

Beyond the Sentence Level: Evaluating LLM Translation of Legal Terms of Service into First-Order Logic

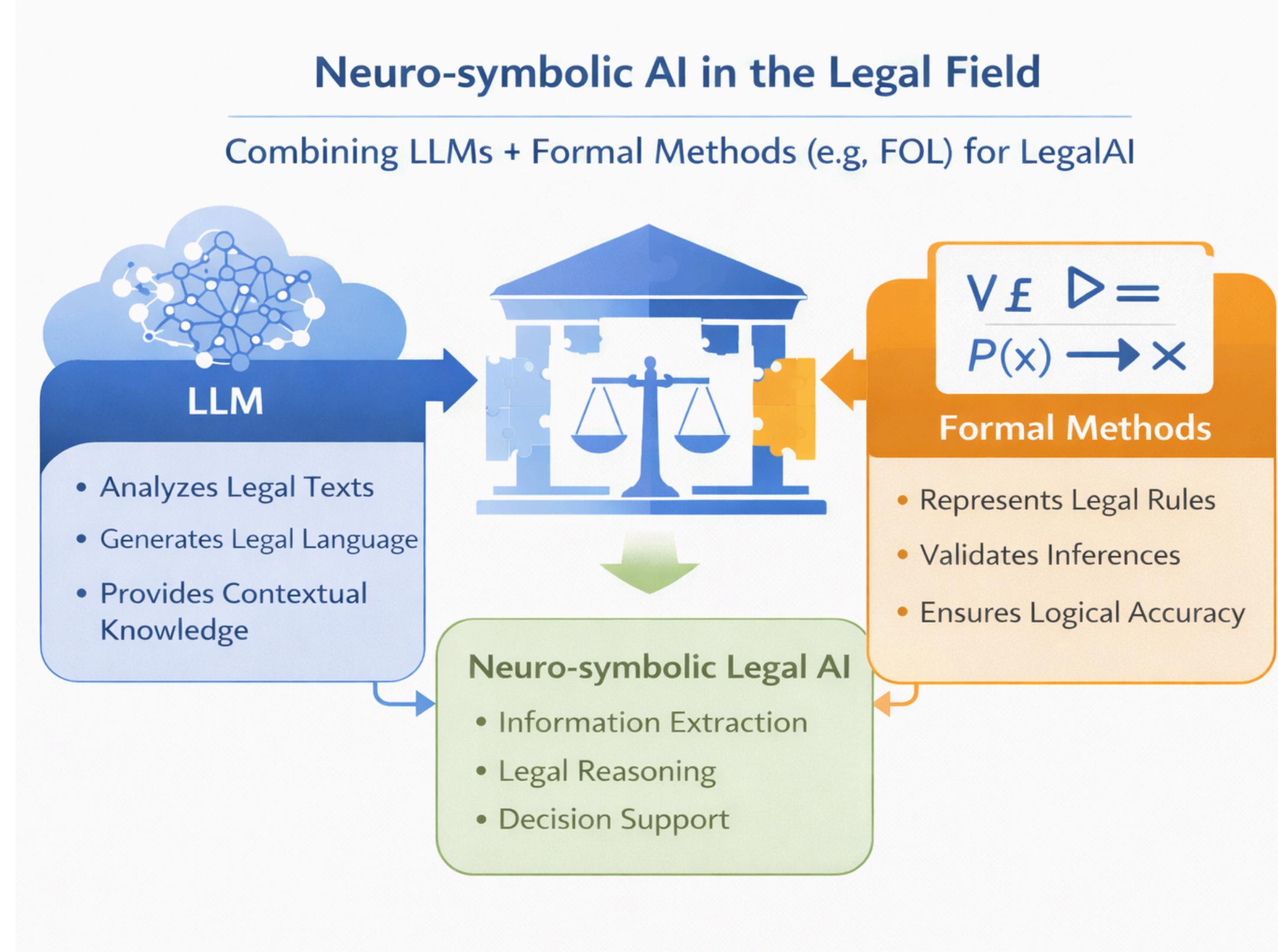
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Introduction

- Legal Natural Language is well-suited for formal methods applications
 - Legal Natural Language is structured and constrained
 - Legal document often operates under a “closed world” assumption
 - Formal Methods can unlock high-value legal applications
 - Automated contradiction detection
 - Logical entailment and consistency checking
 - Compliance verification



