

Summation of primes

The sum of the primes below 10 is $2 + 3 + 5 + 7 = 17$.

Find the sum of all the primes below two million.

Solution

The accompanying C program will be run several times for different values of x to keep the computation time low. To the right is the sum of all prime numbers up to the highest number in the loop.

for(x = 2; x < 100 000; x++) :	Resulting Sum: 454 396 537
for(x = 100 000; x < 200 000; x++) :	Resulting Sum: 1 255 204 276
for(x = 200 000; x < 300 000; x++) :	Resulting Sum: 1 999 906 301
for(x = 300 000; x < 400 000; x++) :	Resulting Sum: 2 749 394 417
for(x = 400 000; x < 500 000; x++) :	Resulting Sum: 3 455 334 664
for(x = 500 000; x < 600 000; x++) :	Resulting Sum: 4 157 590 150
for(x = 600 000; x < 700 000; x++) :	Resulting Sum: 4 838 459 967
for(x = 700 000; x < 800 000; x++) :	Resulting Sum: 5 555 377 126
for(x = 800 000; x < 900 000; x++) :	Resulting Sum: 6 223 668 827
for(x = 900 000; x < 1 000 000; x++) :	Resulting Sum: 6 861 069 758
for(x = 1 000 000; x < 1 100 000; x++) :	Resulting Sum: 7 575 351 672
for(x = 1 100 000; x < 1 200 000; x++) :	Resulting Sum: 8 307 652 436
for(x = 1 200 000; x < 1 300 000; x++) :	Resulting Sum: 8 854 589 641
for(x = 1 300 000; x < 1 400 000; x++) :	Resulting Sum: 9 593 260 875
for(x = 1 400 000; x < 1 500 000; x++) :	Resulting Sum: 10 193 186 609
for(x = 1 500 000; x < 1 600 000; x++) :	Resulting Sum: 10 804 148 932
for(x = 1 600 000; x < 1 700 000; x++) :	Resulting Sum: 11 572 366 516
for(x = 1 700 000; x < 1 800 000; x++) :	Resulting Sum: 12 130 179 143
for(x = 1 800 000; x < 1 900 000; x++) :	Resulting Sum: 12 870 295 635
for(x = 1 900 000; x < 1 950 000; x++) :	Resulting Sum: 6 685 543 695
for(x = 1 950 000; x < 2 000 000; x++) :	Resulting Sum: 6 776 851 745

Add up all these numbers on the right to get the sum of the prime numbers under two million.

142 913 828 922

This is confirmed in Mathematica: $\text{Sum}[\text{Prime}[n], \{n, 1, 148\,933\}] = 142\,913\,828\,922$.