Von der Spezifikation zum Schluss:
Rhetorisches, topisches und plausibles Schließen in
Normen- und Regelsystemen

Herausgegeben von Lothar Philipps und Rainhard Bengez
Legal machines and legal act production within multisensory operational implementations

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**Abstract:** The concept of legal machine is elaborated: first, the creation of institutional facts by machines, and, second, multimodal communication of legal content to humans. Examples are traffic lights, vending machines, workflows, etc. Machines can be imposed status-functions of legal actors. Their acts have legal importance and draw legal consequences. Thus the concept of iustitia distributiva and societal distribution is enhanced. The analogy of machines with humans is explored. Legal content, which is communicated by machines, can be perceived by all of our senses and expressed in multimodal languages: textual, visual, acoustic, gestures, aircraft manoeuvres, etc. This paper introduces the concept of encapsulating human into machine. Human-intended actions are communicated to third persons through the machine’s output channel. Encapsulations are compared with deities and mythical creatures, which can send gods’ messages to people through the human mouth.
1. Introduction: an analogy of machines and human beings in legal context

This paper addresses human beings and machines as actors within legal transactions (Rechtsgeschäfte). The focus is on machines in the transition from raw facts to legal facts (also worded institutional facts). In subjective law, which can be visualised with the metaphor of the stage of life, we view machines in the foreground and humans in the background; see Fig. 1.

Fig. 1: Machine = analogy of human on the horizontal Is stage

A framework to survey comprises the following concepts. Objective law and subjective right, which is relevant to a legal situation, come first. Real-life workflows comprise both humans and machines. Their decisions are qualified as legal acts. The workflows deal with conditions and effects. Legal informatics forms a basis that provides machine coping techniques. Legal theory appears as a metasystem. Ontologies (in the sense of informatics) and logic are used in the languages of discourse. Objective law imposes a structure on machine behaviour.

Machines can communicate acts to humans who perceive the legal contents by multiple senses (sight, hearing, etc.). Thus a kind of multisensory legal
communication is observed. For the term *multisensory law* we are indebted to Colette R. Brunschwig; see e.g. (2011). Multisensory means more than one stimulus. The definition of the discipline is not trivial:

Modifying the noun ‘law’ the adjective ‘multisensory’ refers to which kind of law or which law is at stake. The law in question is not, for instance, copyright law, family law, or penal law, but another legal discipline, that is, multisensory law. The term *multisensory law* not only has terminological implications, but also concerns its subject matter and cognitive interest. [Brunschwig 2011, p. 591]

2. **The context of legal machines**

Factual acts are from the Is world (i.e. the reality that is) whereas legal acts are from the Ought world – the reality that ought to be (*das Sollen, das Sollen in einem objektiven Sinn*); see e.g. [Kelsen 1960]. Paraphrasing Kelsen¹ a purpose of this paper is the cognition of legal machines, not their formation.

We depart from an assumption that machines are tools. Technology is substrate – not part of law. However, machines can trigger institutional facts. The context of legal machines is introduced below by the following cases:

Case 1. Vending machines, such as slot machines used for selling drinks;
Case 2. Traffic lights;
Case 3. Form proceedings, such as FinanzOnline²;
Case 4. Machines which are auxiliary to officials in organisations.

Thus the point of departure is that an *actor* makes an *action* with an *effect* and this is under a *condition* (Fig. 2). An example is *Alice puts a coin in her piggybank*. A notation for the factual act model is the tuple: *factualActType* = (*condition, actor, action, effect*). The actor can be of different types: a human being, a machine, a deity, a text, etc.

