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Analytic study for the parallel processing algorithms

دراسة تحليلية في خوارزميات المعالجة المتوازية

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Abstract:

Parallel processing technology is considered a new and important branch of the (IT) because of what it had of an extra-large prospects that expansion and rapid the processing in the computer, to make sure the work of this technique is correct and effective thus. The researcher found several ways to manage these processes which are called Algorithms (Parallel Processing Algorithms) because this technology is important, in this paper we try to cover topics such as: what is the parallel processing, what are the types of its computers, in addition to the definition of parallel processing algorithms and how to analyze them. Also, in this paper, some studies about this technique have been mentioned.

Furthermore, the designing and building processing parallel algorithms has been taken as an example. Moreover, building an algorithm called (publication Algorithms) which enables the user to access of more than one processor to a specific location in memory at a same time.

The conclusion obtains some results from this paper as well as some of the recommendations.

Keyword: Parallel processing, Information Technology.

الخلاصة :

تعتبر تكنولوجيا المعالجة المتوازية فرع جديد ومهم لفرع تكنولوجيا المعلومات لما تحتويه على احتمالات كبيرة جدا لتوسيع وتسريع المعالجة في الحاسوب، ولضمان عمل هذه التقنية بشكل صحيح وفعال وجدت عدة طرق لإدارة هذه العمليات سميت خوارزميات المعالجة المتوازية كونها مهمة في هذا الوقت. في هذا البحث، حاولنا تغطية المواضيع مثل ما هي المعالجة المتوازية وما هي أنواع الحواسيب التي نستخدمها في المعالجة المتوازية بالإضافة إلى تعريف خوارزميات المعالجة المتوازية وكيفية تحليلها. أيضا في هذا البحث، أشرنا الى دراسات حول هذه التقنية، بالإضافة إلى ذلك، درسنا كيفية تصميم وبناء خوارزميات المعالجة المتوازية كمثال على ذلك، قمنا ببناء خوارزمية وصف نشر خوارزمية والتي تمكن من وصول أكثر من معالج واحد إلى موقع معين في الذاكرة في نفس الوقت. وكان الاستنتاج بعض النتائج المتحصل عليها من هذا البحث وكذلك بعض التوصيات والتوفيق من الله.

1. Introduction

Since the beginning of the era of information processing world realized that it is useful to make the different parts of a computer carrying out different works at the same time, while the CPU calculations can also be read input from the input and output modules and graduated to the means of directing available.

Where the most advanced devices contain several processors respect to each particular job and share with each other to accomplish the tasks to be addressed. Although the processor speed has increased dramatically, but the demand for faster processing tasks become necessary larger, it has led parallel processing devices multiprocessor appearance (synchronous and asynchronous) and the emergence of large networks to rethink the concept of algorithms, as the algorithm is designed after to verify the existence of the solution to the search for a workable solution, and the parallel computer that owns many of the processing units is segmenting the matter given to partial issues will solve simultaneously every bit a matter of a processor is different, and then the results gathered to give a solution to the original problem. With the advent of parallel computers has become

necessary to search for how to be programmed to solve problems in an effective and practical manner with low cost, since these methods are called algorithms (parallel programming algorithms).[1]

1.2 Multitasking processing.

It is the computer's ability to carry more than one task at the same time, as it allows multitasking implementation of several different programs in addition to a print on the printer operation and a storage disk operations, without waiting for the end of each task of those tasks to start implementing other task. [2]

1.3 Multi-processor systems.

It found multiprocessor systems in order to improve efficiency in comparison with the cost and reliability, where the multilateral system is the leading processors of information between the competing systems where both the sole processor and distributed systems alike system.[2]

1.4 Parallel processing computers.

This type of computer has a set of independent processors, each of which contains a separate memory or share together the main memory, as these processors are synchronized. In this type the computer division of the college matters to a set of partial issues and give each issue to the processor where it is resolving those issues simultaneously and then combine the results to give a solution to the original issue, the parallel Machines are divided into two main sections, depending on the connection between the processing units, they are. [3]

1.4.1 Shared memory computers.

This type also known computers parallel RAM, where this type of computers has a shared memory to be shared by the processors on a set, and in the same way and called those divisions blocks any when you want the processors communicate with each other, it is done through shared memory. It allows here for all processors access to the shared memory at the same time in order to read them or write them, and divides this kind of computers into four main categories according to the ability of two or more processors on access to memory the same location and at the same time.

