

Exploring consequences of statutory law through lightweight modeling

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Abstract—The complexity of statutory legislation can generate confusion and disagreement in interpretation even among experts and can leave ordinary citizens disempowered. Technological “solutions”, even with stakeholders’ best interests in mind, can exacerbate this sense of estrangement from the law. We are exploring an alternative application of technology in this area: a digital “sandbox” environment for legislators, lawyers, judges, and citizens to define and explore the consequences of legislation. Our approach employs a “lightweight” method to computational modeling, using automated analysis to uncover hidden assumptions and unintended consequences.

As a case study, we are focusing on a number of U.S. statutes that define conditions under which prior convictions can be expunged from an individual’s public record. We use the Alloy modeling language and analyzer to explore consequences of expungement statutes. Starting with the State of Michigan’s Clean Slate Law and then extending to similar statutes in Utah and Arizona, we can model varying interpretations of the law in terms of modular changes to a base model, and then use the Alloy analyzer to explore the consequences of these interpretations.

We have developed a user interface for the model that is tuned to the needs of individuals seeking expungement and their legal assistants, determining which convictions within the individual’s record can be expunged under varying interpretations, and explaining why some convictions may not be expunged. This application not only serves as a proof of concept for our larger sandbox vision but also has promise as a useful tool for individuals navigating the complexities of expungement.

Index Terms—Rules as Code, statutory law, expungement, lightweight modeling, Alloy

I. TOWARD A DIGITAL SANDBOX FOR EXPLORING STATUTORY LAW

Statutory language has a well earned reputation for being complex, opaque, and often underspecified or contradictory, leading to disagreement and uncertainty even among the legislators who draft these laws and the legal professionals who interpret and apply them. We see an opportunity for formal modeling and automated analysis to allow stakeholders to better understand the law’s interpretive possibilities. The

emerging area of computing innovation known as “Rules as Code” [1] leverages connections between legal code (in the form of legislation, regulations, or business rules) and digital code (as the basis for automated analysis and synthesis). It is imperative to maintain human agency when it comes to the law, and while there are risks of techno-solutionist approaches impinging on this agency [2], [3], we believe there is a legitimate role for computing technology as an aid for human stakeholders as they grapple with the law and its consequences.

Our objective is to develop a technology-empowered approach that guides stakeholders by formalizing statutory language, comparing different interpretations, and anticipating the consequences of rules, both current and proposed—including “black swan” scenarios [4]. Fig. 1 illustrates our vision of a digital sandbox for statutory law: a tool that not only allows users to explore consequences of existing law under a set interpretation, but also compare the consequences of different interpretations, and even create and explore the consequences of extensions or amendments to existing law.

II. CASE STUDY: U.S. EXPUNGEMENT LAWS

As a proof of concept, as well as a meaningful application in its own right, we focus on the emergence in the United States of statutes setting out conditions under which prior criminal convictions can be *expunged* from an individual’s public record. Since the State of Michigan’s so-called *Clean Slate* statute [5] went into effect in 2021, thousands of people have regained employment, housing, and professional opportunities as old convictions are removed from their records [6]. The Clean Slate law was meant to be easy to understand, and there was hope that individuals could navigate the eligibility and filing requirements themselves. Furthermore, since 2023 an automated service called the “Rules Engine” has been detecting and removing many expungeable convictions from individuals’ records. However, as we have discovered through conversations with legal professionals, there are ambiguities

within the legislation, and judges in the state have interpreted it in significantly different ways. Consequently, attorneys, advocates, and ordinary citizens have found it difficult to determine which convictions within a given record are eligible for expungement. Moreover, the Rules Engine as implemented is a black-box solution with minimal explanation for the general public. As individuals may view the Rules Engine results as dispositive of their case, there is a danger that this automation will diminish their sense of agency and engender a passive attitude toward their criminal records.

III. MODELING AND ANALYSIS WITH ALLOY

To explore the potential of computational modeling in this regard, we use the Alloy modeling language and integrated analyzer to provide hands-on experience with automated feedback [7], [8]. The Alloy Analyzer searches within designer-specified bounds for instances satisfying an Alloy model, through a SAT-based constraint solver. Alloy has been used in a wide array of application areas [9], including integration of software requirements with policy and legislation [10], [11].

We can use our Alloy model of expungement law in conjunction with the Analyzer in various ways:

Testing scenarios. We can verify the expungeability of convictions within a given record by searching for a scenario that instantiates the relevant events and their relative time orderings. This important use case is what many individuals will be interested in and is in fact provided by the Rules Engine — but with a substantial fee involved, and no flexibility to explore alternative interpretations of the law.

