High-Performance Computing (HPC) design to improve the quality of Introduction of Parallel Computing lectures

by Febdian Rusydi

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High-Performance Computing (HPC) design to improve the quality of Introduction of Parallel Computing lectures

E Alfianto[1], A Sa'diyah[2], F Rusydi[3], I Puspitasari[4],

[1] Dep. of Computer System, Institut Teknologi Adhi Tama Surabaya, Jl Arif Rachman Hakim 100, Surabaya, Indonesia. 60111
[2] Dep. Of Marine engineering, Politeknik Perkapalan Negeri Surabaya, Jl Jalan Teknik Kimia, Kampus ITS-Sukolilo, Surabaya, Indonesia, 60117
[3] Theoretical Physics Research Group, Dep. of Physics, Fac. of Science and Technology, Airlangga University, Jl. Mulyorejo, Surabaya, Indonesia 60115
[4] Dep. of the information system, Fac. of Science and Technology, Airlangga University, Jl. Mulyorejo, Surabaya, Indonesia 60115

Email: enggar@itats.ac.id

Abstract. High-Performance Computing (HPC) has been created to improve the quality of *Pengantar Komputasi* Parallel lectures. HPC consists of two PCs with AMD Ryzen 7 processor connected by high-speed LAN. HPC is used to solve problems that students can't practice Parallel Computing because the computer used is not adequate. So it takes a machine that can used together that has many processors, so the problems encountered are resolved. The results obtained, participants can use more than four processors to solve tree problems directly.

1. Introduction

The research on Course Introduction to *Pengantar Komputasi* Parallel is a new course in the Department of Computer Systems, ITATS. These courses discuss how to use multiple processors on a PC for simultaneous use. The contents of the route start from the history of processor development, to how to use multiple processors simultaneously. Participants are generally college students who have learned to code using code using C language, so the programming language used in this course using the C language

Participants of this lecture, have a different laptop. The number of processors used they can classify into two. Laptop has two processors and it has more than two processors. It is a problem because there are students who cannot practice programming using more than two processors. So that learning becomes obstructed. Therefore, it takes a solution so that all students can follow the lecture well with support facilities.

From the problems that exist, we try to find a solution that can solve the problem. Namely using a computer that has some processors more than 4, so that one class can use it with the same specifications. However, if it realized by buying some computers for each student, then the funds needed are substantial.

Another solution is to utilize a multi-user PC that can share simultaneously. The alternative is to use Computer-Cluster. With the computer-cluster is expected to be a solution to solving the implementation of numerical computing courses. Computational method and Implementation.

2. Related Work

2.1. Processor Development

The processor is one of the fastest growing electronic components. The first processor was released by Intel in 1971, with the name of a 4004 microprocessor, used as the brain for the Bascom counter machine. This chip is the starting point of the development of current generation processors, in that same year (1971) called the era of integrated electronics (Era of Integrated Electronics) [1].

Development issues the next processor is at increased speed [1]. Evident from the next generation processor raises the speed only. In 1985, the 32-bit processor was first launched by Intel with the name of Intel 30386. In the same year, AMD made a similar processor. The birth of this processor supports the early of Windows operating system that has helped the multitasking process. Since then the competition between Intel and AMD began to tighten [2].

In 1997, Intel created the Pentium MMX (P55C) which is an early generation of Intel Pentium. In the same year, AMD built AMD K6 which is a rival of the Pentium MMX. Pentium generation continues to perfect itself until born a processor with many cores. Currently, Intel has created Intel core i7 generation to 8, and answered with AMD is also issued AMD Ryzen 7 that its performance is almost the same as Intel core i7 [3].

2.2. Development of Cluster-Computers

Linux users in the 1960s first introduced Cluster-Computer. In that era, Cluster-Computers utilise a second-hand computer which is then coupled with a LAN so that it can work together. The purpose of cluster making is that the performance of used computers can increase. Increased production is needed to meet the increasingly complex calculation requirements [1] [4].