- Exclusive Read, Exclusive Write (EREW).
- Concurrent Read, Exclusive Write (CREW).
- Exclusive Read, Concurrent Write (ERCW).
- Concurrent Read, Concurrent Write (CRCW).

1.4.2 Computer communications network.

It is a model of the more powerful of the shared memory model, in which every pair of processors connected to a bi-directional line. Where it is possible for many couples can relate to that one, but on condition that not more than send data to the processor or another processor is trying to receive data from another processor.

1.5 Definition of parallel algorithms.

Is a collection of processes that accomplish each of them their own sequential algorithm and exchange communications with each other through a network of specific communications, including that connect those processors are using shared memory and indivisible Therefore, each processor communicate with each other is no time costs.[4]

1.6 Analysis of Algorithms.

The speed of computers has increased a lot in the past forty years, it was believed that the effectiveness of the algorithm is not of great significance, but the fact that appeared later proved that the efficiency is very important, which invites us to delve deeper into the analysis Parallel algorithms to determine their effectiveness. Where the mean effective here is the degree of the quality of the algorithm which is determined by the time of implementation and the cost of implementation as well as the number of processors that you need. Below we will discuss in the following criteria.

1.6.1 Execution time.

The speed of the accounts is the main reason that made us care about the construction of parallel computers, so this is the most important criterion is the measure in the evaluation of parallel algorithm, and can be defined as the time during which you need to solve the algorithm on a parallel computer. In other words, is the consumer time by the algorithm from the first moment that begins the moment to end it? [5]

1.6.2 The number of processors.

When you solve the issue of what to calculate the number of processors that we need to resolve that issue for the cost of purchase and maintenance account, the more number of processors increased the greater the cost paid for the construction of parallel computers for ensuring high degrees of reliability. For example, in order to resolve the matter of size (n), the number of processors that are needed here to build a parallel algorithm is a function in terms of (n) any P (n).

1.6.3 The cost of implementation.

Possible cost of building a parallel algorithm by following the law's account.
Cost = time of implementation * the number of processors used.
It is to solve the issue of size (n) the cost of building parallel algorithm is a function in terms of (n) i.e. C (n) is calculated from the following equation.
C (n) = P (n) * t (n). …… (1)

Whereas:
C (n): represents the cost of construction of the parallel algorithm.
P (n): represents the number of processors required.
T (n): represents the time required for processing.

1.7 The efficiency of the algorithm.

Know the efficiency of the algorithm as the result of multiplying the number of processors that are used to accomplish a specific process and the time that you need to carry out that process, since the implementation of large strings of linear equations process on the computer could cost a lot of time, effort and example of that achievement multiplication and division on each of the numbers correct and real numbers, so I found many of the research and algorithms to reduce the effort and time and an example of those algorithms are Gauss algorithm which you resolve linear equations and then the cost and effort in solving those equations, which we will discuss them in subsequent research, God willing account.[6]

2. Literature Review.

Kinda Zainal Abidin wrote about the development of the science of informatics since its inception in the mid-twentieth century until the beginning of this century is rapidly and significantly branched branches colorful fields and functions, and became the entry of this science is necessary in all areas of life and all other branches of science, where necessary, the design of appropriate algorithms to solve issues and problems posed to major development in the science of algorithms, and it necessitated the development of algorithms implemented sequentially where those programs are instructions salary careful arrangement is the one implemented after the other. But with an increased volume of issues to be resolved and the complexity of the problems at hand and difficulty. [1]

Mohammed Abdullah and Bassam Abdel Rahman wrote For several years they Parallel Computing exists only in research labs, but today These computers are available and widely used in the fields of trade, as the field of parallel processing has matured enough and is now being taught in the first university stages, and the parallelism technology covering a broad spectrum of hardware design starting from the simplest of those components which the Adder and even theoretical models of the sense of parallel analysis.

