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[white paper]
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# On the arithmetic of automated theorem proving

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**Abstract**

We propose a model to assign prime numbers to axioms and theorems, then by comparing equivalent numbers, it results in new equivalent theorems.

**keywords**: automated theorem proving, prover, prime numbers, Gödel-like numbers

*The most updated version of this paper is available at*
https://osf.io/wbf85/download

# Preamble

1. This is an **open research white paper**.
2. You're very welcome to send us your contributions and co-author this article.
3. The **Open Journal of Mathematics and Physics** (OJMP.org ) *welcomes* the *submission* of **Open Research White Papers**.

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# Introduction

4. We apply [1] in [2].

# Definitions

5. [3]

6. $i, j \in \mathbb{N} = \{1, 2, 3, ...\}$

7. $p_i$ = primes

8. $\equiv$ assignment of a number to an axiom or theorem

9. $\sim$ equivalence

10. $c = p_i \cdot p_j$ means the axioms assigned to $p_i, p_j$ prove the theorem assigned to $c$.

# The arithmetic model

11. Insert the *axioms* and *theorems* into the *machine*.

12. For each **axiom**, it is assigned a different **prime** number.

13. For each **theorem**, it is assigned a **composite number**, the product of the primes assigned to the axioms that prove the theorem.

14. Ask the machine to find *all equivalent primes*.

# Example

15. The following sections present the *Arithmetic Model* applied to the theorem in [2].

## Theorem

16. $(\mathcal{S} = \text{rectangular band}) \leftrightarrow (\forall a, b \in \mathcal{S} : (ab = ba) \to (a = b))$

## The numbers and their meaning

17. $2 \equiv (\forall a, b \in \mathcal{S} : ab = ba)$

18. $3 \equiv (\forall a, b \in \mathcal{S} : a = b)$

19. $5 \equiv (2 \to 3) \equiv$ nowhere commutative

20. $7 \equiv (\forall x \in \mathcal{S} : x^2 = x) \equiv$ idempotent

21. $11 \equiv (\forall a, b, c \in \mathcal{S} : abc = ac)$

22. $(7 \cdot 11) \equiv$ rectangular band

23. $13 \equiv ((7 \cdot 11) \to (5))$

24. $17 \equiv ((5) \to (7 \cdot 11))$

25. $(13 \cdot 17) \equiv ((7 \cdot 11) \leftrightarrow (5))$

26. $N_1 \equiv (\exists L, R : \mathcal{S} \cong L \times R)$ [3]

27. $N_2 \equiv ((\mathcal{S} \cong A \times B) \wedge (A, B \neq \varnothing) \wedge ((a_1, b_1)(a_2, b_2) = (a_1, b_2)))$ [3]

28. $23 \equiv (7 \cdot 11 \sim N_1)$

29. $29 \equiv (7 \cdot 11 \sim N_2)$

## Input

30. $I = \{2, 3, 5, 7, 11, 7 \cdot 11, 13, 17, 13 \cdot 17, N_1, N_2, 23, 29\}$

# Output

31. $N_1 \sim N_2$

32. $O = [7 \cdot 11] = \{7 \cdot 11, N_1, N_2\}$

33. Since $O$ is an equivalence class,

$$7 \cdot 11 \sim N_1 \sim N_2,$$

meaning all three theorems are equivalent.

# What's next?

34. Add a huge number of mathematical axioms and theorems.

35. Ask the machine to calculate all possible equivalences.

# Final Remarks

36. This may sound trivial since it is the first example.

37. Having a knowledge base with thousands of results, new insights and theorems could emerge from the machine.

# Open Invitation

*Review*, *add* content, and **co-author** this paper [4, 5]. *Join* the **Open Mathematics Collaboration** (https://bit.ly/ojmp-slack). Send your contribution to mplobo@uft.edu.br.

# Open Science

The **latex file** for this paper together with other *supplementary files* are available [6].

# Ethical conduct of research

This original work was pre-registered under the OSF Preprints [7], please cite it accordingly [8]. This will ensure that researches are conducted with integrity and intellectual honesty at all times and by all means.


# Acknowledgement

+ **Center for Open Science**
  https://www.cos.io

+ **Open Science Framework**
  https://osf.io


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