Comparing interpretations. The Alloy analyzer allows us to explore broader questions regarding interpretations of the Clean Slate Act. For instance, the ambiguous term “time period” in the statute has led to differing interpretations by judges: does it refer to waiting time between successive convictions, or to time between a conviction and its subsequent expungement? The model and analyzer can uncover the important ramifications of this question for individuals seeking expungement. Through small, modular changes to our model, we can easily switch between these two interpretations, or we can ask the Analyzer to find scenarios where the expungement outcomes differ under the two interpretations.

Revealing black swans. At the heart of Michigan’s Rules Engine is a particular, implicit interpretation of the Clean Slate statute. With our Alloy model of the Rules Engine, we can explore consequences of the particular way in which the Rules Engine operates. For instance, we can easily provide scenarios demonstrating a significant bottleneck: the presence of a non-expungeable conviction like OWI “operating while intoxicated” can prevent an otherwise expungeable conviction, or even many such convictions, from being set aside.

Comparing laws across states. Expungement laws vary from one state to another, reflecting different policy priorities, legal philosophies, and procedural requirements. Our exploration of expungement laws to date includes a comparative analysis of the legal frameworks for the states of Michigan [5], Utah [12], and Arizona [13], [14]. Our findings suggest that the

differences between state statutes can be captured in terms of a small number of parameters.

IV. APPLICATION: EXPUNGEABILITY CHECKING

A key requirement is accessibility to legal professionals and even lay citizens. Asking these stakeholders to program directly in Alloy is unrealistic, so it is important to provide an appropriate set of predefined tools. We are starting with an application for ordinary citizens and their legal assistants who wish to explore the expungeability of a particular conviction history under various interpretations of state law. The application allows users to change details about the interpretation of the statute, for instance the length of waiting periods (Fig. 2). Through the scenario generator interface, users enter the details of their conviction record (Fig. 3). When the user chooses to run an analysis, Alloy code is generated to reflect the user settings and the timeline of convictions. The visualization colors the expungeable convictions green (Fig. 4), and feedback is given on the reasons for unexpungeable convictions (in the example, the 2022 felony cannot be expunged since the five-year waiting period for felonies has not passed by the time of the 2024 expungement inquiry). Changing the underlying settings can affect the expungeability results for the same scenario (Fig. 4) (in the example, adopting a “count-forward” interpretation for waiting periods implies that the 2009 with a five-year waiting period blocks the 2012 misdemeanor from being expunged).

V. FUTURE WORK

The project team will be conducting user testing of the scenario generator with members of the Safe & Just Michigan coalition of legal professionals, who work on a daily basis with Michigan residents on expungement issues. Currently the only recourse residents have to this kind of exploration is through the black-box interface of the Michigan Rules Engine, which requires a fee to use and supplies no explanation for unexpunged convictions. Thus we feel that this application can satisfy an important need in criminal justice, providing a sandbox for individuals to explore and learn in contrast to a disempowering black-box approach. At the same time, we are exploring the design of a more powerful interface into the Alloy model with lawmakers and analysts in mind, allowing them to construct amendments to existing statutes from a set of building blocks. We see computation as one piece of a larger learning system that can enhance individuals’ understanding and agency with regard to the law, thereby also enhancing their ability to clearly articulate and advocate for needed change.

VI. PRESENTATION

Our presentation will consist of a software demonstration with a supporting poster. The scenario generator application will be available for participants to try, and we will demonstrate how it can be used to show how differences between state laws lead to different expungement outcomes. If time permits, we can also present our model of the Michigan Rules Engine and demonstrate certain important consequences of its particular interpretation of the Clean Slate Law.

