International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 14 Issue 6 ǁ June 2026 ǁ PP. 111-115

Generation of the infinite and orderly prime-number list through a ternary matrix yielding a logarithmic expression

Rodolfo Alvarez
Contact: rodolfo.alv.zm@gmail.com

Abstract
The purpose of this article, is showing an alternative method to generate the infinite and orderly list of prime numbers, through a matrix based on the ternary system. After some mathematical processes within the matrix mentioned, the outcome is a logarithmic expression listing all primes orderly.

Keywords: *Logarithms, prime-number list, prime numbers, ternary matrix, ternary numbers.*

Date of Submission: 17-06-2026 Date of Acceptance: 30-06-2026

I. INTRODUCTION

In this article, we will show a ternary method to generate the infinite and orderly list of prime numbers. For this, we will use a matrix in which the ternary system is to be applied, following the prime and natural number patterns of multiplication and division as we will see later. After all calculations in the matrix have been done, we will show a logarithmic expression whose result is the orderly and infinite list of prime numbers, as we have mentioned. In next section, we will basically define the concepts covered in this research, namely prime numbers, ternary system and logarithms.

II. THEORETICAL FRAMEWORK

2.1 Prime numbers

Beyond any alternative definitions that we may find, prime numbers are simply those having two factors, namely one and the number itself (Kumar & Mozar, 2020).

2.2 Ternary system

The ternary number system, also known as the base-3 system, uses three distinct symbols to represent numbers: 0, 1 and 2 (Basta et al., 2026). This system will be used in the matrix to be shown in next section, to perform the corresponding calculations before the final outcome.

2.2 Logarithms

Logarithms are exponents, or interpreted and explained as the inverse of exponents, especially in textbooks. The unique properties of logarithms allow them to transform expressions and help to find the solution for equations (Berry & Wainwright, 1991; Weber, 2016; Kenney & Kastberg, 2013). We will see these points in practice in next section.

III. DISCUSSION

In this section, we will go through the analysis and transformations of a few matrices based on the ternary system. The final outcome of the process is expected to be a logarithmic expression showing the list of prime numbers. First step is generating an empty 15×15 matrix, its semi-perimeter being filled with 2s, and a list of natural numbers from 1 to 15, as shown in Matrix 1. This method was already the means of explanation in previous research but in those cases, the binary system was used. As such, the conclusions derived from this analysis are expected to have an infinite reach (Alvarez, 2024, 2025).

														2
													2	
												2		
											2			
										2				
									2					
								2						
							2							
						2								
					2									
				2										
			2											
		2												
	2													
2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Matrix 1. 15×15 matrix filled with 2s in its semi-perimeter.

As we can see in Matrix 1, the semi-perimeter of 2s works for the natural numbers list from 1 to 15, at the bottom of the matrix. This initial step of the mechanism is essential to effectively show the construct we aim at. Next step is filling the inside of the semi-perimeter, with predetermined sequences of 2s and 0s, following the order of multiples and divisors in natural numbers divisions and multiplications. We have to note that a similar criteria was used in previous research with the binary system (Alvarez, 2024, 2025). This step will build the previous step of the basic mechanism, before performing the calculations. Matrix 2 shows what we have just mentioned.

														2
													2	2
												2	2	2
											2	2	2	2
										2	2	2	2	2
									2	2	2	2	2	2

								2	2	2	2	2	2	2
							2	2	2	2	2	2	2	2
						2	2	2	2	2	2	2	0	2
					2	2	2	2	2	2	0	2	2	2
				2	2	2	2	2	0	2	2	2	2	2
			2	2	2	2	0	2	2	2	0	2	2	2
		2	2	2	0	2	2	0	2	2	0	2	2	0
	2	2	0	2	0	2	0	2	0	2	0	2	0	2
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

Matrix 2. Matrix filled with 2s and 0s.

As we can see, we have the inside zone of the semi-perimeter filled with 2s and 0s, plus the semi-perimeter itself, filled with 2s. As we have said, at this point we have the pre-step of the matrix's final construction to then start performing the calculations. However, one step is still missing, filling the empty zone of the matrix with 1s, to perform the calculations more orderly, and make them more computer-readable. Additionally, first 2 in second row will be replaced by a 1, to prevent natural number 1 from eventually intruding in the expected list if primes. This shows in Matrix 3.

1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
1	1	1	1	1	1	2	2	2	2	2	2	2	0	2
1	1	1	1	1	2	2	2	2	2	2	0	2	2	2
1	1	1	1	2	2	2	2	2	0	2	2	2	2	2
1	1	1	2	2	2	2	0	2	2	2	0	2	2	2
1	1	2	2	2	0	2	2	0	2	2	0	2	2	0
1	2	2	0	2	0	2	0	2	0	2	0	2	0	2
1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

Matrix 3. Final state of the ternary matrix before calculations are performed.

