Object-oriented Conceptual Analysis of Law

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The lecture presents basic principles of a unique approach to law called ‘object-oriented conceptual analysis’ (OOCA) which is rooted in (i) pragmatic accounts of concepts and (ii) principles of object-oriented design. The aim of the lecture is to present usefulness of the approach as regards (i) its ability to offer unique jurisprudential and philosophical insights into the workings of the system of law, (ii) its capability in helping legal practice to offer higher quality solutions to legal problems with less effort and (iii) its potential to ‘computerize’ some elements of legal problem solving processes.
Lecture: Structure

1. Law as a problem-solving process
2. Concepts as ‘vehicles of thoughts’
3. Concepts in law
4. Object-oriented design
5. Basics of OOCA of law
6. Using OOCA to understand ‘legal problem-solving’
7. Using OOCA to capture, accumulate and re-use knowledge of law
8. Using OOCA to ‘computer-code’ law
Section I

Legal Problems
Problem and Problem-solving

Working definitions

**Problem** can be characterized as a set of data exposed to an agent. The process of **solving a problem** can be defined as reading of those data, their interpretation and production of an adjustment of the agent’s inner or outer state.

Ability to solve problems

\[ \text{condicio sine qua non} \text{ of a ‘living’ being} \]

![Diagram](image-url)
Reality

Working definitions

A bit of information that is part of surface of reality in time $t_i$ at place $p_i$ is **true** with respect to $t_i$ and $p_i$. Any other bit of information is **false** with respect to $t_i$ and $p_i$. 

![Diagram showing the relationship between reality, interpretation, cognition, data, and communication.]
Legal Reality

Working definitions

A bit of information that is part of surface of legal reality in time $t_i$ at place $p_i$ is \textbf{legally valid} with respect to $t_i$ and $p_i$. Any other bit of information is \textbf{not legally valid} with respect to $t_i$ and $p_i$. 

![Diagram of Legal Reality]

- **LEGAL NORMS**
  - Expressed as
  - Cognizable data stored on accessible media
- **LEGAL REALITY**
  - Interpret as
  - Essence of legal reality
  - Communication of legal reality
  - Surface of legal reality
Valid/Not valid -vs- True/False
Legal Problem-solving Process
Legal Problem and Legal Problem-solving

**Definition**

**Legal problem** can be characterized as a set of data originating in reality and legal reality exposed to an agent.

**Working definitions**

The process of **solving a legal problem** can be defined as reading of data originating in reality, their interpretation and mapping to interpretations of data originating in legal reality and an adjustment of the agent’s inner or outer state with respect to legal reality. The adjustment is mapped back to reality. The process iterates until an adequate adjustment (solution to the legal problem) with respect to both reality and legal reality is reached.
Fundamental question

What kind of mapping do we seek between reality and legal reality in the process of legal problem-solving and how do we establish it?

Law and belief revision (Alchourrón et al. 1985)
Law as discourse (Habermas 1998)
Law as logic (Yoshino 1997)
Non-monotonic reasoning and law (Prakken 1997)
Law and coherence as CS (Araszkiewicz 2010)
Law and dual-process cognition (Ronkainen 2011)
Law as literature (Posner 2009)
Preliminary Observations Regarding Legal Problem-solving

Observation
At low levels legal problem-solving resembles problem-solving with the help of logic-based calculi. On higher levels the situation seems dramatically different—it appears to be vague, informal and based on intuition. Some would even compare it to arts.

Fundamental Problem
How to reconcile these two fundamentally different approaches in order to establish a unified account of legal-problem solving that works equally well at low and high levels?
Section II

Concepts
Nature of Concepts

Definition

Concepts are the constituents of thoughts. (Margolis and Laurence 2011)

Heavenly forms (Plato 1961)
Universals (Aristotle 1961)
Images of things (Descartes 1980)
Innate ideas (Leibniz 1951)
Objects of the understanding (Locke 1961)
Schemata applicable to sensory appearances (Kant 1965)
Abstract thoughts derived from sense experience (Hegel 1967)
Functions in mathematical sense (Frege 1970)
‘Complicated networks of similarities’ (Wittgenstein 1953)
Emergent states of neural networks (Rumelhart et al. 1986)

(The taxonomy is based on Thagard 1992)
Connectionist Approach to Concepts

Role of Concepts

- Categorization
- Learning
- Memory
- Deductive inference
- Explanation
- Problem solving
- Generalization
- Analogical inference
- Language comprehension
- Language production

(Thagard 1992)
Observation

Concepts are rather ephemeral and the perpetual endeavours to fully grasp the ‘concept of concept’ has so far brought many diverse theories but little universally accepted results. It also seems that particular approaches to concepts are decisively influenced by the field for the purpose of which they have been designed—be it metaphysics, psychology, linguistic studies or cognitive sciences.

