Internetics: Technologies, Applications and Academic Field or Parallel Computing and Computational Science Do Not Really Work

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Dedicated to Richard Feynman

Abstract

Ten years ago, we were all sure that parallel computing technology, and the interdisciplinary academic field of computational science would be center pieces of both academic and economic growth. We show that this insight was, in principle, correct but inevitable realities imply that this is a flawed, or more kindly, an incomplete vision. Parallel computing undoubtedly works on essentially all problems, but we failed to produce deployable software systems. Further, few industries could achieve adequate return to justify investment in parallel computers, except in areas such as databases. Computational science is the academic field (???) on the interface of computer science with fields such as physics, chemistry, and applied mathematics. This expertise allows you to be very useful and, in principle, is the best area of study, but is not a wise field for students as employers and universities prefer traditional fields.

We show how this has evolved into Internetics, which is a vibrant growing field that surely does work. Internetics embodies the technologies and expertise used in building large-scale distributed systems and linking fields like physics not with parallel computers, but with the web. This is CORBA and Java; not parallel computing. It is Internetics that is the emerging academic field, and not computational, and intrnetics is of growing attraction to students and employers.

We argue that we almost "got it right" and the essential features of the original vision were correct and are part of current ????

1 Introduction

In our first book on parallel computing, we joyfully used the well-known fairy tale centered on a mirror that could be asked the question,

"Mirror mirror on the wall—which is the most powerful computer of them all?"

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We thought, in 1987, that choice was between a microprocessor-based parallel array, and a traditional vector supercomputer. However the mirror distorted our vision, and what we should have seen was a distributed array, and not just a closely coupled parallel simulation, but a complex metaproblem with multiple concurrent asynchronous components. There was not one power user using a single large machine, but communities linked by a geographically distributed ensemble that, incidentally, could include one or more large parallel systems.

Corresponding applications of interest extend from those in science and engineering to the information area; computing with a hint of communications—the original parallel computing thrust—becomes communications with some large-scale computing; compilers become interpreters; Fortran becomes Java, and many changes like these. We term this overall concept as Internetic, which is the field centered on technologies, applications, and services enabled by world wide computing and communications. This is defined to be interdisciplinary, as both base technologies and applications are included. It includes issues of large scale from all points of view, not just large individual parallel or distributed compute engines or networks, but also one web client talking to one server. This is large scale for a different reason—it is pervasive.

As described in [daedalus] [cpande], we found in our work at Caltech that interdisciplinary research at the interface of computer science and areas such as physics and chemistry was very rewarding [Fox:94a]. Indeed, individuals who knew both areas, seemed well placed to lead the expected surge of interest in large-scale simulations using parallel systems. Several other groups came to similar conclusions, and the academic field of computational science was set up in several universities, and studied in many conferences [Rice article in IEEE CSandE]. However, this initiative seems to have stalled as student interest has shifted in both the computer science and application areas. In the latter case, in fact, fields like physics are seeing a general drop of enrollment as this is perceived as a difficult area to get jobs. Classic computational science (physics) is not a large enough field to change this. We argue that internetics combined with physics could, however, offer significant growth opportunities for this and similar traditional fields.

References

[Fox:94a] Fox, G. C., Messina, P. C., and Williams, R. D., editors. *Parallel Computing Works!* Morgan Kaufmann Publishers, San Francisco, CA, 1994. http://www.infomall.org/npac/pcw/.