the European Union's Principles of European Contract Law (PECL); (iii) the European Union's Draft Common Frame of Reference (DCFR); and (iv) the Principles on Choice of Law in International Commercial Contracts (2015) (the "Hague Principles").

university level, compared to what a student might have found fifty years ago. Instead of wondering what different contract law systems might have in common, we now wonder why differences remain at all.

And what has become very clear is that all of these questions emerge from a singular problem, an incompletely specified contract. As Mackaay wrote,

> *"a complete contract is one in which hypothetically parties assumed*
> *to be perfectly informed and acting rationally have provided a*
> *solution for any contingency that may arise during the performance*
> *of the contract. In such a contract, all mishaps have been*
> *internalized."* [13]

But contracts cannot be fully specified. And it appears that Coase's Theory of Transaction Costs may be at the core, much as it is for the other half of Obligations, in Tort Law. [14]

Furubotn and Richter's theory of Rational Incompleteness of Contracts states that due to transaction costs, no contract can be both efficient and complete. [15] Even earlier, Herbert Simon had developed a theory of satisfycing, that there are rational limits in even trying to be rational, as that bears costs too. [16]

And of course, life is very complex and if you spent the time required to type all the many potential possibilities, then the object of the intended contract may very well expire before you could finish typing that contract. This problem is known in

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（13） Mackaay 2013, 427-429.

（14） *Id*.

（15） Furubotn & Richter 2005. *See* ch 5.6, "The Incomplete Contract Model," *id*.

（16） Simon 1956, 129. "Both from these scanty data and from an examination of the postulates of the economic models it appears probable that, however adaptive the behavior of organisms in learning and choice situations, this adaptiveness falls far short of the ideal of 'maximizing' postulated in economic theory. Evidently, organisms adapt well enough to 'satisfice'; they do not, in general, 'optimize.'" *Id*.

computational science as algorithmic complexity theory, and most contracts will be too complex to fully determine within the limits of future human history.

Thus, contracts will always be under-detailed and under-specified. Even under Saleilles' call for a 'Natural Law' of contracts, the contracts themselves will be incomplete.

Given that problem, what might be done to aid business negotiators to draft better contracts? Might there be a technological solution?

6. COMPARATIVE LAW AND COMPUTING SCIENCE

A few years ago, my home university decided to sponsor industrial research, offering grants to multi-disciplinary research teams to solve new problems in supporting our North Seas-based economy. It was an exciting opportunity and many professors came together to find new solutions.

6.1. WORKING WITH COMPUTING SCIENTISTS ON CONTRACT DRAFTING

Luckily for me, I was already engaged with the Department of Computing Science, as we were drafting what became the UK's first LLB in Law with Computing Science ― a program that fully trains students as both computer programmers and as lawyers, fully qualified for career paths on both sides. We had already explored many areas of how the future of law would be deeply interactive with the knowledge and skill sets of computer programmers.

We knew of artificial intelligence ('AI') programs that could read case law, e.g. court case decisions, and extract out the court's holdings or new legal rules without human assistance.[17] We knew of programs that could apply legal logic to sets of evidence to determine if rights had been violated and if so, whose rights. We knew some corporations were already making use of AI-based online arbitration platforms,

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（17）　*See* Shulayeva, Siddharthan, & Wyner 2019.

where the AI program enabled quicker arbitration results. We were lucky to have a leading computational linguist,[18] so we also learned of programs that could read stories extract the main story elements. We also saw how AI programs and Deep Learning programs could take a large, rambling story and condense it, accurately into an abstract.

So, we were very aware of the pre-existing capacity in computer programming to facilitate legal work, legal logic, and legal decision making. This is a very wide range of tools, potentially reducing many efforts at modern day law firms.

In exploring potential applications to facilitate client/lawyer interactions, I shared an observation that clients often wanted to negotiate their own contracts, that lawyers might not be invited to contractual discussions until negotiations became complex or until maybe conflicts arose. Such habits could give rise to poor legal consequences, as the clients might lack expertise in multinational comparative contract law, even if well versed in their own domestic contracts laws. We decided to explore the creation of an application that would monitor emails and chats and then automatically draft the contract in the background of those communications; then both client and attorney could then collaborate on edits and re-drafting.

The key problem was that we would need to be able to structurally explain contract law to the computer program so that it could work with the logical elements of the contractual frameworks.

6.2. CONTRACT LAW AS A RATIONAL AXIOMATIC ART

But that might not be as complex as it first seems, as the very foundations of modern contract law started alongside axiomatic geometry.

