Contracts and e smart contracts

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Contract in Italian Civil code

- Art. 1321 Il **contratto** è l'accordo di due o più parti per costituire, regolare o estinguere tra loro un rapporto giuridico patrimoniale
- The **contract** is the agreement of two or more parties to constitute, regulate, or terminate a patrimonial legal relationship between them

- Art. 1322. Le parti possono liberamente determinare il contenuto del contratto nei limiti imposti dalla legge
- Art. 1322. The parties can freely determine the content of the contract within the limits established by the law

Common Frame of Reference (2009)

- Article 1:101: A **contract** is an agreement which is intended to give rise to a binding legal relationship or to have some other legal effect. …
- 1:102: Parties are free to make a contract … and to determine its contents, subject to any applicable mandatory rules.

What can contract do

- Establish obligations, e.g., commit to provide services, money, etc.
- Transfer property: sale (maybe delivery is needed)
- Confer powers: e.g., options
- Etc.

What a legal contract is?

- An institutional-social act (in principle):
  - The parties declare their intention to realise a certain legal result (through their declaration)
  - The law recognised this declaration: it make so that the declaration of the parties realises its content.
- Example:
  - A and B declare that A sells an asset to B for 1000 Euro, to be paid within a week
  - As an outcome of this declaration, the asset no longer belong to A, but to B, A has the obligation to deliver the asset to B, B has the obligation to pay 1000 euro within a week (in some legal system delivery is needed to transfer property).

Effects of contracts

- Institutional effects: creation/modification of institutional positions (obligation to pay, transfer of property)
- Material effect: when and if the contractual obligations are implemented (work done, things delivered, money given, etc.).

Conditions in contact

- The contract's institutional effects may start or terminate when certain triggering future events take place (conditions, possibly retroactive):
  - Land sale under the condition of obtaining a building permit, financial contracts, insurance contracts
  - Obligation to pay penalty when contract cancelled.

Contract are regulated by the law

- The law confers to the parties the power to create legally binding outcomes through contracts
- The law regulates contracts
  - Establishes obligation concerning the formation of contract (e.g., obligation to inform consumers, not to cheat the counterpart)
  - Inhibits certain declared effect (liability exemption), or imposes non-declared effects (warranties in sales, power to withdraw of e-commerce consumers) .

The contract produces what the parties declared/wanted, but …

- Interpretation. A clause may be ambiguous and require interpretation, if the parties disagree by a third party Completion. The contract leave some aspect unspecified (Where should the purchased goods be delivered?) and the law can provide its choice for such aspect
- Reduction. The contract may contain illegal clauses that are void (e.g., unfair clauses in consumer contracts), i.e., they do not belong to the the binding content.

- Invalidity. The contract may be void or voidable (upon request), when it has certain defects pertaining to its context (illegal), the required form (missing), or its formation (mistake, duress, etc.)
- Resolution. The (institutional) effects of a valid contract can be cancelled because of per subsequent facts. (If buyer A does not pay the price, seller B can ask for resolution)

Smart contract

- **Smart contract**: ”a set of promises, specified in digital form, including protocols within which the parties perform on these promises “ (Szabo)
- However, “smart contract” also refers to whatever software operates on on a distributed ledger (e.g. blockchain):
- A contract-software may not instantiate a legal contract:
  - It may implement a previous off-chain contract (e.g. after making a purchase, I pay in cryptocurrency)
  - It may implement a non-contractual act (e.g. a group votes on a proposal, possibly not binding)
- The contract-software may instantiate a legal contact
  - It may be the other face of a contract also specified in natural language (and provide for the implementation)
  - It may be the only expression of a binding agreement.

A smart contract?

- Whatever software adding data to a distributed ledger
- Software that updates a distributed ledger implementing some kind of transaction between parties
- Software that implements a legal contracts
- Software that specifies and implements a legal contract

Contract-act vs Contract-software

- **The contract-act (contract as a social-legal act) constitutes legal effects**: it creates, modifies and transfers rights, duties and powers (conditioned and unconditioned)
- The **contract-software effects computations:** it delivers changes in data structures which may trigger further computations, possibly governing physical actuators
- A legal contract being also a smart contract generates both

What connection?

- The contract software changes the entries that record ownership of rights and obligations according to the contract-act
- The contract software fulfils obligations in contract-act, through
  - changes in the ledger (e.g., payment in cryptocurrency)
  - further computational/physical processes (e.g., block car when instalment not paid)

Contract-act vs contract-software : can what if they clash?

- A contact-software & contract act has a double function
  - Express the declaration/determination meant to create certain legal results/commitments
  - implement these results/commitments
- Problem
  - What is the legally binding content of the contract?
    - What the parties understood?
    - What results from running the contract?

Can the social meaning of contract change?