The main reason for the use of parallelism in software and hardware design is in order to get top performance, high speed and where all kinds of Supper Computer today used in parallel on alarge scale to increase the speed of performance.[3]

Abdul Rahman Ahmed Mohammed wrote,theparallel processing is the way to the division of labor is linked to the parts with each other so that they can accomplish all part of the processor or the nucleus, and are performed in parallel sections at one time.The idea of parallelism has bagun since the sixties of the last century where they were used large computers,which allows for several terminals to share in the PC (Mainframes) but, (Time Sharing) and one by the time the division was famous with the advent of personal computers and cheap price and availability everywhere.[2]

Guy E. Blleloch wrote algorithms are a set of sequential steps that determine the sequence of implementation of the action and every step of those steps will include the implementation of a unilateral process, since these algorithms are appropriate to organize and facilitate the work of computers today that perform actions in sequence, which in turn leads to increase the speed of implementation of operations carried out by the computer in addition to the possibility of expansion in the procedures and the actions carried out. Due to the computer enters into many areas of life and business expansion by the law makes it compulsory that all of this is that the implementation of its business computers quickly and efficiently high and the lowest possible cost. [5]

Bernd Mohr wrote parallel processing is an integral part of daily life that part of this concept we use in our daily lives without that we perceive, when faced with a difficult problem and involve others solve them leading to easy solution to that problem as well as the speed of solving them. Where it is possible that the situation described the parallel processing, it is worth mentioning that the devices used and innovative by the Greeks 2,000 years ago have taken advantage of this principle, In the nineteenth century used the world Babbage principle of parallel processing in order to improve the functioning of the engine, which was designed, it should be noted also noteworthy that the digital design of the computer system, known as ENIAC1 have known computers parallel processing as the high performance of the decentralized system consisting of at least (25) Calculator independent all share in order to solve a particular issue, which is split resolved that issue between those computers and eventually combine the results to be the ultimate solution to the issue. Where he appeared based on this principle is known as parallel processing computers, and for the work of those computers and invested optimal investment has been organizing its work using modern methods and techniques known as algorithms parallel.[7]

3. Built of Parallel Algorithms.

3.1 Basic concepts for the construction of parallel algorithms costing perfect.

If we assume that the time of implementation of sequential algorithm to complete the task of size (n) is O (n) time and perform the same task on the parallel algorithm is O (log n) where (n) represents the number of processors used in completing the task. Where we can calculate the cost by following the law.

Cost =n*O (Log n) =O (n*Log n). ……. (2)

Note that the cost to produce the above law is not perfect the cost, and for algorithm implemented at a cost of job is perfect, we need one of two things either reduce the execution time of O (1) or decrease the number of processors to n / Log n as the result of being hit is:

O (n) = n / Log n * O (Log n). …..... (3)

Let each processor takes Login) data element, if the process was serial written in the number of data elements then each of the n / Log (n) is a processor will perform a sequential process in parallel on all the elements of data Log (n) in time O (Log n).

Add to that the processors n / Log n will be completed the previous algorithm (non-ideal) results n / Log n serial step in.

Log (n / Log n) = Log n – Log (Log n) = O (Log n). …….. (4)

And from the step of each word are:

O (Log n). …… (5)

And the cost is:

(n / Log n) * O (Log n) = O (n). …….. (6)

That will be needed. [8]

3.2 The design of parallel algorithms.

The design of parallel algorithm process is a dynamic process vital, as the natural form of the development of parallel algorithms is by starting from the serial algorithm and then determine the independent steps to get a parallel algorithm, and that this transformation of the sequence to parallelism resulting in often parallel algorithms with cost low and acceptable.

For the purpose of obtaining efficient parallel algorithms, there are a number of techniques that are used for this purpose the most important. [7]

Important note: You will symbolized the time here the symbol (T) material and components are indicated by (H) symbol and the number of processors (P) The time that you need processors in the implementation of its work is (PT).