![Fig. 2: From factual acts (raw facts) to legal acts (legal facts)](image)

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2 [https://finanzonline.bmf.gv.at/](https://finanzonline.bmf.gv.at/)
Factual acts have no legal importance whereas legal acts have. Legal importance is observed, for instance, in conduct implying an intent (konkludentes Verhalten), such as Chris putting coins in a ticket machine to buy a train ticket, a policeman raising hand, etc. You commit a fraud when dropping not valid coins in a vending machine, whereas a child may put them in her piggybank. Legal facts are important since they initiate the birth, change and the termination of legal institutions. McCormick & Weinberger (1992, p. 49–92) even advocate the view Law as institutional fact.

Factual acts can be lifted to the legal acts category by the actor’s role. For example, you are obliged to stand up when the judge enters a courtroom, though you sit when ordinary people come in. Both factual and legal acts are raised by real-life events and can be represented by Boolean propositions, e.g.:

\[
\text{factualAct}_1 = \text{pedestrian}\_\text{Mike}\_\text{raising}\_\text{hand} \\
\text{legalAct}_1 = \text{policeman}\_\text{Steve}\_\text{raising}\_\text{hand}
\]

The difference is in the legal consequences, e.g. factualAct above has no legal consequences, whereas legalAct implies, that the drivers are obliged to halt: \(\text{legalAct}_1 \implies \forall x \in \text{drivers} \quad \text{Obligatio}(\text{halt}(x))\).

Legal effects are important whereas the types of legal acts — speech acts or implications are not. Persons putting coins into a vending machine engage in sales contracts. A traffic light distributes rights to cross the road. The third example is FinanzOnline form proceedings in the e-Government domain.

The condition can have legal importance, too. For example, road radars make photos when the vehicle’s speed exceeds a certain value. Hence, each element — the legal condition, the legal actor, the legal action and the legal effect — are qualified to have legal importance.

**Traffic lights – vertical effect.** In the contract example, the relationships condition-actor-action-effect have horizontal – individual – effect since they concern private law. Traffic lights have vertical – general – effect as regulated by administrative law. The traffic lights normativity can be expressed in different formalisms. The algorithm in terms of a finite-state automaton is shown in Fig. 3: you are prohibited to go on a red light, \(F(\text{go})\), and permitted on green, \(P(\text{go})\), though you can wait on the pavement, too. The automaton’s states are turned from red to green or vice versa. The algorithm changes permissions and obligations and distributes legal time and space between pedestrians and drivers.

The regulation of pedestrian traffic lights can also be expressed with a formula:

\[
O(\neg A) \lor (O(\neg A) \implies P(A)) \lor \neg P(A) \lor P(A)
\]

where \(O = \text{obligation}, \ T = \text{transition}, \ P = \text{permission}, \ A = \text{go-action.} \)

Prohibition to do \(A, F(A)\), is formalised as obligation not to do \(A, O(\neg A)\).

The yellow light is not taken into consideration above in order to simplify the model. On yellow, if a driver cannot stop then he is obliged to drive; otherwise he is obliged to stop. This formulation requires a predicate \(\text{Can}(A)\).
**Workflow and legal machines.** Case 3 is about form proceedings workflows, such as FinanzOnline in Austria. Decision makers are comprised of humans and machines (Fig. 4). Data input to a workflow is a legally binding act. For example, declaring income has legal qualification and you are obliged to input truthful data. You cannot excuse machines saying that you were joking with false data. Machines also check for your input correctness. Hence, all communication combinations are observed: human-to-human, human-to-machine, machine-to-human, and machine-to-machine. Each is of legal importance.

**Fig. 3:** The vertical effect of administrative law regulation by traffic lights. The algorithm is represented in the form of a finite-state automaton. On a pedestrian red light they are obliged not to go, $O(\neg \text{go})$, and drivers are obliged to go. On a pedestrian green light they are permitted to go, $P(\text{go})$.

**Fig. 4:** In a workflow, decisions can be made by machines, too.
**Machines replacing administrators in organisations.** In the production of legal acts by organisations, differences between legal machines and humans are not so big. An organisation can be viewed on three levels (Fig. 5). The first is the legal entity (juristische Person) as a whole. The second level is a body (Organ) of the organisation, and the third one – an administrator (Organwalter) of the body, which can be a human being or a machine, too. An example is an official selling train tickets. A buyer makes a contract with the organisation and not with the cashier. Here the cashier can be replaced with a ticket machine.