- In signing contract-act, the parties make promises (speech acts), and commit to do something in the future
- In signing a contract-software the parties agree on triggering computational processes, and they commit to enable them (not to interfere with them)

Some issues in legal smart contracts

- Interpretation
  - What type of contracts is been agreed: is a transfer of stock a sale or a loan?
  - What if the outcome of execution of the program differs from what parties expected, also based on previous interactions
- Illegal clauses
  - What is a clause is illegal (excessive interest) ? How to substitute the legal clause for the illegal one?

What about undetermined standards?

  - Reasonable request
  - Due diligence (best effort).
  - Timely response
  - Good faith
  - Etc.
- Not use them? Off chain? Have a human oracle to assess?

What if the contract is not void, annulled or resolved

- How to terminate (retroactively) the effects of a contract
  - Trigger that stops execution
  - New contract that inverts the effect of the invalid contract
  - Off chain remedy (e.g. obligation to compensate the counterpart)
  - Sanctions when the contract implements an illegal activity (money laundering, illegal drugs, etc.)

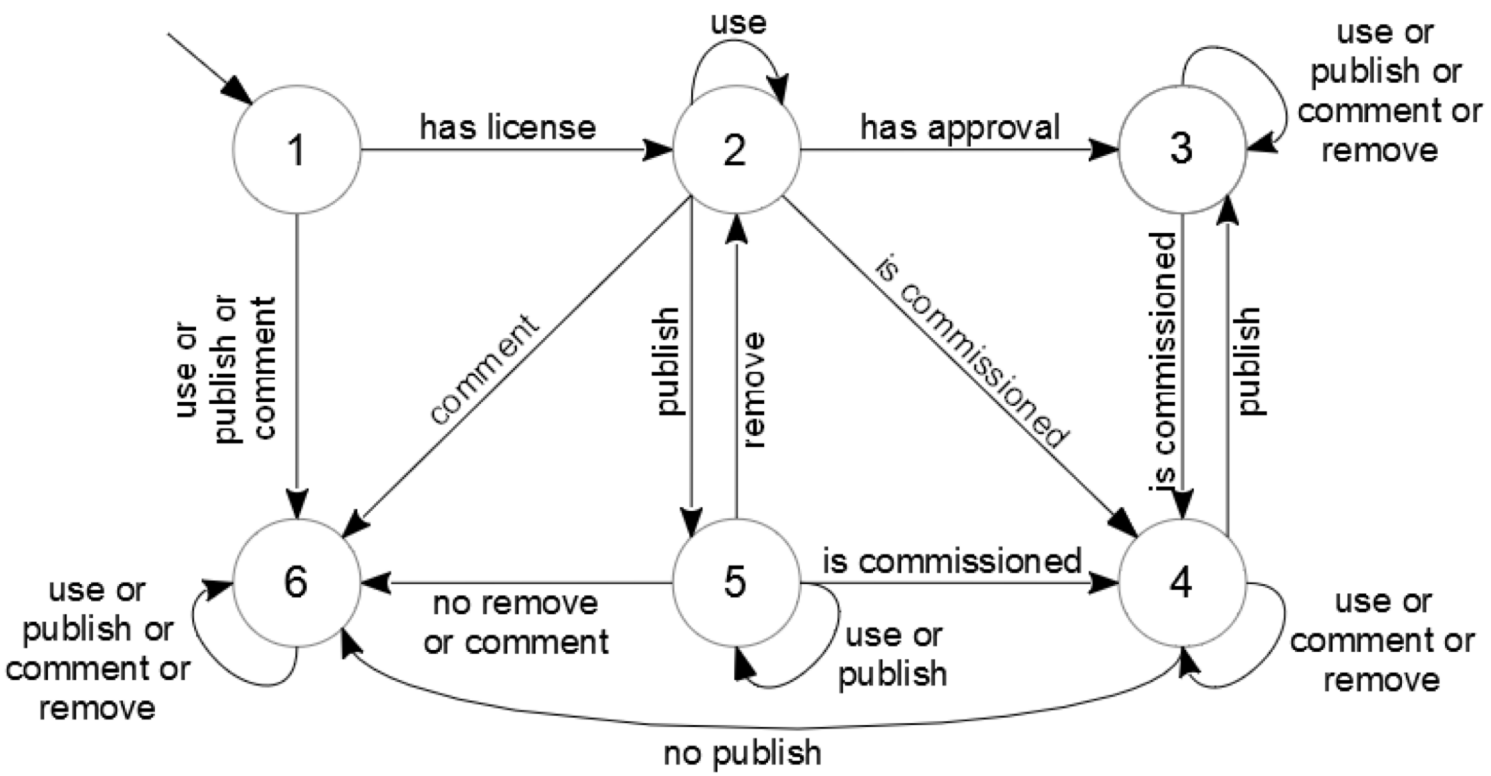
Smart contracts: procedural or declarative?

