# Mersenne Primes: An Exploratory Study of Patterns and Some New Conjectures

Lohan, Rajat (School: Delhi Public School)

*Introduction Mersenne Primes:- A number of the form 2^n – 1 where n is a natural number is a Mersenne number. If its value is prime then it is known as a Mersenne Prime. Mersenne primes are named after the mathematician Marine Mersenne who discovered these around 1550 BC with the help of Perfect Numbers*. Some of the initial Mersenne primes were – 2^2-1=3 ; 2^3-1=7 ; 2^5-1= 31 ; 2^7-1= 127 ; 2^13-1= 8191 and 2^17-1= 131071 The Largest known Mersenne Prime Number is 2^(82,589,933)-1 and it contains 24,862,048 digits. It took approximately 12 months of calculations to find this Prime Number. *Methodology 1. In 2^n – 1 = X, I have observed some patterns between the power of 2, that is n, and the number of digits in its value, that is, X. The patterns were: - 2^311 ~ 32 + 2 × 31 = 94 {i.e. 2^501 has 94 number of digits} 2^321 ~ 33 + 2 × 32 = 97 {i.e. 2^511 has 97 number of digits} 2^331 ~ 34 + 2 × 33 = 100 {i.e. 2^521 has 100 number of digits} 2. I have studied about the Euclid's proof of prime numbers which leads me to propose an easy method to find prime numbers. 3. I have formed a quadratic equation whose roots are the two prime numbers used in the RSA encryption system. *Results and Findings 1. I have formed patterns and two relations between the values of 2^n, 2^n – 1 and their number of digits. They help me to eliminate 33.33% numbers which will never be a prime number. The relations are: - For Power: An = 1 + (n-1)10 For number of digits: - An = 1 + (n-1)3 2. I have proposed a new and easy method of predicting big prime numbers. 3. I am able to find the values for the two primes in the RSA encryption system non computationally. I am working on its computational method.