![Fig. 5: Three layers within an organisation. A legal act establishes a relationship between two entities](image)

**The right of representation** is an issue. The question is, can machine represent an organisation’s body? In other words, can machine appear as a representative of the organisation?

The answer depends not on definitions but on the legal position of machines that is regulated by the law. The legal form results not from raw facts (Kelsen’s Is) but from the legal order (in accordance with the Ought and Pufendorf’s impositio). Imposing regulations by machines is a prerequisite to change their status from tools to legal machines. A legitimisation is necessary.

**The sense (Sinn) of contract.** It lies in the legal act – not the substrate. The institutional fact is of legal importance whereas the actual action of obtaining goods is not. The legal act is from ought whereas the substrate is from the Is. From this viewpoint, we draw an analogy between making contracts via administrators and machines. Machine counts as administrator in organisation; see the formula X counts as Y in context C [Searle 1995, p. 114]. A similar status can be imposed on different ontological categories of phenomena: people and objects (p. 97).

**Creating institutional facts.** Hence, two alternative bridging relationships with a third person, the buyer, are: a) organisation - administrator - person; and b) organisation - machine - person. In both cases the representation powers are
Scoped by the seller’s function. Next section describes a notation for the first arch in a) and b): two distinguished encapsulations, organisation-in-administrator and organisation-in-machine.

Substrates. Machines replacing administrators result with the substrates human-organisation and human-human (Fig. 6). The human-machine substrate is not a reality yet. Machines can have the aura of natural persons but still do not reach the level of legal persons. They lack legal capacity (Rechtsfähigkeit) and contractual capacity (Geschäftsfähigkeit).

Substratum: • Human-organisation • Human-human • Human-machine (not yet)

Fig. 6: Communication relationships. Machine is auxiliary to administrators: machine ≠ legal person

Boundary. The case of organisations draws a boundary of today. Imagine a future situation in which a machine replaces the whole organisation. Suppose national register organisations. Today they operate as legal persons according to the Case 4 model shown in Fig. 5. However, imagine a register which is operated by a legal machine (Fig. 7).

Fig. 7: Machine replaces an organisation and becomes a kind of e-Person

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Thus the machine becomes a kind of e-Person; see e.g. [Schweighofer 2007]. This is not in a reality yet. A paradigm shift for future is to complement legal actors with legal machines.

**Machine is analogy of slave in Roman law.** Administrator-organisation relationship is similar to that of a slave (servus) making a contract in favour of his master (dominus); see Fig. 8. The slave is a thing (res). Therefore this is depicted with a box and a human inside. It is important that slaves could make contracts for their masters (in scope of their property, peculium). The contract is not for the slave but via him. Thus two alternatives of negotium between Aulus Agerius and Numerius Negidius exist: via a slave or directly. Machine’s position in nowadays organisations is similar to the legal position of a slave.

![Fig. 8: Alternativ negotium between AA and NN: via a slave and directly](image)

**Context.** Law is transformed into machine’s input, which has the form of programs (Fig. 9).

![Fig. 9: Legal machines in the context](image)
The machine produces output to a human. The context is also important for him. It comprises various extra-legal contexts, such as cultural, political, social, technical, and economic [Brunschwig 2011, p. 577] and issues, e.g. legal protection, appeal, etc. The output raises an institutional fact and communicates it to the human. The interaction concerns multisensory law and human-computer interface. Hence, the issues of law and information technologies (IT) are tackled.

