

# Computation and Legal Reasoning

## A Guide for Legal Practitioners

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# Outline

## 1 Introduction

## 2 Law and Logic

## 3 Legal Reasoning in Computation

## 4 Symbolic Logic Approach

# Why Theory?

“There is nothing so practical as a good theory” -  
Kurt Lewin

# Uses of Theory

- Pattern detection
- Classification
- Prediction

# Limits of Practice



Figure 1: Beauvais Cathedral, Exterior

# Limits of Practice



Figure 2: Beauvais Cathedral, Interior

# Computational Law

- "Law that works like software"
- (Universal) Encoding
- (Automated) Analysis

# Example applications

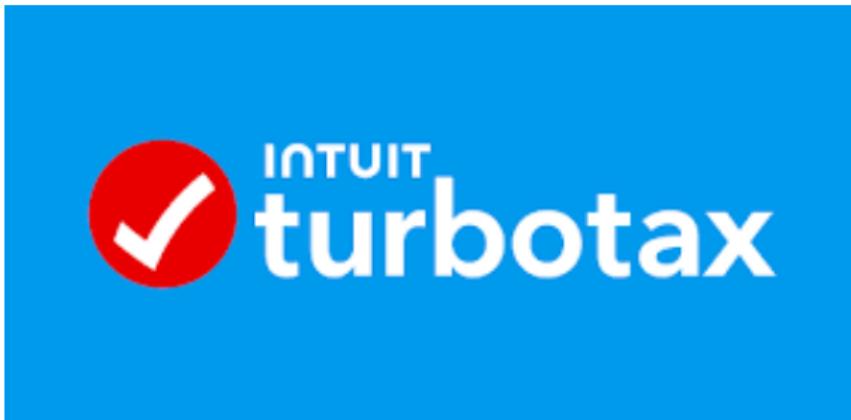


Figure 3:

# Example applications



Figure 4: Autonomous Systems

# Example applications

- Determine possible legal outcomes
- Making plans, giving advice
- Identifying lines of argumentation
- Aiding in the formulation of legislation

# Scope of Computational Law

- Does not mean giving up on decision-making
- Some laws more amenable to computability

# Law and Logic

“The life of the law has not been logic; it has been experience.”

Oliver Wendell Holmes, Jr.

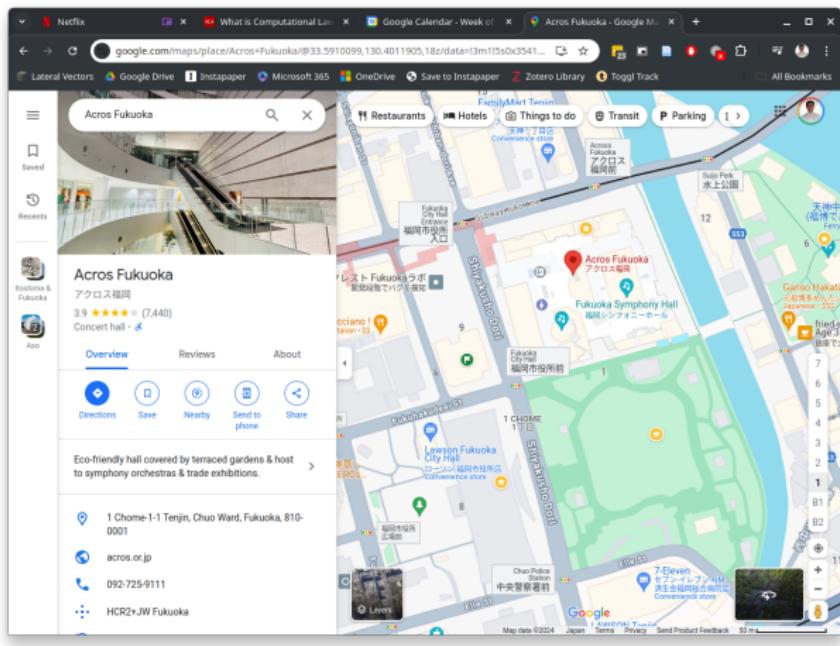
# Historical Arguments

- Development of law and logic has always been intertwined
- Traditional objections to logic - often misquided