3.2.1 Division and customization.

This technique is based on the fragmentation of the matter to an independent partial issues of the same type are resolved in parallel and brings its solutions to get a solution to the original problem.

Let (r) is integer number divide (n).

And let Hi (n / r) and Ti (n / r) such that (i = 1,2,3,4... r). Is a cost of solute (r) to partial problem?

Let Tc (n), Hc (n) is additional parallel cost to solute the original problem after to solute a partial problem, such that:

T (n) <= Max (T1 (n / r), T2 (n / r)... Tr (n / r) + Tc (n))..... (7).
H (n) <= Max (H1 (n / r) + H2 (n / r) + ... + Hr (n / r), Tc (n))..... (8).

Such that the relation no. (7) Will conclude from the following facts:
a- Problem individual.
b- Need to additional work when we solute the partial problems only.

And the relation no. (8) Will conclude from the following facts:
A. Each partial issue was resolved in parallel with the others need to be physical components.
B. the amount resulting from the solid components represent the largest number of resources needed to resolve all issues partial and resources needed to reach the final solution to the original problem.

Assuming that all partial issues equal in terms of the cost of parallelism becomes two relationships (7) and (8) as follows:
T (n) <= T (n / r) + Tc (n).... (9).

H (n) <= Max (r * H (n / r), Hc (n))..... (10).
Where T (n / r) and H (n / r) is the cost of partial matter of arrangement (n / r), and considers these relations (1 ..... 4) is very important for parallel algorithms that we get the analysis from design and customization method.

3.2.2 The method of using the vector.

This technique begins by analyzing the issue and produce algorithms that work on the construction of the data that are commensurate with the vector calculations.

3.2.3 Repeat vectors.

He laid the foundations of this technique is the world Thaub and others to solve a linear system trigonometric, where he will be using a direct serial algorithms and build them the way the iterative parallel, if we took the iterative method for calculating the elements of a triangular matrix as follows.
X1 = a1. …… (11)

Xi = ai - (bi * ci / xi - 1). Such that 2 <= i <= n. …… (12)

Then it is possible that we will get the following frequencies in accordance with the method of Gaues.

$Xi^{(0)} = a1.$ …….. (13)

$Xi^{(j)} = ai - (bi * ci / xi - 1^{(j-1)})$. …….. (14)

Where (j) is the number of repetitions.
It can also be that these frequencies are radial, i.e. it is possible to assume that an amendment to the beam ($x^{(j)}$) where (j> = 0).
We find that in the first step (j = 0) of each element in the beam ($X^{(0)}$) contains the value (a1).
In the second step element (i) to contain ($X^{(1)}$) on the following value.
ai - (bi * ci / xi-1 (0)) = ai - (bi * ci / a1), i = 1,2,3, ..., n. ……(15)
Then it is possible to adjust all the items in the ($x^{(1)}$) and one time together and that the same principle applies to the serial partial duplicates.

3.2.4 Multiplexed to return.

Is transforming the statement of account of the statement as complex linear illustrated in Figure the process of (1) a statement as complex as the logarithmic illustrated in Figure (2), this enables us to get a statement be the degree of complexity continued Lacey (logarithmic) from the statement of the degree of complexity of the written continued.