The language in which the output (Fig. 9) is communicated from the machine to the human needs not to be a natural language like English or German:

>Social facts in general do not require language. … Language is partly constitutive of institutional facts amounts to the claim that institutional facts essentially contain some symbolic elements in this sense of ‘symbolic’: there are words, symbols, or other conventional devices that mean something or express something or represent or symbolize something beyond themselves, in a way that is publicly understandable. [Searle 1996, p.59–60]

**Latency of legal forms.** New technological developments, especially ones involving the Internet, can lack new legal forms. Recall the old forms, written and oral. Suppose two natural persons intending to engage in a kind of a contract relationship and seeking a suitable form. Let us assume that no new legal form is available. Therefore the individuals start seeking for a workaround form. They decide on an old available form. However this old form which is drawn on the persons can have normative and institutional consequences, which are not suitable for the present situation. Examples are gratuitous service contracts which are seeking proxies to read university lectures. Recall also disastrous consequences of bank contracts when the whole loan was paid to individuals.

To sum up, new technological situations may need to create new legal forms or to customise the old ones. Old form consequences can be undesirable.

3. **An analogy between machines and humans**

Above we introduced the context of machines which perform analogous roles with humans. The framework of our survey is depicted in Fig. 1 where law is viewed as a whole. Two approaches to machines can be handled:

1. From human beings to machines;
2. Legal machines as such. The developed approach ought to be sound.

Four themes can be explored:

T1. Transformation of legal text into technical specification languages;
T2. Legal regulation of multisensory properties;
T3. Encapsulation (Verschachtellung) of different entities (humans, machines, etc.). The combinatorics of rhetoric and behaviour;
T4. Formalisation.
Four types of relationships to send legal content. Two types on the output side – human and machine – and two on the input result with four combinations; see Fig. 10.

![Diagram of four types of communicating legal content](image)

**Fig. 10: Four types of communicating legal content**

These four interaction types are viewed differently in the context. The internal representations of information are different: texts for humans and programs for machines. Therefore, on the metalevel, different requirements arise for e.g. human-human and computer-computer interaction. The incoming texts can be read by people, but programs cannot be read by the users.

**Situational flexibility.** Human-human interaction is more flexible than human-computer. People can adjust their behaviour to a concrete situation. As an example suppose a train approaching a station and a person under stress going to buy a ticket. It makes a difference to buy from a cashier or a ticket machine. The cashier can see the global situation, but the machine cannot.

Multisensority can ease layperson’s interaction. Multiple channels, such as voice, face expression, eye contact, etc., can be used concurrently to explain situation details to an administrator. Machines are less flexible in interpreting this multichannel information. Nevertheless examples can be provided. Suppose human-computer interaction by voice, for example, a driver or a military pilot commanding the machine in a quickly changing environment.

Situational flexibility features can be foreseen in machine specifications. An illustration is a rapid but expensive service instead of a slow but cheap. Communication in emergency situations, such as a need of ambulance, police or fire fighters, can be regulated by law.

**Multiple human senses – multiple formats.** Machines are artefacts of man. Multisensory properties mean multiple input channels (Fig. 11). Next question is how to manage outputs which are produced by output channels.
Fig. 11: Multisensority in the imago doctrine: \textit{machina} = \textit{imago hominis}

For example, a legal act which forbids entering can be issued by different actors including machines and technical devices. In the case of a policeman raising hand and whistling, a human recipient perceives the message by sight and hearing. A traffic sign is sensed by sight only. A barrier can also be sensed by touch (blind people). A verbal sign such as ‘Betreten verboten’ is sensed by sight and its comprehension is limited on people understanding German.

Recipient’s input channel format can be modelled with a parameter within the message representation \texttt{command(format, content)}, for example:

\texttt{command(format=gesture, content=’Policeman raising hand’) }
\texttt{command(format=acoustic, content=’Policeman whistling’) }
\texttt{command(format=visual, content=’Traffic light turns red’) }

\texttt{command(format=visual, content=’Betreten verboten’)}
\texttt{command(format=visual, content=’A road barrier on the street’) }

All the messages above mean the obligation to stop with different semantic nuances, \textit{O stop} or \textit{O no action}, \(O \neg A\). Hence, a need appears for a notation which expresses normativity of multisensory messages.

