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Grid Computing for Empirical verification of the even Goldbach conjecture.

Description of the work

The Empirical Goldbach Conjecture verification has been started and coordinates by Tomás Oliveira e Silva since 2005. Before October 2011 the code had run on several supercomputing machines and on the spare time of many computers until reach the 26•10^17. After that, we porting the code in Grid by creating a set of scripts able to manage the complete computation lifecycle: generate dynamically the next numbers to analyze, create the JDL file, then submit the job in Grid, retrieve the output and resubmit the failed jobs. In particular to do that, we take advantage from the Parametric-Job features provided by the WMS component of gLite. About of the 50% of the jobs submitted through the Grid ran on the ScoPE datacentre in Naples, while the rest of the work has been computed in other infrastructure within the Italian Grid Infrastructure (IGI) and in many other site of the EGI by using different virtual organizations: unina.it and infngrid.

Link for further information

http://www.ieeta.pt/~tos/goldbach.html

Wider impact of this work

This work represents a success experience to porting a new application on Grid by scratch and take advantage by the resource availability of the EGI infrastructure. Moreover this work shows a new application domain for the distributed infrastructure, represented by the computer algebra and can be a starting point to individuate a larger Mathematician community.
As regarding the mathematical point of view, our verification represents actually the world record of computation. A recent proof (by Terence Tao) that any odd number larger than 1 is the sum of at most 5 primes uses the fact that the Goldbach Conjecture is true up to 4e14. It seems likely that a (future) proof that any odd number larger than 1 is the sum of 3 primes will require a verification of the Goldbach conjecture to a higher limit perhaps 4e18 will suffice!

Printable Summary

In this work we present our experience in use of Grid technologies to undertake empirical verification of the Goldbach Conjecture. The large availability of resources provided by EGI infrastructure and the advanced use of job submission techniques allowed us to improve the rate of "verified numbers" per day. After the porting in grid of the analysis code, the total amount of verified numbers in 7 month has been of 1,4*10^18 against the 1*10^18 verified in the previous 21 months. In 2012 we reached the desired verification limit (4*10^18,) that overcome the previous world record of computation (4•10^14). Moreover we discovered the largest prime of a minimal Goldbach partition. In our activities, no counter-example of the conjecture was found but several statistical behaviours have been confirmed. Full Mathematical considerations are contained in a more extensive work, while this poster proves that we can take advantage from the Grid to enlarge the knowledge in the math filed.

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Track Classification: Virtual Research Environments (Gergely Sipos: track leader)