Multi-Agent Sistems

2nd Assignement – Goldbach's Conjecture

Master in Electrical Engineering
Electrical Engineering Dept.
Institute of Technology
University of the Algarve

Pedro Cardoso

Updated: March 9, 2017

Introduction

In 1742, a German amateur mathematician named Christian Goldbach wrote to Leonhard Euler with the following conjecture:

> *Every number greater than 2 can be written as the sum of three prime numbers.*

In his conjecture, Goldbach was considering 1 as a prime number. By convention we no longer consider 1 as a prime number. And Euler later modified the conjecture to:

> *Every even number greater than or equal to 4 can be expressed as the sum of two prime numbers.*

There is no formal proof of this conjecture. However, we can verify Goldbach's conjecture in certain ranges.

Assignement

For this programming assignment you are asked to verify Goldbach's conjecture up to a certain integer value, n. The important part is to **use multiprocessing** in order to (try to) beat a sequential implementation.

To help you in your work, we provide a sequential implementation of the methods `prime_producer` (returns a list of primes) and `goldenbach_checker` (prints the conjectures verifications).

The final results should be a print of the even numbers plus all the primes pairs that verify the conjecture. If the conjecture is not verified for some even number then a proper message should be presented. For example, for even numbers lower than $n = 50$ the program should print something like this:

```
4 = 2 + 2
6 = 3 + 3
8 = 3 + 5
10 = 3 + 7 = 5 + 5
12 = 5 + 7
14 = 3 + 11 = 7 + 7
16 = 3 + 13 = 5 + 11
18 = 5 + 13 = 7 + 11
20 = 3 + 17 = 7 + 13
22 = 3 + 19 = 5 + 17 = 11 + 11
24 = 5 + 19 = 7 + 17 = 11 + 13
26 = 3 + 23 = 7 + 19 = 13 + 13
28 = 5 + 23 = 11 + 17
30 = 7 + 23 = 11 + 19 = 13 + 17
32 = 3 + 29 = 13 + 19
34 = 3 + 31 = 5 + 29 = 11 + 23 = 17 + 17
36 = 5 + 31 = 7 + 29 = 13 + 23 = 17 + 19
38 = 7 + 31 = 19 + 19
40 = 3 + 37 = 11 + 29 = 17 + 23
42 = 5 + 37 = 11 + 31 = 13 + 29 = 19 + 23
44 = 3 + 41 = 7 + 37 = 13 + 31
46 = 3 + 43 = 5 + 41 = 17 + 29 = 23 + 23
48 = 5 + 43 = 7 + 41 = 11 + 37 = 17 + 31 = 19 + 29
```

The order of the printed lines is not important.

Your program should have a good, clean logical structure. We will also be looking at good documentation, descriptive variable names, and adherence to the coding convention.

To deliver...

A small report with:

- Brief description of the implemented methods. The minimum is to present the provided sequential implementation and another (yours solution). Nevertheless, your are encouraged to present other solution, even if they do not improve the sequential one.
- Time comparison for different limits, e.g., compare the Goldbach conjecture verification times for $n \in \{10, 50, 100, 500, 1000, 5000, 10000, 50000\}$. Note that for each configuration you should run at least 3 times the methods and present (mean and stddev) statistical results.
- Explanation of the results.
- Code (attached or bitbucket repository)

Delivery date

Although you can deliver your work up to the exams dates, we advise you to deliver it earlier. A good date would be the 30th of April.

References

- Wikipedia Article on Goldbach's Conjecture
- Wolfram Article on Goldbach's Conjecture

Final remarks

If you have any doubts, please contact the professor directly or by email – pcardoso@ualg.pt