This is similar to the multiple formats of text documents. A single document has its structure and can be produced in multiple output formats such as DOC, PDF, HTML, etc. Digital signature and other properties can also be foreseen. Similarly, a legal statement of the form subject-predicate-object can be outputted differently. Different levels and channels can be targeted.

**Multisensory representation of legal content.** Suppose a linear structure subject-predicate-object (Fig. 12) to model sentences in a self-conscious language.

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Fig. 12: From linear sentences to multisensory formats of legal content

The question is: What are sentence formats in the unconscious? Could non-linear formats be more effective? The issue is to contrast conscious information, which is intersubjectively comprehensible, with unconscious one, which is intrasubjectively comprehensible. The question can be formulated: Can the cognitive cube be diced in other formats of legal contents? Or, what could be the formats for visual, acoustic, motor functions, textual, logical, etc. representations of legal contents (Fig. 13)? All the formats are targeted to store information in computer. Distinct formats result in different products – document types. For example, the rules of computer actions are represented in programs, not in texts. We find that multisensory information is multilayered and has multiple dimensions.

Fig. 13: The metaphor of unfolding the multisensory cognitive cube to multiple formats

Multisensory law is at the periphery of textual law. Suppose designing a multisensory legal machine such as traffic lights for disabled people. It has to be equipped with sound devices and touch panels. Therefore, first, the (verbal) road rules concerning disabled have to be transformed into legal content
(multisensory commandments), which would be perceived by disabled. Next transformation leads to technical statements which implement the legal content to be sensed by hearing and touch. The resulting acoustic implementation can be achieved with the following transformations:

\[
\text{Norm(subject-predicate-object)} \rightarrow \text{command(acoustic, 'beep')} \rightarrow \text{technical instructions}
\]

**Multisensory in procedural law.** Law concerns several tiers; see Fig. 1. The lowest tier is actors’ behaviour on the Is stage. Actors interact in different forms: written, oral, gestures, etc. The ‘what’ behaviour is regulated by material law whereas the ‘how’ by procedural law. Both are comprised by the second tier. The third tier comprises promulgation law. Parliaments cannot regulate so flexibly comparing with technical standards which regulate multisensory communication. Legal systems have to satisfy the minimality principle. Therefore the weak rules of multisensory behaviour are placed in technical standards. Though, the written and oral forms of proceedings are regulated by the law. Examples of uni- and multisensory legal or legally relevant phenomena are provided by Brunschwig [2011, p. 592–599]: (1) voting in a parliament and (2) video recording during the questioning of children. She analyses in details the subject matter and cognitive interest of multisensory law.

The actors on the horizontal Is stage, humans and machines, communicate through various channels. Promulgation rules on the vertical tier of law could also be extended to multimodal channels such as Braille or voice. Whether this is reasonable, is another question.

Hence, normative multisensory is a matter for wide regulation by technical standards. The latter are made by expert groups. Technical issues should not be overregulated by the laws in order not to make new technologies illegitimate. For example, the data protection law regulated obligatory formats such as RTF which have nowadays outdated.

Signals are the gestures of machines. Signal languages are regulated by technical standards. Further we investigate the combinatorics of human gestures, machine signals and signal functions.

**Statutory law, customary law and machine law.** Customary law and machine law are in the foreground on the Is stage (Fig. 1). As an example suppose a zebra crossing and pedestrians who aim to cross the street. Statutory law (the road rules) regulates this situation. However, ordinary people are governed primarily by customary law which superimposes statutory law. And finally this situation is governed by traffic lights – machine law steps in.
4. On formalisation of the legal machine concept

The question to explore is: How to formalise the raised legal machines issues in formal models? Following are two subthemes (Fig. 14):

1. **Combinatorics of communication.** Modes: text, acoustic, gestures, etc.
2. **Classification of actors:** animals, humans, allegories, machines, etc.