Jean Domat, a French professor of Roman Law, had designed his *Lois Civiles*

（18）　Dr Adam Wyner. Currently serving as Associate Professor of Law and Computer Science at Swansea University.

dans leur Ordre Naturel ("Civil Codes in their Natural Order") based on the very logical and axiomatic forms of his good friend, Blaise Pascal, whose own works *De l'Esprit géométrique* ("On the Spirit of Geometry") and *De l'Art de persuader* ("On the Art of Persuading") had enlightened the Renaissance world to the benefits of modern axiomatic geometry. So it was, the beginning of modern contract law was drafted by a close companion of Pascal.

And that power of math, of logically driven axioms, is why Domat, then Pothier, and then every other civil code thereafter utilizes the axiomatic method in building civil codes from fundamental legal concepts to expansive codes.

Due to these early efforts of Domat and Pascal, France's intellectual foundations for contract law were axiomatic and logical. And because they lived in the 1600s, and due to the further work on contract law by Pothier in the 1700s, England accepted much of this intellectual framework into its own evolving contract law by case-based reference to these scholars; thus, much of the Contract Law found in the Common Law arises from the same scholarship as the French Law of Obligations. Thus, Common Law and Civil Law both benefit from this shared inheritance of rational axiomatic model of contract law. Thus, it's easier to program contract law than you might first expect.

6.3. Designing a Machine to Compute Contracts

To solve the client/attorney problem described above,[19] the program could create a draft contract that followed a more formal mode of contracting to make it easier to review by both machine and by humans. That text could then be shared by email or by simultaneous cloud-type sharing. Via that mode of sharing, the application could also connect the lawyer so the lawyer could monitor the drafting in real-time evolution, being able to add legal counsel when needed but remain discreet when the

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（19） *See, supra*, sec. 6.1.

business talks were going well. This, from the computing science side, could all be done in some form of XML, a human and machine readable 'mark-up' language, much like the internet's HTML.

And, the legal component, the part of the program that held the legal logic of contracts, could be modular, so that you could implement a choice of law option; the negotiator could select if they wanted London's Contract Law, Singapore's Contract Law, or wherever's contract law, and the program would simply look at a different contract law module and everything else would work the same.

And this was all simple and good, if, and only if, the two parties were inside the same legal culture. But interesting international business contracts are not mono-cultural, no, they are multi-legal-cultural. And that is really true within the EU open market, wherein dozens of Member States have open and flowing economies but retain their own domestic contract law systems.

So, for all the neat stuff just explained, the project was likely to be a failure unless we could somehow automate multinational comparative contract law somehow.

6.4. CONTRACT LAW AND GRAPH THEORY

And herein is the really interesting part of the story. Turns out that a mathematical model already exists to handle such a problem. And that kind of mathematics is called Graph Theory.[20]

Graph Theory looks at both data points (aka *nodes or vertices*), the distance between those data points (aka as *edges*), and potential geometries of how they all connect. So, if you could take a simple legal concept, reduce it to several key dimensions, and then evaluate how each different legal culture graphed its legal rule, then you could algorithmically compare various graphs for the same legal concept.

（20）　For a leading text book on Graph Theory, see Steen 2010.

You could detect the distance and shape of two legal cultures on a single rule and thus determine if they operated the same way, or, if differently, how much differently.

How might one do this?

First, a scholar would decide how many contract concepts exist for his project, it might be dozens or scores of fundamental legal concepts such as 'can a contract be oral' or 'can a minor be bound by contract'. So, a long list of legal concepts would be drafted. Fortunately, comparative contract law has already done much work in identifying and examining this area.

Second, the scholar would need to add the legal answer, which we would call the legal graph. This is where expertise in comparative contract law is needed, to know the answers of how a legal system addresses the many issues of contract law.

But we would need to speak of law in a new way, as that answer needs to be machine readable, so we'd likely need to ask the legal questions in binary, yes/no style, ('can a contractual object be criminal in nature') or in clearly created sets of options ('acceptance to an offer to contract can be delivered (i) written, (ii) oral, (iii) performance, or (iv) other pre-determined manners'). And this step could be completed one of two ways: by human surveying or by deep learning algorithms.

Third, we would need to complete these first two steps for multiple legal cultures. Any legal cultures we would want to include in the software, we would need to create these legal graphs. As a result, we would have a collection of legal graphs for each legal culture.

Fourth, we could analyze all of the legal graphs, to see how much 'distance' existed between each legal concept from each legal culture's graph. This would result in what is called a network model, reflecting the multi-dimensional analysis of each graph in an integrated model.

Given all that work, we could then take a singular draft contract and then computationally analyze it to see how it would be interpreted by different legal

systems, and very importantly for real life negotiations, reveal where multiple legal cultures read the contract in the same way and where the different legal systems do not agree on the meaning of the contract, so that negotiations could work to enhance the drafting to avoid those problems after contractual formation.

