

# Formalising Criminal Law in Catala

LUCA ARNABOLDI\*, DAVID ASPINALL, RONNY BOGANI, and BURKHARD SCHAFER, University of Edinburgh, Scotland  
SCOTT HERMAN, Conan & Herman, USA  
JONATHAN PROTZENKO, Microsoft Research, USA  
EKATERINA KOMENDANTSKAYA, YUE LI, and REMI DESMARTIN, Heriot-Watt University, Scotland

There is a growing interest in law formalisation, however some legal domains are traditionally considered to be more “computational” and therefore more amenable to formalisation than others. For example, tax law has several available implementations. One example is formalisation of the French tax law in Catala – a domain-specific language that takes a semantically principled (and functional) approach to law formalisation. Among the legal domains that are traditionally seen as less “computational” and requiring human interpretation, stands criminal law. We will discuss work in progress in formalising computational fragments of criminal law in Catala, and outline the challenges of extending the frontiers of law formalisations to this domain.

## ACM Reference Format:

Luca Arnaboldi, David Aspinall, Ronny Bogani, Burkhard Schafer, Scott Herman, Jonathan Protzenko, Ekaterina Komendantskaya, Yue Li, and Remi Desmartin. 2018. Formalising Criminal Law in Catala. *J. ACM* 37, 4, Article 111 (August 2018), 3 pages. <https://doi.org/XXXXXXXX.XXXXXXX>

## 1 MOTIVATION

It is well-known that some legal domains lend themselves naturally to computer implementation and formalisation. For example, computer implementations of tax law date back to several decades, and a recent experience of the Catala team [2, 3] has shown that formalisations of tax law can yield elegant semantics and thus give formal guarantees that law implementation indeed follows the intended meaning of the legal documentation. The main motivation for recent attempts at law formalisation is the fact that (naive) computer implementations may contain bugs (see e.g. [1]) that occasionally result in wrong applications of the tax law, and consequently affect the unlucky individuals, who fall victims to buggy or badly documented code.

But is tax law so exceptional in this respect? One might think that other legal domains, such as e.g. criminal law, are largely exempt from this kind of problems. However, this is not entirely true. Many legal domains have developed methods that resemble algorithmic approach. For example, the Florida state judges use “scoresheets” when considering criminal cases [4]. Not unlike tax law

\*All authors contributed equally to this research.

---

Authors’ addresses: Luca Arnaboldi, [luca.arnaboldi@ed.ac.uk](mailto:luca.arnaboldi@ed.ac.uk); David Aspinall, [david.aspinall@ed.ac.uk](mailto:david.aspinall@ed.ac.uk); Ronny Bogani, [r.j.bogani@sms.ed.ac.uk](mailto:r.j.bogani@sms.ed.ac.uk); Burkhard Schafer, [b.schafer@ed.ac.uk](mailto:b.schafer@ed.ac.uk), University of Edinburgh, Edinburgh, Scotland; Scott Herman, [jscottherman@gmail.com](mailto:jscottherman@gmail.com), Conan & Herman, Florida, USA; Jonathan Protzenko, [protz@microsoft.com](mailto:protz@microsoft.com), Microsoft Research, Seattle, USA; Ekaterina Komendantskaya, [ek19@hw.ac.uk](mailto:ek19@hw.ac.uk); Yue Li, [yue.li.picasso@qq.com](mailto:yue.li.picasso@qq.com); Remi Desmartin, [rhd2000@hw.ac.uk](mailto:rhd2000@hw.ac.uk), Heriot-Watt University, Edinburgh, Scotland.

---

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).

© 2018 Association for Computing Machinery.

0004-5411/2018/8-ART111 \$15.00

<https://doi.org/XXXXXXXX.XXXXXXX>

calculations, these scoresheets multiply “points” by coefficients based on the considered offence, and arrive at a verdict that sums up the points cumulatively. Thus, at least to some extent, some practical applications of criminal law seem to follow a computational approach.