![Diagram](image)

**Fig. 14: The types of actors and communication**

Regarding subtheme 2, animals are not legal actors whereas human beings are. Allegories such as the state and juristic persons can denote legal actors. Legal machines are not juristic persons, however can be assigned a status-function. The question is: How to represent encapsulations symbolically?

**Human-in-machine is similar to human-in-animal encapsulation in the ancient world.** Examples of transformations of a human into an animal and vice versa can be found in Greco-Roman myths. Mythical creatures such as minotaur³, centaur⁴, sphinx, etc. embody encapsulations. Characters such as krampus⁵ are still played nowadays during carnival parades. The Mechanical Turk⁶ is an example of human-in-machine. Thus the combinations of human and

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³ A creature with the head of a bull on the body of a man or, ‘part man and part bull’; see [http://en.wikipedia.org/wiki/Minotaur](http://en.wikipedia.org/wiki/Minotaur).


animal can be complimented with the encapsulations of machines: human-in-machine (The Turk) and machine-in-human.

The word ‘person’ is derived from Latin persona – actor’s mask, character in a play, later human being. The word refers to an abstract thing. It can also be implemented by machine.

**Transforming humans into animals and machines.** Human-to-animal transformations in the ancient world are about transforming a man into an animal such as a bird or an ass; recall the myth about Midas and Apollo. It should be noted that the issue is not about evolution.

The combinatorics to explore concerns four kinds of entities: (1) animal, (2) human, (3) mask – person (persona) where allegories such as state, juristic person, etc. are included, and (4) machine.

Each entity speaks a specific language. Formal logic can be viewed as a language of machines. Acoustic output is illustrated by phone answering machines or GPS which give commands in voice.

**DEFINITION.** Encapsulation of an actor $A_1$, called *encapsulator*, into an actor $A_2$, called *encapsulatee*, is a new actor denoted $A_1$-in-$A_2$ (or $A_2(A_1)$ in prefix notation) with the following abilities (Fig. 15 and 16):

a) the encapsulator, $A_1$, monitors (i.e. gives commands to) the encapsulatee, $A_2$, in a language $L_1$ which is understood by both $A_1$ and $A_2$;

b) legal content is sent to third persons in a language $L_2$ of the encapsulatee $A_2$;

c) encapsulator’s, $A_1$, goals (i.e. motives, objectives, values) are pursued;

d) encapsulatee’s, $A_2$, channels are used to transmit legal content.

![Encapsulation diagram](image)

**Fig. 15: Encapsulation $A_1$-in-$A_2$ communicates a legal act to an addressee**

A starting point of the idea is that a man, $A_1$, is empowered with a tool, $A_2$. Not all functions of a human being $A_1$ are empowered, but a specific function,

regulated by a norm \( n \). A purpose of introducing \( A1\text{-in-}A2 \) is to combine the abilities of both \( A1 \) and \( A2 \). The maximal set of abilities is the union of both:

\[
\text{abilities}(A1\text{-in-}A2) = \text{abilities}(A1) \cup \text{abilities}(A2)
\]

![Fig. 16: Encapsulation \( A1\text{-in-}A2 \). In prefix notation also denoted \( A2(A1) \)](image)

a) Encapsulation and goals

We view encapsulation as a goal-governed system. The encapsulator \( A1 \) embodies the external goals concept\(^9\). These goals are intrinsic in the norm \( n \) for which the encapsulation \( A1\text{-in-}A2 \) is designed. The legal machine \( A1\text{-in-}A2 \) operationalises the norm, \( n \).

The encapsulation can be assigned a status-function. It can be viewed as the goal of use value (to be apt to … [Conte & Castelfranchi 1995, p. 124]) on \( A1\text{-in-}A2 \). It can also be viewed as the telos. We view this internal goal as a machine’s state. Note that two views – (a) goals as states of affairs and (b) goals as values – should be distinguished when formalising the notion of goal. Conte & Castelfranchi note that the goal definitions could be shared with the cognitive sciences: a goal is a representation of a world state within a system [p. 123].

