Novel Geometric Series for Application of Computing Science

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Abstract: Nowadays, the growing complexity of mathematical and computational modelling demands the simplicity of mathematical and combinatorial equations for solving today's scientific problems and challenges. This article provides a novel geometric series and its theorem. This idea can enable the scientific researchers for further involvement in research and development.

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1. Introduction

Geometric series played a vital role in differential and integral calculus at the earlier stage of development and still continues as an important part of the study in science, engineering, management and its applications. In this article, a new geometric series [1-6] is constructed for application [7] of computing science.

2. Novel Geometric Series

In this section, new geometric series is formulated using the technique of traditional geometric progression [1-7].

Theorem 2.1 : Let R be a system of real numbers and $p, q \in R$.

$$\sum_{i=0}^{n-1} x^{(p+q)i} = \frac{x^{n(p+q)} - 1}{x^{(p+q)} - 1}, x^{p+q} \neq 1 \text{ and } x = 0 \;\&\; p + q = 0 \text{ must not be at a time.}$$

Proof. Let us prove this theorem by the equality given below:

$$y^n = y^n \Rightarrow y^n = (y-1)y^{n-1} + y^{n-1} \Rightarrow y^n = (y-1)y^{n-1} + (y-1)y^{n-2} + y^{n-2}.$$

If we continue this expansion again and again, we can obtain the following series.

$$y^n = (y-1)y^{n-1} + (y-1)y^{n-2} + (y-1)y^{n-3} + \cdots + (y-1)y + (y-1)y^0 + y^0.$$

$$i.e., \qquad y^n - 1 = (y-1)(y^{n-1} + y^{n-2} + y^{n-3} + \cdots + y + 1). \tag{1}$$

From the expansion (1), we obtain the series $\sum_{j=0}^{n-1} y^j = \frac{y^n - 1}{y - 1}, y \neq 1.$ (2)

Let y be x^{p+q} and substitute it in the series (2).

Then, $\sum_{i=0}^{n-1} x^{(p+q)i} = \frac{x^{n(p+q)} - 1}{x^{(p+q)} - 1}, x^{p+q} \neq 1 \text{ and } x^{p+q} \neq 0^0.$ (3)

Hence, theorem is proved.

Corollary 2.1: $\sum_{i=0}^{r-1} x^{pi} = \frac{x^{rp}-1}{x^p-1}, x^p \neq 1, x^p \neq 0^0, i.e., x = 0 \,\&\, p = 0$ must not be at a time.

Corollary 2.2: $\sum_{i=0}^{r-1} x^{(p_1+p_2+p_3+\cdots+p_n)i} = \frac{x^{r(p_1+p_2+p_3+\cdots+p_n)}-1}{x^{(p_1+p_2+p_3+\cdots+p_n)}-1}$,
where $x^{(p_1+p_2+p_3+\cdots+p_n)} \neq 1$ and $x^{(p_1+p_2+p_3+\cdots+p_n)} \neq 0^0$.

3. Conclusion

Computing science is a rapidly growing multi-disciplinary area where science, engineering, information technology, management and its collaborations use advance computing capabilities to understand and solve the most complex real life problems. In this article, a new geometric series is constituted for application of computing science.

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