

Rules as Code vs. ChatGPT: Lessons from Converting Canadian Federal Legislation into Code using Blawx

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Abstract

This article examines the process of experimentally converting the Canadian Navigable Waters Act definition of “navigable water” into code using an open-source Rules as Code tool called Blawx. The process highlighted the complexity of statutory interpretation and the importance of including legal experts in the process of encoding a legislative provision. Comparing the Blawx (symbolic AI) output to the ChatGPT (generative AI) output illustrated the differences between logic-based systems like Blawx and neural network-based systems like ChatGPT: the Blawx output was accurate and explainable, while the ChatGPT output contained significant errors. Also, while Blawx is a transparent tool, with the underlying s(CASP) code made available to users via the API, ChatGPT is a non-transparent (“black box”) tool, meaning that it is not possible to trace how the conclusions are generated. A hybrid approach that combined the Blawx logic-driven encodings with ChatGPT illustrated the potential benefits of hybrid (“neuro-symbolic”) AI, generating output that was plain language (due to ChatGPT) yet maintained Blawx’s level of accuracy,

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explainability and transparency. As legislative counsel explore potential uses for AI, they should consider whether the AI tool selected can meet the desired level of accuracy, explainability and transparency. In the case of digitizing rules in an accurate, explainable and transparent way, the authors consider that a Rules as Code or neuro-symbolic AI approach holds more potential than an approach focused solely on generative AI.

Introduction

“Rules as Code”, in the legislative context, is the process of taking legislative rules and turning them into a language that computers can read and understand (code). If the encodings are validated by rule makers to make sure they properly reflect the legal meaning, they can be used to power legal automation, simulation, and verification tools that support legislative drafting and that enhance public service delivery.² This article examines the process of experimentally converting an existing Canadian federal legislative provision into code using an open-source Rules as Code (RaC) tool called Blawx.³ For this encoding exercise, we selected the definition of “navigable water” (and related rules) in the *Canadian Navigable Waters Act (CNWA)*,⁴ a law that provides protections for navigation on navigable waters in Canada. We chose to encode this definition as the content and language appear simple, but the process of encoding the rules revealed hidden complexity.

Part 1 of the article describes the process of encoding the legislative definition into Blawx. Part 2 explores the differences in the accuracy, explainability and transparency of the output of Blawx (which is a form of symbolic AI)⁵ versus that of ChatGPT (which is a form of generative AI).⁶ Part 3 assesses the level of accuracy, explainability and transparency of the output of a hybrid Blawx-ChatGPT (“neuro-symbolic AI”) approach. In the article, the term “explainability” focuses on whether the AI output is understandable, with clear, step-by-step logic-based reasons for specific outcomes, whereas “transparency” focuses on whether the AI system’s underlying processes are traceable (known in the programming world as a

² Rules as Code can be used to programmatically test legislative text and the underlying policy to 1) find unintended gaps and ambiguities in the text, 2) facilitate subsequent development of service delivery-related IT tools (e.g. chatbots), and 3) facilitate compliance monitoring and auditing. For background on Rules as Code, see “Cracking the Code: Rulemaking for humans and machines”, OECD Observatory of Public Sector Innovation (2020): <https://oe.cd-opsi.org/publications/cracking-the-code/> (accessed September 27, 2024); Matthew Waddington, “Machine-consumable legislation: A legislative drafter’s perspective – human v artificial intelligence” (2019) 2 *The Loophole — Journal of the Commonwealth Association of Legislative Counsel* <https://www.calc.ngo/sites/default/files/loophole/Loophole%20-202019-02%202019-06-24%29.pdf> (accessed September 27, 2024).

³ GitHub, “Blawx: A user-friendly web-based tool for Rules as Code”: <https://github.com/Lexpedite/blawx> (accessed September 27, 2024). Instructions on how to download Blawx locally can be found at the GitHub link.

⁴ R.S.C., 1985, c. N-22: <https://laws.justice.gc.ca/eng/acts/N-22/index.html> (accessed September 27, 2024).

⁵ Symbolic AI refers to an AI system that works by representing knowledge problems using symbols and efficiently searching the provided knowledge for new information through a series of logical inferences. Marta Garnelo and Murray Shanahan, “Reconciling deep learning with symbolic artificial intelligence: representing objects and relations” (October 2019): <https://www.sciencedirect.com/science/article/pii/S2352154618301943?via%3Dhub> (accessed September 29, 2024).

⁶ Generative AI refers to a type of artificial intelligence that can create new content, such as text, images, audio, or video, by learning patterns and structures from existing data. Inaccurate generative AI content is sometimes referred to as a “hallucination”. IBM, “What is generative AI?” (April 2023): <https://research.ibm.com/blog/what-is-generative-AI> (accessed September 29, 2024).

“white box” or “clear box”) or non-traceable (known in the programming world as a “black box”).

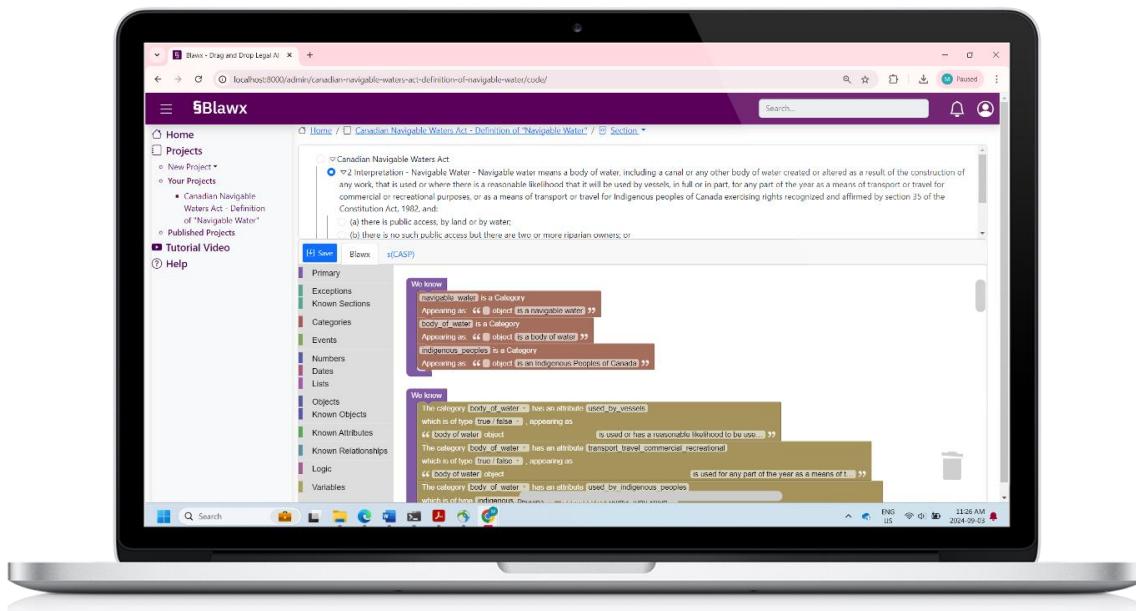
Blawx was selected for this Rules as Code exercise because it is an open-source and user-friendly programming tool designed specifically to help non-programmers encode, test, and use rules. It is powered by a predicate declarative logic programming language called s(CASP) which, in our view, is the optimal programming language for encoding complex legislation. The s(CASP) code is overlaid with a visual programming interface (Blockly) that enables rules to be coded in a drag-and-drop manner that prevents users from placing items in the wrong slots. In addition to offering a user-friendly interface, Blawx can execute hypothetical reasoning tasks and produces natural language answers and the logical explanations on which those answers are based. The combination of these features allows legislative counsel without programming experience to read, write, and analyze encoded legislative provisions in an accessible way.

As a prototype, Blawx is at the stage where it is being used experimentally for drafting and evaluation exercises. A lawyer/developer at the Canada School of Public Service (Martin) wrote the code using Blawx and then validated his modelling decisions with a legislative counsel (Anna) from the Department of Justice Canada’s AI/Rules as Code Working Group. We produced successive versions of the code, taking into account feedback from legislative counsel, lawyers, and subject matter experts, and feedback from Jason Morris, the legal computational expert who built Blawx. Please note that 1) the interpretation of the statutory provisions set out in this article is not an official interpretation of the law but rather our interpretation as individuals conducting Rules as Code experiments,⁷ and 2) Rules as Code encodings are best understood as a supplementary, digitized version of the rules (akin to guidance), to be read alongside the official legislative rules.

By walking you through our code, modelling decisions, tests, and some initial experiments comparing Rules as Code to Large Language Models (LLMs), we hope to convey three considerations when digitizing legislation:

1. encoding legislative rules involves an important element of statutory interpretation, which has implications for the type of coding tool to use;
2. when it comes to digitizing rules in a way that is accurate, explainable, and transparent, Rules as Code has an advantage over generative AI; and
3. combining Rules as Code with generative AI may provide a path to making the digitization of rules trustworthy, practical, and scalable.

⁷ We are lawyers using code on an experimental basis as a means of communicating legal knowledge. Also, neither of us were involved in drafting the legislative provisions mentioned in this article.



