MATHAUDIT / DETAILED REPORT

Correctness, proof completeness, and novelty audit

Powers as Fibonacci Sums

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Prompt	Standardized prompt
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Paper license	arXiv non-exclusive distribution license
Scope	Statements, proofs, and novelty only

Important limitation. AI-generated analysis. This report is not a correctness certificate or a substitute for expert scrutiny. A Correct status may coexist with yellow typos or minor formal corrections that do not affect substantive soundness. It means that this audit found no unresolved substantive error under the stated criteria; it is not formal verification and should remain open to expert challenge and correction.

SUMMARY

01	Statements	Contains wrong statements
02	Proofs	Contains incorrect or incomplete proofs
03	Novelty	No non-novelty findings

01 / STATEMENTS

Statements

Contains wrong statements

The claimed exhaustive classifications for $k = 3$, $k = 4$, and $k = 6$ are false: Tables 1, 2, and 4 omit explicit solutions within the stated ranges, even when the right side is a Zeckendorf representation and the base is not a perfect power. The $k = 5$ exhaustion is not verified because the common bounding argument contains a decisive false inequality.

Theorem 1.1 · $k = 3$: Table 1 omits a valid three-digit solution

Pages 2 and 10 · first bullet of Theorem 1.1 and Table 1 · arXiv:2608.04445v1

Incorrect

The admissible base $y = 86$ is not a perfect power and lies below 25000, but

$$86^2 = 7396 = F_8 + F_{15} + F_{20} = 21 + 610 + 6765.$$

The indices $8, 15, 20$ are pairwise separated by at least two, so this is already the Zeckendorf representation required by the paper's intended convention. The tuple $(86, 2, 8, 15, 20)$ does not occur in Table 1 and is not a member of its displayed Lucas family. Thus the assertion that all $k = 3$ solutions are contained in Table 1 is false.

Theorem 1.1 · $k = 4$: Table 2 omits a valid four-digit solution

Pages 2 and 11 · second bullet of Theorem 1.1 and Table 2 · arXiv:2608.04445v1

Incorrect

The admissible base $y = 286$ is not a perfect power and lies below 1000, but

$$286^2 = 81796 = F_2 + F_5 + F_{20} + F_{25} = 1 + 5 + 6765 + 75025.$$

The four indices are nonconsecutive, so this is a Zeckendorf representation. The tuple $(286, 2, 2, 5, 20, 25)$ is absent from Table 2, disproving the stated exhaustion.

Theorem 1.1 · $k = 5$: The five-digit exhaustion is not established by the supplied proof

Pages 2, 5–9, and 12 · third bullet of Theorem 1.1, Equation (3.1), reduction procedure, and Table 3 · arXiv:2608.04445v1

Not able to verify

Every displayed row of Table 3 satisfies the equation, but completeness depends on the common upper-bound and reduction chain. The derivation of Equation (3.1) uses a false comparison in its first step $j = k$, and the numerical search uses the resulting smaller bound. Correcting that comparison and rerunning a certified exhaustion is a concrete nontrivial obligation; the paper supplies neither, and no independent complete proof of the $k = 5$ exhaustion was verified.

Theorem 1.1 · $k = 6$: Table 4 omits a valid six-digit solution

Pages 2 and 12 · fourth bullet of Theorem 1.1 and Table 4 · arXiv:2608.04445v1

Incorrect

Within the stated range $y \leq 3$, one has

$$3^8 = 6561 = F_6 + F_8 + F_{12} + F_{15} + F_{17} + F_{19} = 8 + 21 + 144 + 610 + 1597 + 4181.$$

Consecutive listed indices differ by at least two, so this is the Zeckendorf representation. The tuple $(3, 8, 6, 8, 12, 15, 17, 19)$ is absent from Table 4, and therefore the $k = 6$ assertion is false.

02 / PROOFS

Proofs

Contains incorrect or incomplete proofs

The Matveev-to-recurrence step contains a false inequality precisely at the first gap, and the final computation is not exhaustive, as witnessed by explicit omitted solutions. The released code also skips bases that the theorem permits. Several dependent-case symbols on page 9 have unique mechanical corrections and are reported separately as typos.