Fundamental Problem

How to build a theory around something that is so difficult to fully understand?
Section III

Legal Concepts
Legal Concepts as Legal Inferences

**Definition**

[...] we should focus on the norms containing [...] terms and on the inferences they enable, and consequently determine what conceptual contents such terms are meant to convey.

**Example**

L1: IF \( x \) is born in Italy, THEN \( x \) is an Italian citizen
L2: IF \( x \) is born from Italian parents, THEN \( x \) is an Italian citizen
L3: IF \( x \) is an Italian citizen, THEN \( x \) has the right to stay in Italy
L4: IF \( x \) is an Italian citizen and \( x \) is of full age, THEN \( x \) has the right to vote in Italian elections

(Sartor 2009)
The Inferential Links of ṬūṬū

TūṬū, an intermediate normative concept (Sartor 2009)
The Inferential Links of TûTû

- $x$ eats of the chief's food
- $x$ kills totemic animals
- $x$ meets $x$'s mother-in-law

$x$ must be purified
$x$ is forbidden from participating in rites

Elimination of TûTû (Sartor 2009)
Ownership, an intermediate normative concept (Sartor 2009)
The Inferential Links of ownership

Elimination of ownership (Sartor 2009)
Ontological Approach

Conceptual knowledge is packed into the terminology, and is expressed through the definition of terms, and through the specification of connections between terms. Rather than abstracting terminological meaning from sentential inferences, we express a conceptual framework through a terminology, and then we use this conceptual framework to express substantive information.

Definition

An ontology can be informally defined as an association of terms with categories (concepts), characterised through (partial or total) definitions and by organising such categories according to relations (such as the inclusion of a species in a genus, or the participation of a part in a whole).

(Sartor 2009)
Legal Ontologies: Example

Porfyry’s tree (Sartor 2009)
Preliminary Observations Regarding Legal Concepts

Observation

In legal philosophy and jurisprudence two very different accounts of concepts has attracted the attention of scholars—study of ‘intermediary legal concepts’ and construction of legal ontologies. It is clear that the main concerns have always been how to organize bulks of interrelated inferences (legal norms?) into higher ‘units’ and how to organize vast amounts of legal data around a unified structure.

Fundamental Problem

How to exploit the potential of both approaches by means of a single account of legal concepts?
Section IV

Object-oriented Design
Basics of Object-oriented Design

- **object**: an artificially created entity that can be understood as a mixture of:
  - set of attributes/data (think about the parallel to the account of legal problem-solving)
  - set of operations (think about the parallel to the provided account of inferences)

- **abstraction**: key principle of the whole methodology (note the similarity to Aristotle 1961 and implicit rejection of Wittgenstein 1953)

- abstraction enables **classification** of objects

- objects are characterized by being an instantiation of a particular class

- classes are characterized by their position in the hierarchy constructed on *is_a* and *is_part* principles
Is_a Hierarchy

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About

Legal Problems

Concepts

Legal Concepts

OO Design

OOCA of Law

OOCA and Legal Problems

OOCA and Legal KM

OOCA and Coding of Law
Is_part Hierarchy

- car
  - wheel
  - seat
  - engine
  - cooler
  - ignition
Class: Examples

Car

type
maxSpeed
color

createNew
getType
getMaxSpeed
getColor

CarShop

location
cars

createNew
getCars
addCar
removeCar
Class and Object: Examples

```
Car
  type
  maxSpeed
  color
  createNew
  getType
  getMaxSpeed
  getColor

Skoda120
  familyCar
  120km/h
  green
  getType
  getMaxSpeed
  getColor
```
Interacting Objects
Informal Exposition

Basically, it is all about **partitioning** a selected phenomenon into abstract entities called classes (ordered into a hierarchy) which can be understood as schemata for the instantiation of individual objects. The working system is then characterized by the **exchange of ‘messages’** among the individual objects (can be influenced by means of interfaces).
Some Principles of Object-oriented Design

- **Information hiding** by means of encapsulation, accessors and mutators
- Exploitation of the structural features by means of **composition** and **inheritance** (composition should be favored)
- Control of the exchange of ‘messages’ by means of **interfaces**
- Openness for **extension**

**Key Remark**

The main purpose of the methodology is to enable **complexity handling**, i.e. to introduce explicit organization into vast systems that are otherwise difficult to manage and understand.
Section V
Basics of OOCA of Law
TûTû subjected to OOCA
TûTû subjected to OOCA

Eating Food
Food.eat(eatenQuantity){
  if Food.owner equals Person.chief(set evilDeeds to true);
  Food.quantity decreases by the amount of eatenQuantity}

Meeting Mother-in-law
meet(OtherPerson){
  if OtherPerson equals spouse.mother(set evilDeeds to true)}

