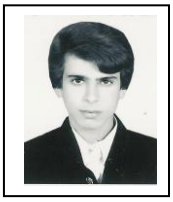
Assessment of New Languages of Multicore Processors



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Abstract

Parallel Process is a model of processing in which jobs are done parallel. Current programming languages that are used for parallel programming use multithread technique. Writing programs using multithread is difficult and complicated so there is a high effort for producing new languages that make programming easier. This paper has considered to new languages for multi core processors like stream languages and PAGS model and finally StreaMIT language for parallel processing is presented and its advantages and disadvantages are considered.

Key words: Parallel Programming, Stream Programming, PGAS Model, StreamIt Language

1. Introduction

In parallel system the end is high speed of computations, but in addition of reducing run time of programs we are going to have increased performance. Current programming languages those are used for parallel programs using multithread technique. In parallel programming model, a program creates several subprograms those are run synchronous, by using the threads. Simply we can assume the threads as its subprograms that are run synchronous.

When the numbers of cores are increased so the created threads management in order to correlation among them and parallel processing is complicated so management and debugging of program is difficult. A programmer cannot deal with thousands of threads and data flow using current programming models. One of the current parallel approaches is using of stream programming. Indeed stream programming is an approach for dominance to this challenge that establishes a cooperative between the programmer and the compiler and in addition of simply programming and improvement of performance also improves portability of programs. Different programming languages are presented to write parallel programs using the streams. In this paper this kind of languages are considered and also PGAS programming models are considered and they are compared with stream languages.

A. Computer structure in paeallel system

Structures of current memory in shared memory model of parallel systems are distributed memory and shared model.

- **Shared memory**

All processors have an integrated and same addressing space for access to memory.
Different processors act independently but using shared memory.
Each change in memory by a processor is visible by all processors immediately.

- **distributed memory**

Systems with distributed memory need a network to connect memory of processors together. Each processor has an independent memory. Addressing of the memories is also independent so public memory is not meaning.
Processors acted independently and the changes on independent memories are cannot effect on other processors memory.

- **Shared memory**

Most powerful computers in worldwide using a combine of shared memory and distributed memory.
This kind of computers have a combined of computers properties with common memory and distributed memory and they have advantages and disadvantages of both.

B. parallel programming models

The first step of writing parallel programs is identifying the parts of the cod those can be process parallel. In other hand break the program to some tasks so that each task can be processed and at same time with other tasks. In many cases the tasks cannot be processed parallel, because might there are data relationship among the tasks. The meaning of Data relationship is that a running computation need to other data that must be produce by other tasks [7,8].

- **data parallelism**

In data parallelism, same computations are run repeatedly on different data. In this case there is no relationship among data. Image processing algorithms that run a filter for each pixel are prominent examples of data parallelism.

- **task parallelism**

Independent constitutions can be mapped in instructions in order to parallel processing on processor (thread). In this model if there is not any relationships among instructions of programs, so we can run the instructions parallel and synchronous.

- **Pipeline parallelism**

One of the usage of parallelism in order to increasing the performance, is using of pipeline. As parallelism of a program, there is might be data relationship that must be considered. Pipeline is a special case of parallel processing. Like a factory that has several robots in its production line and each one adds a part of production.
Pipeline processing is one of the subjects of Operating system and Computer architecture. As an instruction run there are two main steps first one is instruction fetch from memory and the second one is run. Three operations of the chain consist of:

(1) Writing a data segment from file.

(2) Data processing

(3) Writing processed data into other file.

3. parallel programming models in multicore level

There are different models for parallel programming that the main of them are:

- ✓ Shared memory
- ✓ Threads
- ✓ Message passing
- ✓ Hybrid
- ✓ Stream processing
- ✓ Global partitioned addressing space model (PGAS).

