Computation and Legal Reasoning
A Guide for Legal Practitioners

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Outline

1 Introduction

2 Law and Logic

3 LLM's for Legal Reasoning?

4 Symbolic Logic Approach

Background

- Academe -> Practice
- Theory

Why Theory?

"There is nothing so practical as a good theory" - Kurt Lewin
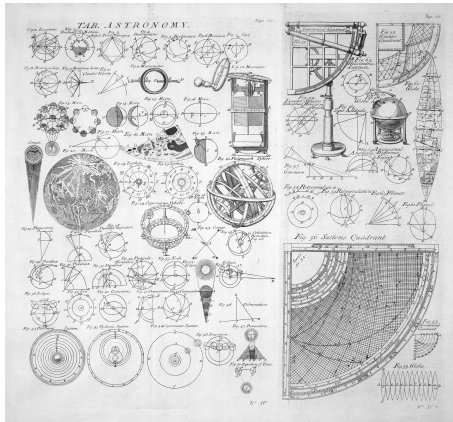
Why Theory?

Figure 1: Empirical Astronomy
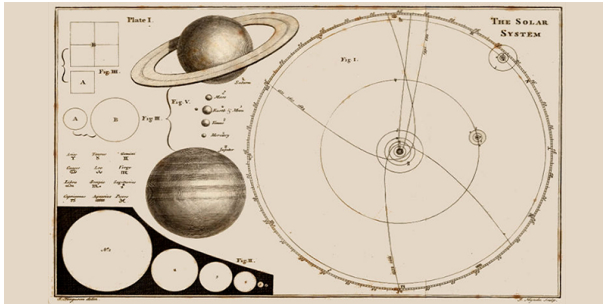
Why Theory?

Figure 2: Astronomy After Principia

Uses of Theory

- Pattern detection
- Classification
- Prediction
- A different language

Limits of Practice

Figure 3: Beauvais Cathedral, Exterior

Limits of Practice

Figure 4: Beauvais Cathedral, Interior

Computational Law

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

Why Computational Law?

- Law - Reason over Power
- Universality in Computation
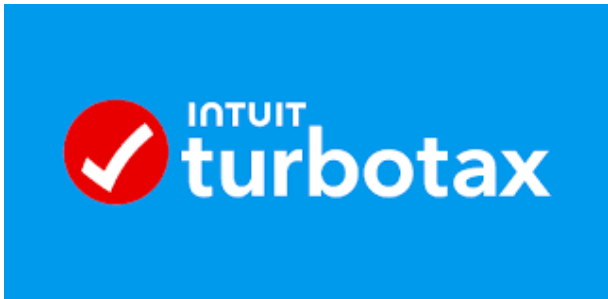- Higher Towers of Consequences

Example applications

Figure 5:

Introduction
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Law and Logic
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LLM's for Legal Reasoning?
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Symbolic Logic Approach
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Example applications

Figure 6: Autonomous Systems

Example applications

- Determine possible legal outcomes
- Making plans, giving advice
- Identifying lines of argumentation
- Drafting of legal documents

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Scope of Computational Law

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

Some Laws More Amenable

- YES:Tax Law, Commercial Law, Contracts
- NO: Criminal Law, Constitutional Law
- ???: Case Law

Not A Substitute for Human Decisions

Figure 7: Decision Support Systems

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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

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Philosophical Arguments

- Law is NOT magic
- Logic is implicit in law
- Perfect fidelity is not required
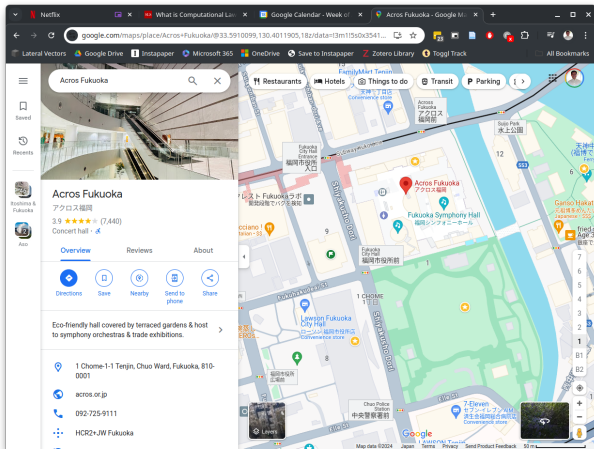
Logical Model as Maps

Figure 8: "All models are wrong, but some are useful - George Box"

Practical Arguments

- Development of software applications
- Common language for collaboration

Computational Approaches to Legal Reasoning

- "Artificial Intelligence" (LLM's, Connectionist)
- Symbolic Approaches

LLM's for Legal Reasoning

Figure 9: IMF, WEF Studies

Market Conditions

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

LLM's for Legal Reasoning

"The abiity to speak does not make you intelligent."
George Lucas

LLM's for Legal Reasoning

Language $<$ Reasoning $<$ Intelligence

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Components of Intelligence

- Reasoning
- Perception
- Action
- Imagination

LLM's for Legal Reasoning

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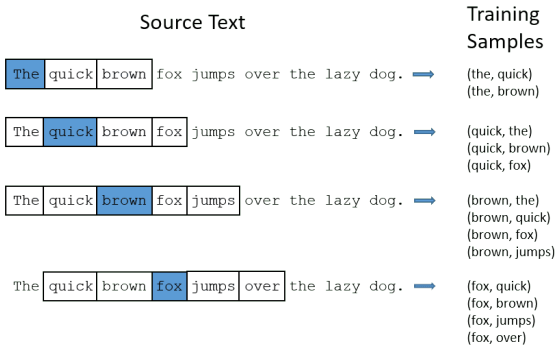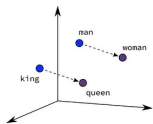- Costs to build and maintain