# Epistemological Arguments

- Law is NOT magic
- Logic is implicit in law
- Perfect fidelity is not required

# Logical Model as Maps



# Practical Arguments

- Common language for collaboration
- Development of software applications

# Computational Approaches to Legal Reasoning

- “Artificial Intelligence” (LLM’s)
- Symbolic Approaches

# LLM's for Legal Reasoning



Figure 6: IMF, WEF Studies

# Market Conditions

- Large addressable market for legal services
- Limited supply of legal talent
- Greater complexity

# LLM's for Legal Reasoning

“The ability to speak does not make you intelligent.”  
George Lucas

# LLM's for Legal Reasoning

Language < Reasoning < Intelligence

# Components of Intelligence

- Reasoning
- Perception
- Action
- Imagination

# LLM's for Legal Reasoning

- Probabilistic sleight of hand, hallucinations
- Limited use case (especially for legal decisions)
- Costs to build and maintain

# LLM's for Legal Reasoning

Source Text	Training Samples
The <span style="border: 1px solid black; padding: 2px;">quick</span> <span style="border: 1px solid black; padding: 2px;">brown</span> fox jumps over the lazy dog. →	(the, quick) (the, brown)
The <span style="border: 1px solid black; padding: 2px;">quick</span> <span style="border: 1px solid black; padding: 2px;">brown</span> <span style="border: 1px solid black; padding: 2px;">fox</span> jumps over the lazy dog. →	(quick, the) (quick, brown) (quick, fox)
The <span style="border: 1px solid black; padding: 2px;">quick</span> <span style="border: 1px solid black; padding: 2px;">brown</span> <span style="border: 1px solid black; padding: 2px;">fox</span> <span style="border: 1px solid black; padding: 2px;">jumps</span> over the lazy dog. →	(brown, the) (brown, quick) (brown, fox) (brown, jumps)
The <span style="border: 1px solid black; padding: 2px;">quick</span> <span style="border: 1px solid black; padding: 2px;">brown</span> <span style="border: 1px solid black; padding: 2px;">fox</span> <span style="border: 1px solid black; padding: 2px;">jumps</span> <span style="border: 1px solid black; padding: 2px;">over</span> the lazy dog. →	(fox, quick) (fox, brown) (fox, jumps) (fox, over)

Figure 7:

# LLM's for Legal Reasoning

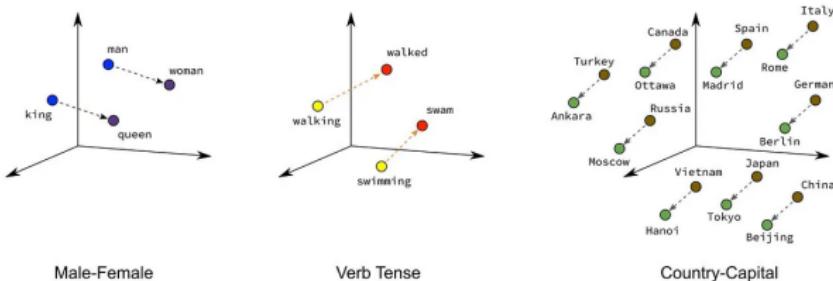
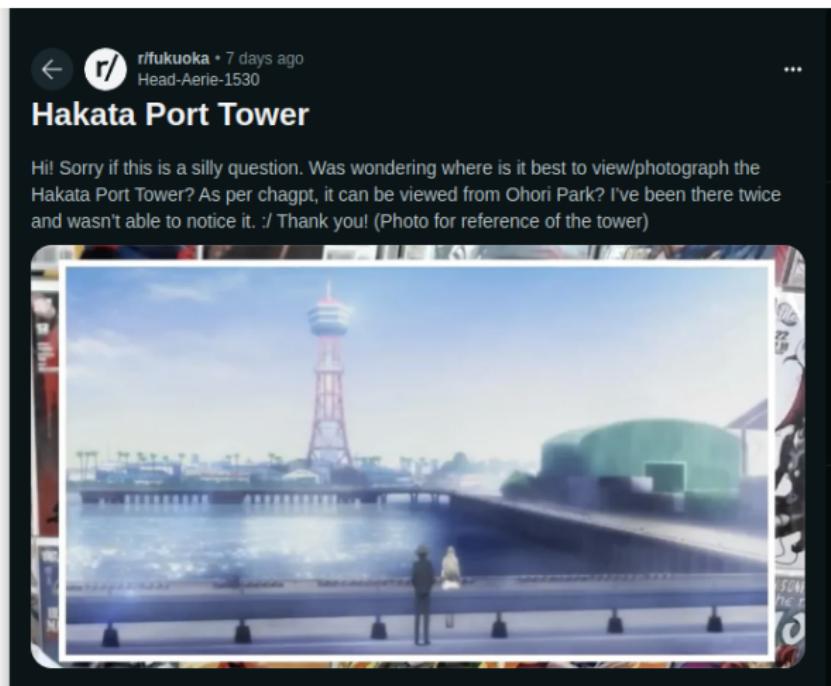


