



# Computation for the Summation of Integers and Geometric Progression of Powers of Two

Chinnaraji Annamalai

## ► To cite this version:

Chinnaraji Annamalai. Computation for the Summation of Integers and Geometric Progression of Powers of Two. 2022. hal-03709941

**HAL Id: hal-03709941**

**<https://hal.science/hal-03709941>**

Preprint submitted on 30 Jun 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Computation for the Summation of Integers and Geometric Progression of Powers of Two

Chinnaraji Annamalai

School of Management, Indian Institute of Technology, Kharagpur, India

Email: [anna@iitkgp.ac.in](mailto:anna@iitkgp.ac.in)

<https://orcid.org/0000-0002-0992-2584>

**Abstract:** Geometric series plays a vital role in the areas of combinatorics, science, economics, and medicine. This paper presents computing technique for the sum of positive integers and geometric series whose terms are powers of two. This computing technique is a methodological advance which is useful for researchers who are working in science, economics, engineering, computation, and management.

**MSC Classification codes:** 40A05 (65B10)

**Keywords:** computation, geometric series, powers of two, summation

## 1. Introduction

In the earlier days, geometric series served as a vital role in the development of differential and integral calculus and as an introduction to Taylor series and Fourier series. The geometric series and its summations and sums [1-9] have significant applications in science, engineering, economics, queuing theory, computation, management, and medicine [10]. In this article, an innovative idea is introduced for the computation of sum of positive integers and geometric series whose terms are powers of two.

## 2. Computation of Geometric Series

Theorem:  $\sum_{i=1}^n i \times 2^{i-1} = (n-1)2^n + 1$ .

*Proof.* This theorem is proved by mathematical induction.

Basis. Let  $n = 3$ . Then  $\sum_{i=1}^3 i \times 2^{i-1} = 1 + 4 + 12 = 17 = 2 \times 2^3 + 1$ . It is true.

Inductive hypothesis. Let us assume that it is true for  $\sum_{i=1}^{n-1} i \times 2^{i-1} = (n-2)2^{n-1} + 1$ .

Inductive Step. We must show that  $\sum_{i=1}^n i \times 2^{i-1} = (n-1)2^n + 1$  is true.

$$\begin{aligned} \sum_{i=1}^{n-1} i \times 2^{i-1} + n2^{n-1} &= (n-2)2^{n-1} + 1 + n2^{n-1} \Rightarrow \sum_{i=1}^n i \times 2^{i-1} = 2n2^{n-1} - 22^{n-1} + 1 \\ &\Rightarrow \sum_{i=1}^n i \times 2^{i-1} = n2^n - 2^n + 1 = (n-1)2^n + 1. \end{aligned}$$

Hence, theorem is proved.

### 3. Conclusion

In this article, an innovative idea is introduced a computational technique for the computation of sum of positive integers and geometric series whose terms are powers of two. This computing technique is a methodological advance which is useful for researchers who are working in science, economics, engineering, computation, and management.

### References

- [1] Annamalai, C. (2009) A novel computational technique for the geometric progression of powers of two. *Journal of Scientific and Mathematical Research*, Vol.3, pp 16-17. <https://doi.org/10.5281/zenodo.6642923>.
- [2] Annamalai, C. (2019) Extension of ACM for Computing the Geometric Progression. *Journal of Advances in Mathematics and Computer Science*, Vol. 31(5), pp 1-3. <https://doi.org/10.9734/JAMCS/2019/v31i530125>.
- [3] Annamalai, C. (2017) Computational Modelling for the Formation of Geometric Series using Annamalai Computing Method. *Jñānābha*. Vol.47(2), pp 327-330. <https://zbmath.org/?q=an%3A1391.65005>.
- [4] Annamalai, C. (2022) Summations of Single Terms and Successive Terms of Geometric Series. SSRN4085922. <http://dx.doi.org/10.2139/ssrn.4085922>.
- [5] Annamalai, C. (2022) Sum of Geometric Series with Negative Exponents. SSRN4088497. <http://dx.doi.org/10.2139/ssrn.4088497>.
- [6] Annamalai, C. (2019) Computation of Series of Series using Annamalai's Computing Model. *OCTOGON MATHEMATICAL MAGAZINE*, Vol. 27(1), pp 1-3. <http://dx.doi.org/10.2139/ssrn.4088497>.
- [7] Annamalai, C. (2009) Computation of Geometric Series in Different Ways. *OSF Preprints*. <https://doi.org/10.31219/osf.io/kx7d8>.
- [8] Annamalai, C. (2009) My New Idea for Optimized Combinatorial Techniques. SSRN4078523. <http://dx.doi.org/10.2139/ssrn.4078523>.
- [9] Annamalai, C. (2022) Algorithmic and Numerical Techniques for Computation of Binomial and Geometric Series. *Cambridge Open Engage*. <https://www.doi.org/10.33774/coe-2022-pnx53-v8>.
- [10] Annamalai, C. (2010) Application of Exponential Decay and Geometric Series in Effective Medicine. *Advances in Bioscience and Biotechnology*, Vol. 1(1), pp 51-54. <https://doi.org/10.4236/abb.2010.11008>.