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Conceptual Structures in Statutory Interpretation

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Abstract. This paper introduces a framework of conceptual structures allocated to statutory expressions during interpretive heuresis. Drawing from cognitive science research on conceptual structures, the study seeks to enhance existing computational models of legal reasoning across various domains. A comprehensive set of conceptual structures applicable in statutory interpretation is reconstructed. This framework increases awareness of potential interpretive options and contributes to the transparency of legal reasoning.

Keywords. Cognitive science, conceptual structures, heuresis, reasoning, statutory interpretation.

1. Introduction

Despite advancements in the formal and computational modelling of statutory interpretation [1, 2], the task predominantly remains in the hands of human lawyers. Given this, it's pertinent to explore how theories from cognitive science, particularly those concerning human mental processes like categorisation and reasoning, can augment the development of statutory interpretation in the AI and Law domain. Concepts are one of the most extensively researched mental representations in cognitive science. This paper adopts the conventional cognitive-scientific portrayal of conceptual representations [3, 4], delving into the role of conceptual structures in interpretive reasoning. We chiefly concentrate on interpretive heuresis, the formation of interpretive statements, and, to a lesser extent, justificatory reasoning. This emphasis on the heuresis process seeks to bridge a gap in the literature, which typically concerns justificatory interpretive reasoning through argumentation [2].

2. Concepts and their Structures

In cognitive science, concepts are often studied as a type of mental representations. They are mental entities which represent knowledge, and they are subject to computational procedures performed by the mind. This assumption enables cognitive science to generate theories that explain intelligent behaviour activities such as learning, problem-solving, planning or reasoning [4].

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Specifically, theories of conceptual representations are employed to explain how humans categorise individual items (tokens) as manifestations of linguistic expressions or how they seek to ascertain the scope of a given linguistic expression. We'll refer to these as lexical concepts. Broadly, there are three primary structures associated with concepts, advocated, respectively, by the classical theory, the prototype theory, and the theory-theory of concepts. Additionally, there are nuanced pluralist theories of concepts.

Classical theory. According to this theory, a lexical concept should be understood as a set of individually necessary and jointly sufficient conditions. In other words, a lexical concept has a definitional structure, and it is composed of simpler concepts [5]. Such a structure implies the following procedure for resolving a categorisation problem: an agent, when confronted with an item, checks whether it satisfies the whole set of necessary and sufficient conditions.

Prototype theory. According to extensive empirical evidence tracing its roots to the work of Rosch and others [5, 6], categorisation and reference-determination tasks are often not solved by using a list of sufficient and necessary conditions but rather by comparing a token to a prototype. Specific sets of features satisfied to a certain degree may be cautiously regarded as sufficient conditions. Such a set of features is sometimes called a core of the concept [3]. The concept's part outside of the core may be referred to as a boundary.

Theory-theory. According to the proponents of this account, concepts (or at least their cores) should be understood as a set of interrelated elements that serve functions similar to those ascribed to scientific theories, that is, explanation and prediction. Theory-theory of concepts enables distinguishing between shallow features of tokens (such features may be registered by prototype theory) and their essential (deep) features [3].

Pluralist theories. There exist views according to which no leading theory of conceptual structure is of universal applicability. Such theories either try to combine different theories to account for the structure of concepts or agree that different linguistic expressions may assume different conceptual structures in different contexts of use [3].

3. The Role of Conceptual Structures in Statutory Interpretation

The role and architecture of concepts within legal reasoning, especially in statutory interpretation, remain widely debated. Legal concepts are conceived, structured, evolved, or examined across multiple levels of legal discourse. This includes legal theory, doctrine, practical applications (encompassing legislative processes and judicial law application), and AI and Law research, particularly relating to the design and development of legal ontologies. These layers, and consequently, the understanding of legal concepts, are intricately intertwined. Key questions emerge regarding how shifts in regulation or case law evolution might influence the perception of legal concepts and how legal theories and the doctrines of various legal branches can shape legislation or judiciary interpretations [7].