Blawx interface depicting the CNWA definition of “navigable water” and our related code

Part 1 – Converting the Legislative Definition of “Navigable Water” into Code

In this part, we will describe 1) the text of the legislative definition, 2) the modelling decisions we made to convert the CNWA definition of “navigable water” and related rules into code using Blawx, and 3) the lessons highlighted by the experiment, particularly in relation to the role of statutory interpretation in the encoding process.⁸

⁸ These modelling notes were written to explain the end state of the code. However, they do not convey the numerous modelling considerations and iterations that were made along the way. To better understand what writing laws into code *feels* like, see Jason Morris, “Rules as Code Demonstration: Encoding the Privacy Act in Blawx” (October 2023): https://github.com/PHACDataHub/privacy_rac_demo (accessed September 27, 2024).

Note: Encoding legislative rules does not have to be an all-or-nothing endeavor. Not all of the provisions of a given ruleset must be encoded for it to be useful, nor must all of the provisions be written with the same degree of specificity. For example, if a legislative rule contains a subjective element (e.g. something must be the case “in the opinion of” an official) or uses flexible terminology (e.g. something must be done within a “reasonable” time), the rule should be encoded in a way that carves out those components so as to not over-prescribe the answer. If a rule has received differing interpretations, it is also possible to encode the rule accordingly, by creating different sets of code corresponding to the differing interpretations of the rule. The best approach for modelling encoded legislation can be viewed as a function of the descriptiveness of the provision and the frequency by which it is referenced (i.e. rules that use descriptive language and are frequently cited are more suitable for a high-resolution encoding; rules that use less descriptive language and are less frequently cited may only merit a low-resolution encoding).

Legislative Definition of “Navigable Water”

The definition of “navigable water” is set out in section 2 of the CNWA (see below). It is presented in both English and French, as both language versions of a Canadian federal statute are official and authoritative expressions of the law.⁹ They must be read in light of each other and in light of applicable common law and civil law. In the Canadian Rules as Code context, this means that the encoding process should involve considering both language versions and legal systems and the encoding should be consistent with the context of the provision. Accordingly, while encoding the definition of “navigable water”, both language versions and legal systems were considered.¹⁰

Definitions

2 The following definitions apply in this Act.

[...]

Définitions

2 Les définitions qui suivent s’appliquent à la présente loi.

[...]

⁹ Canadian Charter of Rights and Freedoms, Part 1 of the Constitution Act, 1982, being Schedule B to the Canada Act 1982 (UK), 1982, c 11, subsection 18(1): <https://laws-lois.justice.gc.ca/eng/const/page-12.html#h-42> (accessed November 25, 2024).

¹⁰ While the Blawx interface is currently in English, it would be possible to add a French interface in a future iteration.

<p>navigable water means a body of water, including a canal or any other body of water created or altered as a result of the construction of any work, that is used or where there is a reasonable likelihood that it will be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes, or as a means of transport or travel for Indigenous peoples of Canada exercising rights recognized and affirmed by section 35 of the <i>Constitution Act, 1982</i>, and</p> <ul style="list-style-type: none"> (a) there is public access, by land or by water; (b) there is no such public access but there are two or more riparian owners; or (c) Her Majesty in right of Canada or a province is the only riparian owner. (<i>eaux navigables</i>) 	<p>eaux navigables Plans d'eau, y compris les canaux et les autres plans d'eau créés ou modifiés par suite de la construction d'un ouvrage, qui sont utilisés ou vraisemblablement susceptibles d'être utilisés, intégralement ou partiellement, par des bâtiments, pendant tout ou partie de l'année comme moyen de transport ou de déplacement à des fins commerciales ou récréatives ou comme moyen de transport ou de déplacement des peuples autochtones du Canada exerçant des droits reconnus et confirmés par l'article 35 de la <i>Loi constitutionnelle de 1982</i> et qui, selon le cas :</p> <ul style="list-style-type: none"> a) sont accessibles au public par voie terrestre ou maritime; b) sont inaccessibles au public et ont plus d'un propriétaire riverain; c) ont pour seul propriétaire riverain Sa Majesté du chef du Canada ou d'une province. (<i>navigable water</i>)
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Encoding the Opening Passage of the Definition

Step 1: Breaking down the legal logic

After reading the English and French versions of the opening passage of the definition (also known as the “chapeau”), we identified two overarching scenarios in which a body of water could be a “navigable water” under the Act (see below).

Scenario 1 (body of water used for commercial or recreational purposes)	Scenario 2 (body of water used by Indigenous peoples)
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<p>When we know all of the following...</p> <ul style="list-style-type: none">• There is a body of water that could be artificial or naturally occurring (open definition).• At least part of that body of water is used or has a reasonable likelihood to be used by vessels, for at least some part of the year, as a means of transport or travel for a commercial or recreational purpose.• The body of water meets one or more of the criteria listed in paragraphs (a) to (c).	<p>When we know all of the following...</p> <ul style="list-style-type: none">• There is a body of water that could be artificial or naturally occurring (open definition).• At least part of that body of water is used or has a reasonable likelihood to be used by vessels, for at least some part of the year, as a means of transport or travel for Indigenous peoples of Canada exercising their section 35 constitutional rights.• The body of water meets one or more of the criteria listed in paragraphs (a) to (c).
<p>We also know that...</p> <p>The body of water is “navigable water” according to section 2 of the CNWA.</p>	<p>We also know that...</p> <p>The body of water is “navigable water” according to section 2 of the CNWA.</p>

Step 2: Defining the legal ontology

Creating categories

After analyzing the logic, we started building the code in Blawx. We first defined the legal ontology, which is the process of representing legal concepts and relationships in a structured manner for the computer to reason with (e.g. the key actors, groups, and concepts, and their relationships with one another). In Blawx, this is done through the creation of categories and attributes for the legal concepts that will later be assembled into a rule. We decided on three categories: one for navigable water (*navigable_water*), one for bodies of water (*body_of_water*), and one for Indigenous peoples of Canada (*indigenous_peoples*). A category can be viewed as a group in which one or many “objects” (a coding term) could belong. For example, “Ottawa River” is an “object” that falls under the category of *body_of_water* and a specific Indigenous people (e.g. the Anishinaabe Algonquin Nation) would fall under the category of *indigenous_peoples*.

We know

- `navigable_water` is a Category
 - Appearing as: “`object is a navigable water`”
- `body_of_water` is a Category
 - Appearing as: “`object is a body of water`”
- `indigenous_peoples` is a Category
 - Appearing as: “`object is an Indigenous Peoples of Canada`”

Assigning attributes to objects

After building our categories, we assigned them attributes. An attribute could be a relationship between an object and a data value. For example, it may be true/false (data value) that the Ottawa River (object under the category *body_of_water*) is used, or has a reasonable likelihood to be used, by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes. An attribute can also be a relationship between two objects. For example, the Ottawa River (object under the category *body_of_water*) could be used, or have a reasonable likelihood to be used, by vessels as a means of transport or travel for the Anishinaabe Algonquin People (under the category *indigenous_peoples*) exercising their section 35 constitutional rights.¹¹ We have written three different attributes for this section of the code.

We know

- The category `body_of_water` has an attribute `used_by_vessels`
 - which is of type `true / false`, appearing as
 - “`body of water object` is used or has a reasonable likelihood to be use...”
- The category `body_of_water` has an attribute `used_in_accordance_with_s35`
 - which is of type `indigenous_peoples`, appearing as `(object, then value)`
 - “`body of water object` is used or has a reasonable likelihood to be use... value exercising their section 35 constitutional rights”
- The category `body_of_water` has an attribute `nav_water_definition_criteria`
 - which is of type `true / false`, appearing as
 - “`body of water object` meets navigable water definition paragraph crite...”

Step 3: Encoding the rule for Scenarios 1 and 2

After defining the legal ontology, we started encoding the rule. We wanted to determine whether an object in the category *body_of_water* was also an object in the category *navigable_water*. In other words, we wanted to determine which bodies of water would qualify as “navigable water”. As discussed earlier, the CNWA sets out two scenarios in which a body of water can be a “navigable water”.

¹¹ Section 35 of the Canada's *Constitution Act, 1982* explicitly recognizes and affirms the existing aboriginal and treaty rights of the First Nations, Métis, and Inuit peoples of Canada. These rights can include, for example, fishing rights.

Scenario 1 (body of water used for commercial or recreational purposes)

To encode Scenario 1, we first created a variable called *Water*, which was used as a placeholder for any object that falls under the category *body_of_water*. We then assembled the attributes to indicate the required combination of conditions that would trigger the application of the rule. At the bottom of the “When we know” portion of the rule, we first indicated that for the conclusion in the opening passage to be true, the conclusion in paragraph (a) of the definition had to be true as well. We then made two near-identical versions of this code for paragraphs (b) and (c).

We also checked the “subject to exceptions” box at the bottom of the purple blocks. This decision was made after encoding section 2.01 of the Act, a section which excludes certain bodies of water from the definition of “navigable water”. By checking the exceptions box, we were asking the Blawx reasoner to verify whether this part of the rule was overruled by another part of the same rule. We discuss this exception further at “Encoding Section 2.01 (“For greater certainty”)”.

Below is the code for Scenario 1:

```

When we know:
Water is in the category body_of_water

body of water Water is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes

The conclusion in CNWA 2.a
that body of water Water meets navigable water definition paragraph criteria
holds

We also know that according to CNWA 2
Water is in the category navigable_water
 subject to exceptions  subject to applicability

```

Note: Blawx does not yet have more advanced reference functionalities for definition sections. In a future iteration, the teal block labelled “CNWA 2.a” could appear as “CNWA 2 – definition of “navigable water” (a)”.