Equation (3.1): The logarithmic comparison is reversed for the indispensable case $j = k$

Page 5 · two inequalities immediately preceding Equation (3.1) · arXiv:2608.04445v1

Incorrect as written

The paper defines

$$m_k = \frac{\log 5}{(k/2)\log(2\alpha)}.$$

For every audited value $3 \leq k \leq 6$, one has $0 < m_k < 2$. At $j = k$, the difference $n_k - n_j$ is zero, so the Matveev bound contains $\log(en_k/m_k)$. The next displayed line replaces this by the strictly smaller quantity $\log(en_k/2)$ while preserving a less-than upper bound. Since $m_k < 2$,

$$\log(en_k/m_k) > \log(en_k/2),$$

and that inference is invalid. This is the first recurrence used to bound $n_k - n_{k-1}$, so every later numerical bound and exhaustion depends on it. Repair classification: Plausible repair only. One may retain m_k (or another valid lower bound for the denominator) in this step, but all downstream reductions must then be recomputed and certified; the currently printed tables cannot be recovered merely by changing the displayed symbol.

Final computation: The claimed exhaustive search omits actual solutions

Pages 9–12 · final paragraph of Section 4 and Tables 1–4 · arXiv:2608.04445v1

Incorrect as written

An exact independent Fibonacci calculation produces the omitted non-perfect-base Zeckendorf solutions $86^2 = F_8 + F_{15} + F_{20}$, $286^2 = F_2 + F_5 + F_{20} + F_{25}$, and $3^8 = F_6 + F_8 + F_{12} + F_{15} + F_{17} + F_{19}$. Each lies in the corresponding stated range. Therefore the final finite search, whatever its intended cutoff, did not exhaust the cases asserted by Theorem 1.1. Repair classification: No repair supplied; corrected rigorous bounds and a rerun that includes these cases are required.

Released SageMath code: Perfect-power bases in the theorem's domain are skipped

Function ‘evaluate_base_y‘ in the archived code cited as Reference [16], compared with Theorem 1.1 on page 2 · arXiv:2608.04445v1

Incomplete as written

The released function returns immediately when ‘Integer(y).is_perfect_power()‘ is true, but Theorem 1.1 imposes no such restriction on y. For example,

$$4^3 = 64 = F_2 + F_6 + F_{10}$$

lies in the $k = 3$ range and is absent from Table 1. A search over primitive bases can classify power values, but it does not enumerate every ordered pair (y, a) claimed by the theorem. Repair classification: Plausible repair only. The theorem would need a consistently propagated restriction to non-perfect-power bases or the tables would need all induced base-exponent pairs; neither change repairs the separate non-perfect-base omissions above.

Verifiable source: Authors' archived SageMath code

Dependent-case reduction: The sign, bound, and target index are mismatched

Page 9 · first three displays · arXiv:2608.04445v1

Typo

The line obtained from Equation (4.2) contains the integer term $n_k s_1 - s_3$, but the next display prints $n_k s_1 + s_3$; replace the latter plus sign by a minus sign. The undefined expression $Nw + r$ in the condition on q_l should be $Ns_1 + s_2$, the bound stated in the preceding sentence. Finally, both occurrences of $n_k - n_j$ in this dependent-case bound should read $n_k - n_{j-1}$, which is the gap on the right of Equation (4.2) and the new gap this stage is intended to bound. These corrections are mechanically forced by the immediately preceding formulas and do not repair the independent false inequality or the incomplete tables.

03 / NOVELTY

Novelty

No non-novelty findings

No non-novelty findings.

METHOD

Scope and decision rules

This audit addressed only the correctness of central statements, the correctness and completeness of proofs, and evidence-backed non-novelty. It did not evaluate importance, exposition, style, suitability for publication, or author reputation.

An adverse finding is included only where the report can give a direct calculation, counterexample, formal contradiction, or a verifiable source establishing the precise claim. An inability to verify is kept distinct from a demonstrated defect. Technical compression is not treated as incompleteness when the omitted reasoning is recoverable and correct.

Before any finding was recorded, the argument was closed under immediate, mechanically checkable consequences of facts already established. An observation was suppressed when the printed conclusion followed by elementary logic, direct substitution, weakening, inclusion, or verified monotonicity and no substantive proof obligation or textual correction remained.

Typographical errors and minor formal corrections remain fully visible in yellow with their locations and repairs. When such a defect is unambiguous, local, and harmless to the paper's substantive conclusions, it does not lower the overall statements or proofs status from Correct.

