CPSC-354 Report

Nikolai Semerdjiev
Chapman University

September 2, 2025

Abstract

Contents

1 Introduction

2 Week by Week

2.1 Week 1

The MU Puzzle

RULES:

1. (Append-U) If a string ends with I, you may append U: $x\mathtt{I} \to x\mathtt{IU}$.
2. (Double) From Mx you may produce Mxx: $\mathtt{M}x \to \mathtt{M}xx$.
3. (III→U) Replace any occurrence of III with U: $x, \mathtt{III}, y \to x, \mathtt{U}, y$.
4. (Delete UU) Delete any occurrence of UU: $x, \mathtt{UU}, y \to x, y$.

Question: Can you go from MI → MU?

Solution: No, it is impossible to derive MU from MI. At first, playing around with the rules, I noticed that the goal was to create the correct number of I's where they would be converted to a single U, which means that we needed the rules to create $N_I \bmod 3 = 0$ as N_I is I count.

Now, consider how each rule affects N_I:

- **(Append-U)** This rule appends a `U` to the end of the string. It does not change the number of `I`'s, so N_I is unchanged.
- **(Double)** The rule $\texttt{M}x \to \texttt{M}xx$ doubles the part after `M`. If the first string has N_I `I`'s, then the new one has $2N_I$ `I`'s. In modular arithmetic, N_I is multiplied by 2 modulo 3.
- **(III→U)** This rule removes exactly three `I`'s. Therefore $N_I \mapsto N_I - 3$, which leaves $N_I \bmod 3$ unchanged.
- **(Delete UU)** This rule affects only `U`'s, not `I`'s, so N_I is unchanged.

Starting from `MI`, we have $N_I = 1$, so $N_I \equiv 1 \pmod 3$. The only nontrivial change is doubling, which cycles $1 \mapsto 2 \mapsto 1 \mapsto 2 \ldots$ but never produces 0. Thus, it is impossible to reach $N_I \equiv 0 \pmod 3$.

Since `MU` has $N_I = 0$, it is not derivable from `MI`.

3 Essay

4 Evidence of Participation

5 Conclusion

References

[BLA] Author, Title, Publisher, Year.