# Super perfect numbers and Mersenne perfect numbers(abstract)

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If a positive integer $a$ satisfies $\sigma(a) - 2a = -m$, then we say that $a$ is a perfect number with translation parameter $m$.

If $\alpha$ is a perfect number , then it is written as $2^e q$.

We shall study $2^e$ and $q$, independently.

In general, If $q = 2^{e+1} - 1 + m$ is prime then $a = 2^e$ satisfies the following equalities. positive integers $a$ and $A$ satisfy $A = \sigma(a) + m$ , $\sigma(A) = 2a + m$.

$a$ is callded a super perfect number with translation $m$.

$A$ is said to be a partner of $a$.

Super perfect number was introduced by D.Suryanaryana when $m = 0$, in 1969. He proves if a super perfect number $a$ is even , then $a$ turns out to be $2^e$ such that $p = 2^{e+1} - 1$ is prime (Mersenne prime).

In general if odd primes $p, q$ satisfy $q = ap + b$, where integers $a > 0, b$ have the properties (1) $p + q \equiv 1 \bmod 4$, .(2) $a, b$ are relatively primes, then $p, q$ are said to be super twin primes by Hiroto Takahashi. In 2019, the prime part $q$ of the perfect number $\alpha = 2^e q$ is studied.

If $a = 2^{e+1} - 1 + m$ is prime, then $\sigma(a) = a + 1$. Thus $\sigma(a) = a + 1 = 2^{e+1} + m$.

Letting $A$ be $\sigma(a) - m$, we get $A = 2^{e+1}$.

From $a + 1 = 2^{e+1} + m$, it follows that

$$\sigma(A) = 2^{e+2} - 1 = 2 * 2^{e+1} - 1 = 2a - 2m + 1.$$

**Definition 1** *A positive integer a satisfying the above equation is said to be super Mersenne perfect number with translation m , and A a partner of a.*