Scenario 2 (body of water used by Indigenous peoples)

We repeated a similar process to encode the rule for Scenario 2.

Below is the code for Scenario 2:

```

When we know:
IndigenousPeoples is in the category indigenous_peoples
Water is in the category body_of_water

body of water Water is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for IndigenousPeoples exercising their section 35 constitutional rights

The conclusion in CNWA 2.a
that body of water Water meets navigable water definition paragraph criteria
holds

We also know that according to CNWA 2
Water is in the category navigable_water
 subject to exceptions  subject to applicability

```

Note: The two encodings above are low-resolution interpretations of the opening passage of the “navigable water” definition. However, the logic can be broken down and represented in a number of different ways, depending on the desired degree of detail. Below is an experimental example of an alternative Scenario 2 encoding that introduces symbolic representations of definitions and key ontological concepts within the Act (e.g. “vessels”, “persons”, and “Indigenous peoples”). This design is more complicated and is of a higher resolution, but it could better explain how these concepts relate to one another within the Act.

When we know:

- Water is in the category body_of_water
- Person is in the category person
- Vessel is in the category vessel
- IndigenousPeoples is in the category indigenous_peoples

body of water Water is used or has a reasonable likelihood to be used by Person with vessel Vessel for any part of the year as a means of transport or travel

person Person is a member of Indigenous peoples IndigenousPeoples and exercising rights in accordance with section 35 of the Constitution Act 1982

The conclusion in CNWA 2.a

that body of water Water meets navigable water definition paragraph criteria

holds

We also know that according to CNWA 2

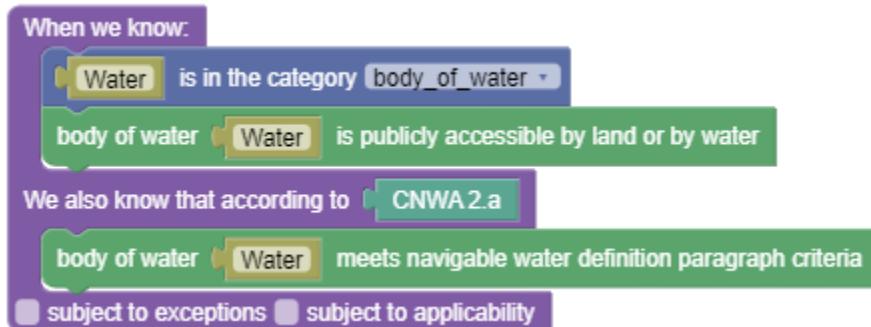
- Water is in the category navigable_water

subject to exceptions subject to applicability

Encoding Paragraph (a) of the Definition

Having encoded the opening passage of the definition, the next step was to encode paragraphs (a), (b), and (c). The condition in paragraph (a) is that “there is public access, by land or by water”/“sont accessibles au public par voie terrestre ou maritime”. To encode paragraph (a), we first created a new attribute for *body_of_water* (“publicly accessible by land or by water”). Then, we indicated that, when a body of water is publicly accessible by land or by water, it triggers paragraph (a) of the “navigable water” definition and therefore meets one of the criteria in paragraphs (a) to (c) of the definition.

Below is the code for paragraph (a):



Encoding Paragraph (b) of the Definition

The condition in paragraph (b) of the definition is that “there is no such public access but there are two or more riparian owners”/“sont inaccessibles au public et ont plus d’un propriétaire riverain”. Encoding paragraph (b) was slightly more complex than encoding paragraph (a), as it is interwoven with facts that are nestled in both paragraphs (a) and (c). We started by creating a new true/false attribute for *body_of_water* to identify instances where the body of water might have two or more riparian owners.

While reading paragraphs (b) and (c) side by side, we also noticed that both paragraphs cannot be true at the same time. In other words, a body of water cannot simultaneously have His Majesty in right of Canada or a province as the only riparian owner and have two or more riparian owners. We therefore created a true/false attribute for *body_of_water* to identify instances where His Majesty in right of Canada or a province is the sole owner of a body of water. We also changed “*Her Majesty*” to “*His Majesty*” in the code, as we now have a King, and subsection 35(1) of the *Interpretation Act* indicates that these terms are interchangeable.¹² Subsection 35(1) also states that a “province” includes a “territory”.¹³ Accordingly, to facilitate comprehension for the reader, we decided to refer to both a “province” and a “territory” in the code.

We used the “*it is false that*” block for “*body of water X is publicly accessible by land or by water*” because the text explicitly says that this information must be discovered in order to generate a conclusion. We used the “*there is no evidence that*” block for “*body of water X has His Majesty in right of Canada or a province or a territory as the only riparian owner*” because 1) if it is true that there is two or more riparian owners, by definition, it cannot be true that there is one riparian owner, and 2) paragraph (b) does not explicitly require this condition to be known in order to generate a conclusion.

¹² However, we did not change “*Her Majesty*” to “*His Majesty*” in the natural (legislative) language that is copy-pasted into Blawx as we were not altering the law itself.

¹³ R.S.C., 1985, c. I-21: <https://laws.justice.gc.ca/eng/acts/i-21/index.html> (accessed November 26, 2024). In a future iteration of Blawx, encoded versions of key drafting rulesets like the *Interpretation Act* could be linked to encoded sets of federal legislation so that such clarifications could be provided automatically.

Note: An important distinction needs to be made between the “*it is false that*” and the “*there is no evidence that*” blocks. “*It is false that*” should be used in instances where a conclusion requires knowledge that something not be true (i.e. it is known to be false), while “*there is no evidence that*” should be used in instances where a conclusion can be generated as long as something is *not* known to be true (i.e. it is either known to be false, or there is not sufficient evidence that it is true). This distinction, while admittedly confusing, has important logical implications. It is akin to finding an accused “guilty” (e.g. evidence the accused committed an offence) or “not guilty” (e.g. no evidence the accused committed an offence) rather than finding them “innocent” (e.g. evidence the accused did not commit an offence) or “not innocent” (e.g. no evidence the accused did not commit an offence).

Below is the code for paragraph (b):

When we know:

- Water is in the category body_of_water

it is false that

- body of water Water is publicly accessible by land or by water
- body of water Water has two or more riparian owners
- there is no evidence that
- body of water Water has His Majesty in right of Canada or a province or a territory as the only riparian owner

We also know that according to CNWA 2.b

- body of water Water meets navigable water definition paragraph criteria
- subject to exceptions / subject to applicability

We also expressed some of our modelling decisions using the internal commentary tool that Blawx has, as shown below:

We changed “Her Majesty” to “His Majesty” in the code, as we now have a King, and subsection 35(1) of the Interpretation Act indicates that these terms are interchangeable. Subsection 35(1) of the Interpretation Act also states that a “province” includes a “territory”. Accordingly, to facilitate comprehension for the reader, we decided to refer to both a “province” and a “territory” in the code.

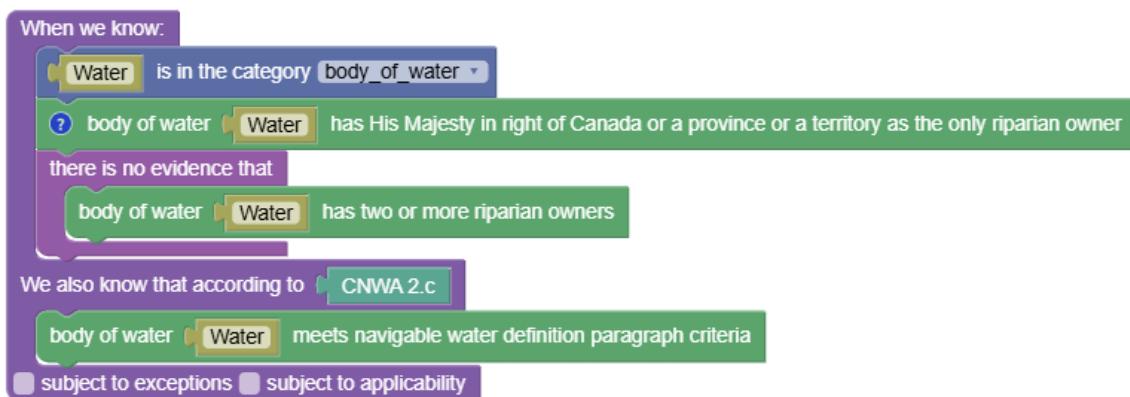
there is no evidence that

body of water Water has His Majesty in right of Canada or a province or a territory as the only riparian owner

Encoding Paragraph (c) of the Definition

The condition in paragraph (c) of the definition is that “Her Majesty in right of Canada or a province is the only riparian owner”/“ont pour seul propriétaire riverain Sa Majesté du chef du Canada ou d'une province”. The logic of paragraph (c) is similar to the logic of paragraph (b), but it is less complicated. The ontology had already been created for paragraph (c) so all we needed to do was to assemble the rule using a similar logic structure to that shown in paragraph (b).

Below is the code for paragraph (c):



Encoding Section 2.01 (“For greater certainty”)

The “navigable water” definition is also impacted by section 2.01 of the Act, so we encoded that rule as well. Section 2.01 of the CNWA reads as follows:

For greater certainty — <i>navigable water</i>	Précision — <i>eaux navigables</i>
2.01 For greater certainty, the definition <i>navigable water</i> in section 2 does not include artificial irrigation channels or drainage ditches.	2.01 Il est entendu que sont exclus de la définition de <i>eaux navigables</i> , à l'article 2, les canaux d'irrigation et les tranchées de drainage artificiels.

