Comparative Study of Reduction Sequences: Baharvand vs Positional Cycle Method

Introduction

Reducing a number$N$ to zero can be performed by different deterministic sequences. This article presents two methods:

- **Baharvand Reduction:** repeatedly subtract the leftmost non-zero digit times its positional value.
- **Positional Cycle Reduction:** subtract powers of ten in a cyclic order of positions.

Baharvand Reduction for $N = 12345$

Step	Current Number	Digit Subtracted	Next Number
0	12345	10000	2345
1	2345	2000	345
2	345	300	45
3	45	40	5
4	5	5	0

Positional Cycle Reduction for $N = 12345$

Step	Current Number	Power of 10	Next Number
0	12345	10000	2345
1	2345	1000	1345
2	1345	100	1245
3	1245	10	1235
4	1235	1	1234
5	1234	1000	234
6	234	100	134
7	134	10	124
8	124	1	123
9	123	100	23
10	23	10	13
11	13	1	12
12	12	10	2
13	2	1	1
14	1	1	0

Positional Cycle Reduction for $N = 6789$

Step	Current Number	Power of 10	Next Number
0	6789	1000	5789
1	5789	100	5689
2	5689	10	5679
3	5679	1	5678
4	5678	1000	4678
5	4678	100	4578
6	4578	10	4568
7	4568	1	4567
8	4567	1000	3567
9	3567	100	3467
10	3467	10	3457
11	3457	1	3456
12	3456	1000	2456
13	2456	100	2356
14	2356	10	2346
15	2346	1	2345
16	2345	1000	1345
17	1345	100	1245
18	1245	10	1235
19	1235	1	1234
20	1234	1000	234
21	234	100	134
22	134	10	124
23	124	1	123
24	123	100	23
25	23	10	13
26	13	1	12
27	12	10	2
28	2	1	1
29	1	1	0

Column Sequence for $N = 6789$

Cycle 1:$6789 \to 5789 \to 5689 \to 5679 \to 5678$
Cycle 2:$4678 \to 4578 \to 4568 \to 4567$
Cycle 3:$3567 \to 3467 \to 3457 \to 3456$
Cycle 4:$2456 \to 2356 \to 2346 \to 2345$
Cycle 5:$1345 \to 1245 \to 1235 \to 1234$
Cycle 6:$234 \to 134 \to 124 \to 123$
Cycle 7:$23 \to 13 \to 12$
Cycle 8:$2 \to 1 \to 0$

Pattern Analysis

Each complete cycle follows the pattern:

Power of 10: $10^k \to 10^{k-1} \to 10^{k-2} \to \cdots \to 10^0$

Where k is determined by the number of digits in the current number.

Comparison Summary

Method	Steps for N=12345	Steps for N=6789
Baharvand Reduction	5	7
Positional Cycle Reduction	15	30

Conclusion

The Positional Cycle Reduction provides a systematic,cyclic approach to reducing numbers to zero. The method consistently follows a power-of-10 subtraction pattern, making it predictable but often requiring more steps than the Baharvand method.