Programming models are defined more than memory and hardware structures and each of programming models can be implemented on each hardware in theory. Different models of programming practically can be implemented on each hardware although their performance is better on a range of hardware. Selection an appropriate programming model for a problem mainly concerns to existing facilities and needed computations.

- **Shared memory programming model**
  - ✓ In shared memory programming, executive programs use a common addressing space for the memory and write on and read from the memory.
  - ✓ To control access to the memory without conflicts of accesses must use different mechanisms like different kind of locking.
  - ✓ One of the main disadvantages of this kind of programming is understanding and management of local relationships of data to processors.
  - ✓ In parallel hardware with shared memory, compilers exactly interpret variables in user's programs and specify them as real addresses of memory.

- **Programming model using threads**
  - ✓ In parallel programming model using threads, an executive program exactly creates several executive subprograms that run synchronous.
  - ✓ Simply, executive threads of a program can know as its subprograms that execute synchronous. Note to figure 1-3:

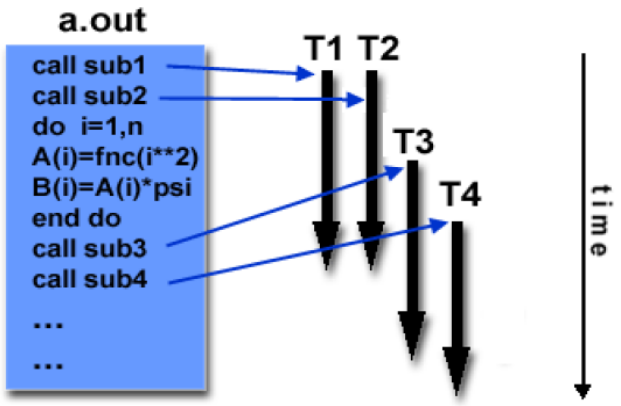

Figure 1-3: multi threads programming model

- **Programming model using message passing**
  - ✓ Properties of a parallel program based on programming model by message passing is as follows:
  - ✓ Each parallel program is consists of some subprograms those have local memory. Several subprograms can execute on one or some processors or computer.
  - ✓ Subprograms transfer data via sending and receiving messages.
  - ✓ Data transfer is usually required to cooperative of sender and receiver of message.

- **stream programming model**

Streams are a set of data those can execute in parallel. Each stream component is consists of one record of values. Streams provide modules for a standard connection among data. In stream programming, data are gathered in a stream from memory and these streams are processed and then the results are sent back to memory.

- **PGAS programming model**

PGAS is a parallel programming model for multi processors shared and distributed memory systems. In PGAS computations are formed in places. Data are in spaces those are created there. A data unit in one place might points to a data unit in other places. Structured data (like arrays) might be distributed among many places.

4. Stream programming model [7, 8, 9, 10, 11, 12,13]

In stream programming, data are gathered in a stream from memory and the streams are processed then the results sent back to the memory. As instance stream practical programs like multimedia programs, continuously read data from an input file, then the data are processed and finally processed data are sent to an output file. Process of network packet is important too, network packets are interred into the practical program and the program is done processes like filtering, capsulation, broadcasting and merging on the packets. Finally the practical program is sent the processed packets to the output channel. Stream programs also are used in the scientific processes. As instance, processing radio telescopes.

- **streaMIT language**

StreaMIT is a language for developing stream usages and has a hierarchical structure that its goal is improving performance and facilitates writing practical stream programs. StreaMIT supports all three models of parallelism : data, task and pipeline.

StreaMIT is an independent language from the architecture that presents a data flow graph. So that the nodes are represented computations and the edges are represented FIFO connection

from data on disk tape. StreaMIT is designed for parallel programming on GPU processors, however can use it for programming on CPU.
Filter is a fundamental structure block and programmable unit in streaMIT(Figure 1-4).

Figure 1-4: Filter in streamit

In fact kernel is in filter StreaMIT. Data are interred in every filters and then new data are exited. Values that filter gets from entry tape and sends to output tape is done by PUSH function. Each kernel has two essential members: Init for announcement and work for main function operation. Init called once at the time of the start and Work is called uncertainly and ultimate and is the process step of the system (figure 2-4).