Step 1: Breaking down the legal logic

Section 2.01 is framed as a “for greater certainty” clause that relates to “artificial irrigation channels or drainage ditches”/“les canaux d’irrigation et les tranchées de drainage artificiels”. “For greater certainty” clauses imply that, even without the existence of the clause, the same legal conclusion would still hold.¹⁴ As per Canadian federal drafting conventions, they are generally used to affirm a statement by providing an example that

¹⁴ P. Salembier, *Legal and Legislative Drafting* (LexisNexis Canada, 2009) at p 364.

restates the existing content in a way that is clearer. However, in this case, it appears that the rule makers may have wanted to alter the nature of the definition by excluding certain types of bodies of water (“artificial irrigation channels or drainage ditches”) from being categorized as “navigable water”. In other words, in terms of the legal logic behind section 2.01, it arguably appears to be a substantive rule (an exception) rather than a “for greater certainty” clause.¹⁵

Step 2: Encoding the rule

Having decided that the rule in section 2.01 could be understood as an exception to the section 2 definition of “navigable water”, we then encoded the rule. To do so, we created a true/false attribute for *body_of_water* to identify bodies of water that are “artificial irrigation channels or drainage ditches” under section 2.01 of the CNWA, and then built a rule to indicate that these bodies of water did not fall under the definition of “navigable water”.

When we reviewed our initial encodings with another legislative counsel who had subject matter expertise with the contents of this Act, it was brought to our attention that 1) there are artificial irrigation channels that are qualitatively similar (e.g. in size and functionality) to bodies of water that are more commonly considered navigable waters, and 2) those types of artificial irrigation channels could be interpreted to be navigable water under the modern rule of statutory interpretation.¹⁶ In response to this, we modified our code to limit the assertion of our exception to instances where such bodies of water did not share similar qualitative properties with known navigable water bodies.

Note: The section 2.01 “for greater certainty” clause is a great example of a rule that cannot be understood by reading the grammatical sense of the words of their own. Without access to specialized legislative expertise, it is highly unlikely that someone encoding this rule would be able to accurately interpret these types of clauses. It is also important to note that, while our interpretation is likely correct, further investigation into this provision could lead us to interpret and encode it differently.

Below is the code for section 2.01:

¹⁵ Section 2.01 was not part of the initial version of the bill which updated the CNWA definition of “navigable water” but was rather added to the bill at the parliamentary committee stage.

¹⁶ Statutes are to be read “[...] in their entire context and in their grammatical and ordinary sense harmoniously with the scheme of the Act, the object of the Act, and the intention of Parliament”: *Rizzo & Rizzo Shoes Ltd. (Re)*, [1998] 1 SCR 27 at para 21. See also “Navigability Assessment Questions and Answers”, Transport Canada: <https://npp-submissions-demandes-ppn.tc.ca/content/doc/Navigability%20Assessment%20E2%80%93%20Questions%20and%20Answers.pdf> (accessed September 27, 2024).

When we know:

- Water is in the category body_of_water
- body of water Water is an artificial irrigation channel or drainage ditch
- there is no evidence that
- body of water Water is similar in size and functionality to bodies of water normally considered navigable water

We also know that according to CNWA 2_01

- it is false that
- Water is in the category navigable_water
- subject to exceptions subject to applicability

In order to link this rule to the code of the opening passage, we encoded an “overrule statement”, which indicates that a conclusion that 2.01 applies will “overrule” a conclusion that a body of water is “navigable water” under section 2.

Below is the “overrule statement” for section 2.01:

We know

- the conclusion in CNWA 2_01
- that it is false that
- Water is in the category navigable_water

overrules the conclusion in CNWA 2

that Water is in the category navigable_water

Encoding Paragraph 28(1)(g.1) (Regulatory Carve-Out)

Another rule that impacts the definition of “navigable water” is paragraph 28(1)(g.1) of the CNWA. This paragraph authorizes the Governor in Council to make regulations excluding any body of water from the definition of “navigable water”. Paragraph 28(1)(g.1) reads as follows:

Regulations by Governor in Council	Règlements du gouverneur en conseil
<p>28 (1) The Governor in Council may, for the purposes of this Act, make regulations [...]</p> <p>(g.1) excluding any body of water that the Governor in Council considers to be small from the definition <i>navigable water</i> in section 2;</p>	<p>28 (1) Le gouverneur en conseil peut, pour l'application de la présente loi, prendre des règlements : [...]</p> <p>g.1) excluant des plans d'eau qu'il estime être petits de la définition de <i>eaux navigables</i> à l'article 2;</p>

The logic of this rule is very similar to the logic for section 2.01; as with section 2.01, if paragraph 28(1)(g.1) applies (or, more specifically, a regulation made under it), then the conclusion is that the body of water is not a “navigable water”, and that conclusion will “overrule” a conclusion that a body of water is “navigable water” under section 2.

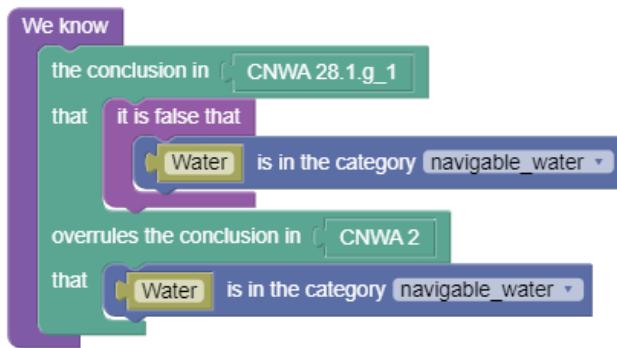
Below is the code for paragraph 28(1)(g.1):

The screenshot shows the "When we know:" section of the Rules as Code interface. It includes the following statements:

- "Water is in the category body_of_water"
- "the Governor in Council has excluded body of water Water from the s.2 definition of navigable water via regulation"
- "We also know that according to CNWA 28.1.g_1"
- "it is false that Water is in the category navigable_water"
- "subject to exceptions subject to applicability"

We then encoded an “overrule statement” to link the code for paragraph 28(1)(g.1) to the code of the opening passage. It indicates that a conclusion that paragraph 28(1)(g.1) applies (or, more specifically, that a regulation made under it applies) will “overrule” a conclusion that a body of water is “navigable water” under section 2.

Below is the “overrule statement” for paragraph 28(1)(g.1):



Lesson 1: Encoding legislative rules involves an important element of statutory interpretation, which has implications for the type of coding tool to use

The first lesson highlighted by this exercise – one that has implications for the use of AI in the legislative space – is that accurately converting legislative language into code is not a purely coding exercise that can be done by programmers alone, but rather a complex exercise that involves an important element of statutory interpretation. While the text of the definition of “navigable water” and related rules at section 2.01 and paragraph 28(1)(g.1) were relatively short (approximately half a page in total), the process of encoding the rules required a comprehensive interpretive process involving legal and legislative knowledge.

Notably, the encoding process involved interpreting both language versions (English and French) of the rules in light of both of Canada’s legal systems (common law and civil law), Canada’s modern rule of statutory interpretation, and the *Interpretation Act*. We suggest that it is unlikely that a person who was not a lawyer could accurately interpret and encode the definition of “navigable water” and related rules from reading the text on its own. While programmers can write rules into code, they lack the knowledge of statutory interpretation required to interpret legislative rules in all their complexity.

An advantage of the Rules as Code tool we selected for this experiment (Blawx) is that it has been designed to enable the coding to be done directly by the people best placed to do statutory interpretation (lawyers, including legislative counsel) – an element that is missing in many other Rules as Code tools that are geared towards programmers. Neither of us had significant training in programming tools prior to using Blawx, yet we were able to use Blawx to reflect in code our interpretation of the rule.

Part 2 – Testing the Blawx Encodings of “Navigable Water” versus ChatGPT’s Interpretation

In this part, we will demonstrate how we tested our Blawx code and assessed the quality of the output by comparing it to the output of ChatGPT 4o mini and ChatGPT 4o. To test the output of the Blawx encodings, we first encoded a test question in Blawx to determine whether an unidentified variable (*Water*) falls under the definition of “navigable water” (a yes/no question). Using this test question (or a modified version of it), we ran three tests on

the Blawx encodings: a test related to the Ottawa River, a test about an artificial irrigation channel, and a test to generate *Why* and *Why Not* explanations.¹⁷

Below is the code for the test question:



Blawx Encodings – Test 1: Ottawa River

For the first test, we chose a specific Canadian use case: the Ottawa River. In the Scenario Editor window of Blawx, we inputted all the relevant information we knew about the Ottawa River to help us determine the ways in which it could fall under the encoded definition of “navigable water”. For example, we inputted that vessels travel along the Ottawa River and that it is not an artificial irrigation channel or drainage ditch. We also inputted that the Ottawa River is used by the Anishinaabe Algonquin People exercising section 35 constitutional rights. We labelled some information “uncertain”, such as whether the Ottawa River has one or multiple riparian owners. This indicated to Blawx to consider whether the information must be true in order to generate a conclusion.

Note: If no information is provided for a specific category, the Blawx reasoner will not assume that this information is false. The absence of information will satisfy the “*there is no evidence that...*” block, but it will not satisfy the “*it is false that...*” block.