The novelty panel reports only central results for which a verifiable primary source predating the earliest public version that contains the result proves the same statement up to notation, or from which the statement follows directly and immediately. It contains no positive novelty certifications and no entries based merely on an unsuccessful literature search.

All mathematical expressions in this report are compiled by LaTeX. The web presentation independently validates and renders the corresponding expressions with KaTeX.

Sources checked

1. Source paper: arXiv:2608.04445v1
2. Authors' archived SageMath code

arXiv acknowledgement

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APPENDIX

Standardized prompt

You are a mathematical auditor. Evaluate only the correctness of the paper's central statements, the correctness and completeness of its proofs, and evidence-backed non-novelty. Do not make editorial comments or evaluate importance, exposition, style, or suitability for publication. Keep the report neutral, precise, and professional.

PART 1 — CORRECTNESS OF THE MAIN STATEMENTS

Identify the paper's central statements and assess each one separately using exactly one of these outcomes:

- Correct: the statement has a correct, verifiable proof; or, despite a defect in the printed proof, you can give a fully verified repair or independent proof.
- Incorrect: you can give strong formal evidence that the statement as written is false, preferably a counterexample or a complete contradiction.
- Not able to verify: the supplied proof does not establish the statement, and you can neither supply a fully verified proof nor disprove it.

For every adverse or unverified outcome, restate the exact claim and hypotheses, identify its location in the reviewed version, and give the decisive reasoning. Do not infer that a theorem is false merely because its printed proof is defective.

Assign the overall statements status by the following priority:

1. Contains wrong statements, if at least one central statement is Incorrect.
2. Contains unsupported statements, if no central statement is Incorrect but at least one is Not able to verify.
3. Correct, if every central statement is Correct, apart from any typographical or minor formal findings allowed by Part 4.

PART 2 — CORRECTNESS AND COMPLETENESS OF THE PROOFS

Audit the proofs of the central statements and every material internal or cited input on which they depend. For each proof or proof segment, use the narrowest supported outcome:

- Correct and complete: every substantive step is verifiable and no case or crucial nontrivial step is missing.
- Incorrect as written: a displayed calculation, inference, lemma, or cited application is formally false or inapplicable.
- Incomplete as written: a necessary substantive step or case is missing, even though no explicit contradiction has been proved.
- Not able to verify: the available paper and sources are insufficient to decide whether the step is valid.

Do not flag omitted routine details, compressed arguments, or "analogously" steps when the omitted reasoning is recoverable and correct. For every defect, identify its smallest exact location, explain its downstream dependency, and classify any proposed repair as one of:

- Verified repair: supply enough reasoning to verify that the repair works throughout every affected use.
- Plausible repair only: describe the possible repair but do not treat it as established.
- No repair supplied.

Assign the overall proofs status by the following priority:

1. Contains incorrect or incomplete proofs, if at least one proof is Incorrect as written or Incomplete as written.
2. Contains unverified proofs, if there is no proved incorrectness or incompleteness but at least one material proof is Not able to verify.
3. Correct, if all audited proofs are Correct and complete, apart from any typographical or minor formal findings allowed by Part 4.

PART 3 — NOVELTY OF THE MAIN STATEMENTS

This is a one-sided, evidence-only check. Evaluate only central results. Report a result only when a verifiable primary source, publicly available before the earliest public version of the paper that contains the result, proves the same statement up to a change of notation, or when the result follows directly and immediately from such an earlier theorem.

For each non-novelty finding, provide the earlier source, its public date, the exact theorem or proposition, and an explicit hypothesis-and-conclusion mapping. A later source cannot establish non-novelty. Do not flag a result merely because an easier proof exists or because it follows through a nontrivial argument. Do not flag a result that the paper itself explicitly presents as known, a survey item, or an alternative proof.

Mention only statements that meet this non-novelty threshold. Say nothing about statements for which no such evidence was found: do not certify novelty, list unsuccessful searches, or add statement-level "no prior source found" entries. If the list is empty, the section may say only "No non-novelty findings."

PART 4 — TECHNICAL AND EVIDENTIARY RULES

1. Criticism must never be overstated. Call a statement incorrect, a proof incorrect or incomplete, or a result non-new only when strong formal evidence supports that exact judgment. Otherwise use Not able to verify where that outcome exists, or remain silent in the novelty section.

