Internet, Computing, application

Miguel Casquilho

Department of Chemical Engineering; CERENA

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Instituto Superior Técnico (Universidade de Lisboa *University of Lisbon*)
Ave. Rovisco Pais, IST, South Tower
1049-001 Lisboa (Portugal)
mcasquilho@tecnico.ulisboa.pt (Ext. 1310)

Abstract

Industrial companies and similar organizations need Computer Engineers for tasks that these engineers sometimes underestimate. From the combination of the latter with the former, advantages will certainly emerge, the Internet being the easy connection, both institutional and physical. To this end, a Proposal is herein schematically presented for a study on **computing** *over the Internet* (essential feature), with the suggestion to:

a) Include heterogeneous parallelization; and
b) Solve applied optimization problems.

It is intended to:

i) Try, in the short term, to publish (in congresses, scientific journals) the results; and
ii) Consolidate the use, over the Internet, of programs of quality that have been already tested, for which important steps in the informatics (used here instead of "information technology") chain are needed: optimized installation, secure access, combination of programming languages, resolution of some an industrial problem

We wish, simultaneously, to: give the candidate (though *i)*) the possibility of a new (or first) expressive mention in his *curriculum*; support the elaboration of computing over the Internet (according to *ii)*); and have a look at some problem in industry.

Public presentation of this Proposal, in more detail, can be made, in sessions to be scheduled with those possibly interested.

Internet, Computing

On the Internet, Computing, particularly scientific, is not very visible.[1] The only reference (to our knowledge) close to this concept is academic —extensive and excellent—, by Prof. V. M. Ponce[2], of the San Diego State University (San Diego, CA, USA), on Hydraulics. We mean software that works via the Internet, needing only a browser, without any installation in the user's computer. There are uses of this type in companies, but they are reserved. Industry can be one of the interested in Computing over the Internet, an environment that has become ubiquitous and accessible.

The present Proposal is based on work done in recent years, which gave rise to various publications (in conferences with refereeing), some of these being sequentially

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[1] Author's opinion, as often told in public.
[2] V. M. Ponce, SDSU , especially, http://onlinecalc.sdsu.edu/ .

cited in the Bibliography[3], always in co-authorship with students of Computer Engineering of IST. These publications have in their titles mentions to "*computing over the Web*".

Operational Research

A constant need in Industry is that the processes be conducted in the best way, *i. e.*, to optimize, obtaining better quality, greater yield, lower cost, less time. Operational Research[4] is a branch of Mathematics mostly dedicated to optimization. For historical reasons, certain areas of Mathematics became chapters of Operational Research, for example: (deterministic models) Linear Programming, transport problems, network problems; (probabilistic models) simulation ("Monte Carlo"), queuing theory, inventory management.

Linear Programming (LP) stands out within Operational Research or even in Mathematics due to wide applicability, despite the apparent limitation of linearity, and exceptional computational efficiency. These two characteristics reinforced each other, straight since the discovery of the method by George Dantzig[5], in the 40s of last century, and are connected to the simultaneous impulse of the first computers. LP was, otherwise, the problem used for intensive testing of the first computers and programming languages.

LP is detailed below in this Proposal as a topic of interest for application, but many other areas, already mentioned or not, can be considered, given the essential informatic objectives of the study.

Application

LP applies to innumerable problems in many industrial domains and others: planning, production (construction, petrochemical, food, assembly), logistics, networks. It can be solved by several commercial programs, namely: (IBM) CPLEX[6], Lindo[7], Excel (Solver), some considered of high quality. These programs are available (in full version) for academic use, including scientific research.

The examples of LP are innumerable. We propose a query to classical websites on the subject, instead of the various examples solvable on the author's website. Giving preference to the website of J. E. Beasley[8] (emeritus professor, Brunel University London), the following may be appropriate:

1) The "cargo plane" problem[9], with continuous variables ("normal" problem)

2) The "blending problem"[10], additionally with integer variables (in this case, binary)

Let it be noted that studying only "normal" LP, *i. e.*, with all continuous variables, is to ignore a very important alternative, the use of integer variables (including binary ones). Several types of non-linear problems can be led to LP, although at the cost of a lower efficiency.

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[3] Full bibliography listed in http://web.tecnico.ulisboa.pt/mcasquilho/ist/research.php .

[4] https://en.wikipedia.org/wiki/Operations_research

[5] G. B. Dantzig, InfORMS; (W) Linear Progr. ; http://www.phpsimplex.com/en/Dantzig_interview.htm .