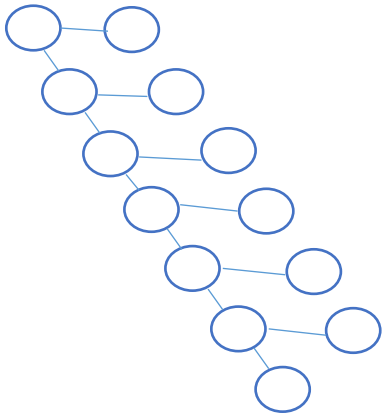

Figure (1): shown
As complex linear statement

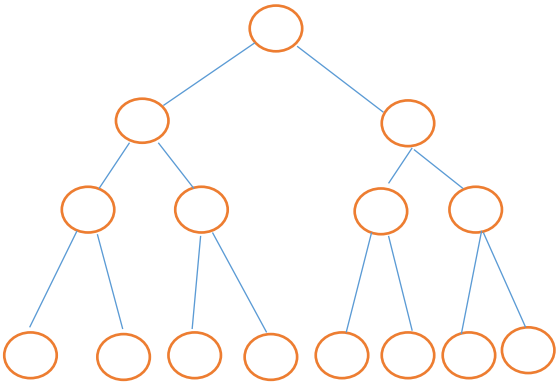

Figure (2): shown
As complex logarithmic

In the above figure for the size of n = 8 note that the depth of the statement of account in Figure (1) is (7) either in Figure (2) is (3). [9]

3.3 An example of the construction algorithm.

To take account of the X^n where $n = 2^k$ for integer (k), where will be the algorithm has the following form.

```
Begin
S  ←  X;
For I  ←  1 To (n-1) Do
S  ←  S * X;
End.
```

We note that the statement of account resulting from this algorithm has the complexity linear (linear depth) which is shown in Figure (3).

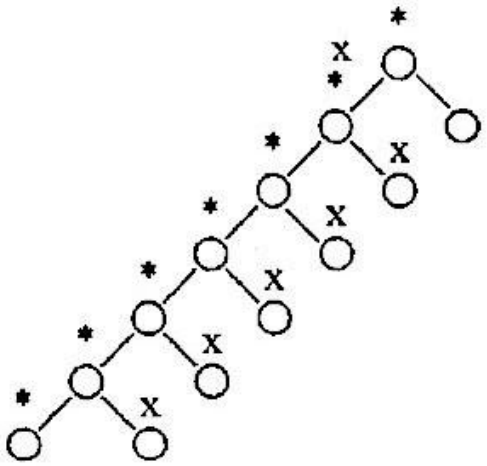

Figure (3): Shown the linear depth of above algorithm

If we want the account by using the degree of complexity of logarithmic would be according to the following algorithm.

```
Begin
S ←——— X;
For I ←——— 1 To K Do
S ←——— S * S;
End.
```

Then we will get the statement described in the following figure (4). It is as complex logarithmic. [10]

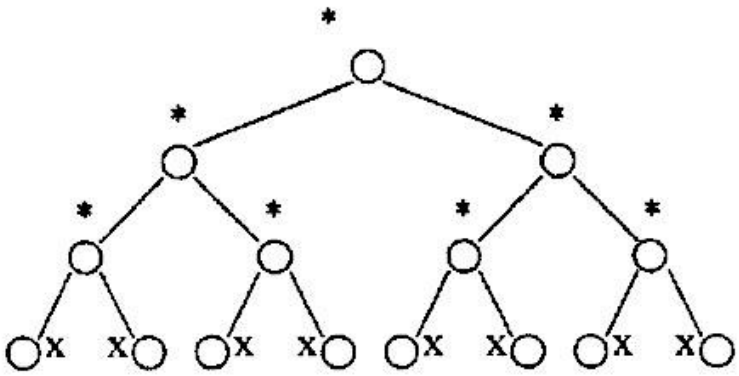

Figure (4): Shown the logarithmic depth of above algorithm

3.4 Examples of parallel algorithms.

3.4.1 Verification of distribution algorithm (publishing algorithm).

I have mentioned in the first part of our research (provided) types of computers, parallel processing and divided into two sections, namely two computers shared memory and computer communications network, and at the same time we've divided computers shared memory into four types according to the ability of two or more processors on access to memory the same site At the same time. It is those kinds so-called PAL Exclusive Read Exclusive Write (EREW) where there is this kind can access the same memory location for therapists together at the same time, however, it is necessary to read several specific data Mahfouz element processors in a particular location of the shared memory.

In other words, we might need to deploy data element on all processors in the parallel computer in order to be used by it all at the same time.