- We are using procedural languages for smart contract (Solidity)
- A tradition in contact automation: EDI, digital rights management, contracts assembly, contract management, compliance checks
- In AI & law a lot of work on the logical/declarative representations of contracts, how determine compliance etc. Various languages for modelling norms and contracts

Issues with procedural models of contracts

- The order of instructions does not reflect the order of the clauses in natural language. The programmer has
  - to come up with such an order,
  - manually determine how a trigger changes the state of the normative outcomes (i.e., obligations, permissions and prohibitions)
  - propagate changes, taking into account temporal specification

What about state machines?



What about declarative contract-specifications

- Art1.0: => [Forb_licensee] use
- Art1.1: hasLicense => [Perm_licensee] use
- Art2.1: => [Forb_licensee] publish [Compensated] [Obl_licensee] remove
- Art2.2: hasLicense, hasApproval => [Perm_licensee] publish
- Art4.0: hasLicense, isCommissioned => [Obl_licensee] publish
- Art5.1: violation => [Forb_licensee] use
- Art5.2: violation => [Forb_licensee] publish
- % Superiority relation
- Art1.1 > Art1.0,
- Art2.2 > Art2.1,,
- Art5.1 > Art1.1, Art5.2 > Art4.

Opportunites with declarative contract specification

- Easier to understand-map to natural language
- More compact
- Executable specification: check soundness of inferences, verify according to logical semantics
- Can better handle time-issues (temporal logics)

Issues with declarative representations

- How to execute a declarative representation (where is the inference engine)
  - off-chain: low cost, performance
  - on-chain: trust

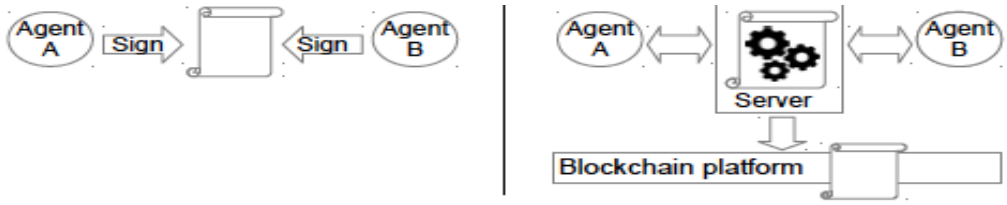


Figure 3: Off-chain option. Agents A and B form a (smart) contract which is stored or a blockchain. The contract is executed in a server external to the blockchain system, and transactions can be recorded in the blockchain.

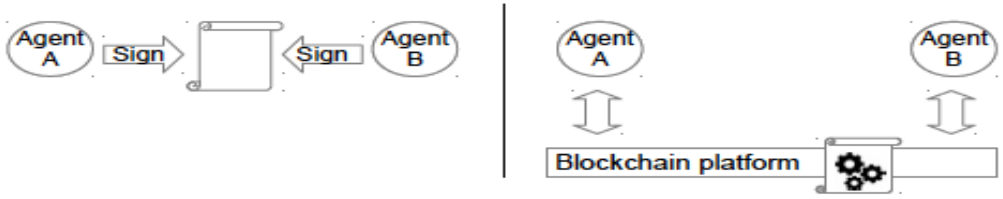


Figure 4: On-chain option. Here, agents A and B form a (smart) contract which is stored and executed in a blockchain platform.

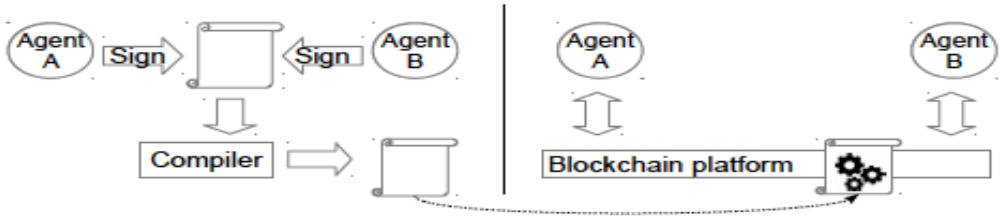


Figure 5: On\off-chain option. Agents A and B form a (smart) contract which is compiled The compiled contract is stored and executed in a blockchain platform.

How to handle legal smart contracts

- Couple a natural language contract with an executable software-contract?
- Make mixed contract, combining non-computable natural language clauses and software
- Use declarative specifications?
- Detect triggers for conditional effects, challenge to automatic detection
- Enable the termination of voided contract and the inversion of their outcomes
- Protect users and consumers (etc.)
- Coordinate in-chain mechanisms and off-chain remedies (what about anonymity)
- Standards and certification for smart contracts
- Etc…

Thanks for your attention!

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