[6] https://en.wikipedia.org/wiki/CPLEX

[7] https://en.wikipedia.org/wiki/LINDO

[8] http://people.brunel.ac.uk/~mastjjb/jeb/jeb.html

[9] http://people.brunel.ac.uk/~mastjjb/jeb/or/lpmore.html

[10] http://people.brunel.ac.uk/~mastjjb/jeb/or/moreip.html

Informatic questions to address

The study will be based on **computing over the Internet,** with desirable **heterogeneous parallelization** on two or more different systems (different OS), possibly geographically remote. The most recent previous study, which the present one should naturally complement, is based on homogeneous parallelization and on a statistical problem of merely academic interest.

Regarding computing, strictly, CPLEX and Lindo are adopted. CPLEX is installed and functional on the Linux system of IST, but lacks various complements. In fact, the installation has been achieved, but: is little versatile; has not been optimized; and must be prepared for combination with other languages, namely, Fortran 90 and, preferably, Matlab (or Octave) or Mathematica, these being languages that can suit most of the external users.

Lindo, besides offering a student version for various platforms, provides an interesting API (application program interface)[11], usable for, at least, the following languages: C or C++, Visual Basic, C#, Delphi, Fortran 90 and Java or Java++. The Lindo installation was attempted, but is not yet functional.

The programs cited in this Section can be confronted with Excel (Solver) resolutions, as this tool is popular among users who are non-specialists but numerous.

CONCLUSIONS

Computing over the Internet is little visible, and, as such, capable of adoption as an activity useful to a Computer Engineer. Remote distributed heterogeneous parallel computing will be an avenue to explore for achieving greater computing power. Programs are available that are known worldwide and considered of high quality. The programs intended (CPLEX, Lindo, Excel) are massively used in personal computers or isolated systems, but their association with Internet seems infrequent. An attempt is considered to publish (congresses, journals) the results of the study.

Acknowledgements

Bibliography

(Some illustrative references, by descending chronological order.)

CAROLINO, Elisabete, Miguel CASQUILHO, Rosário RAMOS, Isabel BARÃO, **2016,** "Web computing of robust methods in Acceptance Sampling for Weibull variables", COMPSTAT 2016, 22.nd International Conference on Computational Statistics, Oviedo (Spain).

CUNHA, Marco, Miguel CASQUILHO, **2016,** "Parallel remote servers for scientific computing over the Web. (Random polygons inscribed in a circle)", CISTI'2016, 11.ª Conf. Ibérica de Sistemas y Tecnologías de Información *(11.th Iberian Conf. on*

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[11] http://web.tecnico.ulisboa.pt/~mcasquilho/compute/or/.Lindo/LindoAPI_part.pdf

Information Systems and Technologies), San Bartolomé de Tirajana, Gran Canaria, Canarias (Spain).

CUNHA, Marco, Miguel CASQUILHO, **2015,** "Applied scientific computing over the Web with remote servers: sampling with and without replacement", CISTI'2015, 10.ª Conf. Ibérica de Sistemas e Tecnologias de Informação *(10.th Iberian Conf. on Information Systems and Technologies)*, Águeda, Aveiro (Portugal).

CASQUILHO, Miguel, Fátima ROSA, **2014,** "Behaviour of the quality index in acceptance sampling by variables: computation and Monte Carlo simulation", COMPSTAT 2014, 21.st International Conference on Computational Statistics, Geneva (Switzerland).

CASQUILHO, Miguel, Marco CUNHA, **2014,** "Scientific computing over the Web in various programming languages --- solving problems in Fortran, C, and Octave", CISTI'2014, 9.ª Conf. Ibérica de Sistemas y Tecnologías de Información *(9.th Iberian Conf. on Information Systems and Technologies)*, Barcelona (Spain).

CASQUILHO, Miguel, Miguel FERREIRA, Fátima C. ROSA, **2013,** "Enchimento de embalagens com itens de peso e espessura aleatórios com somas constrangidas", XXI Congresso da SPE (*21.st Congress of the* Portuguese Statistical Society), Aveiro (Portugal).

CASQUILHO, Miguel, João L. MIRANDA, Jorge BUESCU, **2013,** "Determinantes de matrizes de elementos uniformes inteiros: é a singularidade rara ?", XXI Congresso da SPE (*21.st Congress of the* Portuguese Statistical Society), Aveiro (Portugal).

FRANCO, Bruno, Miguel CASQUILHO, **2011,** "A Web application for scientific computing: combining several tools and languages to solve a statistical problem", CISTI'2011, 6.ª Conf. Ibérica de Sistemas e Tecnologias de Informação, Chaves (Portugal).

CASQUILHO, Miguel, **2010,** "Você comprou 1 quilo de laranjas ?" (*Have you really bought 1 kg of oranges ?*), XVIII Congresso anual da SPE (18.th Annual Congress of the *Portuguese Statistical Society*), São Pedro do Sul (Portugal).

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