We formulate the following research questions:

Q1. What are the structural (as opposed to content-focused) components of heuresis in statutory interpretation?

Q2. What is the role of conceptual structures in legal justificatory reasoning, particularly in constraining or unconstraining the reasoning justifying a particular interpretive conclusion?

In the following, we focus principally on Q1, which logically precedes Q2.

4. Pluralistic Framework of Conceptual Structures

Below are the essential theoretical underpinnings that form the foundation of the ensuing framework:

A1. **Pluralism of Conceptual Structures**: We posit that across jurisdictions, domains, and specific regulations, various conceptual structures can be attributed to statutory terms.

A2. Defeasibility of Legal Reasoning: While we deploy terms like "necessary" and "sufficient" conditions, it's pivotal to emphasise that the model subscribes to the general thesis of the defeasibility of legal reasoning. Nonetheless, the model presented here illustrates how employing diverse conceptual structures in legal interpretation can elevate the challenge of successfully refuting specific legal arguments, occasionally rendering such refutations practically unfeasible.

Let us now follow to present the basics of the framework.

Def 1. Interpretive Statements

Let $e \in E$ denote an expression in natural language in document $d \in D$ and let $o \in O$ indicate an object, where:

E is the set of all expressions of the language L.

D is the set of all legally relevant documents in the domain.

O is the set of all objects recognised in the domain.

P, such that $P \sqsubseteq O$, is a subset of O.

then

$$P \coloneqq e$$

is an interpretive statement and $\coloneqq$ a variable that may be substituted by any symbol expressing an extensional relation, such as equality $\equiv$, inclusion $\sqsubseteq$, strict inclusion $\sqsubset$, etc., [1, 2].

P represents a set of objects present in a given case (actual or hypothetical, but in both situations expressed in generic terms).

Def 2. Concept

A concept $c \in C$ imposed on the expression *e* in *d* is a tuple $\langle m, cs \rangle_{(e,d)}$, where:

2.1. $m \in M$ is the meaning (content) the conceptual structure assigns to e in d;[2]

and

2.2. conceptual structure $cs \in CS$ (CS is the set of all conceptual structures in a domain), is a triple <Cond, Scale, Context>, where:

[2] As mentioned above, we do not discuss the ontology of mental representations here. Content may be understood as a mental correlate of an object or as an abstract entity represented in the mind. See [3] for a broader discussion.

2.2.1 Cond – is structural conditional characteristics, which may indicate that either:

Cond = *N&S*, which means that cs imposes a set of necessary and sufficient conditions for stating that o ∈ O is an example of e ∈ E or

Cond = *S*, which means that cs imposes a set of sufficient conditions for stating that an object o ∈ O is an example of e ∈ E, or

Cond = *N*, which means that cs imposes a set of necessary conditions for stating that an object o ∈ O is an example of e ∈ E, or

Cond = *N ⇃ S*, which means that cs imposes neither a set of necessary nor sufficient conditions for stating that an object o ∈ O is an example of e ∈ E.

2.2.2. Scale – is a scale associated with the content of conceptual structure, which may be one of the following: {*nominal, ordinal, interval, ratio*}.

2.2.3. Context – contextual characteristics, which may indicate that:

Context = *A* – which means that the concept is atomic, that it is assumed to be used independently of any other concept recognised in the domain, or

Context = $H_{(a, \ldots n)}$ – which means that the concept is at least to a degree holistic; that is, it may only be used in connection with another concept recognised in the domain, where this feature ranges from using certain specific (a) to using all (n) concepts identified in the domain.

Naturally, concepts attributed to statutory expressions necessitate invoking other concepts, but sometimes, this process is constrained precisely by applying a particular conceptual structure.

Def 3. Simple and Complex Concepts

Concept c is considered simple concerning language L if its content can be expressed using an atomic expression from the chosen language L. Otherwise, a concept is complex.

