International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

The Strong Goldbach Conjecture is True

Kiran Kalyankar[1], Onkar Wanve[2]

Toshniwal A.C.S. College, Sengaon, India - 431542
kirankalyankar8394[at]gmail.com

JSPM's Imperial College of Engineering & Research, Maharashtra, India 412207
onkarwanve23[at]gmail.com

Abstract: ***The strong (binary) Goldbach Conjecture states that "every even integer greater than 2 can be written as a sum of odd prime numbers." In this present paper we are going to prove this conjecture by two methods. In the first method we are going to prove this conjecture by logical manual calculations and in second one with the help of the computational method.***

Keywords: Goldbach Conjecture, Even Numbers, Odd Numbers, Prime Numbers, Computation

1. Introduction

Goldbach's original theorize (sometimes tabbed the "ternary" Goldbach conjecture), written in a June 7, 1742 letter to Euler, states "at least it seems that every number that is greater than 2 is the sum of three primes" (Goldbach 1742; Dickson 2005). Note that here Goldbach considered the number 1 to be a prime, an institute that is no longer followed. As re-expressed by Euler, an equivalent form of this conjecture (called the "strong" or "binary" Goldbach conjecture) asserts that all positive even integers ≥ 4 can be expressed as the sum of two primes. Two primes (p, q) such that $p + q = 2n$ for n a positive integer are sometimes tabbed a Goldbach partition.

2. First Method

2.1. Given

a) Each odd number greater than one is a sum of an even number.
b) Addition of two even number to another even number.
c) Each odd prime number is the sum of an even number and one.

2.2. Required

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

2.3. Proof

Let, X is an odd prime number.
X = E + 1 ----------(by given 1) ------ Eq no.1
Here, E is the even number previous prime number.

Let, two odd prime numbers X_1 and X_2.
$X_1 = E_1 + 1$ ----------(by given 3)
$X_2 = E_2 + 1$ ----------(by given 3)

By adding two prime numbers,
$X_1 + X_2 = E_1 + E_2 + 2$ ------ Eq no. 2

By given 2, two even numbers in eq no. 2 to get another even number which will be E_3.

$X_1 + X_2 = E_3 + 2$ ------ Eq no. 3
$(E_3 + 2)$ is even number greater than 2.
$X_1 + X_2$ is the sum of two primes.

3. Second Method

3.1. Code In Programming Language "C" for proving Goldbach Conjecture

```
#include <stdio.h>
intisprime(int n);
int * getPrimePair(intnum);
int main()
{
intnum, *arr;
printf("Enter any Even number:");
scanf("%d",&num);
arr=getPrimePair(num);
printf("Two Prime number whose addition is %d are %d and
%d", num,arr[0],arr[1]);

return 0;
}

intisprime(int n){
int x;
if (n == 2)
return 1;

for(x=2;x<=n/2;x++)
 {
if(n % x == 0)
return 0;
return 1;
 }
}
int * getPrimePair( int num){
int x, arr[2];
for(x=2;x<=(num-1);x++){
if(isprime(x))
if (isprime(num-x))
 {
arr[0]=x;
arr[1]=num-x;
returnarr;
```

```
 }
 }

}
```

3.2. Explanation of Code

a) isPrime() Function:

- It is used to determine whether given number is Prime or Not.
- 2 is the only even prime number, so we initially check for 2's condition.
- For other than 2 we are running one for loop starting from 2 to n/2 and we are checking the divisibility ofthe given number, if the number is divisible by any of number between 2 to n/2 then that number is notprime, so we return 0; else the number is prime, so we return 1.

b) getPrimePair() Function:

- The return type of this number is int * as it return the array of the pair of two prime number.
- This function basically return the pair of prime number which can be represented in terms of addition ofgiven number.
- We are declaring one variable called x for the iteration of for loop as well as another variable arr[2] forstoring the pair of prime number.
- We are running one for loop from x=2 to x=n-1, then we are checking first number is prime or not, if itis prime then we check for the second number (which is num-x), if that is also prime we return thisprime pair. Else we are returning null.

4. Conclusion

From both the methods, we are able to illustrate that any even number can be represented as the addition of two prime number.

References

[1] Christian Goldbach, *Letter to L. Euler*, June 7 (1742).
[2] H. A. Helfgott,*"The Ternary Goldbach Conjecture is True", arXiv*:1312.7748v2 [math.NT], 17 Jan 2014.
[3] Lecture on NX(p) Jean pierreserre.
[4] Ritchie, Dennis M. (1993). *"The Development of the C Language". History of Programming Languages, 2nd Edition.* Retrieved 2018-11-11.