Now that we have the full version of the matrix, meaning it has all the elements of a ternary matrix, we are ready to start performing the calculations, which will be key for the next steps of the processes we explain in this publication. If we multiply all the elements within each column except the bottom row, we will obtain two kinds of product, namely 2 to the power of something, which is ultimately the prime number corresponding to that square, and 0, corresponding to a non-prime corresponding to that square as well. This shows more clearly in Matrix 4.

1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
1	1	1	1	1	1	2	2	2	2	2	2	2	0	2
1	1	1	1	1	2	2	2	2	2	2	0	2	2	2
1	1	1	1	2	2	2	2	2	0	2	2	2	2	2
1	1	1	2	2	2	2	0	2	2	2	0	2	2	2
1	1	2	2	2	0	2	2	0	2	2	0	2	2	0
1	2	2	0	2	0	2	0	2	0	2	0	2	0	2
1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2^0	**2^2**	**2^3**	**0**	**2^5**	**0**	**2^7**	**0**	**0**	**0**	**2^{11}**	**0**	**2^{13}**	**0**	**0**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

Matrix 4. The matrix after the multiplications by column.

Now in order to multiply everything and therefore having the logarithmic expression we are looking for, we have to replace the non-prime outcomes with 1s. This will have consequences for all the columns falling within that group, meaning all non-prime columns, in such a way calculations run smoothly. As it is expected, it should be noted all the squares in each non-prime column are to be filled with 1s. This shows in a clear way in next matrix.

1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
1	1	1	1	1	1	2	1	1	1	2	1	2	1	1
1	1	1	1	1	1	2	1	1	1	2	1	2	1	1
1	1	1	1	2	1	2	1	1	1	2	1	2	1	1

1	1	1	1	2	1	2	1	1	1	2	1	2	1	1
1	1	2	1	2	1	2	1	1	1	2	1	2	1	1
1	2	2	1	2	1	2	1	1	1	2	1	2	1	1
1	2	2	1	2	1	2	1	1	1	2	1	2	1	1
1	**2^2**	**2^3**	**1**	**2^5**	**1**	**2^7**	**1**	**1**	**1**	**2^{11}**	**1**	**2^{13}**	**1**	**1**

Matrix 5. The ternary matrix after the calculations per column have been performed.

As we can see, the list of natural numbers at the bottom has been deleted, in order to make the explanation clearer. Now we multiply everything, specifically the products from bottom row to minimize computational work.

$$2^2 \times 2^3 \times 2^5 \times 2^7 \times 2^{11} \times 2^{13} \times \ldots$$

, which in logarithmic notation results in:

$$\log_2(2^{2+3+5+7+11+13+\ldots}) = \mathbf{2 + 3 + 5 + 7 + 11 + 13 + \ldots}$$

, thus yielding an infinite and orderly list of all prime numbers. Therefore we can say that a matrix built with the structure and post-processing shown, orderly yields the infinite list of prime numbers.

IV. CONCLUSION

Through this article, we have explored the potential of the ternary system to yield the infinite and orderly list of prime numbers. We have done this by using a matrix based on the ternary system. After some transformations within the matrix, the final outcome is a logarithmic expression, whose result in the infinite and orderly list of prime numbers, as we have mentioned.

REFERENCES

[1]. Alvarez, R. (2024). A simple method for finding prime numbers: An infinite model based on binary numbers. *International Journal of Scientific and Engineering Research.* Vol. 15, No. 12.
[2]. Alvarez, R. (2025). Prime numbers, binary matrices and generation rules. *International Journal of Research in Engineering and Science.* Vol. 13, No. 10.
[3]. Basta, A., Delong, S. & Basta, S. (2026). Introduction to Number Systems. Mathematics in Cybersecurity, Wiley, pp.51-102, doi: 10.1002/9781394304790.ch3.
[4]. Berry, J., & Wainwright, P. (1991). Logarithms and Exponential Functions. In *Foundation Mathematics for Engineers* (pp. 66-106). London: Macmillan Education UK.
[5]. Chang, J. (2014). Every complete binary tree is prime. *International Journal of Computer Applications.* Vol. 106, No. 14.
[6]. Kenney, R., & Kastberg, S. (2013). Links in learning logarithms. *Australian Senior Mathematics Journal*, *27*(1), 12-20.
[7]. Kumar, A. & Mozar, S. (2020). *Proceedings of the 3rd International Conference on Communications and Cyber Physical Engineering*, p. 170. New York: Springer Nature.
[8]. Mazurkin, P. (2014). Series primes in binary. *American Journal of Applied Mathematics and Statistics.* Vol. 2, No. 2, pp. 60-65. Science and Education Publishing.
[9]. Weber, C. (2016). Making logarithms accessible–operational and structural basic models for logarithms. *Journal für Mathematik-Didaktik*, *37*(Suppl 1), 69-98.