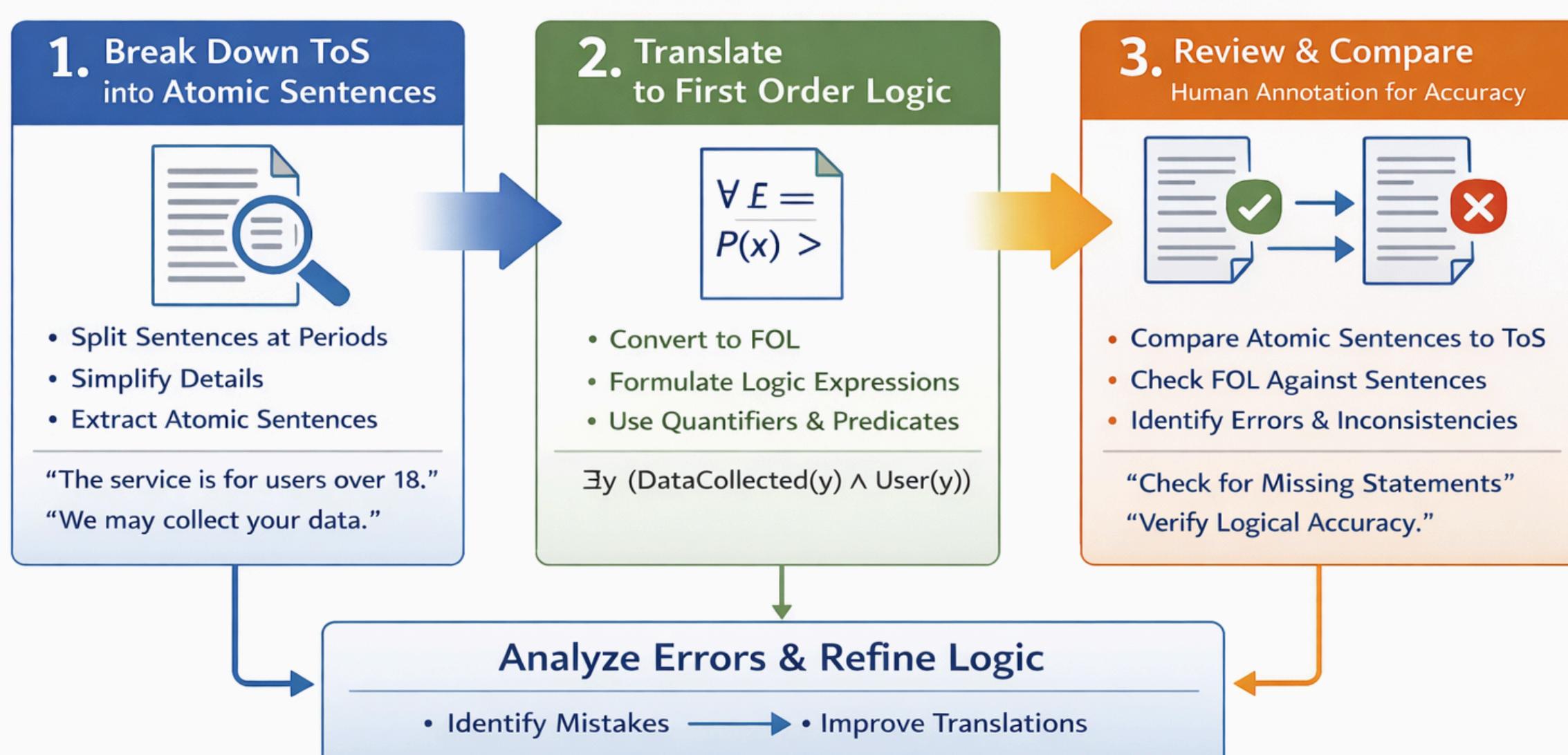
Core Challenge

- Are current Large Language Models capable of reliably formalizing legal text into FOL?
- If not, what limitations remain?
- What methodological or architectural advances are needed to make formal legal verification practical?