Purification
purify(){
  set evilDeeds to false}
checkEvilDeeds

Person.checkEvilDeeds()
if Person.evilDeeds equals true(return true);
else return false

Adding a Participant to a Rite

Person.addParticipant()
if Person.(TuTu.checkEvilDeeds) equals false (add Person to participants)
TûTû subjected to OOCA

Person
- name
- sex
- mother
- father
- spouse
- chief
- evilDeeds

createNew
- eat
- kill
- meet
- purify

Food
- type
- quantity
- owner

createNew

Rite
- time
- participants

createNew
addParticipant
removeParticipant

Animal
- kind
- status

createNew
Remark

After removing TûTû from the conceptual framework only the addParticipant operation of Rite class had to be changed. The analysis shows that the TûTû class was not necessary for the workings of the system. The finding corresponds to those of Ross’s.

Adding a Participant to a Rite

Person.addParticipant()
if Person.evilDeeds equals false(add Person to participants)

Fundamental Question

Does OOCA show that ‘intermediary legal concepts’ like TûTû are useless?
Observation
At low levels legal problem-solving resembles problem-solving with the help of logic-based calculi. On higher levels the situation seems dramatically different—it appears to be vague, informal [...]

Fundamental Problem
How to reconcile these two fundamentally different approaches in order to establish a unified account of legal-problem solving that works equally well at low and high levels?

Address to the Problem by OOCA
OOCA specifically aims at being applicable within vast systems that are complex and difficult to understand (only intuition provides the necessary guidance). It can be employed from the lowest levels to the highest ones.
Reminder of Some Preliminary Observations

Observation
Concepts are rather ephemeral [...]. It also seems that particular approaches to concepts are decisively influenced by the field for the purpose of which they have been designed [...].

Fundamental Problem
How to build a theory around something that is so difficult to fully understand?

Address to the Problem by OOCA
OOCA is mainly purpose oriented. It does not provide its own account of concepts and does not need to adhere to any other rigid account. It is not about ‘grasping the reality and legal reality’ but being useful in ‘operating both of them.’
Reminder of Some Preliminary Observations

Observation

In legal philosophy and jurisprudence two very different accounts of concepts has attracted the attention of scholars—study of ‘intermediary legal concepts’ and construction of legal ontologies. […]

Fundamental Problem

How to exploit the potential of both approaches by means of a single account of legal concepts?

Address to the Problem by OOCA

OOCA offers both—possibility to organize individual inferences (operations?) into higher units (classes that can be instantiated as objects) as well as possibilities to organize the whole system into a unified structure (Is_a, Is_part, interfaces).
Section VI

OOCA and Legal Problems
Possible Account of Legal Problem-solving Offered by OOCA

Informal Explanation

The process can be understood in terms of information hiding (particularly encapsulation) principle. At higher levels a legal problem solver attempts to establish a class hierarchy (conceptual framework) to ‘frame’ the legal problem at hand with no regards to the inner workings of the objects that are going to be instantiated and subtleties of their interplay. At lower levels selected attributes (data) and operations (inferences?) are examined and possibly tweaked, removed or added with particular regard to their immediate surroundings without any need for holistic considerations.

Remark

The above described process should not be understood as linear progress from higher levels towards the lower ones. It is an iterating adjustment of the whole system to make it fit the particular situation.
Section VII

OOCA and Legal KM
Organization of Knowledge
The main opportunity offered by OOCA is possibility to organize the knowledge around a class hierarchy (conceptual framework), not individual provisions of law or court decisions (prevalent method in contemporary legal IR systems).

Re-use of Knowledge
Possibly, one can have the whole stock of previously designed and gradually re-fined classes. These can be instantly used to establish a class hierarchy (conceptual framework) to frame the legal problem instead of designing the whole solution from scratch. Consequently, one would be only required to select appropriate classes and to tweak them to fit the peculiarities of the problem at hand. (What about shared repositories of such classes? Consider Java application development.)
Section VIII

OOCA and Coding of Law
## Explanation

**Coding of law** refers to an activity of transforming a selected portion of law into a computer code by means of available programming languages.

## Purpose

The purpose is to either **automate** a particular legal problem solving process or to **expose** hidden features of the selected legal regulation.

## History

Historically, many attempts have been done to automate selected legal domains on the basis of **logical programming**, especially Prolog (Kowalski, Yoshino). However, the growing complexity of the created programs allowed only limited progress.
Conclusions

OOCA seems to be a promising approach to law mainly because it:

- specifically aims at being applicable within vast systems
- it emphasizes its utility
- offers possibility to organize individual inferences into higher units as well as possibilities to organize the whole system into a unified structure

Key Remark

Thank you for your attention!
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References 1


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References III


References IV


References V