Figure 8:

# LLM's for Legal Reasoning



# LLM's for Legal Reasoning

How can I see Hakata Tower from Ohori Park?



Are you looking for specific viewpoints or general directions on how to spot Hakata Tower from Ohori Park?

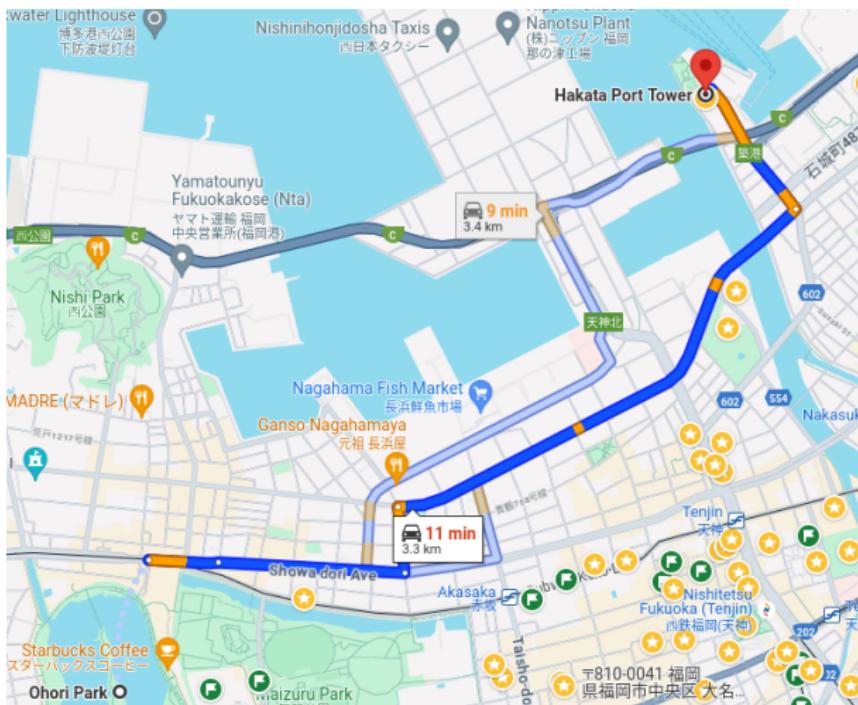
Asking for viewpoints



Try heading to the eastern edge of Ohori Park near the lake. From there, you might get a clear view of Hakata Tower against the city skyline.

Figure 10:

# LLM's for Legal Reasoning



# Extended Horn Clauses

British Nationality Act 1981:

“A person born in the United Kingdom after commencement shall be a British citizen if at the time of birth his father or mother is  
(a) a British citizen; or...”

