[original idea]

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Using prime numbers for automatic theorem proving

Open Mathematics Collaboration^{*†}

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Abstract

We apply an analogous setting from Gödel's numbering system to automatic theorem proving.

Gödel's numbering, automatic theorem proving, artificial intelligence

The most updated version of this paper is available at

<https://osf.io/g7usc/download>

Introduction

1. The strategies in this work mimic Gödel's numbering system [1].
2. P = set of prime numbers
3. C = set of composite numbers
4. $P = \{2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, \dots\}$
5. $C = \{4, 6, 8, 9, 10, 12, 14, 15, \dots\}$

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Notation & Definition

6. If S is a set, then $S[i]$ is the i -th element of S .
7. Example: $P[3] = 5$.
8. $x \in X$ means $p \in P, c \in C, \dots$
9. In some family of sets, $\mathcal{Y}[i] = 0$ means “no” and $\mathcal{Y}[j] = 1$ means “yes”.
10. $(\mathcal{Y}[i] = 0) \equiv (\nexists y \in \mathcal{Y}[i])$
11. $(\mathcal{Y}[j] = 1) \equiv (\exists y \in \mathcal{Y}[j])$

Axioms

12. $A = P$ = set of axioms
13. $A[i] = i$ -th axiom

Theorems

14. $T = C$ = set of definitions and theorems
15. In the following, some examples are provided for the meaning of $T[p_i]$.
16. $T[p_j] \equiv$ definition of simple groups
17. $T[p_k] \equiv$ definition of normal subgroups
18. $T[p_l] \equiv$ definition of abelian elements
19. $T[p_m] \equiv$ *Any non-abelian group of order 6 is isomorphic to S_3*

Exponents

- 20. $E = P$ = set of strategies performed in theorem proving
- 21. In the following, some examples are provided for the meaning of the prime exponents.
- 22. $E[1] = 2$ = there exist both abelian and non-abelian cases
- 23. $E[2] = 3$ = check if there are subcases in each case
- 24. $E[3] = 5$ = use contrapositive law

Computer (artificial intelligence)

- 25. Let $g = (3 \cdot 5)^{7 \cdot 11 \cdot 37}$.
- 26. g means the strategies 7, 11, and 37 were applied in the theorem 15, which is a combination of the axioms 3 and 5.

Final Remarks

- 27. *Automatic theorem proving can be transformed into arithmetic calculations in a machine.*

Open Invitation

*Review, add content, and **co-author** this paper [2, 3]. 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 [4].

Ethical conduct of research

This original work was pre-registered under the OSF Preprints [5], please cite it accordingly [6]. This will ensure that researches are conducted with integrity and intellectual honesty at all times and by all means.

Acknowledgement

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