Below is the set of facts that we inputted into the Blawx reasoner for Test 1:

¹⁷ *Why* and *Why Not* tests are used to identify every hypothetical way in which a rule might (“why”) or might not (“why not”) apply, which can be useful for drafting (e.g. identifying edge cases or unintended outcomes).

Facts

- the_Ottawa_River is a body of water
- the_Anishinaabe_Algonquin_People is an Indigenous Peoples of Canada
- body of water the_Ottawa_River is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes
- body of water the_Ottawa_River is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for the_Anishinaabe_Algonquin_People exercising their section 35 constitutional rights
- body of water the_Ottawa_River is publicly accessible by land or by water
- it is uncertain whether body of water the_Ottawa_River has two or more riparian owners
- it is uncertain whether body of water the_Ottawa_River has His Majesty in right of Canada or a province or a territory as the only riparian owner
- it is false that body of water the_Ottawa_River is an artificial irrigation channel or drainage ditch
- it is uncertain whether the Governor in Council has excluded body of water the_Ottawa_River from the s.2 definition of navigable water via regulation

When we ran this set of facts through the encodings (by clicking the “Run” button in Blawx’s Scenario Editor), we received one answer from the Blawx reasoner (namely that the Ottawa River could be a “navigable water” based on the facts provided), with four different explanations. These explanations are based on combinations of Scenarios 1 and 2 of the opening passage and the criteria of paragraphs (a) and (c) of the “navigable water” definition. The test could not generate a conclusion as to whether the Ottawa River would meet the criteria of paragraph (b) because doing so would have required that there be no public access to the body of water.¹⁸

Below is how the Blawx output appears when the headings are collapsed. For reasons of brevity, we will only discuss in detail explanations #1 and #4.¹⁹

Answers

Answer #1^

Explanation #1▼

Explanation #2▼

Explanation #3▼

Explanation #4▼

Explanation #1 from Blawx indicated that the Ottawa River could be a “navigable water” under the CNWA because it falls under Scenario 1 of the opening passage (body of water

¹⁸ In other words, the fact that the Ottawa River is publicly accessible by land or by water (i.e. it is true that there is public access) triggered a component of the paragraph (a) criterion that cannot also trigger the paragraph (b) criterion (i.e. it is false that there is public access).

¹⁹ Explanations #2 and #3 are similar to explanations #1 and #4 (explanation #2 covers Scenario 2 and paragraph (a); explanation #3 covers Scenario 1 and paragraph (c)).

used for commercial or recreational purposes) and paragraph (a) (there is public access), and because there is no evidence that section 2.01 or paragraph 28(1)(g.1) applies.

Below is a set of key conclusions from explanation #1:

We know it holds that according to [section 2](#), the_Ottawa_River is a navigable water because

- according to [section 2](#), the_Ottawa_River is a navigable water [\[1\]](#) and
- there is no evidence that the conclusion in [section 2](#) that the_Ottawa_River is a navigable water is defeated [\[1\]](#).

We know according to [section 2](#), the_Ottawa_River is a navigable water because

- the_Ottawa_River is a body of water [\[1\]](#)
- body of water the_Ottawa_River is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes [\[1\]](#) and
- it holds that according to [section 2_paragraph_a](#), body of water the_Ottawa_River meets navigable water definition paragraph criteria [\[1\]](#).

There is no evidence that the conclusion in [section 2](#) that the_Ottawa_River is a navigable water is defeated because

- there is no evidence that it holds that it is false that according to [section 2_01](#), it is not true that the_Ottawa_River is a navigable water [\[1\]](#) and
- there is no evidence that it holds that it is false that according to [section 28_subsection 1_paragraph_g_1](#), it is not true that the_Ottawa_River is a navigable water [\[1\]](#).

Explanation #4 hypothesizes a way in which the Ottawa River could be a “navigable water” through Scenario 2 of the opening passage (body of water used by Indigenous peoples) and paragraph (c) (His Majesty is the only riparian owner). This output was the result of our indicating that it was “uncertain” whether the Ottawa River has one or multiple riparian owners. The output also indicated that neither section 2.01 nor paragraph 28(1)(g.1) can apply for this conclusion to hold.

Below is a set of key conclusions from explanation #4:

We know it holds that according to [section 2](#), the_Ottawa_River is a navigable water because

- according to [section 2](#), the_Ottawa_River is a navigable water [\[1\]](#) and
- there is no evidence that the conclusion in [section 2](#) that the_Ottawa_River is a navigable water is defeated [\[1\]](#).

We know according to [section 2](#), the_Ottawa_River is a navigable water because

- the_Anishinaabe_Algonquin_People is an Indigenous Peoples of Canada [\[1\]](#)
- the_Ottawa_River is a body of water [\[1\]](#)
- body of water the_Ottawa_River is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for the_Anishinaabe_Algonquin_People exercising their section 35 constitutional rights [\[1\]](#) and
- it holds that according to [section 2_paragraph_c](#), body of water the_Ottawa_River meets navigable water definition paragraph criteria [\[1\]](#).

There is no evidence that the conclusion in [section 2](#) that the_Ottawa_River is a navigable water is defeated because

- there is no evidence that it holds that it is false that according to [section 2_01](#), it is not true that the_Ottawa_River is a navigable water [\[1\]](#) and
- there is no evidence that it holds that it is false that according to [section 28_subsection 1_paragraph_g_1](#), it is not true that the_Ottawa_River is a navigable water [\[1\]](#).

Note: When providing an explanation, Blawx differentiates conclusions based on known facts from ones that depend upon assumptions. It is important to highlight any assumptions identified in the explanations, such as the fulfillment of conditions, as the explanations hold only if the assumptions turn out to be correct (e.g. if all applicable conditions are met). Take, for example, the text below, which was displayed in all four of the Blawx explanations generated during our Ottawa River test.

There is no evidence that body of water ottawa_river is an artificial irrigation channel or drainage ditch.
It is assumed that there is no evidence that the Governor in Council has excluded body of water ottawa_river from the s.2 definition of navigable water via regulation.

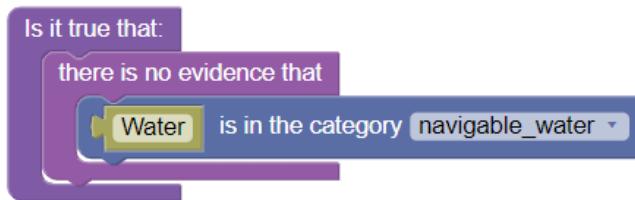
Since we explicitly indicated in our facts that the Ottawa River was not an artificial irrigation channel or drainage ditch, the first portion of the text (i.e. “there is no evidence”) provides a clear statement which indicates that this criteria has been met. However, since we told our code that we were “uncertain” as to whether the Governor in Council excluded the Ottawa River from the section 2 definition, the second portion of the text indicates that this criteria must be assumed in order for the explanation to hold.

The Blawx answer and explanations for Test 1 were accurate based on our input. We did not see any errors generated. In addition, because of the Blawx explanation functionality, all of the logical steps that led to the conclusion that the Ottawa River was a “navigable water” were also laid out for the user to read and validate.

Blawx Encodings – Test 2: Artificial Irrigation Channel

For the second test, we wanted to see how our code responded when section 2.01 applied. To do this, we reversed the formulation of our test question to see whether there was *no* evidence that a body of water was “navigable water”.

Below is the code for the test question:



We then created a body of water called “A” and kept our facts simple. Similar to explanation #1 from our Ottawa River test, we activated facts that would trigger Scenario 1 and paragraph (a). We also indicated that “A” was an artificial irrigation channel and that it was not similar in size or functionality to a body that is normally considered “navigable water”.

Below is the set of facts that we inputted into the Blawx reasoner for Test 2:

Facts

- A is a body of water
- body of water A is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes
- body of water A is publicly accessible by land or by water
- body of water A is an artificial irrigation channel or drainage ditch
- it is false that body of water A is similar in size and functionality to bodies of water normally considered navigable water

Running these facts generated one answer, namely that, despite “A” meeting the section 2 criteria through Scenario 1 and paragraph (a), “A” was not a “navigable water” because section 2.01 applied.

Below is a set of key conclusions from the explanation generated by Blawx:

There is no evidence that it holds that according to [section 2](#), A is a navigable water because

- according to [section 2](#), A is a navigable water [\[i\]](#) and
- the conclusion in [section 2](#) that A is a navigable water is defeated [\[i\]](#).

We know according to [section 2](#), A is a navigable water because

- A is a body of water [\[i\]](#)
- body of water A is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes [\[i\]](#) and
- it holds that according to [section 2 paragraph a](#), body of water A meets navigable water definition paragraph criteria [\[i\]](#).

We know according to [section 2.01](#), it is not true that it is not true that A is a navigable water because

- A is a body of water [\[i\]](#)
- body of water A is an artificial irrigation channel or drainage ditch [\[i\]](#) and
- there is no evidence that body of water A is similar in size and functionality to bodies of water normally considered navigable water [\[i\]](#).

As with Test 1, the Blawx answer and explanation for Test 2 were accurate, explainable and transparent. The outlined reasoning reliably and properly reflected our encoding of the rules, and the outputs clearly explained how a conclusion was rendered, given the facts provided.

Note: The Blawx explanation for section 2.01 incorrectly repeats the words “it is not true” in its reasoning. There are also instances where double negations are used in the explanations in a way that can be confusing for the reader. These are known bugs in the software that are fixable and that will be addressed in a future iteration of Blawx.