2. Review a specified paper version. Give exact page, theorem, equation, or proof locations; restate relevant quantifiers and hypotheses; and check domains, endpoints, parameter ranges, constants, and dependencies explicitly. Apply a defect only to the regimes and downstream results that actually depend on it.

3. Immediate-consequence closure: when deciding whether a conclusion is supported, treat the argument as including every immediate formal consequence of facts established earlier in the paper and available at that point. An immediate formal consequence is a local, mechanically checkable inference using only definitions already in force, elementary logic, direct substitution or renaming, weakening of an inequality or set inclusion, or a monotonicity or symmetry property explicit in a definition or already proved.

4. Such an inference must introduce no new lemma, estimate, construction, case analysis, limiting or compactness argument, external result, or new issue of uniformity or parameter dependence. Check the direction of monotonicity and the dependence of every threshold or constant explicitly. Do not exchange pointwise and uniform conclusions, change exceptional sets, interchange quantifiers or limits, or extend an endpoint under this rule unless the required fact was already established.

5. If the claimed conclusion follows after immediate-consequence closure, it is fully supported. Do not report a gap, unsupported statement, minor formal correction, or recommendation to add an explanatory sentence, and do not mention the suppressed item in the report. This suppression does not apply to a genuine typographical error as defined below, because a typo is a literal notation defect that still requires a textual correction. For example, if $P(delta)$ is proved for every sufficiently small delta > 0 and P is immediately monotone in the required direction, then the claim that $P(delta)$ holds for every delta > 0 requires no correction; the omitted monotonicity step is exposition rather than an audit finding.

6. Immediate-consequence closure permits reconstruction of an omitted inference; it does not permit silent alteration of the printed domain, hypotheses, or quantifiers of an intermediate statement later invoked outside its stated scope. If formal validity requires changing the text of that statement or its stated range, report the appropriate finding even when the repair is easy. Thus a result stated only for $t > 0$ and subsequently applied at $t = 0$ remains a formal scope mismatch unless the endpoint case was separately established before the application.

7. Apply this mandatory gate before recording any adverse, unverified, typographical, or minor formal finding: (a) identify the exact assertion or inference alleged to be defective; (b) reconstruct the strongest conclusion following from the preceding argument after all admissible immediate formal consequences are added; (c) identify the specific defect that remains — a formally demonstrated falsehood, a concrete nontrivial unresolved proof obligation, or a genuine domain, hypothesis, quantifier, or notation mismatch requiring a textual correction; and (d) state the evidence and minimal repair. If no specific defect remains, or if the only possible addition would be explanatory, suppress the finding entirely. Use Not able to verify only when a precise, nontrivial unresolved obligation can be identified.

8. A typographical error is an incorrect symbol, index, exponent, sign, variable name, or notation mismatch whose unique intended correction is mechanically determined from the surrounding text and does not alter the mathematical argument. Report it in yellow as Typo, with the printed text, correction, exact location, and reason it is harmless. It does not lower an overall status.

9. A minor formal correction is a boundary, endpoint, or displayed parameter-range defect that can be repaired consistently in every affected statement by a local change, without a new argument, without invalidating any related result or application, and without creating another substantive defect. Report it in yellow as Minor formal correction, with the same details. It does not lower an overall status.

10. Do not use either minor category if more than one materially different repair is possible; if the repair changes the substance or scope of a central result; if an excluded case is used later; if the correction fails to propagate consistently; or if a new mathematical idea is required. In such cases use the strongest substantive classification actually supported by evidence.

11. Write every mathematical expression as valid, compilable LaTeX. Use ... for inline mathematics and

...

for displayed mathematics, with balanced delimiters and braces. Do not leave raw LaTeX commands outside math delimiters.

12. Separate theorem truth from the correctness of the printed proof. A theorem can be Correct in Part 1 because of a fully verified independent proof while its printed proof is adverse in Part 2. Conversely, a defective proof alone never licenses an Incorrect theorem classification.

Organize the report under Parts 1–3 and apply Part 4 throughout. Do not add editorial commentary, scores, rankings, recommendations, or a list of suppressed observations.

END OF REPORT

Each claim in this prototype report remains open to independent challenge and revision.