Just as computer implementations of the tax law may contain bugs, the manual application of the “scoresheet method” is imperfect. According to the Florida Department of Corrections report [5], the score sheets used in real court sentences tend to have “*the compliance rate is 57 to 93 percent*”. Our manual examination of the archives of completed score sheets [6] shows incomplete fields and ambiguous markings. The report does suggest that often incomplete fields do not have any significance for the score calculation, but even in those cases, incomplete fields can complicate accurate statistical analysis of sentences.

Our research question is: can the domain of criminal law benefit from high standards of correctness assurance that modern programming languages offer?

## 2 OVERVIEW OF THE TALK

In this ProLaLa talk, we will report on our on-going work on formalisation of the Florida scoresheets in Catala. This work has several goals:

- Firstly, using the Florida scoresheets, we aim to provide a first proof-of-concept implementation of criminal law in Catala, as it is applied in real court hearings and sentencing. It would be a first formalisation of real-life criminal law practice we are aware of, and as such will raise several research questions to investigate.
- The first set of questions concerns practical utility of verified computer programs in the court room. Is running formal code during a hearing practical or helpful, either as an aid at the time of sentencing or for subsequent analysis and documentation? We plan to have a case study of Catala running alongside the judge during court hearings to estimate the practical pitfalls of this approach.
- The second set of questions concerns the underlying semantics of Catala, and whether the DSL constructs introduced for the French tax law formalisation [2] extend fully to other legal domains. Our initial study shows that Catala may require some modifications to capture more intricate temporal reasoning involved in judging criminal cases.
- Finally, our analysis indicates that several aspects of the Florida scoresheets rely on *context* parameters that are left to the appreciation of the judge. We will explain how our work identifies and isolates those context parameters (that is, inputs to the case at stake), and separates them from the general-purpose reasoning that is algorithmic in nature and can be captured in Catala.

## ACKNOWLEDGMENTS

We would like to extend our sincerest thanks to the full team of lawyers who have helped us validate fact patterns, answered questions and provided useful insights into the Florida Criminal law: David Bigney, Esq., James Scott Hetman, Esq., Hon. Janet Bigney and Hon. Jeff Ashton.

## REFERENCES

- [1] Government Accountability Office. 2021. COVID-19: Urgent Actions Needed to Better Ensure an Effective Federal Response – Report to Congressional Committees. <https://www.gao.gov/products/gao-21-191#appendix24>
- [2] Denis Merigoux, Nicolas Chataing, and Jonathan Protzenko. 2021. Catala: A Programming Language for the Law. *Proc. ACM Program. Lang.* 5, ICFP, Article 77 (aug 2021), 29 pages. <https://doi.org/10.1145/3473582>
- [3] Denis Merigoux, Raphaël Monat, and Jonathan Protzenko. 2021. A Modern Compiler for the French Tax Code. In *CC '21: 30th ACM SIGPLAN International Conference on Compiler Construction (CC 2021: Proceedings of the 30th ACM SIGPLAN International Conference on Compiler Construction)*. ACM, Virtual, South Korea, 71–82. <https://doi.org/10.1145/3446804.3446850>

- [4] Florida Department of Corrections. 2022. FLORIDA CRIMINAL PUNISHMENT CODE Scoresheet Preparation Manual. Retrieved Oct 27, 2022 from <http://www.dc.state.fl.us/pub/scoresheet/2022%20CPC%20Manual%201998-As%20revised%2007-2022.pdf>
- [5] Florida Department of Corrections. 2022. Florida Department of Corrections Sentencing Scoresheets Compliance Report. Retrieved Oct 27, 2022 from <http://www.dc.state.fl.us/pub/scoresheet/2021-2022%20Compliance%20Report.pdf>
- [6] Florida Orange County. 2022. *My Orange Clerk*. Retrieved Oct 27, 2022 from <https://www.myorangeclerk.com/>