Blawx Encodings – Test 3: Why and Why Not Explanations

For our third test, we used *Why* and *Why Not* tests to identify all the ways in which a body of water could (or could not) be a “navigable water”. This type of test could be used, for example, if rule makers are hoping to amend the definition of “navigable water” and wish to understand the scope of the definition, including unanticipated scenarios resulting from the outlined logic.

First, we started by identifying all potential ways that a body of water can fall under the “navigable water” definition. We did this by reusing our test question from Test 1 (i.e. “Is it true that a body of water is in the category navigable water?”) and activating all of the selectable parameters with the “uncertain” label. Unlike the “true” and “false” statements used in previous tests, we use the “uncertain” label when we want the Blawx reasoner to consider whether the information must be known as true/false in order to make a specific conclusion. The Blawx reasoner identifies which of the facts are required by converting them into “known” statements in the explanations. For example, the input “*it is uncertain that body of water is publicly accessible by land*” becomes the output “*we know the body of water is publicly accessible by land*” in explanations that require it as a known fact.

Note: We also did not name our objects for this test. By saying “*It is uncertain whether any object is a body of water*” and “*It is uncertain whether any object is an Indigenous peoples of Canada*”, we are asking the Blawx reasoner to consider whether one or more of these statements are required in order to generate a conclusion. Some Blawx explanations may require both statements, but others may only need one.

Below is the set of facts that we inputted into the Blawx reasoner for Test 3:

Facts

- it is uncertain whether any object is a body of water
- it is uncertain whether any object is an Indigenous Peoples of Canada
- it is uncertain whether body of water any body_of_water is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes
- it is uncertain whether body of water any body_of_water is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for any indigenous_peoples exercising their section 35 constitutional rights
- it is uncertain whether body of water any body_of_water is publicly accessible by land or by water
- it is uncertain whether body of water any body_of_water has two or more riparian owners
- it is uncertain whether body of water any body_of_water has His Majesty in right of Canada or a province or a territory as the only riparian owner
- it is uncertain whether body of water any body_of_water is an artificial irrigation channel or drainage ditch
- it is uncertain whether body of water any body_of_water is similar in size and functionality to bodies of water normally considered navigable water
- it is uncertain whether the Governor in Council has excluded body of water any body_of_water from the s.2 definition of navigable water via regulation

Running these facts generated twelve answers, each with one explanation. For example, explanation #10 hypothesizes an instance where a body of water labelled “H21”²⁰ – an artificial irrigation channel with similar size and functionality to a navigable water – meets the definition requirements through Scenario 1 of the opening passage and paragraph (c).

Below is a set of key conclusions from explanation #10:

²⁰ When running a test in Blawx, the reasoner will label any hypothetical entities using a combination of letters and numbers.

We know according to [section 2](#), H21 is a navigable water because

- H21 is a body of water [i](#)
- body of water H21 is used or has a reasonable likelihood to be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes [i](#) and
- it holds that according to [section 2 paragraph c](#), body of water H21 meets navigable water definition paragraph criteria [i](#).

There is no evidence that according to [section 2_01](#), it is not true that it is not true that H21 is a navigable water because

- H21 is a body of water [i](#)
- body of water H21 is an artificial irrigation channel or drainage ditch [i](#) and
- body of water H21 is similar in size and functionality to bodies of water normally considered navigable water [i](#).

Next, we reversed our question (i.e. we used the Test 2 question – “Is it true that there is no evidence that a body of water is in the category of navigable water?”) and repeated the same steps. This produced sixteen answers in a similar format to the ones shown above. Both sets of answers and explanations could be reviewed by rule makers to assess the accuracy of the encodings.

As with Tests 1 and 2, the Blawx output for Test 3 was accurate and explainable. In addition, it automatically generated every way that a legal conclusion might and might not hold with a high degree of accuracy and explainability, making it the only user-friendly tool for non-programmer lawyers that we are aware of that can do this.²¹

ChatGPT 4o mini – Definition of “Navigable Water”

Having tested the quality of our Blawx encoding of the definition of “navigable water” and related rules, we then tested two ChatGPT chatbots to see which type of AI – symbolic AI (Blawx) or generative AI (ChatGPT) – generated the most accurate and explainable output. First, we tested the less expensive ChatGPT 4o mini. Then, to see if the quality of results improved with a more expensive version, we tested ChatGPT 4o. For the test of ChatGPT 4o mini, our questions focused on whether the Ottawa River could be a “navigable water” under the CNWA as well as whether an artificial irrigation channel could be a “navigable water”.

Below is our first question and ChatGPT 4o mini’s response:

²¹ For another example of writing rules into s(CASP) (the programming language used in Blawx) to answer *Why* and *Why Not* legal questions, see Jason Morris, “Constraint answer set programming as a tool to improve legislative drafting” (2021) Proceedings of the 18th International Conference on Artificial Intelligence and Law: <https://ink.library.smu.edu.sg/cclaw/7> (accessed September 27, 2024).

Is the Ottawa River considered "navigable water" according to the Canadian Navigable Waters Act? Please explain your reasoning and cite the specific sections of the law that you consulted when coming to your conclusion.



Yes, the Ottawa River is considered "navigable water" according to the Canadian Navigable Waters Act (NWA). Here's a detailed explanation based on the law:

Understanding Navigable Waters

The Canadian Navigable Waters Act is designed to ensure that navigable waters in Canada are protected, and it defines "navigable waters" broadly. According to the Act:

- Navigable waters are generally those where a vessel can be navigated, and this includes rivers, lakes, and other bodies of water that are used or capable of being used for navigation.

Key Sections of the Act

1. Definition of Navigable Waters:

- Section 2 of the NWA provides the definition: "navigable water" means any body of water, whether it is a lake, river, or other body of water, that is capable of being navigated by any type of vessel."

2. Regulation of Navigable Waters:

- Section 5 of the NWA outlines that the Minister has authority to assess and regulate any project or activity that might affect the navigation of a navigable water. This regulation applies to any body of water that qualifies as navigable.

Specific Application to the Ottawa River

The Ottawa River is a major river that has been historically and currently used for various types of navigation, including recreational boating and commercial activities. Given its usage and the definition provided in the Act, it clearly qualifies as navigable. The river has significant commercial and recreational importance, which further supports its status as navigable under the Act.

Therefore, based on the general definition of "navigable water" and the applicability of regulations under the NWA, the Ottawa River is indeed considered a navigable water. This means that any development or activity affecting its navigability would be subject to the provisions of the Canadian Navigable Waters Act.

While the answer that "the Ottawa River is indeed considered a navigable water" was correct, the explanations provided by ChatGPT 4o mini to support its answer contained numerous hallucinations as well as information that was not pertinent to the Act's definition of "navigable water". For example:

- The definition of "navigable water" provided by ChatGPT 4o mini was *not* the actual definition from the Act, despite being confidently displayed to the user as if quoted directly from its source.

- ChatGPT 4o mini did not mention or appear to consider the French version of the definition, which is equally authoritative.²²
- The reference to section 5 of the CNWA was irrelevant. Section 5 concerns work permit applications to be submitted to the Minister of Transport for projects on navigable waters and it is not relevant to the analysis of whether a body of water is a “navigable water”.
- The answer did not mention that the Ottawa River is used by Indigenous peoples exercising section 35 rights (relevant to Scenario 2 of the opening passage of the definition).
- The answer did not mention the section 2.01 “for greater certainty” clause nor paragraph 28(1)(g.1) in its reasoning, even though those provisions would need to be considered to determine if a body of water was “navigable water”.

Whereas the Blawx reasoner generated reliable output that directly communicated and cited our encoded legislation (see *Blawx Encodings – Test 1: Ottawa River* above), ChatGPT 4o mini’s response to a similar question about the Ottawa River generated significant errors and omissions.

We decided to give ChatGPT 4o mini a second chance to consider section 2.01 in its reasoning by asking whether an artificial irrigation channel could be a “navigable water” under the CNWA.

Below is our second question and ChatGPT 4o mini’s response:

²² ChatGPT does not appear to understand the characteristics of Canada’s legal system and structure. In hindsight, we should have asked ChatGPT to consider both the official French and English versions of the law prior to providing an answer. In a future experiment, it would be interesting to see how generative AI tools like ChatGPT deal with divergences, if any, in their language-dependent answers.

Let's do a different example. Assume we're talking about a body of water called X, and let's say X is an artificial irrigation channel. Would X also be navigable water according to the Canadian Navigable Waters Act?

The status of an artificial irrigation channel, such as the body of water X in your example, under the Canadian Navigable Waters Act (NWA) depends on several factors related to its navigability. Here's how the Act would apply:

Definition of Navigable Water

Under the Canadian Navigable Waters Act, a "navigable water" is defined as:

- Section 2: "navigable water" means any body of water, whether it is a lake, river, or other body of water, that is capable of being navigated by any type of vessel."

Determining Navigability

For a body of water to be considered navigable under the Act, it must be capable of supporting navigation by a vessel. This includes:

- Usage: The body of water must be used or capable of being used for navigation.
- Navigation Capability: The water must be suitable for the type of vessels intended to use it.