# Extended Horn Clauses

$x$  becomes a British citizen  
if  $x$  was born in the United Kingdom on date  $y$   
and date  $y$  is on or after commencement  
and  $x$  has a parent  $z$  and  $z$  is a British citizen

# Ontologies

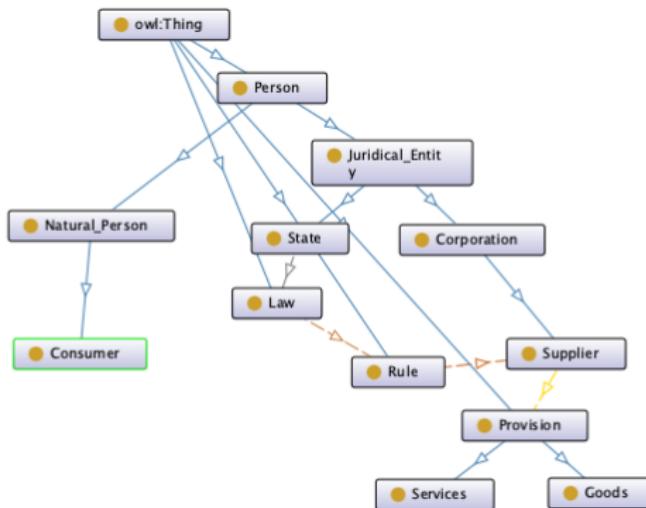


Figure 12: Ontology of legal concepts

# Ontologies

Demo: Querying Facts from an Ontology (DBpedia)

# Ontologies

Demo: Rule Inference from an Ontology

# Deontic Statements

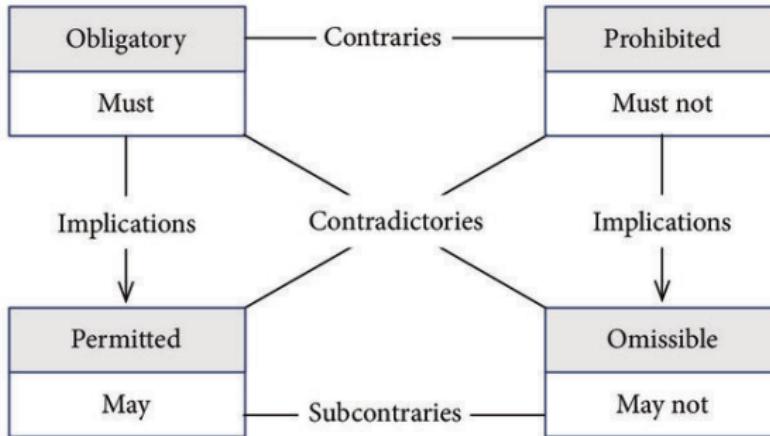


Figure 13: Deontic square

# Deontic Statements

Text	Deontic Logic Version
A1 - Grants exclusive rights for a supplier to provide goods or services	<p>If it is <i>permitted</i> to supply goods, AND it is <i>obligatory</i> that the supplier = 1 THEN</p> $(P(\text{Supply Goods}) \wedge (O(\text{Supplier}=1)) \rightarrow$ <p>(0 - No effect; 1 - Indirect Effect; 2 - Direct effect)</p>

# Defeasibility

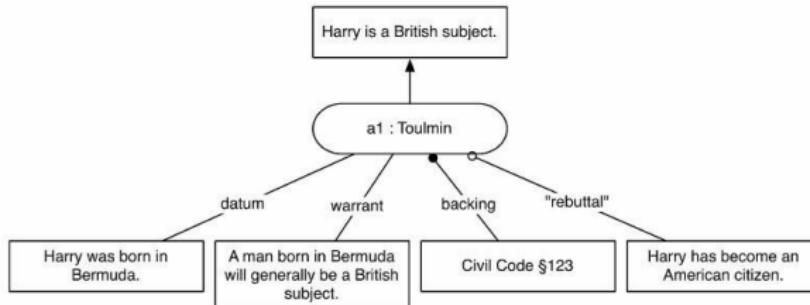


Figure 15: Defeasible arguments

# Defeasibility

Demo: Evaluation of Defeasible Statements  
(Carneades)

# Advantages, Symbolic Approach

- Easier to review and evaluate (formal proof)
- Easier to correct and update
- Better accessibility

# Conclusion

Thank You!  
Questions and (Defeasible) Answers