It is clear that an effective simulation of this process cannot be accomplished in one step in the EREW model and the need for those simulations to establish a procedure carried out this task, as the process of building this procedure will be as follows. [11]

3.4.2 Publishing building algorithm.

To not have a very large file is composed of (m) a separate entry, and assume that's untidy in any way, if we want to search for specific, such as an (x) in this file on the computer of the form EREW with a (n) processor, as the (n < m) then we need to deploy this component on all processors and symbolized those processors are indicated by P1, P2, ..., Pn. Where it will be the publishing process by using the following procedure.

1. Processor (P1) reads (x) and a (P2).
2. at the same time the processor P1, P2 of P3, P4, respectively.
3. At the same time the processor P1, P2, P3, P4 amounting to P5, P6, P7, P8, respectively.

And so the process continues until you get all the processors (x), where doubling the number of processors in each stage, which means that this process requires (log n) step. Let's assume that all the processors need a certain data element at a given moment during the implementation of the algorithm Let this element is reserved at the site (D) of memory, in order to simulate multiple process this process through the publishing process, known procedure Broadcast. As it is assumed in this procedure and the existence of a matrix name (A) length (N) in the memory, as will those empty matrix initially used the measure as a venue for the dissemination of the contents of (D) to the processors, symbolized by the PAL A (i).[11]

Steps publishing algorithm.

Step (1).

- Read the value in (D).
- Stored in the memory B (P1).
- Write it down in A (1).

Step (2).

From (i = 0) To (n-1)
From (j = 2i + 1) To (2i + 1)
Processor (Pj).

- Read the value in A (j-2i).
- Stored in the memory b (Pj).
- Write it down in A (j).

Where the algorithm will be as follows.

```
Void BROUDCAST (D, N, A)
{
```

Step1: Process P1
(i) Read the values in (D).
(ii) Store it in its own memory.
(iii) Write it in A (1).
Step2:
For (i=0 ; I < = log (N-1) ; i++)
For (j=2^i+1 ; j<=2^{i+1} ; j++)
Process Pj
(i) Read the value in A(j-2^i).
(ii) Store it in its own memory.
(iii) Write it in A (j).
}

The following figure (5): shows Broadcast action for N = 8, D = 5.