Application to an Artificial Irrigation Channel

1. Type of Water Body: An artificial irrigation channel is typically designed for the specific purpose of irrigation, not for navigation. The primary use of such channels is to direct water for agricultural purposes.
2. Navigation: For X to be considered navigable, it would need to be used for or capable of supporting navigation. If the irrigation channel is too narrow, shallow, or otherwise unsuitable for any type of vessel, it would not meet the definition of "navigable water."
3. Regulatory Considerations: If X were to be used for navigation or if there were projects that might affect its navigability, then it could be subject to regulations under the NWA. However, if it is purely an irrigation channel without any navigational use or capability, it would not be classified as navigable water under the Act.

Conclusion

In summary, an artificial irrigation channel like X would generally not be considered navigable water under the Canadian Navigable Waters Act unless it meets the criteria for navigation. Since irrigation channels are primarily designed for water management and not for navigation, they typically do not fall under the scope of navigable waters as defined by the Act.

Here again, while the final answer from ChatGPT 4o mini was correct, the reasoning was riddled with errors and hallucinations. Notably, ChatGPT 4o mini failed to pick up on the existence of section 2.01 – the only provision in the CNWA that references “artificial irrigation channels”. It also again generated an incorrect citation of the section 2 definition of “navigable water”.

Finally, we decided to direct ChatGPT 4o mini to the section 2.01 “for greater certainty” clause in the Act to see if it would lead to a more accurate generative AI answer.

Below is our third question and ChatGPT 4o mini’s response:

You forgot to consult section 2.01 of the Canadian Navigable Waters Act. Review this section and let me know if you would like to change your original answer (and if so, how).

 You're right; Section 2.01 of the Canadian Navigable Waters Act (NWA) is crucial for understanding the scope of what constitutes a "navigable water." Let's review it:

Section 2.01 of the Canadian Navigable Waters Act

Section 2.01 states:

"For the purposes of this Act, a body of water that is artificially created is not a navigable water unless it is used or capable of being used for navigation by a vessel."

Implications for Artificial Irrigation Channels

According to Section 2.01, an artificial body of water, such as an irrigation channel, is not considered navigable unless it meets the following conditions:

- Use for Navigation: The channel must be used for navigation.
- Capability of Navigation: The channel must be capable of being used for navigation by a vessel.

Applying Section 2.01 to the Irrigation Channel Example

Given the specific provision in Section 2.01, here's how it affects the determination:

1. Artificial Creation: Since X is an artificial irrigation channel, it is not automatically considered navigable.
2. Criteria for Navigability:
 - Used for Navigation: If X is used for navigation (e.g., if boats or other vessels travel through it), it might qualify.
 - Capable of Being Used for Navigation: Even if it is not currently used for navigation, if X is designed and maintained in a manner that could support navigation by a vessel, it might be considered navigable.

Conclusion

Considering Section 2.01, the original conclusion needs adjustment:

- If X is solely an irrigation channel and is neither used nor capable of being used for navigation, it would not be considered navigable under the NWA.
- If X is used or could be used for navigation, despite being artificial, it would be classified as navigable water according to the NWA.

Thus, Section 2.01 clarifies that artificial bodies of water are excluded from being considered navigable unless they meet the criteria for use or capability for navigation.

ChatGPT 4o mini generated further errors in response to this last question, hallucinating a completely inaccurate alternative version of the text of section 2.01 and citing it as the basis for its answer. By contrast, when Blawx was asked about whether an artificial irrigation channel could be a “navigable water” under the CNWA (see *Blawx Encodings – Test 2: Artificial Irrigation Channel* above), it generated output that accurately, consistently, and clearly explained why such a body of water could not meet the Act’s definition criteria.

ChatGPT 4o – Definition of “Navigable Water”

The ChatGPT 4o mini results in relation to the definition of “navigable water” were worse than expected, so we decided to test the GPT 4o model as well. ChatGPT 4o is aimed at reducing hallucinations but at a higher cost per token. While the results from ChatGPT 4o were much better, this model was also prone to hallucination and error.

Below is our question and ChatGPT 4o’s response:

 Is the Ottawa River considered "navigable water" according to the Canadian Navigable Waters Act? Please explain your reasoning and cite the specific sections of the law that you consulted when coming to your conclusion.

 Yes, the Ottawa River is considered "navigable water" according to the Canadian Navigable Waters Act.

Here's why:

1. **Definition of Navigable Water:** Under section 2 of the Canadian Navigable Waters Act, "navigable water" is defined as any body of water that is used or capable of being used by the public for navigation, whether by vessel, regardless of its size. The Ottawa River, being a large river, has been historically used for navigation by various types of vessels, including commercial and recreational boats, so it fits this definition.
2. **Exception Clauses:** I also reviewed section 2.01, which deals with exceptions to the definition of "navigable water." This section states that certain waters may be excluded from the definition under specific conditions, such as minor works or other circumstances where navigability is not deemed significant. However, the Ottawa River is not listed among the exceptions, nor does it meet the criteria typically associated with the exclusion of navigable waters under this section.

Therefore, based on its historical and practical use for navigation, and its inclusion in the list of protected waters under federal jurisdiction, the Ottawa River meets the criteria as navigable water under the Canadian Navigable Waters Act.

If you'd like more details on a specific provision, feel free to ask!

Compared to ChatGPT 4o mini, ChatGPT 4o did a much better job in identifying both section 2 and section 2.01 as key provisions of the CNWA relating to the definition of

“navigable water”, and the answers reused more of the original legislative text. However, ChatGPT 4o still made a number of significant mistakes, for example:

- The way ChatGPT 4o described “use by the *public* for navigation” as a core component of the definition of “navigable water” was incorrect. The presence of “public access” to the body of water is only one of three ways by which a body of water could be a “navigable water” according to paragraphs (a) to (c) of the definition of “navigable water”.
- ChatGPT 4o’s reference to “whether by vessels” is grammatically incorrect. It seems that ChatGPT 4o is describing the use by vessels as an optional element of the definition when it is actually part of a core requirement.
- ChatGPT 4o also hallucinated while describing the application of section 2.01. Instead of exclusively discussing the non-application of the “navigable water” definition to artificial irrigation channels and drainage ditches, it referenced elements that are not in section 2.01, such as “minor works” and the concept of a list of exceptions.
- Like ChatGPT 4o mini, ChatGPT 4o did not mention the element of the definition concerning use by Indigenous peoples (relevant to Scenario 2 of the opening passage of the definition), nor the regulatory carve-out in paragraph 28(1)(g.1).²³

By contrast, Blawx did not commit any of the above errors as it reliably cited the law and explained how each section applied given the specific facts provided by the user.

Lesson 2: When it comes to digitizing rules in a way that is accurate, explainable and transparent, Rules as Code has an advantage over generative AI

The second lesson illustrated by this exercise – another lesson relevant to the use of AI in the legislative space – is that Rules as Code has an advantage over generative AI when it comes to digitizing rules in a way that is accurate, explainable and transparent. In this case, comparing the output of the Blawx encodings (symbolic AI) to that of ChatGPT (generative AI) revealed that the Blawx output and explanation were accurate, while the ChatGPT output contained significant errors. In addition, Blawx provided detailed explanations for its conclusions while ChatGPT did not explain its behind-the-scenes process (instead, it simply tried to “predict” what such an explanation might be).²⁴

It is important to recognize that generative AI models like ChatGPT are providing users with unvalidated “word prediction” models. More specifically, they are models that predict “tokens”, which can be words, subwords, or individual characters. This type of prediction

²³ ChatGPT4o also mistakenly made references to sections 3, 4 and 29 of the CNWA. The explanations for the sections were also prone to error to the point that displaying and unpacking them in this article would have required more space than we had.

²⁴ See also P. Burgess, *AI and the Rule of Law: the Necessary Evolution of a Concept* (Bloomsbury Publishing, 2024) at p 113.

performed by neural networks is not the same thing as the logical “reasoning” performed by rules-based, deterministic symbolic AI tools like Blawx. A commonly-used analogy for the differences in these types of AI comes from psychology: whereas ChatGPT is akin to “System 1” thinking (automatic, fast, intuitive, and prone to error and bias), Blawx is akin to “System 2” thinking (deliberate, slow, and logical).²⁵ While context-stuffing (packing relevant information such as URL links into a prompt), fine-tuning, Retrieval Augmented Generation (RAG) and Chain-of-Thought (CoT) can help yield somewhat higher-quality predictions from generative AI, the generations are still inherently not reasoning-based and therefore not explainable (and still prone to error and hallucination).²⁶

Furthermore, the “black box” nature of generative AI tools means it will not be possible to see how the tool came to the generated conclusion. In other words, even if generative AI tools can appear to provide explanations for the answers they produce, these explanations are also merely “predictions” (often inaccurate ones) of what a potential explanation *could* be, and *not* the true basis for their conclusions. The inherent limitations of generative AI in terms of accuracy, explainability, and transparency are of particular concern in the legal and legislative context, as accuracy, explainability and transparency are key components of the rule of law.²⁷

Part 3 – Testing a Hybrid Blawx-ChatGPT Approach to Interpreting “Navigable Water”

In this part, we will describe the test we did to assess the quality of the output of *combining* our Blawx encodings with ChatGPT. ChatGPT is not known for its accuracy, explainability or transparency, but it is known for its capacity to summarize concepts in plain language. While this article’s title is “Rules as Code *versus* ChatGPT”, we were curious to see if an approach that used both Rules as Code *and* ChatGPT could yield results that brought together the best of both worlds: the accuracy, explainability and transparency of a logic-based Rules as Code tool, on the one hand, and the plain language capabilities of neural network-based ChatGPT, on the other.