Intentional goals (i.e. serving as external goals, values, intentional stance) cannot be assigned to every entity. Deities and some allegories such as the state and juristic persons can be assigned goals but machines cannot. A stone \textit{per se} does not have and cannot have any kind of goal [p. 123-124]. Paraphrasing this, a machine (a tool, a gun) \textit{per se} is neither good nor bad.

\(^9\) We follow [Conte & Castelfranchi 1995] and their terminology; see especially Chapter 8 \textit{Towards a unified theory of goals and finalities} [p. 120–141].
b) Examples of human-in-machine and machine-in-human encapsulations

Deities in Greco-Roman mythology have the form of human bodies. Recall gods, goddesses, titans, giants, etc. Thus the personifications obtain both unnatural physical powers of gods and human bodily features. The human mouth serves to send legal content to people.

**Human+machine:** What type to assign to this pair? Human-in-machine or machine-in-human? A starting point is that machines are tools monitored by humans. Second, machines do not have goals. The aim of coupling human + machine is to leverage human abilities. In a powerful combination, humans give intelligence to machines whereas machines leverage physical and computational abilities of human beings. Thus humans obtain capabilities to fly, drive, calculate, transmit information via telecommunication devices, etc.

The definition of encapsulation above implies the following consequences.

- **Human-in-machine, **MA(HU)**, means that (i) human’s goals are pursued and (ii) machine’s channels are used to transmit legal content to the third party.**
  
  The human uses the machine as a tool, e.g. pilot-in-aircraft and driver-in-car.

- **Machine-in-human encapsulation, **HU(MA)**, means that (i) machine’s goals are pursued and (ii) human’s channels are used to transmit legal content.**

  Let us take a policeman-in-machine example. A policeman watches images on computer display that are transmitted from a distant camera which monitors a barrier. The policeman’s command to stop the traffic is expressed in machine’s gesture – the barrier is being dropped.

  It is not trivial to provide a meaningful example of machine-in-human encapsulation. The reason is that machines do not have goals. Nevertheless, suppose a malfunctioning machine $A_1$ sending a false alarm message to an authorised human $A_2$. The human commands Alarm resulting with bad consequences. However, the false alarm has legal consequences.

  **Human-in-machine, **MA(HU)**, examples illustrate encapsulations of a man. Human functions are assigned to different entities such as machines and animals:**

  - **Pilot-in-aircraft, **AIRCRAFT(PILOT)**. Suppose two aircraft in the air. The first pilot orders the second one immediate landing$^{10}$. The signalling is in aircraft gestures, for instance, waving aircraft wings. The first pilot stands for $A_1$ and his aircraft for $A_2$. The goal of $A_1$ is to force landing the second aircraft. Aircraft signals stand for $L_2$. Usually this is additional to the hand signals of the first pilot and an eye-to-eye contact.

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$^{10}$ This happens in extraordinary situations, for example, the second pilot does not answer radio communications between the aircraft or does not obey the first pilot’s orders.
- **Policeman-in-car, CAR(DRIVER).** Suppose a policeman, \(A1\), in a car, \(A2\), commanding a violator driver to stop during night. The policeman can use any communication channels such as car lights, manoeuvres, a loudspeaker or even a gun. His goal is to stop the violator. Car signals stand for \(L2\).

- **The Turk\(^{11}\).** The type is human operator, \(A1\), in the mechanical device, \(A2\) that moves chess pieces. The goal of \(A1\) is to win against the opponent player thus cheating him that machine thinks. Chess moves stand for \(L2\).