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REFERENCES

- [1] J. Mohun and A. Roberts, *Cracking the Code: Rulemaking for Humans and Machines*. Organization for Economic Cooperation and Development, 2020.
- [2] A. D. Selbst, D. Boyd, S. Friedler, S. Venkatasubramanian, and J. Vertesi, "Fairness and abstraction in sociotechnical systems," in *ACM Conference on Fairness, Accountability, and Transparency*, 2019.
- [3] S. E. Lageson, *Digital Punishment: Privacy, Stigma, and the Harms of Data-Driven Criminal Justice*. Oxford University Press, 2020.
- [4] N. Kolt, "Algorithmic black swans," *Washington University Law Review*, vol. 101, 2023.
- [5] Michigan State Legislature, *MCL Section 780.621: Set Aside Conviction*, 2021. <https://legislature.mi.gov/Laws/MCL?objectName=MCL-780-621>.
- [6] K. Sandiford and J. S. Cooper, *Clean Slate Year 3: The First Year of Automatic Expungements*. Safe and Just Michigan, 2024. https://www.safeandjustmi.org/wp-content/uploads/2024/04/Clean_Slate_Year_3_Report.pdf.
- [7] D. Jackson, *Software Abstractions: Logic, Language, and Analysis*. MIT Press, 2012.
- [8] J. Brunel, D. Chemouil, A. Cunha, and N. Macedo, *Formal Software Design with Alloy 6*. 2021.
- [9] D. Jackson, "Alloy: A language and tool for exploring software designs," *Communications of the ACM*, vol. 62, no. 9, pp. 66–76, 2019.
- [10] R. Toahchoodee and I. Indrakshi, "Validation of policy integration using alloy," in *Proceedings of the Second International Conference on Distributed Computing and Internet Technology (ICDCIT)*, vol. 3816, pp. 420–431, Springer LNCS, 2005.
- [11] W. Hassam and L. Logrippo, "Towards a process for legally compliant software," in *Proceedings of the 6th International Workshop on Requirements Engineering and Law (RELAWS)*, pp. 44–52, 2013.
- [12] Utah State Legislature, *Utah Code Section 77-40-105: Expungement of Adult Criminal Records*, 2019. <https://le.utah.gov/~2019/bills/static/HB0431.html#77-40-105>.
- [13] Arizona State Legislature, *Arizona Revised Statutes Title 13. Criminal Code § 13-905. Setting aside judgment of convicted person on discharge; application; release from disabilities; certificate of second chance; firearm possession; exceptions*, 2022. <https://codes.findlaw.com/az/title-13-criminal-code/az-rev-st-sect-13-905/>.
- [14] Arizona State Legislature, *Arizona Revised Statutes Title 13. Criminal Code § 13-911. Sealing of arrest, conviction and sentencing records; requirements; fee; appeal; definition*, 2022. <https://codes.findlaw.com/az/title-13-criminal-code/az-rev-st-sect-13-911/>.

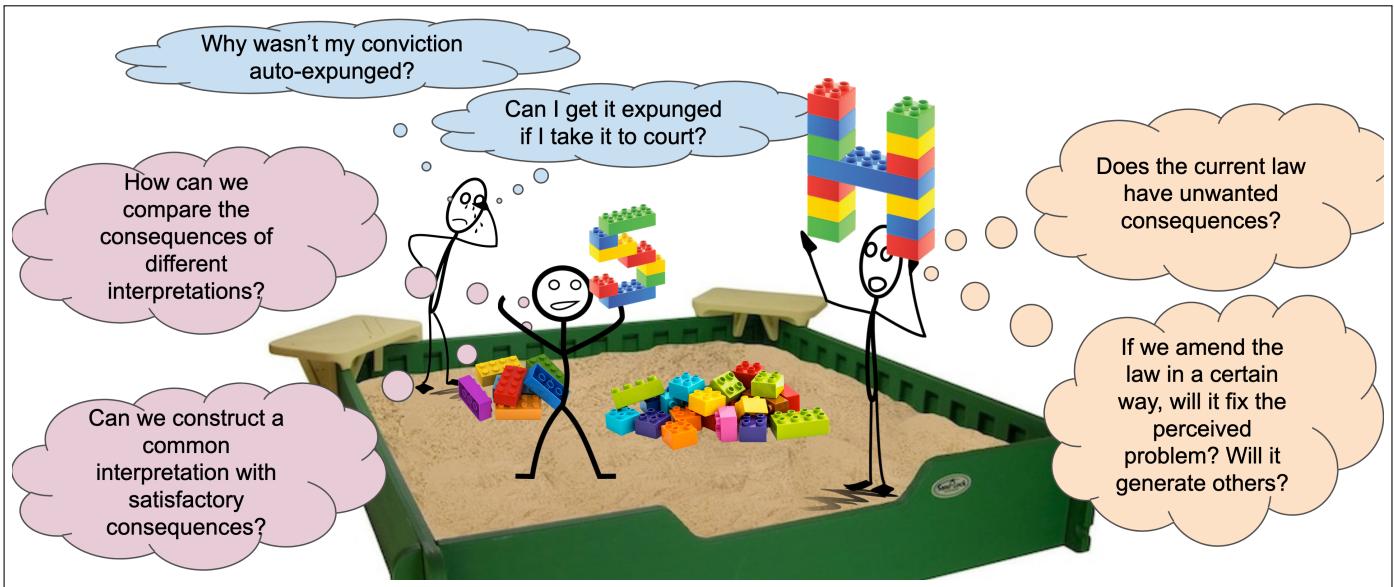


Fig. 1. Ways to play in the sandbox.

