Polite numbers - Jiali Huang

when trying to find a pattern to the sums of consecutive numbers I begun by trying to sum different quantities of numbers consecutively.

1+2 = 3
2+3 = 5
3+4 = 7
4+5 = 9
5+6 = 11
6+7 = 13
7+8 = 15
8+9 = 17

odd + even = odd so all odd numbers are polite numbers

from here, so far we can see that all odd numbers are polite numbers

Therefore the first 9
63, which is a sum of
31+32 is a polite number

Then I begun to sum 3 positive consecutive integers

1+2+3 = 6
2+3+4 = 9
3+4+5 = 12
4+5+6 = 15
5+6+7 = 18
6+7+8 = 21

giving a sequence of numbers which are multiples of 3

following on summing ~~multi~~ 4 consecutive numbers would give

1+2+3+4 = 10
2+3+4+5 = 14
3+4+5+6 = 18
4+5+6+7 = 22
5+6+7+8 = 26
etc.

with a difference of 4, since each number would add 4 each time when every on of them increases.

similarly

1+2+3+4+5 = 15
2+3+4+5+6 = 20
3+4+5+6+7 = 25

showing that all multiples of 5 are polite.

An impolite number is one that cannot be written as the sum of 2 or more consecutive positive numbers

when looking at the numbers from 1-20 and through the process of elimination

1 2 ~~3~~ 4 ~~5~~ ~~6~~ ~~7~~ 8 ~~9~~ ~~10~~
~~11~~ ~~12~~ ~~13~~ ~~14~~ ~~15~~ 16 ~~17~~ ~~18~~ ~~19~~ ~~20~~

~~and~~ powers of 2 cannot be written as the sum of 2 or more consecutive positive numbers

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So powers of 2 are impolite
→ written as 2^n

impolite numbers cannot be odd, unless its 1
as if you sum 2 consecutive positive numbers
$n + n+1$ will give $2n+1$, which will always be
an odd number.

proving the rule that all powers of 2 are impolite numbers

note: the sum of a set of consecutive numbers always has
~~an~~ odd factors

e.g multiples of odd numbers would give
$n-1$, n, $n+1$
consecutive numbers, ~~and~~ one is a multiple of 3
so sum of 3 consecutive numbers would always have
3 as a factor

multiples of 5 can be written as
$(n-2), (n-1), n, n+1, n+2$
this is also the case for all odd numbers

for example
$25 = 5 \times 5$
5 numbers
$3+4+5+6+7$
$19 = 1 \times 19$
is the sum of $9+10$

proof that summing consecutive numbers cannot be made.

considering the form above, n is an average of
the consecutive numbers, giving a sum

average x number of consecutive numbers
~~so~~ = whole number x odd

~~odd~~ polite numbers always have an odd
factor, which 2^n can't so
odd number of consecutives can't give 2^n

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I also tried this with an even amount of consecutive numbers.

$n-1$, n, $n+1$, $n+2$

adding 2 consecutive numbers always gives odd.

even + odd = odd

~~even + odd + even~~:

adding even

Sum of the consecutive numbers =

$\frac{1}{2}$ × sum of 2 numbers in the middle × number of consecutive numbers

↓

($\frac{1}{2}$ × even number) × sum of 2 consecutive numbers

= Sum of 2 consecutive numbers × natural number

↓ odd

has an odd factor always

2^n does not have any odd factors.

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