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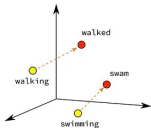
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LLM's for Legal Reasoning

Figure 10:

LLM's for Legal Reasoning

Figure 11:

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LLM's for Legal Reasoning

Figure 12:

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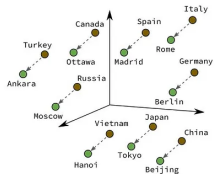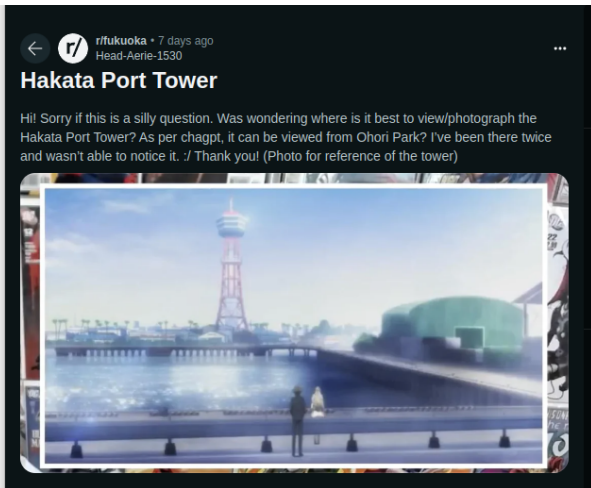
LLM's for Legal Reasoning

How can I see Hakata Tower from Ohori Park?

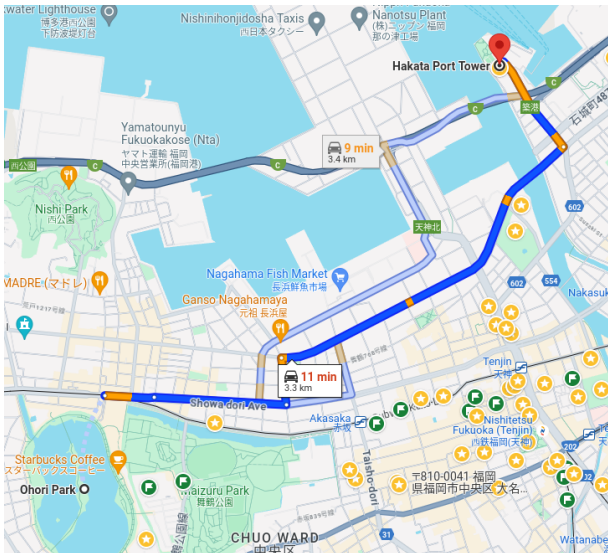⚙ Are you looking for specific viewpoints or general directions on how to spot Hakata Tower from Ohori Park?

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 13:

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
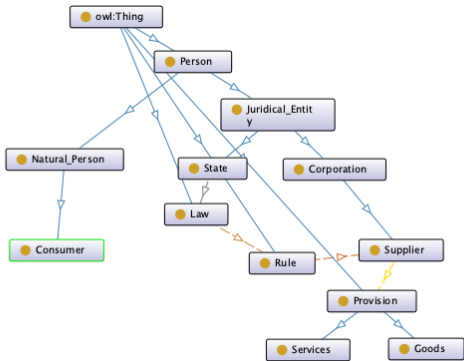and x has a parent z and z is a British citizen

Ontologies

Figure 15: Ontology of legal concepts

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Ontologies

Demo: Querying Facts from an Ontology (DBpedia)

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Ontologies

Demo: Rule Inference from an Ontology

Deontic Statements
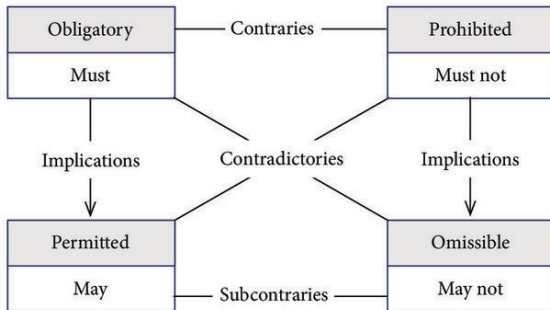
Figure 16: Deontic square

Deontic Statements

Text	Deontic Logic Version
A1 - Grants exclusive rights for a supplier to provide goods or services	If it is *permitted* to supply goods, AND it is *obligatory* that the supplier = 1 THEN (P(Supply Goods) ∧ (O(Supplier=1)) → (0 - No effect; 1 - Indirect Effect; 2 - Direct effect)

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Defeasibility

Figure 18: Defeasible arguments

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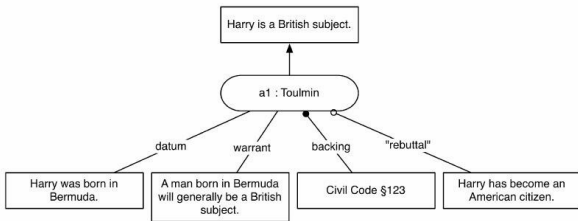○○○○○

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Defeasibility

Demo: Evaluation of Defeasible Statements
(Carneades)

Advantages, Symbolic Approach

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

End

Thank you!

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`public`