

FAR-1: Faizan Ali Reduction — A Fast Integer Reduction Method Compared to Collatz and Half-Collatz

Faizan Ali

July 9, 2025

Abstract

We introduce a novel integer reduction algorithm called **FAR-1 (Faizan Ali Reduction - Version 1)**, which follows a simple rule: "If a number is divisible by 3, divide by 3; otherwise, subtract 1." This method is compared against the well-known Collatz and Half-Collatz functions across the range of 1 to 10,000,000. Our results show that FAR-1 significantly outperforms Collatz and even surpasses Half-Collatz in over 93% of cases. We present step-count comparisons, performance graphs, and analyze edge cases where each algorithm excels.

Introduction

Integer reduction functions are often studied for their simplicity and unpredictability, with the Collatz conjecture being one of the most famous open problems in mathematics. Variants such as the Half-Collatz method have been proposed for simplified heuristics. This paper presents a newly defined method — FAR-1 — that reduces integers using division by 3 and subtraction. The goal is to reach the integer 1 in the fewest steps possible.

Unlike Collatz, which multiplies by 3 and adds 1 before halving, FAR-1 only uses integer division and subtraction, reducing computational complexity and overall steps.

Algorithm Definition

FAR-1:

```
while n != 1:
    if n % 3 == 0:
        n = n / 3
    else:
        n = n - 1
```

Half-Collatz:

```

while n != 1:
    if n % 2 == 0:
        n = n / 2
    else:
        n = n + 1

```

Collatz:

```

while n != 1:
    if n % 2 == 0:
        n = n / 2
    else:
        n = 3n + 1

```

Experimental Setup

- Range: $n = 1$ to 10,000,000
- Metrics: Number of steps to reduce n to 1
- Tools: Python 3.12, matplotlib, pandas
- Device: MacBook Air 2017

Results and Analysis

- FAR-1 faster than Half-Collatz: 9,391,611 numbers (93.92%)
- Equal to Half-Collatz: 261,205 numbers (2.61%)
- Slower than Half-Collatz: 347,184 numbers (3.47%)
- FAR-1 faster than Collatz: In virtually all cases
- Max lead by FAR-1 over Half-Collatz: 25 steps
- Max lead by Half-Collatz over FAR-1: 12 steps (only 1 number)

Average Steps

- FAR-1: 26.74
- Half-Collatz: 33.20
- Collatz: 155.27

Conclusion

The FAR-1 method proves to be a compelling alternative to traditional integer reduction techniques. With its simple rule and superior performance across a large dataset of 10 million integers, it offers both theoretical and practical advantages in computation and algorithm design.

Future Work

- Prove or analyze FAR-1 convergence formally
- Extend testing to $n = 100$ million or higher
- Analyze runtime vs. power efficiency
- Explore hybrid versions of Collatz, Half-Collatz, and FAR-1

Author

Faizan Ali

Inventor of FAR-1 Algorithm