- **Transforming a human into an animal.** The type is a man-in-animal, \(BIRD(MAN)\) and \(ASS(MAN)\); see the Golden ass\(^{12}\) mythical story. The man, \(A1\), intends to spy with the goal to practice magic. Therefore he intends to transform into a bird, \(A2\). The man-in-bird would acquire the abilities of both. The man’s goal is to be small and fly. However, while trying to perform a spell to transform into a bird, he is transformed into an ass.

**Representing communication via phone or Skype.** To illustrate the human-in-machine notation, phone and Skype communication between two humans \(H1\) and \(H2\) is described below. The communication chain between \(H1\) and \(H2\) is represented with two encapsulations and one transmission (Fig. 17).


A simple phone can hardly be viewed as a legal machine. However, a legal status can be imposed on intelligent phone machines. The obligation to answer calls (of certain callers) can be comprised in the status.

There are two channels between $H1$ and his phone $M1$: (i) voice to the $M1$’s microphone and (ii) acoustic signal from the $M1$’s speaker to ear. The transmission between the two phones is through one channel: electric signal encodes voice. The whole chain is described as follows:

1. Encapsulation human-in-machine $H1$-in-$M1$. A message from $H1$ to $M1$ is transmitted by voice. $M1$ encodes the voice message in electric signals.
2. Communication. The message is transmitted from $M1$ to $M2$.
3. Encapsulation human-in-machine $H2$-in-$M2$. $M2$ transforms electric signals into the phone’s speaker vibration thus transmitting to $H2$ via an acoustic channel. $H2$ is encapsulated into $M2$ with the purpose to receive electric-signals, which are decoded to acoustic signals by the speaker.

Skype communication employs video and file transfer as additional channels. Therefore people can communicate in gestures and mimics.

Fig. 17: Human-in-machine encapsulation notation in communication via (a) phone and (b) Skype
Other devices and languages can be used for transmission. Examples are naval flag signalling and Morse code which can be transmitted by lights. Lighthouses serve as legal machines for seamen and radio beacons for pilots.

In contrast to encapsulating a human, human-in-A2, following is an example of encapsulation into human, A1-in-human, namely, allegory-in-human:

- **Leviathan by Thomas Hobbes**<sup>13</sup>. The state allegory, A1, is encapsulated into the human-form sovereign Leviathan, A2. The L2 language is that of rule by an absolute sovereign – to wield the sceptre, a gesture language.

- **Biblical Leviathan**<sup>14</sup>. A gatekeeper mask, A1, is encapsulated into a biblical sea monster, A2. The allegory can be viewed as a mask-in-animal. The Hell gate keeping language stands for L2.

### 5 Conclusions

This paper departs from the view *Machines are tools*. The target view is *Legal machines are legal actors* – they are capable of triggering institutional facts. Any computer bit can encode a complex meaning. In organisations there is an analogy between the administrator’s position and machine. The paper identifies law production and communication patterns of machines and raises research issues in multimodal communication. Legal content can be expressed in multimodal languages: visual, audio, machine gestures, etc. It can be communicated by machines and perceived by all of our senses.

The paper introduces the encapsulation concept: a human A1 is encapsulated into a machine A2. Actions intended by A1 are communicated to the third person via the output channel of A2. Encapsulations can be compared with Greco-Roman mythical creatures, part human and part animal, which can send gods’ messages to people through the human mouth.

Multimodal communication is regulated by technical standards. This gives flexibility to the how. The promulgation law cannot regulate so flexibly the details of different forms.

The paper can be viewed from several perspectives: legal informatics, multisensory law and operationalisations. Computer scientists develop various normative frameworks and security platforms. Software engineers do not know the concepts of Ought and Is though implicitly make use of them. We aim at a formalisation which is suitable for both jurisprudents and (software) engineers.

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<sup>14</sup> A sea monster referred to in the Bible, one of the seven princes of Hell and its gatekeeper; see [http://en.wikipedia.org/wiki/Leviathan](http://en.wikipedia.org/wiki/Leviathan).
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