Offense Categories

Date Ranges (For Waiting Periods)

Waiting Periods (Logic)

Assign waiting periods to convictions. (E.g if 5 years needs to pass before a felony is considered valid for expungement, then pick 5 as the waiting period and pick Felony as the conviction).

Pick "Never" if the conviction is an unexpungeable conviction.

Select Conviction Type	Select Waiting Period	Add
Conviction	Waiting Period	Action
Felony	5 Years	trash
Misdemeanor	3 Years	trash

Expungement Limits

Fig. 2. Selecting expungement settings.

Create Scenario

Choose State

Michigan

Select Conviction Type Select Year Add

Assaultive

Conviction Type	Year	Assaultive	TenYearFelony	OWI	Action
Felony	2009	No	No	No	
Misdemeanor	2012	No	No	Yes	
Misdemeanor	2019	No	No	No	
Misdemeanor	2022	No	No	No	

Choose Interpretation

Backward Waiting

[Go Back](#)

Fig. 3. Scenario creation editor.

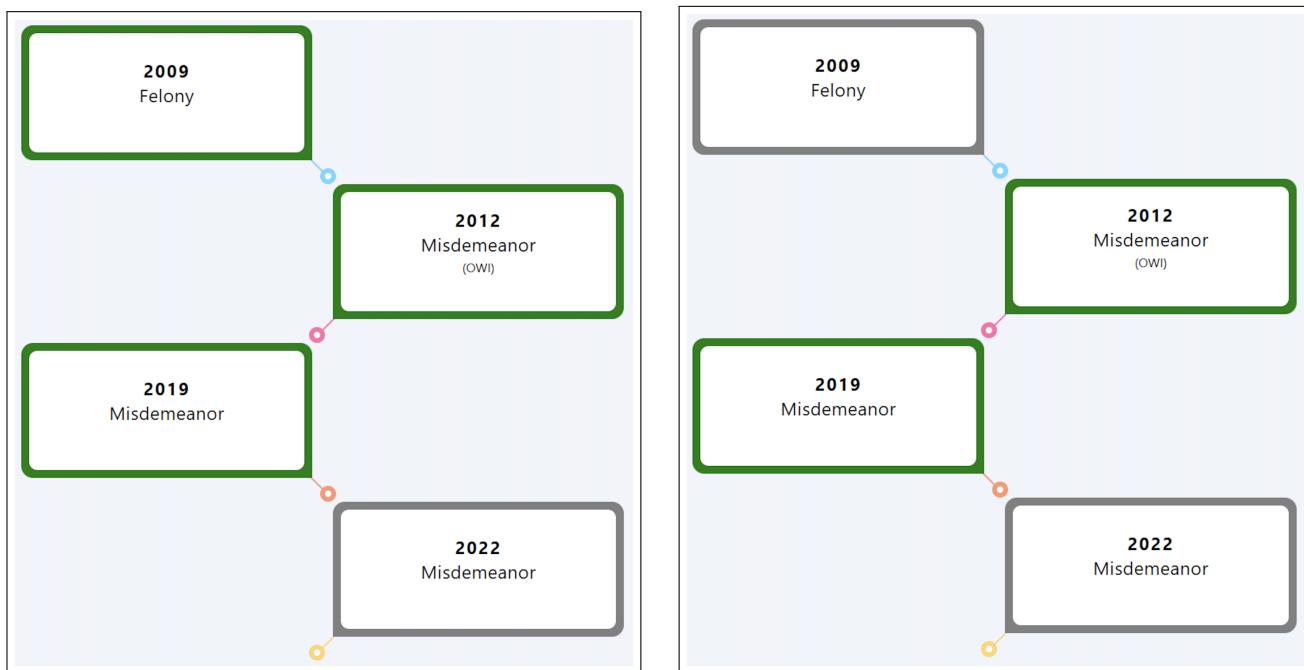


Fig. 4. Expungeability results: (a) without forward-counting; (b) with forward-counting.