Methodology

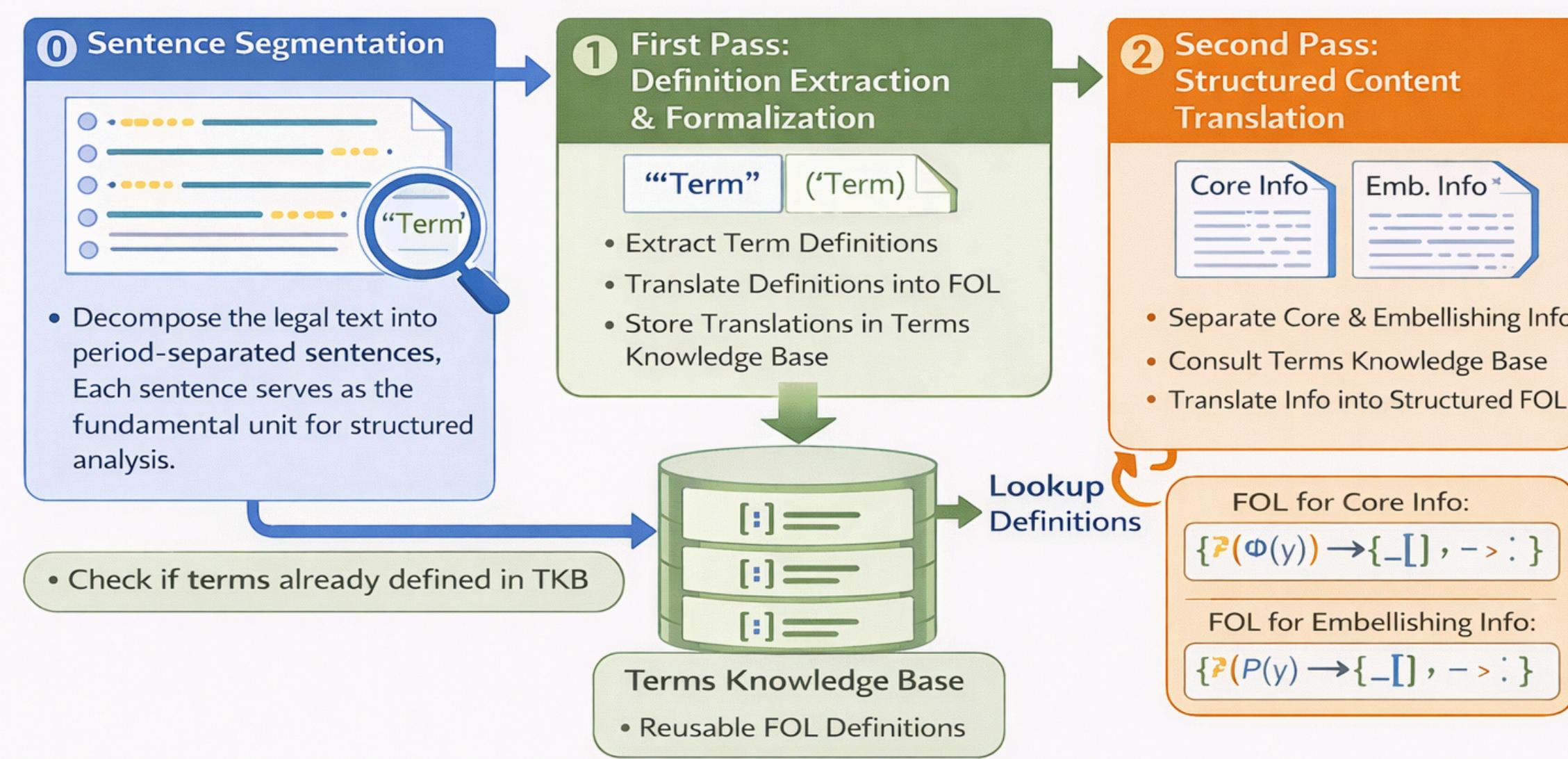
Atomic Decomposition & Translation Workflow

Our methodology decomposes document-level ToS into sentence-level, easy-to-translate atomic sentences and translates the sentences into First-Order Logic (FOL).



Two-Pass Decomposition & Translation Workflow

Our methodology adopts a software engineering-inspired two-pass architecture to systematically translate legal texts into First-Order Logic (FOL).



Error Analysis

Error Analysis

- Omission of critical exceptions during the decomposition stage
- Omission of critical exceptions during the translation stage
- Inaccurate representation in translation
- Duplicated definition
- Omission of parallel phrases
- Omission of supplemental qualifiers
- Ill-formed Formulae
- Low human-readability

References

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