The proposed framework highlights potential interpretive avenues stemming from the structural dimension of concepts, even before exploring diverse contents. Assuming for simplicity that we only focus on simple concepts and a binary Context feature (disregarding the degree of holism), we derive 4 x 4 x 2 = 32 distinct conceptual structures that might correspond to a given linguistic expression. One can discern clear correspondences between conceptual structures outlined in cognitive science and certain combinations of conceptual structure features presented in this framework. Classical categories evidently correspond to structures boasting necessary and sufficient (N&S) conditional features. Prototypes align with structures possessing sufficient (S) conditional features (symbolising concept cores) that employ at least ordinal or more intricate scale features. Structures contemplated by the theory-theory of concepts are non-atomic concerning the Context feature. Significantly, our framework facilitates the exploration of structures that amalgamate features from different "canonical" structures, hence its pronounced pluralism. It doesn't only acknowledge diverse types of conceptual structures, but it also captures atypical structures and paves the way for integrating varied structures in complex concepts.

5. Discussion and Related Work in AI and Law

In essence, the paper introduces a novel framework that elucidates the integral role of conceptual structures in the heuresis of statutory interpretation. This research trajectory has left a gap concerning the formation or genesis of interpretive statements. While the process of legal heuresis, in general, is computationally intractable, this paper attempts to pinpoint precisely the tractable part of the process, captured by combinations of features of conceptual structures supported by the framework.

Notably, this paper underscores that a singular content could be associated with diverse structural attributes, necessitating distinct methods or procedures to discern if specific objects or scenarios align with a given statutory linguistic expression. It proposes a dynamic framework that integrates conceptual structures into statutory interpretation, providing valuable insights for case-based reasoning (CBR), the structures of which are also present in statutory interpretation [8, 9, 10]. Historically, various knowledge representation structures, such as dimensions [11] or binary factors [12], have been proposed and utilised to model knowledge in CBR systems. The significance of this new framework can be distilled into its pluralistic approach. The existing models in CBR often gravitate towards certain rigidity, leveraging either rule- or earlier factor-based representations, usually determined by the natural fit of the structure to the domain in question. However, it may also be the case that one domain will support different structures. This framework allows for a more fluid approach. By acknowledging the multifaceted nature of legal concepts, the framework accommodates multiple structures, even within a single domain. The structures discussed in the literature on CBR in AI and Law may be mapped onto the structures presented in this framework, also in dynamic, evolutionary perspectives [13, 14, 15]. Notably, the contribution of this paper offers a relatively complete (concerning the set of assumed criteria) list of structures that may be extracted from the existing case law pertaining to understanding particular terms. Consequently, it clearly connects with the approach advocated by Branting [16], combining rules and cases in legal explanation. The framework developed here may also be fruitfully used in developing dynamic legal ontologies, as it emphasises the possibility of alternative structural interpretations and changes in the definitional structure of legal concepts.

Finally, the linguistic markers indicating specific conceptual structures should be systematised to enable automated extraction of relevant information directly from the rationales of judicial decisions. The results of the automated processing of information vital for statutory interpretation are promising [17].

6. Conclusion and Further Research

We have introduced a comprehensive framework of conceptual structures relative to the assumed features that a reasoner can adopt while interpreting a statutory expression. These structural features pertain to the conditional characteristics of concepts, the types of scales employed, and whether a concept is perceived atomically or demands holistic considerations.

This approach lays the foundation for a comprehensive, interdisciplinary research programme that centres on creating hybrid systems that would integrate human experts, symbolic models of legal reasoning, and ML-based predictive systems. The information flow in such a system can be delineated as follows:

A human expert is tasked with crafting interpretive statements about a statutory expression within a specific domain and elucidating the procedural aspects of determining if an object exemplifies the expression. Throughout this process, the expert can be aided by a symbolic model of legal reasoning—guided by the framework presented here—which offers various potential structural interpretations and their justifications via interpretive canons. An expert's decisions can then be analysed and cross-referenced against those of other experts (or laypeople) in experimental settings. Such processes may elucidate the dependencies between heuristic and justificatory layers of interpretive reasoning. Subsequently, the ML-based predictive system would furnish the expert with suggestions on the most likely structural aspects of interpretations within the domain, assuming these structures can be accurately derived from linguistic markers.

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