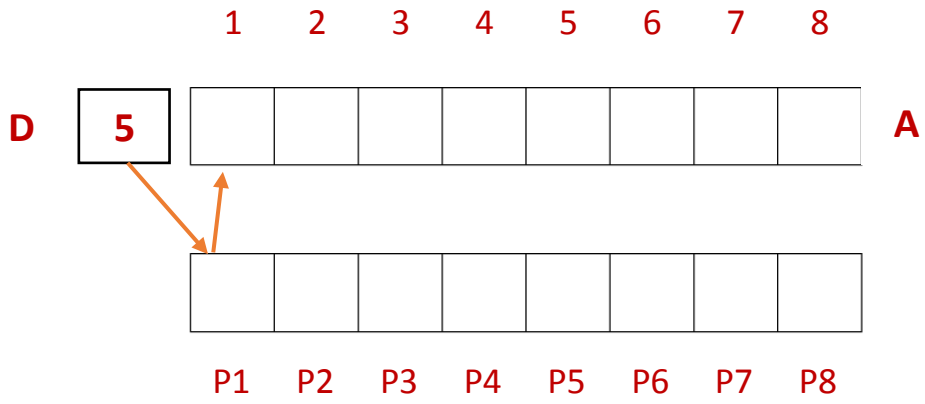

Figure (5-a): shows the implementation of step (1) in the algorithm

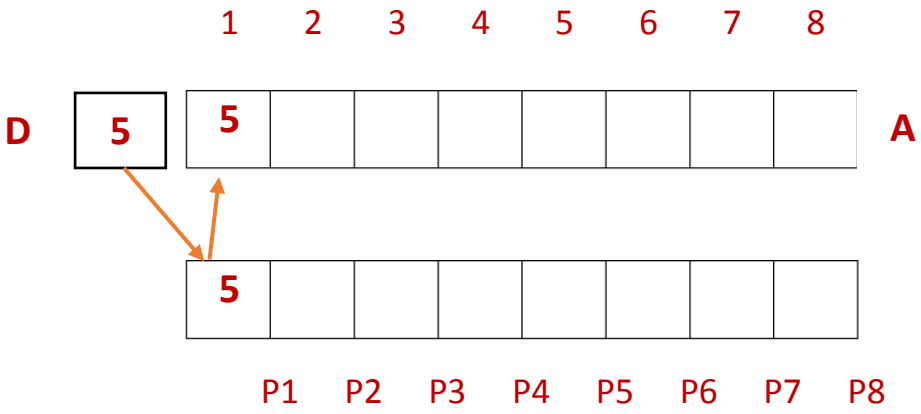

Figure (5-b): shows the implementation of step (2) when (i = 0)

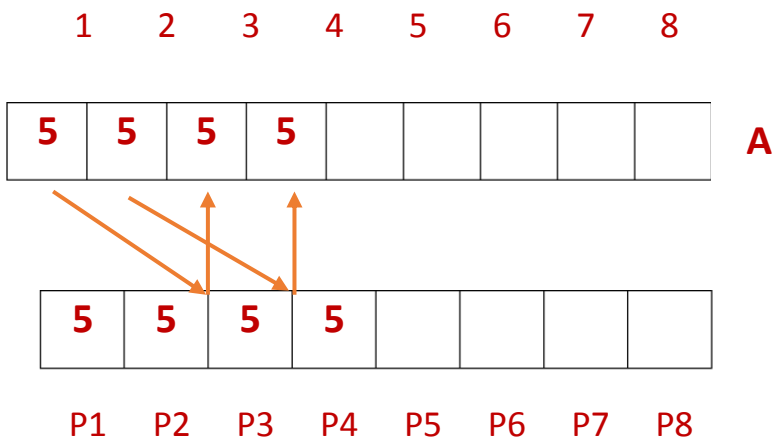

Figure (5-c): shows the implementation of step (2) when (i = 1)

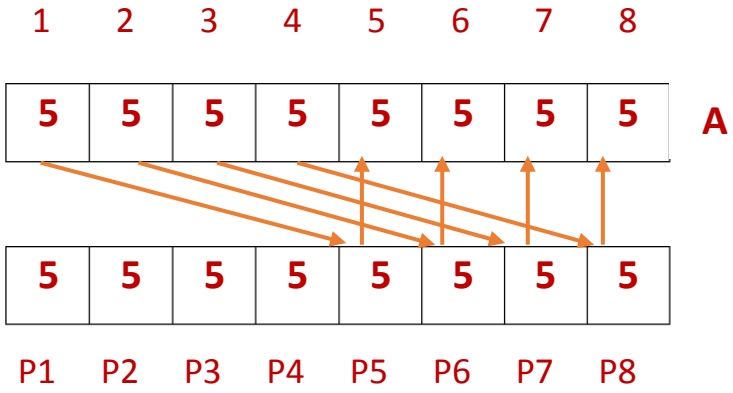

Figure (5. d): shows the implementation of step (2) when (i = 2)

When the procedure ends are all processors have stored value (D) in the local memory for other use, as long as the approved processors have read (D) twice in each iteration the procedure ends in time O Log (n).

The memory required by the action Broadcast is the matrix length (N) and the words of finer matrix than half that length because in the last repetition of the procedure are all processors have received value in (D) does not require that you write again in (A). And it is shown in the figure above (5-D).

Broadcast can hold that easily adapts to prevent the recent writing for that uses a matrix (A) length (N / 2). [11]

4. Conclusions.

We have seen that it is useful to conclude our research that some of our findings, and those results.

a) The process of studying parallel algorithms, this new branch of informatics branches are considered difficult issue at the present time due to lack of availability of suitable devices allow the translation of algorithms designed to process programs reach through the application to realistic results serve our operation.

b) The application of the principle of parallel processing on multiprocessor devices helps us to increase the size of the issues could be resolved, and help us to get more information and better solutions by reducing the cost of resolving issues.

c) The need to allocate large scale parallel computers to invest better processors.

d) The use of parallelization technique leads to reduced access to the best solution time. As it enables early access to the solution and thus reduce the execution time.

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