6.5. BACK TO THE METHODOLOGY CHOICE FOR COMPARATIVE CONTRACT LAW

Graph Theory could give us a method to explore the similarity and differences within comparative contract law systems, but a very fundamental problem remained at the very core of our project. How to create the basic graphs, by human scholastic survey and feedback, or, by using deep learning algorithms?

And key to that question, what do we gain or lose by that choice of method? Is it a matter of speed or convenience, is it a matter of grappling with bias and cherry picking, is it a matter of human meaning versus mathematical coefficients?

In studying this potential computer program for comparative law work, we may have discovered something very important, that humans and deep learning systems operate differently, that we create different results, and that the choice of methodologies needs to be better understood by lawyers as we grapple with law in the future.

7. THE NEW DANGER OF DEEP-LEARNING IN CONTRACT LAW
－ AND ITS CURE

The danger we faced in examining the legal rules to create legal graphs for each system of contract law was how to actually get that work done, by human or by machine?

7.1. DANGERS OF MECHANICAL COMPARATIVE CONTRACT LAW

The first option was for a human to sit down, write out a list of legal issues, determine how to phrase the issues in a machine friendly format, and then to determine the answer for each issue in the new format. This is both tedious and

exposes the data set to the personal legal biases of the legal researcher. The bias problem could be reduced by using teams of researchers and averaging their answers, but that is even more laborious and time-consuming. But, to retain human input would reflect an understanding of comparative contract law from a human perspective, informed by our culture, legal theories, and legal histories.

The alternative was to allow deep-learning systems to identify issues and their graph-based answers. The technology now exists that deep learning systems can process large libraries of text files to identify patterns, even clusters of patterns. Deep learning machines and artificial intelligence programs can also be written to extract rules from narrative texts, like court cases. So, the 'legal research' task could be automated, letting the machines determine how many legal issues are important enough to examine, and, how each legal culture 'graphs' their legal rule. And of course, as the work would be done by machines, their work product would be machine readable.

But several problems would quickly emerge.

First, we may not recognize the 'legal rules' that the machines identify as 'legal rules.' The machine does not feel our culture and our morals, no, it merely spots trends and patterns in legal data. The rules identified by the machines may have no cultural meaning for humans, no connection to our core legal theories or notions of justice. The computer identified rules will simply be meaningless correlations, data edges with no necessarily humanistic meanings. But the machine will identify patterns and process them as patterns.

Second, the choice of data to feed the computer is messy at best. Does one feed the machines all of a country's legal corpus? Does one limit the data to certain years, to certain types of legal materials, does one include non-legal but clearly guiding materials, such as religious testaments or philosophical works? A 'cost effective' answer might be to use large, pre-made specialty databases, e.g., a database

on CISG materials or collections of arbitration cases. And could one ensure that each legal culture benefitted from identical data sets, to ensure a proper match of data. Low cost to use data sets that would appear to focus on the necessary commercial or contract laws. But cost effective might be the wrong measure; is equity and justice to be founded on cost savings?

Third, a deeper question: does our law mechanically emerge purely from our history of law, is law purely a pre-determinative process, that if you know all the past law to a point that you could forecast all the future of law? Or, does law continue to experience new genius, new goals of justice, new areas of conflicts, new political problems or dreams? If the answer is the first, that human law is a mechanically produced set of legal rules, fully predictable like a baseball can be predicted by physics, then deep learning and artificial intelligence machines will do an efficient job of determining our comparative contract laws and also the future of our laws.

But if that is not true, then the answer is that law evolves in connection to the genius of the human spirit. And if law emerges from our hearts and souls, if law can suddenly take on new unexpected goals, then allowing the machines to compute and determine our rules would in fact lock us into a prison of law based on historical modes of law. We would be presented with an interesting interpretation of the history of law, from a machine's identification of rules and rule clusters, but that result might be unintelligible to us, as if written by space aliens.

We will have lost both control of our law and the cultural meaning of our laws.

7.2. MORE BROADLY ON COMPUTING BABYLONIAN CONTRACTS

This article has discussed a particular legal software project that exposed our researchers to the broader issues facing contract law and comparative contract law in the future. But the problem is fundamentally present in all digital contract law, not just this one experience.

Smart contracts, as written in computer languages, do enable an interesting

form of formalized contract language.[(21)] So long as the performance space remains within the cyber-world, contracts can be fully self-monitoring and completing of contractual objectives.

But computers, and computer users, can readily include input from the outside world into cyber-world, so real world performances, such as finished painting the house or washing the car, can be inputted and validated so that the digital contract continues its own performance of the contract. And indeed, we see examples of this in modern taxi services, such the US's Uber, China's Didi, and Korea's Tada wherein most of the contracting is automatic and online, with elements of real-world confirmations of service built-in.

