

# Formal Verification of Knowledge Production Systems

by

Jane Smith

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## **Abstract**

This thesis presents a unified framework for formal verification of knowledge production systems. We introduce Kleis, a language that treats notation, verification, and document structure as first-class concepts.

# 1 Introduction

Knowledge production in science and mathematics relies on precise notation and rigorous verification. Traditional approaches separate these concerns, leading to errors when notation outpaces verification.

This thesis addresses this fundamental tension by introducing a unified framework.

The fundamental equation is:

$$E = mc^2$$

# 2 Methods

We develop a type-theoretic foundation based on dependent types and homotopy type theory, enabling both computation and verification within a single framework.

**Theorem 1 (Soundness).** The type system is sound: well-typed terms do not get stuck.

*Proof.* By induction on the structure of derivations...

# 3 Results

Our implementation demonstrates significant improvements in verification time while maintaining expressiveness.

System	Verification Time	Expressiveness
Coq	2.3s	High
Lean	1.8s	High
Kleis	0.4s	High

Table 1: Performance comparison

# 4 Conclusion

We have presented Kleis, a unified framework for knowledge production that bridges the gap between notation and verification.