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Datasheet for the decision of 4 May 2017

Case Number: T 0923/12 - 3.5.06
Application Number: 09751301.4
Publication Number: 2165260
IPC: G06F9/50, G06F9/45
Language of the proceedings: EN

Title of invention:
PARALLEL PROCESSING OF DISTRIBUTED ARRAYS

Applicant:
The MathWorks, Inc.

Headword:
Data distribution schemes/MATHWORKS

Relevant legal provisions:
EPC Art. 83

Keyword:
Sufficiency of disclosure - (no)

Decisions cited:
Catchword:
Case Number: T 0923/12 - 3.5.06

DECISION
of Technical Board of Appeal 3.5.06
of 4 May 2017

Appellant: The MathWorks, Inc.
(Applicant)
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Representative: Betten & Resch
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted on 6 December 2011 refusing European patent application No. 09751301.4 pursuant to Article 97(2) EPC.

Composition of the Board:
Chairman W. Sekretaruk
Members: S. Krischer
A. Teale
Summary of Facts and Submissions

I. The appeal is directed against the decision of the examining division, dated 6 December 2011, to refuse application No. 09751301.4 for added subject-matter (Article 123(2) EPC). Under "further remarks", the decision states that the invention is insufficiently disclosed (Article 83 EPC).

II. A notice of appeal was received on 20 January 2012. The appeal fee was paid the same day. A statement of grounds of appeal was received on 5 April 2012. Claim sets according to a main and an auxiliary request were filed. Oral proceedings were conditionally requested.

III. In its summons to oral proceedings, the board gave reasons for its preliminary opinion that the application lacked sufficient disclosure (Article 83 EPC).

The following documents were referred to:


D3 M. Hall et al.: "Interprocedural compilation of Fortran D for MIMD distributed-memory machines", Proceedings of the Supercomputing Conference,


IV. In a letter dated 4 April 2017, the appellant filed a claim set of a new second auxiliary request.

V. Oral proceedings were held on 4 May 2017. At their conclusion, the board's decision was announced.

VI. The appellant requests that the decision be set aside and a patent granted based on the main or first auxiliary request, both filed with the grounds of appeal, or the second auxiliary request, filed on 4 April 2017.

The further application documents on file are: description pages 1-38 as published; drawing sheets 1-47 as published.

VII. Claim 1 of the main request reads as follows:

"1. A computing device-implemented method for performing parallel processing, comprising:

identifying, via a single programming language, one or more data distribution schemes for executing a program;"
VIII. Claim 1 of the first auxiliary request reads as follows:

"1. A computing device-implemented method for performing parallel processing, comprising:
   simultaneously executing, to derive an efficient data distribution scheme, the steps of identifying, via a single programming language, one or more data distribution schemes for executing a program and selecting an appropriate data distribution scheme of the one or more identified data distribution schemes for executing the program, selecting a fastest algorithm for executing the program, and selecting appropriate resources for executing the program;
   transforming, via the single programming language, the program into a parallel program based on the efficient data distribution scheme;
   allocating the parallel program to two or more labs for parallel execution, each of the labs being a hardware and/or software unit;
receiving one or more results associated with the parallel execution of the parallel program from the two or more labs; and

providing the one or more results to the program, wherein the efficient data distribution scheme is derived such as to optimize a time to solution."

IX. Claim 1 of the second auxiliary request reads as follows:

"1. A computing device-implemented method for performing parallel processing, comprising:

identifying, via a single programming language, one or more data distribution schemes for executing a program;

selecting an appropriate data distribution scheme of the one or more identified data distribution schemes for each operation of a plurality of operations in the program to optimize a time to solution;

transforming, via the single programming language, the program into a parallel program based on the selected appropriate data distribution scheme for each operation of the plurality of operations;

allocating the parallel program to two or more labs for parallel execution, each of the labs being a hardware and/or software unit;

receiving one or more results associated with the parallel execution of the parallel program from the two or more labs; and

providing the one or more results to the program."
Reasons for the Decision

1. Overview of the invention

The application relates to specifying "data distribution schemes" by means of parallel processing constructs in a program (see original description page 15, lines 21-23; page 19, paragraph 3 and lines 17-20 and 29-31; called a "single programming language" in the claims). The data to be distributed may be a "distributed array", i.e. an array (the data-structure) which is divided into segments for being processed in parallel on different processors or different cores of one processor (page 1, third paragraph; page 7, lines 9-12; page 3, lines 29-30; page 15, paragraph 5; for "distributed arrays" see D1, page 1, right column, second paragraph). The parallel processing constructs (not explicitly claimed) of the single programming language are "Distribution scheme commands" (page 19, paragraph 5; figures 11-14) and "Distributed array commands" (paragraph 6; figures 16-21). The central notion of the "data distribution scheme" itself is not explained in the description. What is disclosed, is that the distribution scheme commands "provide a mechanism (e.g. a distribution property of a distributor object) for obtaining a specific distribution scheme object" (page 22, line 6-8; see also figure 14) and that the data distribution scheme may be user-defined (figure 15: 1530; page 22, lines 23-24, 26-31; page 30, line 14-17; page 37, lines 1-5). Further, distribution scheme commands specify a layout of data onto a parallel resource set (e.g. labs; page 4, lines 2-9), and specify which parallel resource
set is to be used for a distribution (page 29, lines 27-29).