But where these digital contracts fail, and fail us as a society, is how they lack awareness of their own contractual performance. The machine cannot render 'good faith' to you no more than it can genuinely understand equitable reliance or notions of liability. In all of the digital contracts reviewed in my research, none have ever addressed contract law beyond that Mesopotamian style of clerically written contract templates. For that is honestly what smart contracts are for now. Digital versions of Babylonian contracts.

These digital contracts are not Justinian's Roman contracts, nor are they Aristotle's Attic Greek contracts, they merely enable ancient modes of contracting by form and template. And as many of today's lawyers cannot read, dissect, or program these new digital contracts, there is little guarantee that either the contract nor the fora of its performance recognize any of our transnationally held *Grundnormen* for contract law. When a digital contract mis-performs, how do you tell it *pacta servanda*

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(21)　For example, when people speak of BitCoin, they often include discussions on smart contracts and decentralized autonomous organizations, both particular forms of algorithmic contracts that can be programmed in computing languages. Smart contracts can be written in general purpose languages, e.g., Python, or in specialized languages such as Ethereum.

sunt?

8. SUMMARY AND CONCLUSION

If we, as comparative contract scholars, do not learn to find a way to speak law in a more formal mode, Law and her Justice will no longer be ours. No longer in our voice as humans. For the wheels of commerce will seek to mechanize legal services and legal advice much as industry has already mechanized so many aspects of commerce. And as explored above, the computing machines will not find law as we find it.

The key is to enable lawyers to be able to remain in control of this process. For it is very clear that corporations and universities will continue to encourage and finance the development of mechanically computed law and legal projects. Thus, legal researchers and legal professionals must learn to code, to math, and to see law in new ways － to fund a way to express law formally so that we can lead the conversation on how to compute law.

If the legal community lets the machines do the work, then we will lose our own control of law, our own sense of legal meanings and theories, and as a consequence, we will lose our ability to seek and claim justice. It sounds dramatic today, but if we cannot engage as programmers, as modelers, then those who can so program the machines will be left to engineer 'law' for us.

OR, we can find new ways to write and speak of law. We can complete Leibniz's vision for law to have its own formal language, so that humans can design legal problems for machines to compute, but securely on our terms, in our legal cultures, with our notions of fairness and justice central to the calculations.

And most importantly, by achieving this capacity, we will best protect our ability to be creative legal scholars and ardent advocates for the future generations of humanity.

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和文抄録

　本稿は、「法科学の進歩と法政策の構築において、コンピューターと人工知能にどれくらい深く依存すべきか」という今日の法学者が直面しているもっとも重要な問題の一つを取り上げる。

　今日に法と呼ばれているものを発展させるための数千年にわたる長い挑戦は、我々の根本規範と道徳的価値に対する創造的、文化的、不可避の質問を含む生得的で人間的な作業であった。契約法の比較法的観点から、人が作った法とは、2000 年以上にわたって文書化され、法的進化による包括的な概念を導出し、各文化に当てはまる法の概念および社会福祉における大きな公平性と効率性を図るために絶えず変化してきた。

　本稿は、各地域社会と国の秩序と正義についての人文学的表現としての法、特に契約法において、その歴史が様々な文化や時代においてどのように共通するかを見つける。また、ドーマ、パスカルおよびライプニッツの研究方法からすでに数学的研究方法の起源が存在したことを発見し、法が「科学がもつ形式的な言語」を同様に有することができるかについて探究する。これは、人工知能システムが契約法の比較法的研究の方法論として全面的に活用することができるかについての検討につながる。この検討を通じて、コンピューター基盤の方法論から発生しうる問題点を指摘し、やはり法律家が主導的に形式的な言語を考慮しながら新たな技術を開発することにより、法の正義と公平に関する人文学的思考を反映し、その利益を享有できると主張する。

〔追記〕

Prof. Dr. Roy Andrew Partain による本講演は、2019 年 11 月 21 日（木）に広島大学法学部・経済学部 B255 室において、広島大学法学部法学会の主催により実施された。Roy Andrew Partain 教授は、現在イギリスの University of Aberdeen School of Law で副学部長の職にあり、アメリカ弁護士（J.D, the

State Bar of Texas）である。御多忙の中、広島大学におきまして、「Comparative Contract Law：METHODOLOGICALLY HUMAN OR ARTIFICIALLY INTELLIGENT」という問題を扱ったご講演を通じ新たな時代における人工知能システムの活用に関する問題意識を共有し、今後の法律家の役割とそのあり方に関する視野を拡張することができましたことに心より感謝申し上げる。（世話人　金旼姝）