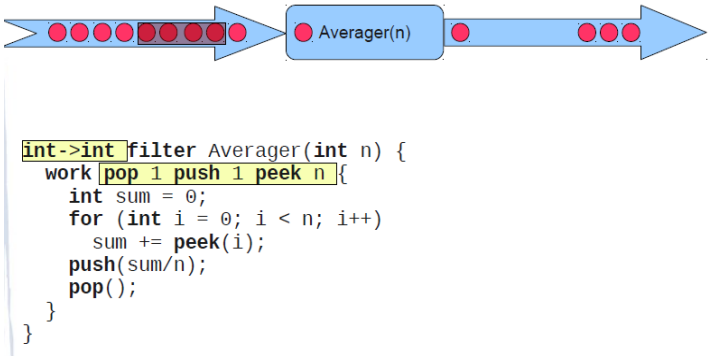

Figure 2-4: an instance of streams structure in streaMIT with its flow model

5. PGAS programming model [14,15]

PGAS languages are appropriate for clustered network hardware and also for shared memory hardware like symmetric multiprocessors and for distributed shared memory systems like SGI Altix, and for machines with support of global addressing space like Cray X1. In figure 1-5 PGAS and two famous models of parallel model are shown.

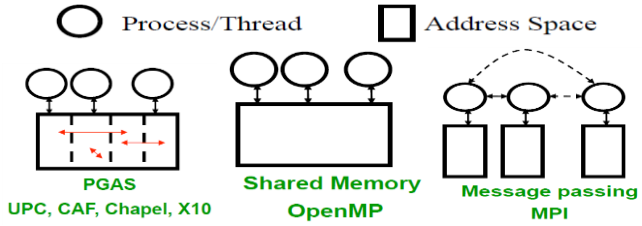

Figure 1-5: PGAS model

In PGAS computations are down in places. Data are in spaces that created there. A data unit in a place might points to a data unit in other places. Structured data (like array) might be distributed among many places.

- **X10 programming language**

X10 is an experimental developed language in IMB PERCS that is used as a part of Darpa program on computation system with high productivity capability (HPCS). In most applications with high scientific computations, with C++ and Fortran and by using MPI are developed for parallelism. Anyway these models are not appropriate for development of efficient applications, this low efficient , is caused of Code Complexity,…….

In 2003 Darpa created HPCS program. HPCS is a computation system with high efficiency. A topic of HPCS program for creating new parallel languages to support applications on architecture of computers in emerging.there were two languages with parallel usage on these systems named Chapel and X10.
X10 is designed for parallel programming by using PGAS() model. In X10 a process is divided among a set of places , that there are several activities for data processing. The activities might done at same time in one or many places. Place also is the best idea of a addressing space to run activities in it. X10 ensures that a programmer easily can convert a hybrid cod to a parallel code. X10 needs less changes in original serial code compared with multithread Java and MPI Java. Its programming model also is object oriented. Other properties is consists of : definable primary structure by user, global distributed arrays and structural and nonstructural parallelism.

6. Conclusions

In this paper streaMIT of stream language model and X10 of PGAS language model of multi-core processors languages are discussed absolutely. We chose these two languages because of their paramount properties like performance, high usage and easy programming. However X10 in many cases has same properties with streaMIT and its designers claim easily can convert hybrid cod to parallel cod but in general usages is more usage because of full supporting of all three models: data parallelism, code parallelism and pipeline parallelism. As instance easily can done parallel processes like network packet processing in streaMIT language. In X10 language because of complexity of structure most of management is in programmer responsibility but in streaMIT because of strength management of compiler in parallelism programmer less deals with management. StreaMIT language is not concerned to hardware architecture and in both CPU and GPU processors is suitable for parallel usage

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