Deontic Reasoning: From Ancient Texts to Artificial Intelligence. Workshop report

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The interdisciplinary workshop 'Deontic Reasoning: from Ancient Texts to Artificial Intelligence' (ATAI), bringing together experts from the fields of Logic, Sanskrit, Philosophy, Artificial Intelligence and Law, was held at the Vienna University of Technology (TU Wien) on June 11-13, 2018. *In nuce,* the aim of the workshop was to foster new connections between the aforementioned research areas and facilitate the interchange of ideas with respect to shared grounds of interest, in particular normative reasoning.

The workshop was part of the research project 'Reasoning Tools for Deontic Logic and Applications to Indian Sacred Texts' (2017-2021) funded by the Wiener Wissenschafts-, Forschungs- & Technologiefonds Vienna (WWTF). The project aims to use formal logic to analyze and provide a better understanding of the deontic reasoning of the Mīmāṃsā school of Indian philosophy. Flourishing for more than two millennia, Mīmāṃsā provided a systematic and formal interpretation of the normative part of the Indian Sacred Texts, the Vedas. To this aim Mīmāṃsā established interpretative principles which are so rational and systematic that some of them are still applied in Indian Jurisprudence to decide court cases. The overarching aim of the workshop was to brainstorm and explore potential mutual benefits of the application of formal tools to the analysis of ancient texts. Throughout the workshop the following questions functioned as guiding threads:

i) How can formal tools, such as mathematical logic or argumentation frameworks, enhance the understanding of ancient texts?
ii) What can be learned from ancient analyses with respect to formal reasoning about normative statements (e.g. for ethical machines such as self-driving cars)?

The ATAI workshop served to map out these benefits in a lively interdisciplinary setting.

The three-day event was attended by 32 participants from 14 different universities. The scientific part of the workshop consisted of 12 one-hour talks, given by invited speakers, together with 5 panel discussions. The presentations were grouped by five central themes generally addressed through the topics of the talks. Each of these blocks closed with a corresponding discussion, paneled by the respective speakers and moderated by members of the organization committee.

Featured talks

» Karin Preisendanz (University of Vienna)

Opening Talk

» Agata Ciabattoni (TU Wien), Elisa Freschi (ÖAW, University of Vienna)
Deontic Reasoning: From Mīmāṃsā to AI

» Matthias Baaz (TU Wien)
Logical Aspects of Legal Reasoning

» Giovanni Sartor (University of Bologna)
Defeasible Legal Argumentation

» Dov Gabbay (King's College London)
Principles of Talmudic Logic - Sample Export to Modern AI

» Lawrence McCrea (Cornell University)
Contextual Factors in the Interpretation of Prohibitions

» David Brick (Yale University)
Arguments Regarding Sati from Classical Hindu Law

» Xavier Parent (University of Luxembourg)
A Rule-Based Deontic Reasoner

» Parimal Patil (Harvard University)
The Cognition of Commands in Navya-Nyāya

» Eberhard Guhe (Fudan University)
Ross' Paradox and the Navya-Nyāya Interpretation of Injunctions

» Patrick Cummins (Cornell University)
Appointment as Linguistic Category in Prabhākara's Hermeneutics of Deontology

» Andrew Ollett (University of Chicago)
Different Deontic Concepts in Mīmāṃsā

In the remainder of this report we briefly discuss a selection of talks and corresponding panel discussions, that explicitly address the interdisciplinary potential of combining logic and AI with law and with ancient texts.

With respect to normative reasoning in legal systems and its formal counterpart, Matthias Baaz spoke about how different contemporary legal systems deal with logical contradictions and presented several commonly applied schemata of legal reasoning that are particularly challenging for formal logic. Giovanni Sartor gave a tutorial on reasoning in legal argumentation, including several attacking strategies for rebutting

and undercutting juridicial arguments. From the Indological side, David Bricks discussed various historical solutions and arguments concerning the problem of *Sati*, i.e., the immolation of a widow on her deceased husband's pyre, in Hindu law.

During the corresponding panel discussion, there was a vivid debate concerning the rôle of contradictions in normative systems: are they undesirable and should they be resolved? The discussion revealed that several scientific fields employ similar (formal) answers: From a legal perspective it was emphasized that, although in some juridical systems contradictions are resolved by adjusting the system, others leave contradictions untouched and, instead, resolve conflicting cases through principles such as *lex posterior derogat legi priori* (cf. 'specificity principle' in AI). In accordance with this, from the side of Indian Philosophy, it was pointed out that Mīmāṃsā authors aimed at resolving any apparent normative conflict through very similar interpretative principles, since the Vedas, as the source of normative statements, is always consistent. In particular, the Mīmāṃsā authors also reasoned by specificity, and, as a very last resort, would apply the principle of *Vikalpa*: 'in case of two conflicting obligations, you ought to perform at least one obligation' (cf. 'disjunctive response' in deontic logic).

Concerning the connection between logic, AI and the study of ancient philosophical texts, Dov Gabbay gave an introduction to the project of extracting different systems of *Talmudic Logic*. This included discussions of the Talmudic interpretation of future conditionals, changes of identity over time, and how Talmudic reasoning suggests a new approach to the paradox of the heap by viewing properties of an object as dependent on how it is constructed. In a similar spirit, Eberhard Guhe presented his formalisation of obligations and permissions in the interpretation of another fundamental school of Indian Philosophy called Navya Nyāya. Witnessing the potential of cross-fertilisation of the different disciplines, his formalisation provides a novel method for solving several well-known paradoxes of deontic logic, such as Ross' Paradox or Veltman's Puzzle. Conversely, the benefits of applying formal methods to the study of ancient texts were demonstrated by Andrew Ollett in his presentation of a formalisation of normative concepts in the Mīmāṃsā interpretation.

Questions concerning benefits of the formalisation of philosophical notions were also considered in detail in the panel discussions. Among the many points discussed, it was stressed by Gabbay that the study of decision making in AI must be able to deal with the reasoning employed by *real* people and not just with idealised mathematical reasoning. Yet, employing human reasoning is exactly what is essential to systems like Talmudic or Mīmāṃsā reasoning, which makes their study very relevant for designing good AI systems. Furthermore, it was generally agreed upon that hermeneutics and philosophical reasoning have more aspects than just logic, implying that logic is not suitable for all philosophical problems. However, as a benefit for philosophy, it was also pointed out that formal logic can be used as a tool for deriving new (philosophical) hypotheses and questions, even explaining or solving certain conflicts.

The workshop took place in the Zemanek room at the TU Wien. The venue was in close proximity to the historical city centre of Vienna with its many sights. The attendants enjoyed ample time for discussion over original Sicilian coffee and sweets during the extended coffee breaks. The event was funded by the WWTF project, University of Vienna, Vienna Center for Logic and Algorithms, Institut für Kultur- und Geistesgeschichte Asiens, TU Wien and Wolfgang Pauli Institute.

Further information about the workshop can be found on the official website under https://mimamsa.logic.at/atai/.