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

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*Introduction Mersenne Primes:- A number of the form $2^{\wedge} n-1$ 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 $-2 \wedge 2-1=3$; $2^{\wedge} 3-1=7 ; 2^{\wedge} 5-1=31 ; 2^{\wedge} 7-1=127 ; 2^{\wedge} 13-1=8191$ and $2^{\wedge} 17-1=131071$ The Largest known Mersenne Prime Number is $2^{\wedge}(82,589,933)-1$ and it contains $24,862,048$ digits. It took approximately 12 months of calculations to find this Prime Number. *Methodology 1. In $2^{\wedge} n-1=X$, 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: $-2^{\wedge} 311 \sim 32+2 \times 31=94$ \{i.e. $2^{\wedge} 501$ has 94 number of digits \} $2^{\wedge} 321 \sim 33+2 \times 32=97$ \{i.e. $2^{\wedge} 511$ has 97 number of digits\} $2^{\wedge} 331 \sim 34+2 \times 33=100$ \{i.e. $2^{\wedge} 521$ 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 $2^{\wedge} n, 2^{\wedge} n-1$ 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: $-A n=1+(n-$ 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.