Blawx and ChatGPT 4o mini – Definition of “Navigable Water”

To test this hybrid/neuro-symbolic Blawx-ChatGPT approach, we gave ChatGPT 4o mini a short prompt (shown below) and copied-and-pasted a detailed Blawx explanation into its conversation window (the Blawx explanation is not shown in the image to save space, but it appeared after the prompt). The Blawx explanation was based on a combination of Scenario

²⁵ P. Jean & Forbes Technology Council, “When To Use Symbolic And Generative AI” (June 2024) *Forbes* <https://www.forbes.com/councils/forbestechcouncil/2024/06/05/when-to-use-symbolic-and-generative-ai/> (accessed November 3, 2024).

²⁶ We repeated both ChatGPT exercises using context-stuffing practices (i.e. by providing a URL to the CNWA). This helped to reduce the risk of hallucination when referencing the text of the rules, but it did not significantly improve the quality of the legal conclusions that were generated.

²⁷ Burgess at pp 61, 156, 157 and 161: “The need for transparency is a key component of the Rule of Law [...]. After all, in many respects the judicial system is based not only on the principal [sic.] that the right decision is arrived at, but that the right decision can be seen to have been arrived at [...]. The inability of [generative] AI to be able to provide explanations of its decision making [...] represents a fundamental Rule of Law problem.”

1 and paragraph (a) leading to the conclusion that the Ottawa River was a “navigable water”. The same exercise could be repeated for each of the four Blawx explanations that were generated by this test.

When asked to summarize the explanation generated by our Blawx encodings, ChatGPT 4o mini’s summary correctly indicated how the Ottawa River met the Act’s “navigable water” definition under paragraph (a) (based on our initial input into Blawx that “body of water ottawa_river is publicly accessible by land or by water”). It also indicated that the Ottawa River was not an artificial irrigation channel or drainage ditch under section 2.01 and that the Governor in Council had not excluded it from the definition of “navigable water” through a regulation made under paragraph 28(1)(g.1).

Below is a prompt with our Blawx input and ChatGPT 4o mini’s summary:

What follows is an automatically generated explanation stemming from encoded version of a rule. Restate it in plain language without restating mathematical calculations and without further justifying conclusions for which there is only an absence of evidence in support. Please link conclusions to specific parts of the law and provide to the user a clear explanation of the reasoning.

{Blawx explanation}

 The Ottawa River is classified as a navigable water according to Section 2 of the law. Here's why:

1. **Definition of Navigable Water:** According to Section 2, the Ottawa River qualifies as a navigable water because it is a body of water used, or likely to be used, by vessels for transport or travel. This use can be for commercial or recreational purposes, either all year or part of the year.
2. **Accessibility:** The Ottawa River is publicly accessible either by land or by water, which meets the criteria outlined in Section 2, Paragraph a.
3. **No Evidence Against Navigability:** There is no evidence that contradicts the conclusion that the Ottawa River is a navigable water. Specifically:
 - It has not been shown that the river is an artificial irrigation channel or drainage ditch.
 - There is no indication that the Governor in Council has excluded the Ottawa River from the definition of navigable water provided in Section 2.

Thus, based on the information provided, the Ottawa River remains classified as a navigable water under Section 2 of the law.

ChatGPT’s summary of the Rules as Code encodings was largely accurate. Its description of the definition was close to the actual legislative definition. It correctly cited a specific paragraph (paragraph (a)) that would apply based on our input that the Ottawa River is publicly accessible. It also correctly noted that there was no evidence that contradicted the conclusion that the Ottawa River is a “navigable water”, referencing the exception for

artificial irrigation channels as well as the Governor in Council’s ability to exclude bodies of water from the definition by regulation. There were some minor issues, such as the reference to “Section 2, Paragraph a” (which, as mentioned earlier, is due to Blawx not yet having more advanced reference functionalities). However, overall, the quality of ChatGPT’s summary based on the Blawx input was very good. This initial experiment demonstrated that using encoded rules (a Rules as Code/symbolic AI approach) as a foundation can help AI tools interpret legislation with more accuracy, explainability and transparency than if they rely on a purely generative AI approach.²⁸

Note: While Rules as Code can significantly improve the quality of the generative AI text, the plain language summaries should be accompanied by detailed Blawx explanations and the relevant legislation for greater explainability and transparency.

Lesson 3: Combining Rules as Code with generative AI may provide a path to making the digitization of rules trustworthy, practical, and scalable

The third lesson from this exercise is that, rather than choosing between Rules as Code and generative AI when digitizing rules, a better approach may be to combine the strengths of both types of AI to get the best of both worlds. In this case, a hybrid approach combining Blawx encodings with ChatGPT generated output that was plain language (due to ChatGPT’s predictive language technology) yet maintained accuracy, explainability and transparency (due to Blawx’s reasoning capabilities). While Part 3 was limited to showing the use of ChatGPT to summarize Blawx (Rules as Code) reasoning, it is worth noting that there are other ChatGPT abilities that could be combined with Rules as Code. Notably, because of ChatGPT’s conversational functionality, it would be possible to combine Blawx (or another Rules as Code tool) and ChatGPT (or another generative AI chatbot) to create a conversational chatbot, based on Rules as Code, that prompts users for relevant information and produces output conversationally.²⁹

In addition, with the emergence of symbolic AI-based LLMs like Logic-LM, it may be possible in the coming years to autogenerate high-fidelity initial drafts of rule encodings directly from legislative texts.³⁰ Validation by human legal experts would still be needed, but having an automated initial draft of rule encodings could significantly streamline code drafting and validation and allow the use of Rules as Code to scale more quickly.

²⁸ Martin’s team is working on integrating generative AI summaries into the current version of Blawx.

²⁹ M. Perron, A. Logie and J. Turner, “EN Team 7 - Develop ‘rules as code’ chatbots for use in public services” (August 2024) *Global Government Forum* <https://www.youtube.com/watch?v=UIz4TLBO4WQ> (accessed September 27, 2024).

³⁰ Logic-LM: “Empowering Large Language Models with Symbolic Solvers for Faithful Logical Reasoning” <https://arxiv.org/abs/2305.12295> (accessed September 27, 2024). The legal computational expert who first developed Blawx (Jason Morris) is also working on an LLM integration that helps autogenerate a first draft of code: <https://www.linkedin.com/feed/update/urn:li:activity:7218822246675439616/> (accessed September 27, 2024).

Conclusion

This article explored the process of converting a Canadian legislative provision into code using Blawx and compared the quality of output of the Blawx encodings against the quality of output from ChatGPT 4o mini and ChatGPT 4o. The findings illustrated the hidden complexities of statutory interpretation, the risks of relying too heavily on programmers or generative AI for interpreting legislation, and the importance of developing Rules as Code tools specifically designed to be user-friendly for rule makers. In this experiment, the ChatGPT “black box” generated answers that contained significant hallucinations and lacked explainability and transparency. By contrast, both Blawx and the hybrid Blawx-ChatGPT approach were “clear boxes” and yielded answers that were accurate and grounded in logical explanations and in traceable software processes. When it comes to digitizing legislative rules in an accurate, explainable and transparent way, we consider that logic-based systems like Blawx or Rules as Code-based LLMs hold more potential than approaches that rely solely on neural network-based tools like ChatGPT.

As legislative counsel start to explore potential uses for AI in the legislative drafting space, here are a few questions for them to consider (noting that the answers may vary depending on the specific use case):

1. What is the level of accuracy, explainability and transparency that is desired or needed for the AI use case? How will accuracy, explainability and transparency be assessed and who will assess them?
2. Can the type of AI selected (e.g. generative AI) meet the level of accuracy, explainability and transparency required? If not, are there other types of AI (e.g. symbolic AI), or hybrid approaches (e.g. neuro-symbolic AI), that could do so?
3. What skills and training would legislative counsel benefit from to support their use of diverse forms of AI in the legislative space?

Annex

As an experiment, we asked ChatGPT (Auto) to “explain” whether Blawx or ChatGPT provide more accurate and explainable answers. Since its answer was, in this case, largely accurate, we decided to include it in this Annex. One error ChatGPT made was assuming that Blawx “encodes” legal provisions; in reality, Blawx does not create the encodings, but rather enables encodings to be done and validated by lawyers, including legislative counsel.

If a legal provision has been encoded into Blawx by legal experts, would ChatGPT or Blawx provide more accurate and explainable answers in response to legal questions about that provision? Please explain your answer in less than 200 words.

- ④ If a legal provision has been encoded into Blawx by legal experts, Blawx would provide more accurate and explainable answers compared to ChatGPT.

Accuracy: Blawx encodes legal provisions as specific rules, ensuring answers that directly reflect the encoded law without deviation. It applies the rules consistently, making its answers precise and reliable for legal questions about the provision.

Explainability: Blawx is designed to show the exact reasoning behind each decision, providing step-by-step transparency on how a conclusion is reached based on the encoded rules. This is essential for legal contexts, where understanding the logic behind a decision is crucial.

ChatGPT's Limitations: ChatGPT generates responses based on patterns from its training data and does not have explicit, rule-based encoding of specific legal provisions. While it can provide general explanations, its answers are not traceable to specific laws and may lack accuracy, consistency, and explainability.

Conclusion: Blawx, when encoded by legal experts, offers precise, consistent, and fully explainable responses tailored to the provision, making it far superior for answering specific legal questions compared to ChatGPT.