The claimed method performs the following steps: the parallel processing constructs of the program are identified (page 29, lines 14-17) and an optimal data distribution scheme is selected in order to optimize a time to solution (page 29, lines 18-19; and page 18, line 25-27 for the expression "time to solution"). Then, the program is transformed according to the selected data distribution scheme into a "parallelly" executable form (page 19, lines 20-22 and 33-35; see also page 20, lines 8-12; repeated on page 29, lines 31-35) and executed in parallel by several processors (figure 3) or cores of a processor (page 7, lines 9-12).

2. Insufficient disclosure (Article 83 EPC)

2.1 The board agrees with the statements in the grounds of appeal (page 10, third paragraph) and the decision (sections 17.4 and 18.2) that the difference between the claimed invention and the prior art is the selection of an optimal data distribution scheme. None of documents D1 to D4 discloses a selection, let alone an optimal selection, of a data distribution scheme (decision page 5, lines 1-4; page 11, last paragraph).

2.2 The decision (sections 17.4 and 18.2) argues that this optimal selection is the core of the claimed invention.

2.3 In the grounds of appeal, this is confirmed by the formulation of the objective technical problem derived from this difference ("to improve the performance of
parallel executing of a particular program"; page 10, paragraph 4).

2.4 The board agrees that the selection of an optimal data distribution scheme in order to improve the time to solution in executing a program is the core of the invention.

2.5 However, the application does not disclose how this core should be programmed by the software developer implementing the claimed invention. The description merely states that the invention automatically selects an optimal data distribution scheme which minimises the time to solution (page 18, lines 25-30; page 29, lines 18-25), but not what data distribution schemes look like, how a set of possible data distribution schemes might be derived, and how the fastest one should be selected from such a set for any program to be parallelised and executed by the invention before actually executing that program.

2.6 The grounds of appeal (page 9, last paragraph) argue that, since D1 disclosed performance metrics, the skilled person would have been "aware of various techniques for implementing performance metrics and thus for optimizing the time to solution".

2.7 However, the performance metrics of D1 consist in measuring "execution time ... as compared with serial MATLAB, the underlying MatlabMPI communication library and C+MPI benchmarks" (page 4, table 1, line "Metrics" below the "Goal - High performance"; see also section 2, third sentence: "The performance metrics ... primarily look at the computation and memory overhead of programs written with pMatlab relative to serial
programs written using MATLAB and parallel programs written using C with MPI."). This means that they measure the execution time of three manually written program variants (see figure 4 for the pMatlab program) implementing the same mathematical function (e.g. Fast Fourier Transform/FFT) to compute the result for the same benchmark suite as input (Abstract, ninth sentence: "Performance is evaluated by implementing the HPC Challenge benchmark suite and comparing pMatlab performance with the equivalent C+MPI codes.").

2.8 In the board's view, this does not enable a skilled person to implement an algorithm which selects the fastest data distribution scheme before executing the program to be analysed. Such an algorithm would have to estimate the execution time beforehand with possible (applicable) data distributions schemes. DI merely shows how to measure the execution time of a program with a data distribution scheme given by the writer of that program.

2.9 The appellant argues that "given past performance metrics for programs and/or operations executed under known data distribution schemes, the skilled person may choose a known data distribution scheme for future execution of a program and/or operation that optimizes a time to solution for the program by selecting a data distribution scheme with optimized past performance metrics relative to other data distribution schemes" (letter dated 4 April 2017, page 2, last paragraph).

2.10 For the board, this sounds like an instruction as to how to make an invention. Instead of filling the gaps in the disclosure with common general knowledge, a
skilled person would need to make extensive experimentation, and also theoretical research in order to generalise the results of such experimentation to find heuristics to determine optimal data distribution schemes for as many typical programs as possible to be input to the claimed method. However such preparatory work before programming the claimed computer-implemented method would clearly impose an undue burden on the skilled person in carrying out the invention.

2.11 Furthermore, in view of the disclosure that distribution scheme commands specify a layout of data onto a parallel resource set and specify which parallel resource set is to be used for a distribution (page 29, lines 27-29), the question arises where the leeway for selecting an optimal data distribution scheme could lie, if the data distribution scheme is specified by the program constructs which the writer of the program to be parallelised and executed had chosen beforehand.

2.12 The appellant argues that "there is leeway in the number and types of labs to use" (letter dated 4 April 2017, page 3, third paragraph).

2.13 However, there is no disclosure of how to exploit this leeway. The skilled person would have to find the solution on his/her own.

2.14 This shows that the core of the invention, i.e. the selection of an optimal data distribution scheme, is not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, contrary to Article 83 EPC.
Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

B. Atienza Vivancos W. Sekretaruk

Decision electronically authenticated