Title: Goldbach Conjecture

Author: Barry Foster

Abstract: The Goldbach Conjecture may be stated as follows:

Every even number greater than 4 can be written as the sum of two primes.

Examples:

6 = 3+3
8 = 3+5
10 = 3+7; 5+5

We will call the two primes summing to a particular number a Goldbach Pair (GP) for that number.

Method

Absent a function for generating primes this demonstration uses a simple fact about primes less than a given even number so that, to paraphrase Santayana: "Even numbers that cannot learn the lessons from history are doomed not to repeat it."

Consider the following identity valid for all real numbers (N,u,v).

$$N = (N-u) + (N-v) - (N-u-v)$$

We will limit our considerations to the set:

$$N = (N-u) + (N-v) - (N-u-v) \qquad \{N,u,v \text{ even}; N>v>=u>6\} \qquad (1)$$

Thus N and the () are even numbers, and the () are GP’s and if N is a GP its primes have been used in the even numbers $<N$ providing there are no gaps in those even numbers.

Apparently the following solution to (1) exists but must be found by informed inspection:

$$N = (A+a) + (B+b) - (a,b) \qquad (A,B,a,b \text{ are all prime})$$

Where
$$(A+a) = (N-u)$$
$$(B+b) = (N-v)$$
$$(a+b) = (N-u-v) = E \text{ say}$$

Thus
$$u+v = N-E$$

Examples

$$\begin{aligned} \mathbf{N} &\mathbf{= 12} \\ &\mathbf{= (7+\underline{3}) + (5+\underline{3}) - (\underline{3}+\underline{3})} \\ &\mathbf{= (7+5)} \end{aligned}$$

$$\begin{aligned} \mathbf{N} &\mathbf{= 30} \\ &\mathbf{= (23+\underline{3}) + (7+\underline{5}) - (\underline{5}+\underline{3})} \\ &\mathbf{= (23+7)} \end{aligned}$$

Etc.