Computer Performance-Cluster obeys Amdahl's law, which was formulated by Gene Amdahl of IBM who published his writings in 1967. Datapoint Corporation commercially commenced the use of Computer-Cluster in 1977 [4].

To date, computer clusters have widely developed. The development followed by the development of communities that participate in developing this Computer-Cluster. From that formed, was born Rock Cluster, Open HPC, Beowulf and so forth [5].

2.3. Development of parallel computing research

Parallel computing usually utilizes Message Passing Interface (MPI) as a means to run programs in parallel. MPI built by a consortium consisting of several elements, Education, Industry and several developers [6]. Although MPI does not use IEEE or ISO standards, MPI has used as an industry standard in parallel program writing [7] [8]. In this study, MPI used as the main engine in running parallel programming.

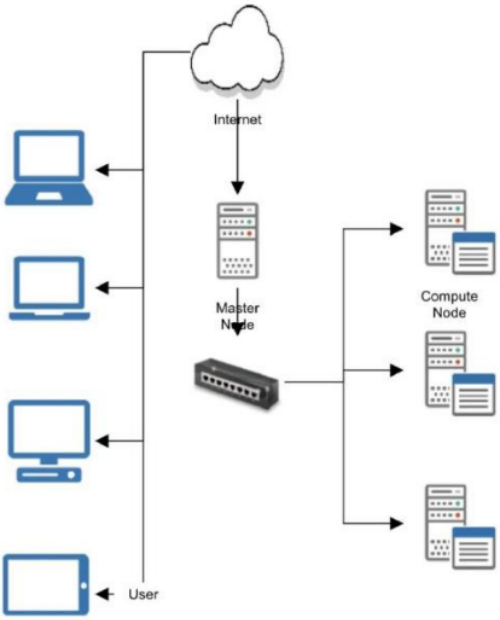

Figure 1. Cluster-Computer scheme

3. Research Method

This research begins with the preparation of computer clusters which will be utilised to support the Parallel Computing lectures. The Cluster Setup is

1. Analyze the PC to used as a computer cluster
2. Installing the operating system used (Centos 7-x86-64-DVD-1804).
3. Filtering unnecessary services for numerical computing lectures.
4. Create a local repository (Centos 7-x86-64-Everything-1804.iso)
5. Build system environment for node installation with PXE.
6. Performing the Compute Node installation
7. Setting up the Master Node to enter the Compute Node without using a password.
8. MPI Installation.

The computer cluster has a master node, and three compute nodes (**Figure 1**), between the master node and the compute node connected by a hub switch. The master node directly related to the internet, so the master node can be accessed by various devices (Laptops, PCs, Tablets). To access Clusters using the SSH client that is on the user's device. So that it can be used to assign tasks to computers anytime [8][9].

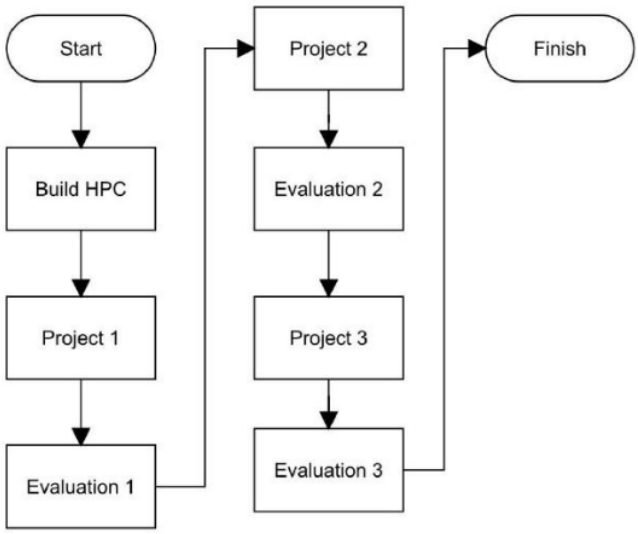

Figure 2. Flowchart of the research

The study continued with the introduction of the use of MPI in students. Then students are taught to run programs remotely using ssh. In a test, it was carried out by giving three projects which contained examples of cases in parallel programming. The flowchart is shown in **Figure 2**.

4. Project

4.1. Project 1

The first project that given was serial programming to find the root of the Gauss elimination method and the backward method. The matrix used is 100x100 with a random number generated by generating a random number. Students must record the program performance time.

4.2. Project 2

The second project is to create a program by assigning tasks to each processor to do different jobs at the same time. So that at the same time, the program can work on various functions. The goal is for students to be able to define tasks for each processor.

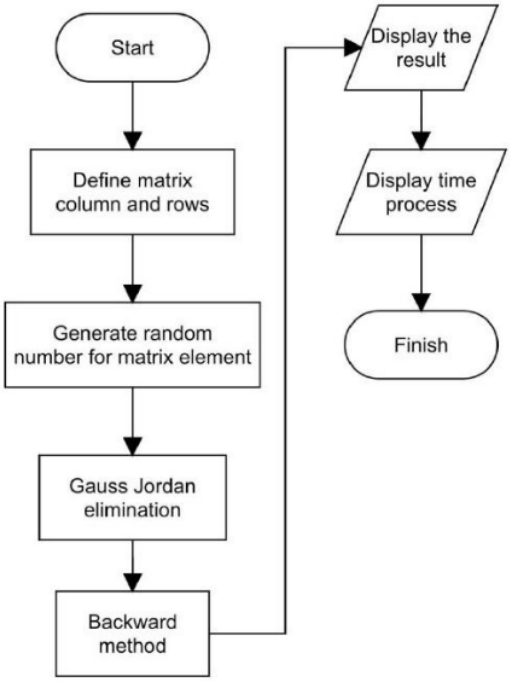

Figure 3. Flowchart of Project 2

4.3. Project 3

The third project is to make a program based on the elimination of Gauss to find the value of xi with some 1000x1000 matrices. Programming is done using a parallel paradigm. Here, students are expected to be able to understand how its performance entirely. How useful algorithms divide processor tasks in parallel Algorithm.

5. Result and discussion

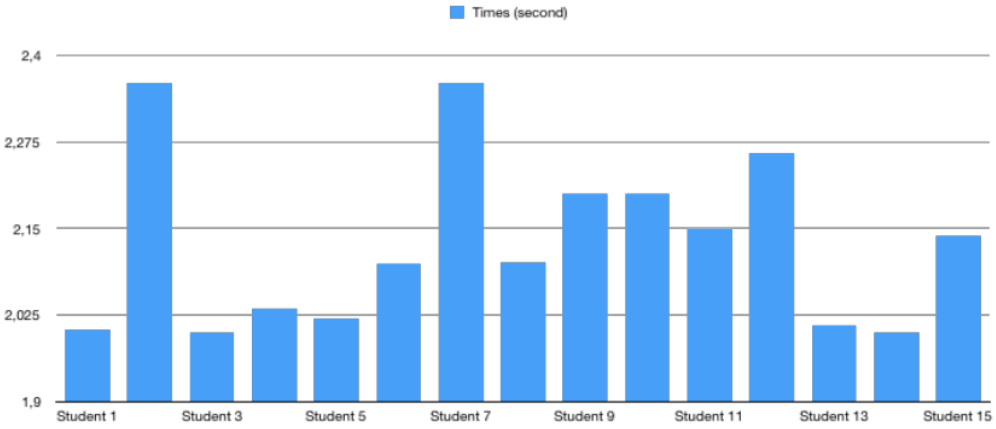

Figure 4. Running time of project 1

From the project, then the calculation time obtained by students to do the project. From the assignment given, students are free to do coding. Then, the program that has completed run in computer clusters. The results show in **Figure 4**.

6. Conclusion

From this, it can conclude that computer clusters that are made to facilitate students in computer parallel introductory courses are a solution to answer existing problems. By using HPC, students can run parallel programs with more than 4 processors. So that they can understand how parallel computers performance works. One of these understandings obtained from the difference in time between parallel and serial. Other parameters can be seen with the student's score of 70% getting an A.

7. References

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